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Thermal Effects
on
Aquatic Organisms
Annotated Bibliography
of the
1975 Literature

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**THERMAL EFFECTS ON AQUATIC ORGANISMS -
ANNOTATED BIBLIOGRAPHY OF THE 1975 LITERATURE**

Compiled and Edited by

Charles C. Coutant
Environmental Sciences Division

Sylvia S. Talmage

Bobbie-Neal Collier

Romance F. Carrier

Nancy S. Dailey

Ecological Sciences Information Center
Information Center Complex
Information Division

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INTRODUCTION

This is the fifth in a series of scientifically indexed bibliographies concerning thermal effects on aquatic organisms. The references are arranged alphabetically by first author. The thermal effects literature of this and earlier bibliographies is available for machine searching through the authors or through the ERDA Technical Information Center's RECON System. This automated file of references is indexed and abstracted to highlight the effects of temperature and makes it possible to cover the rapidly expanding literature specifically and quickly. Documents in which temperature is a variable or where it is important in the experiment were included. Heat sterilization studies, laboratory studies that do not relate to the environment, and seasonal field studies with no specific mention of temperature were not included.

The literature on thermal effects has been reviewed annually for several years in the Journal of the Water Pollution Control Federation (JWPCF). The literature indexed herein forms the basis of the review of the 1975 literature assembled for the JWPCF by C. C. Coutant and S. S. Talmage.

Citation Form

The bibliographic data were arranged according to the Environmental Information System standard format for computer entry of information. As a result of computer limitation in indicating superscripts and subscripts in the standard manner, certain conventions have been established in the bibliography:

- 1) "X sub t" (X being a variable) means X_t or X subscript t.
- 2) In chemical compounds and elements, "NaIO3" (for example) means NaIO_3 .
- 3) "10(E+3)" or "X(E-3)" (E denoting exponent) means 10^3 or X^{-3} , respectively.
- 4) For units of measurement, such as cubic centimeters or square feet, X3 (for example) means X^3 .

Indexes

Indexes are provided for: (1) author, (2) keywords, (3) subject category, (4) geographic location, (5) taxon, and (6) title (alphabetical

listing of keyword-in-context of the nontrivial words in the title).

ACKNOWLEDGMENTS

Opal Russell of the Central Research Library ordered documents by interlibrary loan for this project. Fay Fletcher of the Information Center Complex Data Base Management Operations Section carried out the computer production of this document.

<1>

Abel, P.D., Toxicity of Synthetic Detergents to Fish and Aquatic Invertebrates.

1978. Jour. Fish Biol., 6, 279-290 (University of Aston in Birmingham, Gosta Green, Birmingham, England)

As part of a review of the toxicity of synthetic detergents to fish and aquatic invertebrates, the influence of temperature on toxicity was reviewed. Information on the influence of temperature on detergent toxicity was scarce. Temperature appeared not to be of well-defined importance. (37)

<2>

Adams, B.L., U.S. Zaugg, and L.R. McLain, Inhibition of Salt Water Survival and Na-K-ATPase Elevation in Steelhead Trout (SALMO GAIEDENSII) by Moderate Water Temperatures.

1975. Trans. Amer. Fish. Soc., 104, 766-769 (Western Fish Nutrition Laboratory, Cook, WA)

Steelhead trout (SALMO GAIEDENSII) metamorphosis from a freshwater parr to a seawater-tolerant smolt possessing the migration tendency was evaluated at six different growth temperatures ranging from 6 to 15 C during January through July. The highest temperature where a transformation was indicated was 11.3 C. By April fish reared at 6 C had elevated ATPase levels typical of smolts or migratory animals and showed 92% survival in sea water. Ten and 11.3 C-reared fish showed a short-lived elevation in ATPase in mid-April alone concurrently with 100% sea water survival at that time. Only in 6 C-reared animals did the salt water survival ability continue into May. High ATPase levels likewise were prolonged into May and June only in the 6-C reared group. The data indicate that metamorphosis (and therefore successful migration) of juvenile steelhead trout is directly controlled by water temperature. (38)

<3>

Aiken, D.E., and S.L. Vaddy, Temperature Increase Can Cause Hypercaldyosmia in American Lobsters (HOMARUS AMERICANUS) Injected with Ecdysterone.

1975. Jour. Fish. Res. Bd. Can., 32, 1883-1885 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

In the lobster, HOMARUS AMERICANUS, the threshold dose for premolt acceleration by ecdysterone can be altered by changes in temperature. Two dose levels of ecdysterone (0.5 and 1.0 ug/g body weight) were compared at three different temperatures 10, 17, 21 C: all three doses remained subthreshold at 10 C but at 17 C the 1.0-ug dose caused hypercaldyosmia--rapid but abnormal completion of premolt terminating in death at ecdysis. In contrast, the 0.5-ug dose remained subthreshold even at 21 C. These results demonstrate a dose-temperature relation for response to injected ecdysterone. (39)

<4>

Albrecht, W.L., Investigations on Cold-Adaptation in Warmwater Carp (CYPRINUS CARPIO L.).

1978. Z. f. Fischsch. (E. Ger.), 21, 103-110 (Institute Neuenfischerei, Berlin-Friedrichshagen, Neuenfischerei, German Democratic Republic)

Carp that had overwintered at 5 C were acclimated to 20 or 25 C for 90 days and further acclimated to 15 C in seven days.

<1>

They were then tested for tolerance to low temperatures of 7 to 8, 5, 3 to 4, and 2 to 2.5 C. Reduction of the temperature to 15 C led, within 30 days, to complete adjustment of the warm-adapted carp to the new conditions. Protein and carbohydrate synthesis was stimulated, resulting in an increased protein and glycogen content and increased mass of the kidneys and liver. At 7 to 8 C these synthetic processes were observable, but internal injuries and death of some of the carp occurred. Two percent of the carp at 3 to 4 C survived without externally visible injury for 30 days. Subsequent placement in water at 10 C led to adaptation as evidenced by both the normal behavior of the fish and the relative mass of the organs and also by amounts of protein and glycogen synthesis. It was concluded that carp adapted to warm water cannot be exposed to temps under 10 C. (Auth) (37)

<5>

Alcaraz, M., Oxygen Consumption in Relation with Size and Temperature in Crustacea.

1978. Invest. Pesq., (Sp.), 38, 289-295 (Instituto de Investigaciones Pesqueras, Laboratorio de Vigo, Ouelle de Bouzas, Vigo, Spain)

The relationships between O₂ consumption, body weight and temperature were studied in the crustacea PHALARUS TILGARS. Equations for oxygen consumption and Q₁₀ values at 15, 18, and 20 C are given. (37)

<6>

Alderdice, D.P., and C.B. Forrester, Early Development and Distribution of the Flathead Sole (HIPPOGLOSSOIDES ELASMOBOS).

1978. Jour. Fish. Res. Bd. Can., 35, 1699-1918 (Department of the Environment, Fisheries and Marine Service Pacific Biological Station, Nanaimo, British Columbia, Canada)

Laboratory studies were conducted on eggs from a southern British Columbia population of HIPPOGLOSSOIDES ELASMOBOS. Salinity of neutral buoyancy of eggs decreased from about 25 ppt shortly after fertilization to 17 to 18 ppt at hatching. The incubation period ranged from 20.9 days (2.36 to 4.0 C) to 7.2 days (10.65 C). At temperatures of 5.5 C or lower and salinities of 19 ppt or lower, larvae tended to hatch at a less advanced stage of development. Mean length of newly hatching larvae increased in successive periods throughout the hatching interval. At mean hatching time, larval length varied from 3.2 mm (15 ppt, 3.0 C) to 6.3 mm (25 ppt, 6 C). Larvae from eggs incubated over the range of test conditions (10.62 to 19.58 ppt, 2.36 to 10.65 C) reached a length of 6.9 to 7.2 mm at yolk exhaustion. Hatching success was highest in trials at 25 ppt, 6 and 7 C; maximum percent viable hatch is predicted at incubation conditions of 29.16 ppt, 7.38 C. Posthatching larval survival appeared normal at salinities of about 20 to 37 ppt and temperatures of about 5.5 to greater than 10.65 C. Extensive early larval mortality occurred at salinities of 19 ppt or lower and at temperatures below 5.5 C. Incipient low lethal temperature levels are estimated to be near 3.5 to 4.0 C for incubating eggs and 4.0 to 4.5 C for larvae. Egg and larval characteristics of the experimental material were compared with similar data from the literature on North Pacific Ocean HIPPOGLOSSOIDES. (37)

(7)
(7)

Ali, H.F., and C.C. Lindsey, Heritable and Temperature-Induced Aesthetic Variation in the Mudpuppy, *AMBIAS LATIPES*.

1974. Can. Jour. Zool., 52, 959-976 (Fisheries Department, Sussex, Bangladesh; University of Manitoba, Winnipeg, Manitoba, Canada)

Eggs from 25 pairs of mudpuppy, *AMBIAS LATIPES*, were reared at constant temperatures ranging at two-degree intervals from 20 to 30 C or were abruptly changed from 20 to 30 C or from 30 to 20 C and then reared at the new temperature until aesthetic characters could be counted. Crowding, mechanical shock, container type, amount of aeration, and malachite green prophylaxis did not alter numbers of vertebrae and pectoral or dorsal rays; nor did these numbers vary between eggs laid on different days by the same parents. Numbers of anal and caudal rays were significantly different between sibling egg batches, and were decreased by crowded rearing conditions. Mechanical shock increased anal ray counts. Caudal rays were sometimes decreased by lack of aeration. Response of vertebrae to different sustained temperatures was U-shaped in nine groups, with nadirs varying from 24 C to 32 C; in two groups, vertebrae were progressively fewer at higher temperatures. Pectoral ray counts usually were progressively lower at higher temperatures. Dorsal ray counts of most formed arched curves. In all series, heritable variation at one temperature roughly equalled phenotypic variability between temperatures. Inherited differences in response patterns of different aesthetic series are largely independent of each other, mortality and hatching time. Temperature breaks produced an overcompensation in vertebrae if applied early, or a paradoxical reaction if applied late. (Auth)

(8)

Alison, A.P., Metabolic Rate in Freshwater Bivalves.

1975. Ekologiya, 1, 10-20 (Zoology Institute, Leningrad, USSR)

Literature data and present studies show the metabolic rate of different freshwater bivalves to be exponentially weight dependent. No statistically reliable differences have been found in the metabolic rates of molluscs of identical weights belonging to different families and thus an equation describing the relation has been described which is applicable to all freshwater bivalves. An empirical metabolic rate-temperature relationship has been obtained which differs from the frog normal curve primarily at temperatures less than 10 C and greater than 20 C. The results are presented graphically. (Auth)

(9)

Allen, R.O., Notes on the Culture of Striped Bass in Tanks and Small Raceways.

1974. Progressive Fish Culturist, 36, 60-61 (Bureau of Sport Fisheries and Wildlife, Fish Farming Experimental Station, Stuttgart, AB)

Growth of striped bass in culture tanks and raceways was good at 20 C. A decline in water temperature to 22 C did not affect growth, but growth was depressed during one period when water temperatures were above 30 C. The incidence of synechocystis infections decreased when water temperature dropped from 28 to 22 C. An initial moderate mortality due to synechocystis infections was associated with the transfer of fish from 30 C pond water to 20 C well water. (ST)

(10)

Allen, R.O., Effects of Stocking Density and Water Exchange Rate on Growth and Survival of Channel Catfish *ICTALURUS PUNCTATUS* (Walbaum) in Circular Tanks.

1976. Aquaculture, 4, 29-39 (U.S. Fish and Wildlife Service, Fish Farming Experimental Station, Stuttgart, AB)

Growth of cultured channel catfish in well water averaging 23 C was only two-thirds as rapid as growth in recycled water averaging 29 C.

(11)

Allen, L.G., and H.B. Hara, Abundance, Diversity and Seasonality of Fishes in Colorado Lagoon, Alacitos Bay, California.

1975. Estuarine Coastal Marine Sci., 3, 371-380 (California State University, Department of Biology, Fullerton, CA)

Numbers of fish species and individuals in Colorado Lagoon, an arm of Alacitos Bay in southern California were highly correlated with lagoon temperature which ranged from 12.0 to 25.0 C. Abundance and diversity were highest during the summer (May to September). Four species, northern anchovy, topmullet, along anchovy and shiner wriggle, comprised 99% of the catch. Five species, starhorn sculpin and along anchovy, occurred in wide size ranges and during most or all of the year and were considered to be residents. Juveniles of northern anchovy were extremely abundant in August and September. (ST)

(12)

Amund, D.F., and L. Smith, Pathophysiology of Infectious Hematopoietic Necrosis Virus Disease in Rainbow Trout (*Salmo gairdneri*): Early Changes in Blood and Aspects of the Immune Response after Injection of IHN Virus.

1976. Jour. Fish. Res. Bd. Can., 33, 1371-1378 (U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Western Fish Disease Laboratory, Seattle, WA; University of Washington, Seattle, WA)

Acid-base alterations and elevation of one of the lactic dehydrogenase (LDH) isoenzymes occurred in rainbow trout infected with infectious hematopoietic necrosis (IHN) virus at 10 C but not at 18 C. These two changes are consistently associated with the early development of IHN disease. The immune response of fish to viral infections is discussed. (ST)

<13>

Abundant, J.P., D.J. Faber, and A. Kest, Seasonal Succession of Free-Swimming Perciform Larvae in Lake Opinicon, Canada.

1974. Jour. Fish. Res. Bd. Can., 31, 1661-1665 (Queen's University, Kingston, Ontario, Canada; National Museum of Natural Sciences, Ottawa, Ontario, Canada)

The temporal relationship between spawning, hatching, and the subsequent appearance of larvae in open water of five perciform species in Lake Opinicon, Canada, is reported. Free-swimming larvae of all species were collected with tow nets in large numbers from May to August of 1969 and 1970. The species appeared in the same seasonal sequence during the two years: first yellow perch (*PERCA FLAVESCENS*), followed by logperch (*PUNCTA CAPROBES*), black crappies (*POMOXIS WICOMACULATUS*), and pumpkinseeds and bluegills (*LEPOMIS GIBBOSUS* and *L. MACROCHIRUS*). Peaks of larval abundance, and also hatching, occurred earlier in 1970, when water-site temperatures from early May to mid-June showed faster lake warm-up than in 1969. (Auth) (ST)

<14>

Anderson, C.D., and R.J. Roberts, A Comparison of the Effects of Temperature on Wound Healing in a Tropical and a Temperate Teleost.

1975. Jour. Fish Biol., 7, 173-182 (University of Stirling, Unit of Aquatic Pathobiology, Stirling, Scotland)

The rate of healing of a surgical wound was studied in two teleost fish, one with a tropical (*TILACHTHUS ALBOLABRIS*) and the other with a temperate (*SILURUS SILURUS*) temperature range. The rate of wound healing at temperatures of 30, 23, 10 and 5 C increased with increasing temperature; temperatures across had little effect on healing rates. (ST)

<15>

Anderson, U.K., and U.N. Lewis, Use of a Sudden Temperature Decrease to Reduce the Excitability of Channel Catfish During Handling.

1974. Progressive Fish Culturist, 36, 213-215 (Southern Illinois University, Fisheries Research Laboratory and Department of Zoology, Carbondale, IL)

The excitability of yearling channel catfish was successfully controlled by instantaneous transfer of the fish from 26.7 to 15.6 C water. After eight hours at the lower temperature, the fish did not exhibit noticeable effects when transferred back to the higher temperature. Fish transferred from 26.7 to 19 C or cooler water exhibited an initially violent reaction; the majority of the fish lost their equilibrium. Transfer of fish from 26.7 to 8.8 resulted in immediate death of 40 out of 145 fish. (ST)

<16>

Andrews, J.W., and Y. Matsuda, The Influence of Various Culture Conditions on the Oxygen Consumption of Channel Catfish.

1975. Trans. Amer. Fish. Soc., 104, 322-327 (University of Georgia Agricultural Experiment Station and Shidaway Institute of Oceanography, Savannah, GA)

Several experiments were conducted on relationships between oxygen consumption of channel catfish (*ICTIURUS PUNCTATUS*) and environmental dissolved oxygen concentrations, feeding status, weight of fish, and temperature. Estimates of oxygen

<13>

consumption under culture conditions were obtained by determining the rate of oxygen depletion in a still tank without aeration. Respiratory dependence (decrease in oxygen consumption rate with a decrease in environmental oxygen concentration) in both well-fed and fasted fish was noted at oxygen concentrations between 1 and 7 milligrams/liter. The oxygen consumption rates obtained one hour after feeding or from fasted fish. A log-log relationship between oxygen consumption and body weight of fish (2.3 to 1,000 g) was demonstrated. The slope (b) for the equation, oxygen consumption equals (a) (weight) (b) was 0.80 for both well-fed and fasted fish. The relationship between oxygen consumption and environmental temperature was linear over the range 24 to 28 C for well-fed fish and 24-30 C for fasted fish. The Q₁₀'s for plots for the well-fed and fasted fish were 1.9 and 2.3, respectively; thus the data were in accord with van't Hoff's Law. (Auth)

<17>

Andronikova, V.B., and I.V. Drogol'skaya, Ciliated Cell Epithelium Thermotaxis of the Black Sea Mussel and Marine Water Temperature.

1974. Tsitologiya (USSR), 16, 723-727 (Institute of Cytology, Leningrad, USSR)

Cellular heat resistance of *HYTILUS GALLOPROVINCIALIS* underwent daily and seasonal changes. At midday it was maximum; in the morning and evening it decreased. The spring to summer increase in water temperature of the Black and Azov Seas was accompanied by a rise in cellular heat resistance. The cells of *H. GALLOPROVINCIALIS* from the Azov Sea were more heat resistant than those from the Black Sea, reflecting the difference in water temperature between the two seas. (ST)

<18>

Ang, E.J., and C.N. Fernando, Dynamics and Production of *SINCEPHALUS SEMULATUS* (Koch) in Two Large Natural and Man-made Ponds in Eastern Canada.

1973. Verh. Int. Ver. Limnol., 18, 1048-1054; Part of Proceedings of the International Association of Theoretical and Applied Limnology, Vol. 18, Publishing House Nauka, Leningrad, USSR (Not Given)

Laboratory and field experiments were conducted to determine the rate of egg development, population growth in the absence of predation, physiological death, number of instars and duration of juvenile and adult stages of *SINCEPHALUS SEMULATUS*, the dominant littoral zooplankton in two Canadian lakes. In the laboratory the rate of egg development at 8, 18, and 28 C was 7.9, 3.2 and 1.5 days, respectively. Temperatures below 2 to 7 C appeared to restrict egg production in the field. Duration of juvenile development at 8, 18, and 28 C was 18, 13 and 3 to 4 days, respectively; adult development took 29.3 plus or minus 2.3 days at 18 C and 17.5 plus or minus 2.3 days at 28 C. The average birth rate was 0.62 in Columbia Lake and 0.87 in Miller's Lake. These birth rates corresponded to an average turnover rate of 1.5 days in Columbia Lake and 2.1 days in Miller's Lake. The highest birth rates were recorded in July and August. The dynamics and production of this species in the field is discussed. Physical and chemical characteristics of the lakes are given. (ST)

<19>

<19>

Ingell, C., Gonad Maturation and Fixation of CRASSOSTREA RHizophora in a Hypersaline Lagoon in Northeastern Venezuela.

1972. Estac. Invest. Mar. Margarita No. 48 (Fundacion La Sella de Ciencias Naturales, Venezuela)

The monthly percentage of mature gonads of the oyster, CRASSOSTREA RHizophora was negatively correlated with temperature. Temperatures near 30 degrees C appeared to inhibit maturation. Spawning activity as evidenced by percentage of mature gonads, intensity of set and larvae counts was most intense during cooler months (January to May). Oyster setting was heaviest within 50 cm of the surface and occurred throughout the year. Sex ratios always favored females. The cooler months generally had lower percentages of females. Hermaphrodites comprised 1.5% of the total sample and were found only in months of below average temperature. They may represent transitions from female to male. (Auth) (ST)

<20>

Inraku, H., Review: Warm Water Effluents and Plankton.

1978. Bull. Plankton Soc. Jap., 21, 1-111 (Seikai Regional Fisheries Laboratory, Nagasaki, Japan)

The influence of warm water effluents on the ecology and physiology of phyto- and zoo-plankton in inshore waters is reviewed. Changes of species composition of phytoplankton was observed in the field as well as in experimental pools following the addition of warm water effluents into an enclosed environment. The diatom population may be replaced by green algae with gradual increase of temperature, and they are succeeded by a population of blue green algae. On certain occasions, diatoms give way to dinoflagellates with increasing temperature. The degree of species diversity is heightened with temperature rise and the biomass of a single cell also increases. The succession from diatoms to other algal populations may change pathways of the energy flow in a stable food chain system and thus influence the balance of the ecosystem as a whole. The primary productivity is variable in thermal effluents. Increased water temperature has either an inhibitive or a stimulative effect on the productivity depending on the temperature of the intake water. The chemical composition such as proteins, lipid, carbohydrate and DNA of the phytoplankton cells changes with increasing temperature. These phenomena may have a profound effect on the organisms that graze on these food organisms as well as their environments. The study of the influence of warm water effluents on the production of zooplankton should be continued for a long period of time before and after the installation of a power plant. In certain cases, the quantity of total zooplankton increases accompanying the discharge of heated waste waters, depending mainly on the

appearance of a high density of larvae of barnacle and mussel with the elongation of their breeding periods. The increase of warm water species may in turn induce the decrease of cold water zooplankton there. The change of species composition may therefore affect the feeding of their predators, especially that of the early developmental stages of fish. In general, rates of metabolism and activity of zooplankton increase with increasing temperature over most of the species-specific temperature tolerance range and decrease suddenly near the upper limit. The rates of increase are usually different for different species and frequently for different biological processes. At temperature lower than the upper optimum for survival, oxygen consumption increases with increasing temperature, but the feeding rate increases to its maximum at close to the optimal temperature and thereafter decreases. Ability of adults to breed following heat shock is uncertain. Rate of hatching is usually low. Juvenile stages are less heat tolerant than adults. Energy flow and patterns may be altered if benthic species of zooplankton are more thermal tolerant than planktonic species or if changes in body size of individual species caused by temperature changes occur. (Auth) (ST)

<21>

Aherton, W.D., The Effect of Different Levels of Dietary Fat on the Growth of Rainbow Trout (SALMO GATRODONTI Richardson).

1975. Jour. Fish Biol., 7, 565-571 (Stockport Technical College, Science Department, Stockport, England)

Two types of fat, represented by cod liver oil and lard, were added to the diet of rainbow trout to investigate the level of dietary fat that would promote the greatest growth at selected temperatures (12, 16, 20 C). Levels of 15% and more of cod liver oil added to the diet had an adverse effect on the growth of fish when kept at 12 and 16 C. Oil fed at 5 and 10% appeared to promote growth at these temperatures. At 20 C all fish including the controls fared badly, indicating that the effects were due to the high temperature. There was no significant change in the growth rates of any of the experimental groups fed lard. (ST)

<22>

Austin, H.R., A.D. Sosnov, and C.B. Hickey, Jr., The Effects of Temperature on the Development and Survival of the Eggs and Larvae of the Atlantic Silverside, MENIDIA MENIDIA.

1975. Trans. Amer. Fish. Soc., 104, 762-765 (Department of Fisheries Oceanography, New York Ocean Science Laboratory, Montauk, NY)

Eggs of Atlantic silverside, MENIDIA MENIDIA, were fertilized and incubated at 15, 17, 20, 25 and 30 C. The times to hatching at each temperature were 27.0, 12.8, 9.8, 8.8 and 3.0 days respectively. Thermal shocks of 1 C produced 0% mortality for larvae reared at 17 and 20 C, 1% for larvae reared at 25 C, and 1% for larvae reared at 30 C. Thermal shocks of 10 C produced 3% mortality for larvae reared at 17 C, 0% for larvae reared at 20 C, and 100% for larvae reared at 25 and 30 C. Since the larvae of MENIDIA MENIDIA are present in Long Island Sound when temperatures are in the 15-20 C range, it appears that the population will undergo a minimum of stress due to thermal shock as a result of nuclear power plant development on Long Island. (Auth)

<22>

Wainbridge, V., G.A. Cooper, and P.J.B. Hart, Seasonal Fluctuations in the Abundance of the Larvae of Haddock and Herring in the North-eastern Atlantic and North Sea.

1974. Part of Blaxter, J.B.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1973. Springer-Verlag, Berlin-Heidelberg (Institute for Marine Environmental Research, Plymouth, England; Institute for Marine Environmental Research, Oceanographic Laboratory, Edinburgh, Scotland).

The seasonal occurrence and distribution of haddock and herring larvae in the Atlantic Ocean and North Sea was studied. In the North Sea haddock spawned during the summer, a possible adaptation to temperature conditions at the northern limit of its range. The Celtic Sea haddock population spawned in spring. Several spring spawning stocks of herring could be distinguished in the North-eastern Atlantic. Larval production by stocks of both species was closely associated with the biological spring when food for the larvae is most plentiful. Larvae produced by autumn or winter spawning herring populations seemed likely to encounter poor feeding conditions until the following spring. (ST)

<23>

Baker, J.W., Distributions, Ecology, and Life Histories of Selected Cyprinidaceae (Cyprinidae, Osteichthyes) from the Southern California Mainland Shelf.

1975. Ph.D. Thesis, University of Houston, 219 p. (University of Houston, Houston, TX)

One group of cyprinids collected on the continental shelf area of southern California consisted of four abundant widely occurring species of northern origin, found primarily at depths below 30 m in sand and silt at temperatures around 15 C. A second group was comprised of three species of southern origin and was found at depths less than 30 m in predominantly sand sediments with water temperatures around 17 C. Each species appeared to share the same general environment but preferred different microhabitats. (BPC)

<25>

Balaparameswara, P.M., and P.V. Ganapati, Resistance of the Limpet *CELLISA BIDIATA* (Jorn) to Variations in Temperature, Salinity and Desiccation.

1974. Proc. Indian Natl. Sci. Acad. Part B, 30, 135-149 (Andhra University, Department of Zoology, Andhra Pradesh, India)

Tolerance limits of *CELLISA BIDIATA* to high and low temperatures to salinities above and below ambient conditions and to desiccation were studied. The upper lethal temperature was 42 C. Salinities above 37 ppt and below 20 ppt appeared to be critical to the animals. Animals living at higher levels were more tolerant to dry air than those living at lower levels. (ST)

<24>

Balashova, N.B., Algal Flora of Hot Springs in Elise, Azerbaijan USSR.

1974. Vesta. Leningr. Univ. Ser. Biol. (1958), 2, 34-41 (University of Leningrad, Leningrad, USSR)

In July of 1972, 31 species of Cyanophyta, 12 species of Bacillariophyta and four species of Chlorophyta were found in the hot springs of Elise, Azerbaijan USSR. Blue-green algae dominated the collections and were found at temperatures from 21 to 30 C. Diatoms commonly occurred in springs with temperatures up to 35 C. Biotic diversity was greatest at 24 to 32 C. The maximum temperature for green algae was 32 C. (ST)

<27>

Baliqued, P., A. Grady, A. Poiry, H. Bouvier de Mais, and M. Dumont, Use of Heat from Thermal Discharges in Agriculture, Pisciculture and Space Heating.

1975. CONF-740820; STI/P02/370; IAEA-SB-107/33; Part of Proceedings of a Symposium on the Environmental Effects of Cooling System at Nuclear Power Plants held in Oslo, Norway, August 21-30, 1974, (p. 717-730) (Commissariat a l'Energie Atomique, Paris, France)

Projects relating to the utilization of thermal discharges from nuclear reactors in France are described. These include a pilot site at the Cadarache, Centre for Nuclear Studies using heated water in forestry, open farming and fish culture projects and research at the Grenoble Centre for Nuclear Studies using heated water for heating greenhouses and space heating. (ST)

<28>

Banerji, T.K., and A. Ghosh, Effect of Heat Exposure to the Catechol Hormones Content of the Teleostean Adrenal Tissue.

1974. Folia Histochem. Cytochem., 11, 191-194 (University of Calcutta, Department of Zoology, Calcutta, India)

Following acute heat shock at 35 C for five hours, the concentration of adrenaline in the chromaffin cells of *OPHICHTHALMUS* was totally depleted while in *TRICHOCASTER* *TRICHOPTERUS* no response was noted. (ST)

<29>

Bannister, J.V., The Respiration in Air and Water of the Limpets *PATELLA CAERULEA* (L.) and *PATELLA LUSITANICA* (Gmelin).

1974. Comp. Biochem. Physiol., 49A, 827-831 (Royal University of Malta, Department of Physiology and Biochemistry, Msida, Malta)

Following acclimation at 10 C, the oxygen consumption of *PATELLA CAERULEA* and *PATELLA LUSITANICA* was measured at temperatures between 10 and 30 C. The rate of oxygen consumption of both species increased with an increase in temperature in both air and water. In *P. CAERULEA* a decrease was observed above 25 C in water. The rate of oxygen consumption of *P. LUSITANICA* was approximately three times higher in air than in water, whereas the rate of oxygen consumption of *P. CAERULEA* in water was twice that in air. The results were discussed in terms of the effect of temperature on metabolism. (Auth) (ST)

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Barnes, R., The Effect of Food, Temperature, and Light-Period (Day-Length) on Moulting Frequency in *BALANUS BALANOIDES* (L.).

1974. Jour. Exp. Mar. Biol. Ecol. (Beth.), 15, 275-284 (Dunstaffnage Marine Research Laboratory, Scotland)

Raising the temperature from 10 to 15 C had no effect on the moulting frequency of the barnacle, *BALANUS BALANOIDES*. Temperature had little influence on the moulting frequency of starved animals. (37)

<31>

Becker, C.D., Columbia River Thermal Effects Study: Reactor Effluent Problems.

1973. Jour. Water Poll. Control Fed., 45, 850-869 (Battelle Memorial Institute, Pacific Northwest Laboratories, Ecosystems Department, Richland WA)

Results of studies conducted under the Columbia River thermal effects study (COTES) on the thermal relationships of Columbia River organisms are reviewed in an attempt to assess the total ecological effect of thermal additions to bodies of water. Studies incorporated in the COTES program attempted to define more precisely the axiomatic temperatures for salmonids and their tolerance to temperature change. The studies also attempted to clarify particular temperature-modifying influences existing or anticipated in the Columbia River basin, namely, the impact of isopondsments that result from hydroelectric development and the effect of heated discharges from operating reactors (at Hanford) or proposed thermoelectric nuclear plants. (37)

<32>

Becker, C.D., R.G. Genoway, and J.A. Merrill, Resistance of a Northwestern Crayfish, *PACIFASTACUS LEWISICULUS* (Dana), to Elevated Temperatures.

1975. Trans. Amer. Fish. Soc., 104, 374-387 (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

PACIFASTACUS LEWISICULUS from two populations in Washington State, the central Columbia River and a small tributary, were acclimated at 5 C intervals and exposed to elevated temperatures in 48 hour thermal bioassays. The upper lethal temperature for both crayfish populations increased relatively slightly, from about 28.5 to 31.5 C, over the entire acclimation range. A rise of 1 C in test temperature often represented the difference between zero and total mortality when lethal limits were approached. The ultimate upper lethal temperature was near 32 to 33 C. Statistically significant differences in thermal resistance patterns (slope and spacing of regression lines) occurred between the two crayfish populations at all acclimation levels, but resistance in terms of eventual mortality was similar for practical purposes. Moulting individuals were particularly susceptible to high

temperature stress. Mature, pre-breeding female crayfish from the Columbia River during fall appeared less resistant, and egg-bearing females during winter more resistant, than other individuals. Larger crayfish from the Columbia River were slightly less resistant to elevated temperatures than smaller ones, and females were more resistant than males. The upper temperature triangle for *P. LEWISICULUS* encompasses an area of 824 C(2). This freshwater decapod is more tolerant of elevated temperatures than native salmonids, but less tolerant than some introduced "saltwater" fish. (Auth)

<33>

Beitinger, T.L., Thermoregulatory Behavior and Diel Activity Patterns of Bluegill, *LEPOMIS MICROCHIRUS*, following Thermal Shock.

1974. Fishery Bull., 72, 1087-1093 (University of Wisconsin, Department of Zoology, Laboratory of Limnology, Madison, WI)

Individual bluegill were allowed to thermoregulate for three days in a temperature preference apparatus and then were exposed for 30 min to one of three temperature treatments: 21.0, 31.0, or 36.1 C. Fish exposed to 31 C served as controls for handling procedures. Thermoregulatory performance of surviving fish was monitored for an additional 3 days. Pretreatment results indicated mean lower and upper avoidance temperatures of 29.3 and 33.1 and 31.2 C as the midpoint of the preferred range. All 20 fish exposed to 21 and 31 C survived treatment and demonstrated no significant differences between pretreatment and posttreatment thermoregulatory performance. Thirty-five percent of fish (7 of 20) exposed to 36.1 C died during treatment. Fish surviving the 36.1 C treatment retained the ability to thermoregulate; however, their mean lower and upper avoidance temperatures increased 0.6 and 0.7 C, respectively. Activity patterns were typically diurnal, but variable, in all three treatment groups. Immediately after treatment, the activity of fish exposed to 21 and 36.1 C was markedly decreased. Thereafter, activity tended to be higher in the 21 C group and lower in the 36.1 C group than during the pretreatment period. (Auth)

<34>

Beitinger, T.L., and J.J. Magnuson, Influence of Social Rank and Size on Thermoselection Behavior of Bluegill (*LEPOMIS MICROCHIRUS*).

1975. Jour. Fish. Res. Bd. Can., 32, 2133-2136 (University of Wisconsin, Department of Zoology, Laboratory of Limnology, Madison, WI)

Juvenile bluegill (*LEPOMIS MICROCHIRUS*) (95 to 110 mm TL) were given a choice between an environment at their preferred temperature (31.0 C) plus a social dominant (130 to 160 mm TL) or an environment either cooler (27.0 C) or warmer (34.0 C) than their preferred temperature, but without a large bluegill. During a 3-day control period, when 20 small fish were isolated in individual experimental aquaria, each spent more than 75% of its time at 31.0 C rather than warmer or cooler temperatures. After an adult was placed into the preferred temperature side of each aquaria, small fish spent nearly the entire 3-day experimental period at previously non-preferred temperatures on the side without the larger bluegill. No significant correlation was found between length and selected temperatures of 35 individual bluegill (70 to 180 mm) tested in a temporal temperature gradient. (Auth)

<35>

Seitinger, T.L., J.J. Macdonald, W.H. Beill, and W.B. Shaffer, Behavioral Thermoregulation and Activity Patterns in the Green Sunfish, *LEPOMIS CYANELLUS*.

1975. Animal Behavior, 23, 222-229 (University of Wisconsin, Department of Zoology, Madison, WI)

Behavioral thermoregulation and locomotory activity of green sunfish were examined in a temporal temperature gradient apparatus. Green sunfish actively avoided temperatures exceeding 30.3 C and below 26.5 C and had a median preferred temperature of 28.2 C. Temperature preference did not vary significantly during the diel period even though locomotory activity patterns were markedly crepuscular. Activity was stimulated by the change in illumination levels at dawn and dusk. (auth)

<36>

Belan, B.W., and A.C. Giese, Oxygen Consumption of an Asteroid and an Echinoid from the Antarctic.

1976. Biol. Bull., 166, 157-166 (University of California, Department of Biological Sciences, Santa Barbara, CA; Stanford University, Department of Biological Sciences, Stanford, CA)

There was no significant increase in rates of oxygen consumption with a small rise in temperature (-1.8 to 3 C) for the antarctic echinoid *STERECHINUS NEUTRIZI* and the asteroid *ODONTASTER VALIDUS*. The O₂ consumption rate of the body wall of the urchin was higher at 3 C than at either 0 or -1.8 C. The study could not be extended to a wider range of temperatures because below -1.8 C the medium froze and at 5 C the animals became flaccid and eventually died. (ST)

<37>

Beach, V., Some Facts on the Growth of *CITHARINUS CITHARUS* (Fishes, Stonecarps) in the Chad Basin.

1976. Cah. O.R.S.T.O.N., Ser Hydrobiol., 8, 23-33 (Hydrobiology Center, ORSTOM, N'djamena, Chad)

The growth of *CITHARINUS CITHARUS* in the southeast archipelago of Lake Chad stopped from November to March, the period during which the temperature was below 25 C. (ST)

<38>

Bennett, D.H., and J.W. Gibbons, Reproductive Cycles of Largemouth Bass (*MICROPTERUS SALMOIDES*) in a Cooling Reservoir.

1975. Trans. Amer. Fish. Soc., 104, 77-82 (Savannah River Ecology Laboratory, Aiken, SC)

Annual reproductive cycles of largemouth bass (*MICROPTERUS SALMOIDES*) collected in the heated area of Par Pond on the Savannah River Plant were similar to cycles from bass collected in unheated waters during 1969 and 1970. Average maximum monthly temperatures at the heated area exceeded those in unheated waters by greater than 10 C for the two years. Few monthly differences in

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gonosomatic indices were found between heated and unheated areas. Earlier attainment of maximum gonadal size and the presence of significantly larger juvenile bass at the heated area suggested that reproduction might be accelerated by thermal discharge. However, gonadal condition indicated that the reproductive period started in March and continued through April in both areas. Reproduction may have been advanced in some heated-area bass, although this was not obvious from overall changes in the reproductive cycles of bass from unheated areas. (auth)

<39>

Berrien, P.L., A Description of Atlantic Haddock, *SCOPHES SCOPHES*, Eggs and Early Larvae.

1975. Fishery Bull., 73, 186-192 (National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Sandy Hook Laboratory, Highlands, NJ)

Hatching of eggs of laboratory reared Atlantic Haddock occurred between 90 and 102 hours after fertilization at an average incubation temperature of 13.8 C. The yolk-sac stage ended by the 137th hour. Development of the eggs and early larvae is described. (ST)

<40>

Berry, W.C., and J.D. Branner, The Effect of Temperature on Oxygen Consumption in *AEDES AEGYPTI* Pupae.

1975. Ann. Entomol. Soc. Amer., 68, 298-300 (University of Vermont, Department of Zoology, Burlington, VT)

The O₂ consumption of pupae of *AEDES AEGYPTI* was measured at 10 temperatures ranging from 12 to 35 C. Oxygen consumption increased with increasing temperature. From 12 to 25 C the Q₁₀ was approximately three, then decreased with increasing temperature. Significant differences in pupal O₂ consumption were found between the first and second hour of each trial at all temperatures. Oxygen consumption decreased during the second hour at 30 and 35 C because the thermal death point is reached in this range. (ST)

<41>

Beyers, R.J., Ecological Studies in a Cooling Reservoir in the Southeastern United States.

1976. Part of Callagher, B.J. (Ed.), Proceedings of a Symposium on Energy Production and Thermal Effects held in Oak Brook, Illinois, September, 10-11, 1973. Limnetics, Inc., Milwaukee, Wisconsin (Savannah River Ecology Laboratory, Aiken, SC)

The effects of elevated water temperatures on the fish, reptiles, amphibians, waterfowl, rooted aquatic vegetation and the eutrophication of Par Pond on the Savannah River Plant, S.C., are reviewed. Positive and negative aspects of thermal additions are discussed. (ST)

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Sin, D., and E. Saisse, The Planktonic Copepod CALANOIDES CARINATUS Distribution and Life Cycle off the Ivory Coast.

1975. Cah. O.R.S.T.O.M., ser. Oceanogr., 13, 15-30 (Océanographes Biologistes de l'O.R.S.T.O.M., Centre de Recherches Océanographiques, Cote d'Ivoire, Africa)

In the shelf and slope waters between Cap Palmes and Cap Three Points, Ivory Coast, CALANOIDES CARINATUS showed a correlation between the cooling of waters and the total number of the same fortnight, also between the mean cephalothoracic length and the temperature of the preceding fortnight. (RFC)

<83>

Sinyukov, V.I., A.S. Golovacheva, L.G. Loginova, A.S. Kapel'yants, E.I. Kilyuryanov, V.I. Sestina, and D.W. Ostrovskii, Temperature-Induced Structural Modification of Membranes of Thermophilic Bacteria Studied by Spin Probe and Light Scattering.

1978. Mikrobiologiya (USSR), 43, 499-503 (Institute of Biochemistry, Moscow, USSR)

Structural transitions in the isolated membranes of the obligate thermophilic bacterium, BACILLUS STEROTHERMOPHILUS, grown at 60 and 70 C were detected by spin probe and light scattering. These temperatures are the lower and upper temperature limits of the bacterial growth. It was suggested that the transitions were due to changes in components of the lipoprotein membrane. (ST)

<84>

Birch-Anderson, P., CHRYSOSPHAERELLA SALINA A New Species of the Chrysophyceae from Salt Marsh Pools.

1973. Bot. Tidskrift, (Den.), 68, 140-144 (University of Copenhagen, Institut for Sporeplanter, Copenhagen, Denmark)

In Danish salt marsh pools, a new species of plankton, CHRYSOSPHAERELLA SALINA, was observed as colonies or isolated scales only in May, June, September, October and November when the water temperature was 7.5 to 21.2 C and the salinity was 1.4 to 24.0 ppt. (BPC)

<85>

Bishop, J., The Influence of Selected Conditions on the Oxygen Consumption and Hemolymph Osmolality of the Brown Shrimp, PENAEUS AZTECUS Ives.

1978. Ph.D. Thesis, Louisiana State University and Agricultural and Mechanical College, 161 p. (Louisiana State University and Agricultural and Mechanical College, Baton Rouge, LA)

The oxygen consumption rates and hemolymph osmolality of two size classes 6.7 g and 3.7 g of brown shrimp, PENAEUS AZTECUS, were measured at all combinations of 10, 20, and 30 ppt salinity and 18, 23, 28, and 33 C. Increasing temperature significantly increased shrimp oxygen consumption; at 18, 23, 28, and 33 C, the average oxygen consumption was 0.29, 0.35, 0.48, and 0.55 mg O₂/g wet wt/hr, respectively. Increasing salinity significantly increased the shrimp hemolymph osmolality. Results suggested that P. AZTECUS is well adapted to estuarine salinities and temperatures and expends little energy for osmoregulation between 10 and 30 ppt salinity. (ST)

<86>

Blake, J.A., The Larval Development of Polychaeta from the Northern California Coast II. NOTHRIA ELEGANS (Family Onuphidae).

1978. Ophelia, 13, 43-61 (University of the Pacific, Pacific Marine Station, Billion Beach, CA)

The larvae of NOTHRIA ELEGANS, an onuphid polychaete common in northern California were reared in the laboratory from artificial fertilization. At a temperature of 17.5 C, larvae developed rapidly and settled 6 days after fertilization. Development in the plankton is lecithotrophic, with feeding delayed until just prior to settlement. Seta and branchial characteristics of juveniles are different from those of adult N. ELEGANS and present difficulties in identification of small onuphids taken from benthic samples. It is concluded that development strategies in the Onuphidae are dominated by a dependency on yolk reserves. N. ELEGANS and 2 other onuphid species recorded in the literature have lecithotrophic development, whereas 7 other species are reported to develop directly with no planktonic phase at all. (Auth)

<87>

Blancher, E.C., II, Abundance, Distribution, and Diversity of Fishes in a Louisiana Estuary.

1975. Assoc. Southeast Biol. Bull., 21, 40 (Louisiana State University, Baton Rouge, LA)

Fish populations and pertinent abiotic factors were sampled monthly in Little Lake, St. Tammany Parish, Louisiana, for a year. Analysis of fish abundance, distribution, and diversity shows strong seasonal trends concomitant with changes in certain physicochemical parameters, particularly temperature and salinity. Trends in diel differences in fish populations indicate daily movement within the estuary. (Auth)

<88>

Bland, C.E., and R.V. Anderson, Occurrence and Distribution in North Carolina Waters of LAGENIDION CALLINECTES Couch, a Fungal Parasite of Blue Crab Ova.

1973. NOAA-7504406; 5 p. (East Carolina University, Department of Biology, Greenville, NC)

Infection of ovigerous blue crabs, CALLINECTES SAPIDUS, with the fungus, LAGENIDION CALLINECTES was high during the month of May, 1971 and 1972, but declined steadily during June and July with no infected crabs being collected after July 19, 1972. Attempts to correlate infection rate with water temperature and salinity were inconclusive. PAROPEUS HERBERTII and LIBinia DUNIA ova were also naturally infected. Ova of NERIPPE HERBERTII were susceptible to artificial infection in the laboratory. (ST)

<49>

Slaxter, J.R.S. (Ed.), The Early Life History of Fish.

1974. Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association, Oban, Scotland, May 17-23, 1973. Springer-Verlag, Berlin-Heidelberg (Scottish Marine Biological Association, Dunstaffnage Marine Research Laboratory, Oban, Scotland)

Sixty-two papers covering the current status of research into marine fish eggs and larvae were presented. Emphasis was on the use of egg and larval surveys in fish population dynamics. Other topics covered included larval micro-distribution, the effects of high temperatures and physical and chemical stresses, culture methods, taxonomy, and developmental and behavioral studies. Fifteen papers were selected and abstracted for the data base. (ST)

<50>

Blinn, D.W., and K.S. Batten, The Effect of Temperature on Parasitism of *PANDORINA* sp. by *DANGEBDIA NANNILLATA* S. SCHRODER in an Arizona Mountain Lake.

1973. Jour. Phycol., 9, 323-326 (Northern Arizona University, Department of Biological Sciences, Flagstaff, AZ)

A chytridiaceous fungus, *DANGEBDIA NANNILLATA*, was found to be selectively parasitizing the volvocalean *PANDORINA* sp. in a shallow eutrophic mountain lake in northern Arizona. Population estimates of infected algal colonies reached 68 percent during epidemic periods (February to March). Selected physicochemical parameters were measured during the infection period, with temperature found to be the most important factor in regulating chytrid parasitism. Infection only occurred at temperatures below 17 C in the field, and infection only at low temperatures was confirmed by laboratory investigations. Other parameters showed no apparent relationship with the chytrid-algal association. The roles of photosynthetic exudates are also discussed in regulation of chytrid parasitism. (Auth)

<51>

Bloom, S.G., A.A. Levin, and G.E. Raines, Future Uses of Mathematical Models to Predict Ecological Effects from Thermal Discharges.

1974. Part of Gallagher, B.J. (Ed.), Proceedings of a Symposium on Energy Production and Thermal Effects held in Oak Brook Illinois, September 10-11, 1973. Limnatics, Inc., Milwaukee, Wisconsin (Battelle Memorial Institute, Columbus Laboratories, Columbus, OH)

Preliminary mathematical simulations of ecosystems were undertaken to indicate the possibilities of predicting the response of aquatic biota to thermal effluents, to illustrate the type of information needed from ecological surveys to develop these models, and to speculate on the outlook for future developments and uses of these models. Several steps required in the development of a comprehensive model are identified.

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Following a review of existing information of the environment of interest a preliminary mathematical model can be formulated from the literature data and estimates of unknown parameters. This preliminary model can then be used to guide the acquisition field and laboratory data. Complementary laboratory data are needed on biomass transfer rates as a function of temperature and other factors related to the effluent. With sufficient data, a comprehensive mathematical model can be developed to predict the response of biota and can be subjected to tests by field experiments. The model, thus developed and validated by field experiments, can then be used, with confidence, to predict ecological effects of thermal effluents. (Auth) (ST)

<52>

Boltsov, N.P., Morphology of Fingerlings in the Ivan'kovo Reservoir Affected by Hot Water Discharge from the Konakovo Hydroelectric Power Station.

1974. Vopr. Ikhtiol., (USSR), 18, 1046-1052 (State Research Institute, Upper Volga Division, Lake Silver Fisheries, Konakovo, USSR)

There were no significant differences in morphological indices between fingerlings of roach, bream, perch, and pike in areas of the Ivan'kovo Reservoir, USSR, affected by hot water discharge and control fish. Spawning and development occurred earlier in the hot water area at temperatures similar to the control areas. There were some differences in the dimensions of the fins and ventroanal space. Body length and head length were somewhat increased in fish from thermally affected areas. (ST)

<53>

Bontemps, S., Trials with Keeping Rainbow Trout in a Pond Swelled with Warmed Water.

1975. Roczn. Nauk Rolniczych [Pol.], 96, 7-15 (Instytut Rybnictwa Środlądowego, Zakład Gospodarki Rybackiej w Rzekach i Zbiornikach Zaporowych, Zabieniec koło Warszawy, Poland)

Rainbow trout weighing 100 g were reared in a pond receiving cooling water from a power plant on the Vistula River, Poland, for four winter months. Individual fish weight increase was 240 g and the survival rate was 90%. (ST)

<54>

Boonprakob, U., and Y. Dhebtarason, Experiments on Artificial Fertilization and Descriptive Studies of Eggs and Larvae of the Indo-Pacific Mackerel *RASTRELLIGER NEGLECTUS* (Van Name).

1972. Indo-Pac. Fish. Coun. Proc. (Thailand), 15, 144-158 (Marine Fisheries Laboratory, Bangkok, Thailand)

Hatching periods of artificially fertilized mackerel were 20.5 hours at 29 C and 27.5 hours at 28.4 C. At temperatures varying between 25.3 and 28.1 C, larvae reached the postlarval stage within 72 hours after hatching. Descriptions of eggs and developmental stages of the larvae are given. (ST)

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Bott, T.L., Bacterial Growth Rates and Temperature Optima in a Stream with a Fluctuating Thermal Regime.

1975. Limnol. & Oceanogr., 20, 191-197 (Academy of Natural Sciences of Philadelphia, Stroud Water Research Center, Department of Limnology, Philadelphia, PA; University of Pennsylvania, Department of Biology, Philadelphia, PA)

Direct measurement of bacterial growth rates in a natural stream showed that the unicellular and filamentous populations had doubling times of 42 to 51 hr when the water temperature was 0 to 5 degrees C, 9.4 to 10.8 hr when water temperature was predominantly 11 to 16 C, and 2.8 to 6.0 hr when the water temperature was 16.7 to 21.0 C. The populations were not optimally adapted to the prevailing stream water temperature, but rather to temperatures 5 to 20 C higher. (Auth)

<56>

Bottrell, H.N., The Relationship Between Temperature and Duration of Egg Development in Some Epiphytic Cladocera and Copepoda from the River Thames, Reading, with a Discussion of Temperature Functions.

1975. Oecologia (Ger.), 16, 63-84 (University of Reading, Department of Zoology, Whiteknights, Reading, England)

Data on the duration of egg development at 5, 10, 15, and 20 C are given for eight cladocerans and one cyclopoid copepod species found associated with the yellow water lily (NUPHAR LUTEA) in the River Thames. A decrease in temperature caused a marked increase in the time taken to complete development for all nine species. The data are compared with published data and a number of conclusions drawn. In general, cladoceran eggs tended to take longer to complete development than copepod eggs, and within the Cladocera the eggs of epiphytic species tended to take longer to develop than those of planktonic species, and the eggs of large species longer than the eggs of small species. A curvilinear logarithmic model was found to be the most generally applicable model for the relationship of development time to temperature. (Auth) (ST)

<57>

Bottrell, H.N., Generation Time, Length of Life, Instar Duration and Frequency of Moulting and Their Relationship to Temperature in Eight Species of Cladocera from the River Thames, Reading.

1975. Oecologia (Ger.), 19, 129-139 (University of Reading, Department of Zoology, Whiteknights, Reading, England)

Generation time, length of life, instar duration and frequency of moulting of eight species of epiphytic cladocera from the River Thames, England, were inversely related to temperature. The number of juvenile instars was constant for a particular species, but varied between species. Large species tended to have more juvenile instars than small species. (ST)

<58>

Bourne, W., and J.C. Lee, Predation of Juvenile Bivalves by the Shore Crabs HEMIGRAPSUS OREGONENSIS and H. RUBENS.

1973. Proc. Natl. Shellfish Assn., 64, 10 (Pacific Biological Station, Nanaimo, British Columbia, Canada)

Predation rate of the shore crabs, HEMIGRAPSUS OREGONENSIS and HEMIGRAPSUS RUBENS, on juveniles of three bivalve species, SASSIDORUS GIGANTUS, VESUS JAPONICA, and MYTILUS EDULIS, was similar at 10 and 15 C. Whether SASSIDORUS GIGANTUS and VESUS JAPONICA were buried in substrate or exposed in experimental dishes had little effect on predation rate. (ST)

<59>

Bowen, R.C., Effects of Certain Chemical Pollutants on Small Aquatic Animals.

1975. Kansas Water Resources Research Institute Contributions No. 157; 11 p. (Kansas Water Resources Research Institute, University of Kansas, Lawrence, KS)

At higher temperatures the toxic effect of cadmium on the protozoan, TETRAHYMENA PYRIFORMIS, was detrimental in parts per billion as compared to parts per million at lower temperatures. As part of this study a rapid, inexpensive photomicrographic method of recording effects of chemical pollutants on the swimming rate of TETRAHYMENA PYRIFORMIS was developed. (ST)

<60>

Bowler, K., R.T. Cladwell, and C.J. Duncan, Acclimatization to Temperature and Death at High Temperatures in the Crayfish AUSTROPATANGIUS PHILIPPI.

1973. Part of Abrahamsson, S. (Ed.), Freshwater Crayfish, Papers from the First International Symposium on Freshwater Crayfish held in Austria, 1972, (p. 121-131). Studentlitteratur, Lund Sweden (University of Durham, Department of Zoology, Durham, UK)

Deaths at high temperatures of the freshwater crayfish, AUSTROPATANGIUS PHILIPPI, were dependent upon previous acclimation temperatures. Death at high temperature was linked with a breakdown of cation permeability, injury to the normal bioelectrical features of the muscle fiber membrane, and the temperature sensitivity of an ATPase surrounded by membrane.

<61>

Boyce, W.P.J., Biology of EUBOOTHION SALVELINI (Cestoda: Pseudophyllidae), a Parasite of Juvenile Sockeye Salmon (ONCORHYNCHUS NEKA) of Sabine Lake, British Columbia.

1970. Jour. Fish. Res. Bd. Can., 31, 1735-1742 (Department of the Environment, Fisheries and Marine Service, Pacific Biological Station, Nanaimo, British Columbia, Canada)

The rate of development of EUBOOTHION SALVELINI in its intermediate host was temperature dependent. In copepods reared at 5 C the worms appeared little developed past the oncosphere stage after 20 days; worms in copepods reared at 10 C were large and elongate; in copepods reared at 15 C development of the metacercaria was nearly complete. Susceptibility of the final host, sockeye salmon fry, was size dependent, with smaller fish being more readily infected. (ST)

<62>

Bradley, E.P., The Seasonal Influence of Salinity on Temperature Tolerance of Summer and Winter Populations of the Copepod *EUTIMENA AFFINIS*.

1975. Biol. Bull., 140, 26-30 (University of Maryland, Department of Biological Sciences, Baltimore City, Catonsville, MD)

Thermal tolerances of populations of the copepod, *EUTIMENA AFFINIS*, were measured by temperature shocking at 30.5 C and observing the time to succumb (TS) and time to recover (TR) over a 30 day period. There were repeatable and significant differences in tolerance between populations collected in March and August and also between salinities. Average tolerances and differences between populations generally increased with salinity. The distinction between populations in thermal tolerance was greater when the animals were osmotically acclimated for 20 hr. A simple index of tolerance combining TS and TR was suggested. The seasonal distribution of *E. AFFINIS* was contrary to that expected from the thermal tolerance-salinity relationship found. (ST)

<63>

Branch, C.G., The Ecology of *PATELLA* Linnæus from the Cape Peninsula, South Africa. 2. Reproductive Cycles.

1970. Trans. Roy. Soc. S. Africa, 41, 111-160 (University of Cape Town, Department of Zoology, Cape Town, South Africa)

The gonad structure and reproductive cycles of seven species of the mollusc *PATELLA* are described. Most species spawn once a year. Spawning time was related to distribution. Autumn and winter breeders occurred on the cold west coast and probably also on the warmer coasts. Spring and summer breeders were restricted to warm waters. The role of sea temperatures in limiting larval dispersal was discussed. (ST)

<64>

Branch, S.L., Limiting Factors for the Gametophytes of Three South African Laminariales.

1970. Investl. Rep. Sea Fish. Brch. S. Africa, 100, 1-10 (Not Given)

The tolerance of the gametophytes of the South African subtidal kelp *WELDONIA NATHA* to physical factors of desiccation, light and temperature in culture was related to the natural distribution of the sporophytes. The sporophytes occurred naturally where the mean annual sea temperature was 10.5 C or less, while the gametophytes tolerated higher temperatures in culture (optimum 15.0 C, maximum 17.5 C). Temperature fluctuations as low as 3 degrees C for two days retarded gametophyte development. The gametophytes of *LAMINARIA PALLIDA* and *WELDONIA NATHA* showed a temperature optimum (15.0 C) and range for attaining maturity similar to *E. NATHA*. (Both) (ST)

<65>

Bratberg, E., and B. Bockle, Temperature Preference in Cod (*GADUS MORHUA* L.).

1970. Fiskerihavet (Nor.), No. 20, 20 p. (Fiskeridirektoratets Havsforskningsinstitutt, Bergen, Norway)

Cod held in aquaria composed of two sections held at different temperatures and connected by a tunnel accepted temperatures up to 16 to 17 C and sometimes up to 18 to 19 C before an aversive reaction occurred. The lowest acceptable temperature could not be clearly determined. (ST)

<66>

Bratberg, E., and B. Bockle, Mortality of Prawns (*PANDALUS DORVILLEI* Gray) and Cod (*GADUS MORHUA* L.) in Warmed Seawater.

1970. Fiskerihavet (Nor.), No. 21, 27 p. (Fiskeridirektoratets Havsforskningsinstitutt, Bergen, Norway)

Deep water prawns acclimated to a mean temperature of 5.0 C survived temperatures of 15 to 15.5 C for a 10-day period. When acclimated to 9 C they survived a 1 C higher temperature. It was concluded that prawns could become accustomed to higher temperatures resulting from discharge from a nuclear power plant. Cod survived temperature of 19.5 to 20 C for a 10-day period. Mortality occurred mostly during the first day. Following acclimation at 16 C they survived at 20.5 to 21 C. (ST)

<67>

Bratberg, E., B.D. Danielsen, and S.A. Iversen, Mortality and Growth in Warmed Seawater of I-Group Sole (*SOLEA SOLERA* L.) and Hybrid of Plaice (*PLEUROCENTES PLATESSA* L.) and European Flounder (*PLATICHTHYS FLEBUS* L.).

1970. Fiskerihavet (Nor.), No. 23, 16 p. (Fiskeridirektoratets Havsforskningsinstitutt, Bergen, Norway)

The long term effect of high temperatures on sole and a plaice-European flounder hybrid was investigated using warmed seawater. Experimental temperatures were normal seawater at 20 m depth, 12, 15, 18, and 21 C. Temperature was increased from ambient by 1 C/day to the desired temperature. During the temperature increase the mortality rate of the sole was higher than that of the hybrids. The mortality of sole declined, while that of the hybrids increased steadily during the experimental period, though not reaching that of the sole. Mortality was highest among the smallest fish. The sole showed more significant growth differences between experiments than did the hybrids. (ST)

<68>

Broer, H., Ganglioside Pattern and Thermal Tolerance of Fish Species.

1975. Life Science, 16, 1059-1060 (University of Stuttgart-Hohenheim, Zoology Institute, Stuttgart, German Federal Republic)

In a study of fish living at different temperatures, those with higher body temperatures had a lower relative proportion of brain polynialgangliosides. (ST)

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Wroter, H., and S. Rabeaux, Temperature Effect on Brain Glycogen of Fish.

1978. Brain Res., 88, 360-365 (University of Stuttgart-Hohenheim, Zoology Institute, Stuttgart, German Federal Republic)

Glycogen content of *SCABINUS* *ENTHROPTALMUS* and *CARASSIUS AURATUS* brains reached a peak of greater than 20 μ moles/g fresh wt in December and fell to 4 to 6 μ moles/g fresh wt in May. In fish placed in cold water a definite increase in glycogen storage was observed within six hr, rising to 26 μ moles/g fresh wt in 10 days at 7 C compared with 13.1 μ moles/g fresh wt at 20 C. It is suggested that the rapid storage or synthesis of glycogen by the CNS when placed in a cold environment could be a short term compensatory biochemical mechanism to bridge the gap between initial stress and tissue adaptation mechanisms. (1978) (ST)

<70>

Brett, J.B., Tank Experiments on the Culture of Pacific Sockeye (*OSMOCYSTUS SERNA*) and Pink Salmon (*O. GORBUSCHA*) Using Environmental Control.

1978. Aquaculture, 8, 341-352 (Pacific Biological Station, Nanaimo, British Columbia, Canada)

Sockeye (*OSMOCYSTUS SERNA*) and pink (*O. GORBUSCHA*) salmon were grown from 8 g to sea size (230 g) in a least 200 days in 15 C salt water (10 and 28 ppt) with a photoperiod increasing from 15 to 18 hr light/day. A provisional table of growth rates for sockeye salmon is presented which can be used to predict the expected weight (up to 500 g) for any temperature, time and starting size when on excess ration. (BPC)

<71>

Breiden, D.L., J.C. Fenwick, and T.W. Moon, The Effects of Acclimation Temperature and Conditioning Temperature on the Learning Rate of the Goldfish *CARASSIUS AURATUS*.

1975. Comp. Biochem. Physiol., 50A, 373-377 (University of Ottawa, Department of Biology, Ottawa, Ontario, Canada)

Fish acclimated to 5, 10, 20 and 28 C were subjected to conditioning at their respective temperatures of acclimation, and fish acclimated to 13 and 20 C were conditioned at 25 and 28 C respectively. Fish acclimated to 5 C were unable to acquire the avoidance response of the conditioning experiment. Fish acclimated to 20 C and conditioned at 28 C learned at the same rate as fish acclimated to 28 C and conditioned at 28 C learned faster than fish acclimated to 20 C and conditioned at 20 C, but slower than the fish conditioned at 28 C. Fish acclimated to 10 C and conditioned at 10 C exhibited the slowest learning rate. It is concluded that it is the temperature of conditioning which affects the rate of acquisition of information, and that learning rate is dependent on factors which rapidly adapt to environmental temperatures. (18th)

<72>

Brinad, P., Ecological Studies of Benthic Phytoplankton of Southern California.

1978. Ph.D. Thesis, University of California, 186 p. (University of California, Irvine, CA)

Phytoplankton in natural sea-water cultures were reduced in species number by 10%, 33%, and 72% when temperatures were elevated 5, 10 and 15 C, respectively. Generally, a 5 C rise enhanced growth rate and biomass. Greater elevations resulted in a reduction of phytoplankton volume, proportional to the magnitude of the rise and more pronounced when applied to warmer waters. Division rates were reduced similarly by a 15 C increment, but were increased by as much as 51% and 68% when 10 C ambient water was heated 10 and 5 C respectively. Results suggested that the high phytoplankton mortalities encountered at operating power plants are attributable to synergistic effects between temperature, mechanical agitation and also chlorine, which increases the sensitivity of most species to heating. (BPC)

<73>

Bridges, D.W., J.J. Coch, Jr., and D.W. Pedro, Neurological Responses of Winter Flounder to Long and Short Term Environmental Change.

1975. Part of Coch, J.J., Jr., et al. (Eds.), Respiration of Marine Organisms. Proceedings of the Marine Section of the First Maine Biomedical Science Symposium held in Augusta, Maine, March 18-19, 1975. Research Institute of the Gulf of Maine (TRIGOM), South Portland, Maine, (p. 171-182), 211 p. (Research Institute of the Gulf of Maine (TRIGOM), South Portland, ME)

Studies of winter flounder (*PLEUROPLEURUS AMERICANUS*) hematological responses to short and long term environmental shifts were performed. Statistically significant differences between seasons were found for hematocrit; erythrocyte number; immature erythrocyte number; mean corpuscular volume; mean corpuscular hemoglobin; total leukocytes, lymphocytes, thrombocytes and neutrophils; and plasma proteins. The seasonal temperature levels at which the flounder were held in respirometers represented mean autumn (10 C), mean summer (15 C) and summer maximum (18 C) temperatures. Short term temperature increases (change of temperature of 5 C in two hours) produced few significant hematological responses. No significant changes could be ascertained between fish held at 10 C and 15 C. (ST)

<74>

Brock, S.A., Circannual Rhythmicity in Cnidaria and Other Invertebrate Animals.

1978. Intl. Jour. Chronobiol. (Eng.), 2, 114-115 (National Institutes of Health, Laboratory of Cellular and Cooperative Physiology, Bethesda, MD)

In the laboratory the circannual rhythms of the colonial marine cnidarian, *CAPNULANIA PLEUROSIA*, remained nearly uniform despite culture at constant temperatures of 10, 17, and 28 C. (ST)

<75>

Brock, T.D., Predicting the Ecological Consequences of Thermal Pollution from Observations on Geothermal Habitats.

1975. COWP-740020; STI/PUB/378; IAEA-SM-187/9; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 24-30, 1974, (P. 599-622) (University of Wisconsin, Department of Bacteriology, Madison, WI)

Observations on the ecology of organisms in hot springs and other geothermal habitats are used to derive a set of general principles for predicting the ecological consequences of thermal pollution. The advantages of using geothermal habitats for such studies is that they are natural, stable, and of long duration. There are distinct upper temperature limits for different groups of organisms: fish and other aquatic vertebrates, 38 C; insects, 45 to 50 C; protozoa, 50 C; vascular plants, 45 C; mosses, 40 C; eucaryotic algae, 56 C; fungi, 40 C; blue-green algae, 70 to 73 C; bacteria, greater than 99 C. Thus, increases in temperature can lead to a greatly simplified ecosystem structure. Even at temperatures below the upper limit for a group of organisms, the species diversity for this group may be severely restricted. A temperature of 40 C is seen as critical, since rises above this will eliminate most higher organisms as well as eucaryotic algae, and only blue-green algae and bacteria will be able to grow. Careful consideration should be given to the natural temperature fluctuation of the habitat receiving thermal water, since thermal pollution may have such greater effects in summer than in winter, especially in temperate habitats. Tentative recommendations for siting power plants to avoid serious ecological consequences are given. (Auth)

<76>

Brock, T.D., and J. Hoffmann, Temperature Optimum of Algae Living in the Outfall of a Power Plant on Lake Monona.

1974. Trans. Wis. Acad. Sci., Arts, Lett., 62, 195-203 (University of Wisconsin, Madison, WI)

Temperature optima for photosynthesis were measured for algal populations living in the outfall of an electric power plant on Lake Monona and were compared with the temperature optima of algae living in a control area in the nearby Yahara River. The temperature of the power plant outfall averaged about 8 degrees C higher than that of the Yahara River. Studies were carried out in both summer and winter. In the winter, no differences in species composition between the two study areas could be detected, *CLADOPHYTES* and *WOLFFIA* being the dominant algae. The temperature optima of the populations from the two locations were the same, around 27 C, although the habitat temperatures at both locations were considerably lower. The only difference in response to temperature seen between the two populations was that the population at the outfall was able to photosynthesize at higher temperatures, still showing high

photosynthesis at 35 C and detectable photosynthesis at 46 C, a temperature at which the population from the Yahara River showed no detectable photosynthesis. In the summer, the dominant algae at the power plant outfall were *STIGODONIA* and filamentous blue-green algae (family *Oscillatoriaceae*), whereas at the Yahara River the algal population was almost exclusively *CLADOPHYTES*. The temperature optima of both summer populations were the same, 31.5 C, only slightly higher than the mid-winter optima. Again, the population from the power plant was able to photosynthesize at higher temperatures than the control population, showing quite active photosynthesis at 42.5 C, a temperature at which the population from the Yahara River was completely inactive. These results are discussed in relation to the possible environmental impact of power plants on Wisconsin lakes and rivers. (Auth)

<77>

Brooke, L.T., Effect of Different Constant Incubation Temperatures on Egg Survival and Embryonic Development in Lake Whitefish (*Coregonus clupeaformis*).

1975. Trans. Amer. Fish. Soc., 104, 555-559 (U.S. Fish and Wildlife Service, Great Lakes Fishery Laboratory, Ann Arbor, MI)

Eggs of lake whitefish (*Coregonus clupeaformis*) were incubated in a constant-flow incubator at constant temperatures of 0.5, 2.0, 4.0, 5.9, 7.0, and 10.0 C. The time from fertilization to median hatch was inversely related to temperature, and ranged from 41.7 days at 10.0 C to 182 days at 0.5 C. The percentage hatch was highest (70.9 to 73.3%) at 4.0, 5.9, and 7.0 C, and was greatly reduced (6.0 to 28.4%) at 0.5, 2.0 and 10.0 C. The mortality of embryos was greatest during the early stages of development. Abnormally developed fry were most frequent (85.9% of the hatch) at 10.0 C and least frequent (2.8%) at 4.0 C. Mean lengths of fry at hatching were shortest at 7.0 and 10.0 C (12.4 and 8.8 mm, respectively) than at lower temperatures (13.1 to 13.5 mm). The optimum temperature range for incubation of lake whitefish eggs was 3.2 to 8.1 C. Equations were derived for predicting development time to 20 successive stages, and to hatching, at constant incubation temperatures and at fluctuating daily mean water temperatures. (Auth)

<78>

Brown, L.V., and L.C. Fitzpatrick, The Effects of Acclimation and Acclimatization to Six Seasonally-Encountered Temperatures on the Energy Budget of the Hellgrammite, *COLEOPTERUS*.

1973. Amer. Zoologist, 13, 1291 (North Texas State University, Denton, TX)

Effects of acclimation and acclimatization to six seasonal temperatures (2, 10, 15, 20, 25, and 30 C) on acutely determined 82 consumption rates were examined in the predaceous aquatic insect larva, *COLEOPTERUS*. Seasonal acclimated larvae had significantly lower metabolic rates than winter acclimated larvae at each common experimental temperature, while animals collected at intermediate temperatures had intermediate rates. Q10 values and Precht Type compensations are given. (Auth) (ST)

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Brown, D.B., T.A. Olson, and T.O. Odlaug. The Response of Nearshore Periphyton in Western Lake Superior to Thermal Additions.

1976. OHSU-S-820-HISU; 174 p. (University of Minnesota, Water Resources Research Center, Minneapolis, MN)

The study ascertained that a 10 to 12 C increase in temperature of near-shore areas of Lake Superior, such as from a power plant cooling water discharge, would result in changes in the phyletic composition of the local periphyton community. The effects of the change from diatoms to green algae on benthic grazers and the feedback of the affected area are discussed. (57)

(80)

Dryan, J.E., and D.A. Rato. Spawning of Lake Whitefish, *Coregonus clupeaformis*, and Round Whitefish, *Coregonus cylindricornis*, in Aishihik Lake and East Aishihik River, Yukon Territory.

1975. Jour. Fish. Res. Bd. Can., 32, 203-208 (Department of the Environment, Fisheries and Marine Service, Vancouver, British Columbia, Canada)

Spawning grounds used by lake (*Coregonus clupeaformis*) and round whitefish (*Coregonus cylindricornis*) were discovered in the course of an investigation on effects of hydroelectric development. The spawning period for lake whitefish extended from early November to at least mid-December 1973. Lake whitefish spawned over silt and POTAMOGETON in water which had little current and was 2.0 to 2.5 m deep. Spawning of round white fish was probably completed in November. Round whitefish spawned during the day. Eggs were apparently broadcast over a variety of substrates ranging from silt and POTAMOGETON to gravel and boulder. Round whitefish eggs were deposited in both fast and slow current at depths ranging from 0.7 to 2.5 m. Although deposited in a range of habitats, round whitefish eggs seemed to be most abundant on gravel in fast current at depths less than 1 m. From November 7 to 23 the surface water temperature at one of the locations ranged from 1.0 to 1.6 C. (Both)

(81)

Bullard, H.J., A Preliminary Report on the Effect of Water Temperature on the Early Growth of Rainbow Trout (*Salmo gairdneri*).

1976. Jour. East. Fish. Syst., 5, 16-22 (Scientific Services, North Eastern Region, C.S.C.B.)

Eyed rainbow trout (*Salmo gairdneri*) eggs were incubated in ambient water from the River Trent 7 days prior to, when, and in cooling water from station on Lake Trusmydd aimed at water to give a water temperature of 5 and 8.75 C above ambient but in advance of those at ambient temp. The resulting slowest started to feed 21 days earlier than those at ambient. Mortality of the two batches was similar. Although the margin of growth advantage obtained by trout reared for 10 weeks in warm water declined as time proceeded, sufficient food was obtained to suggest that a minimum saving of three months in an 18 month growing cycle of rainbow trout produced for the table or for stocking into fisheries could be obtained. (57)

(82)

Bunting, B.L., Zooplankton: Thermal Regulation and Stress.

1976. Part of Gallagher, B.J. (Ed.), Proceedings of a Symposium on Energy Production and Thermal Effects held in Oak Brook, Illinois, September 10-11, 1973. Limnology, Inc., Milwaukee, Wisconsin (University of Tennessee, Department of Zoology, Knoxville, TN)

Literature on the effects of elevated temperature on zooplankton development and thermal tolerance and predation, and the effects of entrainment on zooplankton populations is reviewed. (57)

(83)

Bunting, B.L., and E.B. Robertson, Jr., Lethal and Sublethal Effects of Herbicides on Zooplankton Species.

1975. Water Resources Research Report No. 63 (University of Tennessee, Water Resources Research Center, Knoxville, TN)

As part of a study on the effects of herbicides on zooplankton species, temperature was shown to affect the rate at which the herbicides aminotriazole and alitrole acted on cladocerans. Rates of survival of *Daphnia pulex* exposed to aminotriazole were similar at 15 and 20 C when the concentration of the herbicide at 15 C was double that at 20 C. Decreases in temperature and concentration and increases in exposure time resulted in increased time to 50 percent mortality (LT50). The effects of alitrole were of a similar nature. In preliminary tests using *Chironomus* 2, 4-B Amino No. 8 and Vena 2, 4, 5 (2, 4, 5-T), *Daphnia* at 15 C demonstrated a slower reaction to the herbicides than those at 20 C. In studies using *Coregonus punctipinnis*, a planktonic dipteran, the toxicity of ammoniac sulfonate appeared to significantly increase with a 5 C (from 15 to 20 C) increase in temperature. The 127 hour fifty percent immobilization constant (IC50) was 2713 ppm at 15 C and 1099 ppm at 20 C. (57)

(84)

Burkett, B.D., The Influence of Temperature on Uptake of Methylmercury 203 by Bluntnose Minnow, *Pimephales notatus* (Rafinesque).

1976. Bull. Environ. Contam. Toxicol., 12, 763-769 (Battelle Memorial Institute, Columbus Laboratories, Columbus, OH)

In bluntnose minnow, *Pimephales notatus*, maintained at 10, 21, and 23 C and exposed to similar concentrations of methylmercury 203, significant differences in methylmercury burdens due to temperature were observed between the 10 and 21 C groups. A direct interrelationship among temperature, uptake over the gills and metabolic rate may exist between these two parameters, but not between 21 and 23 C. These hypotheses for the lack of significant difference above 21 C are presented. The importance of the results with respect to thermal pollution is discussed. (57)

(85)

Burton, R.T., and P.B. Abell, Initial Compensatory Responses in Ventilation Frequency of Three Eurythermal Estuarine Fish Exposed to a Moderate Temperature Increase.

1973. Amer. Zoologist, 13, 1290 (Academy of Natural Sciences of Philadelphia, Benedict Estuarine Laboratory, Philadelphia, PA)

TRIPLETES VACILLATUS, *MORONE AMERICANA* and *LETOSTOMUS XANTHOPTERUS* were acclimated to 5, 15 and 25 °C subjected to a 5 °C increase over a 15-minute period. All fish were held at the elevated temperature for 24 hours. Changes in ventilation frequency were used as a secondary metabolic indicator to assess physiological adjustments to temperature. Ventilation rates increased concurrently as temperatures increased over the 15-minute period. Ventilation quickly stabilized at the higher rates and remained relatively constant throughout the 24 hours in all acclimation groups. Analysis of acclimated rate-temperature curves (P-T curves) showed that there were species differences in response to a moderate temperature increase in the range of capacity adaptation as well as differences in the time course of adaptation to environmental change. (Both) (ST)

(86)

Burton, R.T., and C.J. Moore, Ventilation Frequency Changes in Three Estuarine Fish Exposed to a 5 °C Increase at Acclimation Temperatures of 5, 15 and 25 °C.

1978. Assoc. Southeast Biol. Bull., 21, 88 (Academy of Natural Sciences of Philadelphia, Benedict Estuarine Laboratory, Philadelphia, PA)

The ventilation frequency responses of bay anchovy, *TRIPLETES VACILLATUS*; white perch, *MORONE AMERICANA*; and spot, *LETOSTOMUS XANTHOPTERUS* acclimated at 5, 15 and 25 °C and exposed to a 5 °C increase were compared. Ventilation rates increased concurrently in all species as temperatures were increased and stabilized at the higher rates in all acclimation groups. Interspecific differences were found at each acclimation temperature and in response to the elevated temperature at each acclimation temperature. (ST)

(87)

Beach, G.B.S., B.L. Schell, and G.L. Hartman, Environmental Factors Affecting the Strength of Walleye (*STIOSTEDION VITREUM VITREUM*) Year-Classes in Western Lake Erie, 1960-70.

1975. Jour. Fish. Res. Bd. Can., 32, 1733-1743 (U.S. Fish and Wildlife Service, Sandusky Biological Station, Sandusky, OH; Ohio Department of Natural Resources, Division of Wildlife, Sandusky, OH)

Commercial production of walleye (*STIOSTEDION VITREUM VITREUM*) from western Lake Erie declined from 5.9 million pounds in 1954 to 180,000 pounds by 1969. Since 1954, marked irregularity in year-class success has developed. Only four year-classes were considered good during 1959-70. The rate and regularity of water varying during the spring spawning and incubation periods in 1960-70 had a positive effect on the density of egg deposits and the resulting year-class strength. Rates of varying were not themselves detrimental, but rather the

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extended length of the incubation period in cool springs increased the exposure of eggs to such negative influences as dislodgment from the spawning reefs by strong current action generated by spring storms, or siltation and low oxygen tensions. The annual brood stock size had much less influence on year-class strength than did water temperature. Reproductive success was unrelated to fluctuations in size of suitable reef spawning area caused by changes in water level. Apparently the embankment spawning area at any water level is more than adequate to serve the limited valley brood stocks. (Both)

(89)

Bustard, B.B., and B.B. Harver, Aspects of the Winter Ecology of Juvenile Coho Salmon (*Oncorhynchus kisutch*) and Steelhead Trout (*Salmo gairdneri*).

1975. Jour. Fish. Res. Bd. Can., 32, 667-680 (British Columbia Fish Wildlife Branch, Seithers, British Columbia, Canada)

The major physical characteristics of overwintering areas for juvenile coho salmon and steelhead trout were described for a small, unlogged west coast Vancouver Island, Canada, stream. Water velocities in which steelhead trout occurred were positively correlated with rising temperature above 8 °C. As water temperature decreased from 9 to 2 °C, coho and steelhead moved closer to cover. At 7 °C or less most fish were associated with water velocities of less than 15 cm/sec. (ST)

(90)

Byrne, P., and E.S.C. Jones, Effect of Salinity on Spore Germination of Terrestrial and Marine Fungi.

1975. Trans. Brit. Mycol. Soc., 60, 497-504 (Pernmouth Polytechnic Institute, Department of Biological Sciences, Pernmouth, England)

The combined effect of salinity and temperature on spore germination in 11 terrestrial, freshwater and marine fungi was investigated. Spore germination in the terrestrial fungi decreased with increasing salinity and these inhibitory effects were more marked at low temperatures. The five marine fungi examined exhibited a broad tolerance to both salinity and temperature stresses. (Both)

(91)

Cain, T.B., Reproduction and Recruitment of the Brackish Water Clam *Strophia cuneata* in the James River, Virginia.

1975. Fishery Bull., 73, 812-830; Virginia Institute of Marine Science Contribution No. 542 (University of Virginia, Charlottesville, VA)

Temperature was more important than salinity in initiating gonotogenesis of the brackish water clam, *Strophia cuneata*, in the spring and fall in the James River, Va. A temperature of approximately 15 °C in April coincided with gonotogenesis at all stations throughout the 30 mile range of the clam. A renewed surge of gonotogenesis occurred at the high summer temperatures of 20 to 25 °C. Spawning of *Strophia* appeared to correlate with changes in salinity. Seasonal reduction of freshwater input induced spawning and recruitment in upstream populations. Best recruitment occurred to the middle of the habitat range which had an annual salinity change from fresh to 5 ppt. (ST)

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Culres, J., Jr., A.C. Booth, and B.C. Parker, Temperature Influence on Chemical Toxicity to Aquatic Organisms.

1975. Jour. Water Poll. Control Fed., 47, 267-280 (Virginia Polytechnic Institute and State University, Blacksburg, VA)

The literature on the effects of temperature on chemical toxicity to aquatic animals and microorganisms is reviewed. Microbial photosynthesis and respiration is briefly discussed. It is concluded that there is a paucity of information on the inter-relationships of temperature and toxicants to algae, bacteria, and protozoa and that standards based on the in situ response of indigenous organisms to specific discharge areas should be developed. (57)

(92)

Caldwell, E.S., Hydrogen Sulfide Effects on Selected Larvae and Adult Marine Invertebrates.

1975. WRI-31; 22 p. (Oregon State University, Water Resources Research Institute, Corvallis, OR)

Dungeness crab (*CANCER MAGISTER*) zoeae exposed to 0.56 mg/l dissolved hydrogen sulfide in seawater for 74 hr were less able to tolerate a 15 or 90 min period of heat shock at 29 C than were control organisms or those exposed to 0.18 mg/l. Zoeae exposed for 48 hr to either 0.5 or 1.0 mg/l sulfide survived as well as controls at temperatures of 25 to 28 C. Following heat shock at 29 C all zoeae were nearly immobilized and within minutes rested on the bottom of test vessels. Five other species of marine invertebrates including *COCCHINOSPHEERUSA OREGONENSIS* (Isopod), *ABISOGAMMARUS COFFINICOLA* and *COROPHION SALMONIS* (amphipods), and *CRASSOSTREA GIGAS* and *MACOMA BALTHICA* (oysters) were examined for their tolerance to hydrogen sulfide. It was suggested that estuarine organisms live very close to their tolerance limits for hydrogen sulfide. (57)

(93)

Calow, P., The Feeding Strategies of Two Freshwater Gastropods, *ANCYLUS FLUVIATILIS* Reull. and *PLANORBIS CONTORTUS* Linn. (Pulmonata), in Terms of Ingestion Rates and Absorption Efficiencies.

1975. Oecologia (Ger.), 20, 33-40 (University of Glasgow, Department of Zoology, Glasgow, Scotland)

Radiotracer and gravimetric techniques were used to investigate the effects of starvation, temperature, body size and food quality on both the ingestion rates and absorption efficiencies of *ANCYLUS FLUVIATILIS* (an algal grazer) and *PLANORBIS CONTORTUS* (a detritivore which utilizes the bacterial fraction of its food). In a food supply disturbance snails showed a considerable potential for adaptation. Both ingestion rates and absorption efficiencies increased with starvation, and ingestion rate increased with reductions in food quality. Absorption efficiencies were independent of temperature and Q10 values for absorption rates suggested that snails showed some acclimation to temperature disturbance. Food absorption was linearly related to body surface area but absorption efficiencies were to a large extent independent of age and size. The above homeostatic are discussed in terms of the possible underlying causal mechanisms. The implications of physiological homeostasis for ecological efficiencies are also discussed. (Auth)

(94)

Calow, P., The Respiratory Strategies of Two Species of Freshwater Gastropods (*ANCYLUS FLUVIATILIS* Reull. and *PLANORBIS CONTORTUS* Linn.) in Relation to Temperature, Oxygen Concentration, Body Size, and Season.

1975. Physiol. Zool., 48, 114-119 (University of Glasgow, Department of Zoology, Glasgow, Scotland)

The snail, *ANCYLUS FLUVIATILIS* conditioned to either 8 or 10 C, then transferred to 10 C moved at a progressively reducing respiratory rate on to a target level (representing the rates of individuals conditioned to 10 C) whereas *PLANORBIS CONTORTUS* similarly conditioned overshoot the target before attaining it. The former displayed reverse acclimation. Both species reflected their ecological niches in their respiratory adaptation behavior. *ANCYLUS FLUVIATILIS* adapted to low and rapidly fluctuating temperature conditions and lives in shallow, fast-flowing or wave-swept habitats whereas *P. CONTORTUS* adapted to higher more gradually fluctuating temperatures and lives in deeper, more stagnant situations. Both species regulated respiratory rates to reduced environmental O2 but *P. CONTORTUS* responded more completely and showed a longer average survival time than *A. FLUVIATILIS*, reflecting O2 conditions in natural habitats. Both showed a seasonal effect on respiratory rate. (BPC)

(95)

Cargo, D.C., Enhancement of Recreational Uses of Estuarine Waters through Study of Potential Control Methods for Stinging Sea Nettle.

1974. OBT-B-002-88; 15 p. (University of Maryland, Water Resources Research Center, College Park, MD)

Temperature tolerance studies of stinging sea nettle polyps showed that they encyst at 4 C and at 35 C. Peaks of abundance and spawning took place in late July and early August. (57)

<96>

Carr, W.E.S., and J.T. Ciesiel, Impact of Thermal Effluent from a Steam-Electric Station on a Marshland Nursery Area During the Hot Season.

1975. Fishery Bull., 73, 67-80 (University of Florida, C.V. Whitney Marine Laboratory, St. Augustine, FL; University of Florida, Department of Zoology, Gainesville, FL)

Elevated water temperature resulting from the discharge of condenser cooling water by the two units of the Northside Generating Station in Jacksonville, Fla. has a detrimental effect on the capacity of two marshland creeks to serve as a nursery area for juvenile fishes during the hot season. Evidence for this detrimental effect is based upon the marked differences in both the density of fishes and the species composition which exist between an ambient temperature creek and two creeks receiving thermal effluent. In the thermally affected creeks, both the numbers and the biomass per unit area of juveniles of utilizable species were three- to ten-fold smaller than those obtained in collections from the ambient temperature creek. When data for the entire hot season are considered, the creek receiving the largest input of thermal effluent supported a population of fishes having approximately 19% of its numbers and 32% of its biomass composed of juveniles of utilizable species. In contrast, the ambient temperature creek supported a population having approximately 73% of its numbers and 93% of its biomass composed of such species. Whereas juveniles of two species of snail (MUCIL CUPINA and M. CYPHALUS) accounted for the majority of the utilizable fishes using the thermally affected creeks as a nursery area, large numbers of juveniles of at least five additional utilizable species occupied the ambient temperature creek. These species were as follows (in order of decreasing abundance): tidewater silverside, MENIDIA BERYLLINA; spot, LEIOSTOMUS XANthurus; Atlantic menhaden, BREVOORTIA TYRANNUS; silver perch, SIDDIELLA CHRYSURA; and Atlantic thread herring, OPISTHOBERNA OCLINUS. (auth) (ST)

<97>

Carter, V.L., and W.F. Barry, Effects of Shock Temperature on Biological Systems.

1975. Proc. Amer. Soc. Civil Engr., Jour. Environ. Engr. Div., 101, 229-241 (Michigan Technological University, Department of Civil Engineering, Houghton, MI; Iowa State University, Department of Civil Engineering, Ames, IA)

The effects of sudden temperature shifts in biological treatment systems was studied. Oxygen uptake rates per gram of mixed liquor volatile suspended solids (MLVSS) were essentially the same for both a 35 and a 50 C control unit. However, the total amount of oxygen required per gram of MLVSS at 50 C was about four times that required at 35 C to achieve complete removal of soluble chemical oxygen demand. (COD). The rate of initial soluble COD removal per gram of MLVSS was more than six times greater in the 35 C control unit than in the 50 C unit. More solids were produced per gram of soluble COD

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removed in the 35 C unit than in the 50 C unit. A BOD removal of 95% or better was achieved in both the 35 C and the 50 C control units. Shock temperatures to the 35 C control unit did not significantly inhibit the biological system until 45 C. A shock temperature of 50 C required an acclimation period of 5 hr and the time of soluble COD removal was four to five times longer than at the control temperature. The 50 C control unit was not inhibited at a shock temperature of 45 C. An acclimation period of 1 hr was required at 35 C and the time for soluble COD removal was about double that of the control unit. When the 50 C control unit was tested at a shock temperature of 20 C, the bacterial activity was completely inhibited for 7 hr. A soluble COD removal of 75% was obtained in 36 hr. (ST)

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Cather, S.B., and A.E. Goffin, Life History and Ecology of MENIDIA SIGMATA (Pisces: Menidiidae), Will Creek, Wasatch Mountains, Utah.

1975. West Basin Naturalist, 35, 39-48 (University of Utah, Department of Biology, Salt Lake City, UT)

The most rapid growth of the stonefly, MENIDIA SIGMATA, in Will Creek, Utah, occurred at the lowest (warmer) stream stations. Cooler stream temperatures apparently retarded growth rate. Periods of maximum absolute growth rate corresponded with maximum carnivorous feeding from August to September and March to April. Emergence began in early May at the lower stations when water temperatures were 3 and 5 C, and lasted until mid-June when the water temperature was 12 C. Emergence lasted until late June (5.5 to 7 C) at the upper stations. (ST)

<99>

Caulton, W.S., The Ability of Cichlid Fishes TILAPIA REUDALLI Boulenger, TILAPIA SPARNHAUSII A. Smith and MENIDIA PLOCHRONIS (=PSEUDOCRENILABRUS) PHILANDER (H. Weber) to Enter Deep Water.

1975. Jour. Fish Biol., 7, 513-517 (Rhodes University, Zoology Department, Institute for Freshwater Studies, Grahamstown, South Africa)

The cichlid fish, TILAPIA REUDALLI, TILAPIA SPARNHAUSII, and MENIDIA PLOCHRONIS PHILANDER compensated for pressure at different rates and the rate was affected by temperature. Adult T. REUDALLI could descend to a maximum compensation depth of only 8.5 m and T. SPARNHAUSII to a depth of 15 m at 22 C. Adult M. PHILANDER compensated to a maximum depth of 16 m at 22 C and 20 m at 30 C, whereas the females descended to a depth of 26 m at 22 C and 27 m at 30 C. Although the mean maximum compensation depth for females at 22 and 30 C was not significantly different, the rate of descent was more rapid at the higher temperature. At 22 C the females attained their maximum depth in 280 hr, but at 30 C they reached their maximum depth in 120 hr. Similarly, the males descended more rapidly at higher temperatures. Fry and juveniles were capable of ascending to greater depths and were capable of more rapid depth compensation than were adults. (ST)

<100>

<100>

Coch, J.J., Jr., D.W. Bridges, and J.R. Lavigne, Cardiovascular Responses of the Winter Flounder, *PSEUDOPLEUROCTES AMERICANUS*, to Near-Lethal Temperatures.

1975. Part of Coch, J.J., Jr., et al. (Eds.). Respiration of Marine Organisms, Proceedings of the Marine Section of the First Maine Biomedical Science Symposium held in Augusta, Maine, March 14-15, 1975. Research Institute of the Gulf of Maine (TRIGOM), South Portland, Maine, (p. 155-162), 211 p. (Research Institute of the Gulf of Maine (TRIGOM), South Portland, ME)

The cardiovascular response of winter flounder to sea water warmed to near-lethal temperatures was measured. Half of the fish were measured at the seasonally acclimatized temperature of 18 C. The remainder were raised from 18 to 23 C over a 2 hr period just prior to measurement. Statistically significant ($p < 0.01$) increases in O₂ consumption rate and heart rate were recorded for the 23 C group when compared with the 18 C group. Cardiac output remained approximately constant due to a concomitant decline in cardiac stroke volume. An elevated arteriovenous O₂ content difference also characterized the response pattern at 23 C. Possible limiting factors with regard to cardiovascular function at high environmental temperatures are discussed. (Auth) (ST)

<101>

Ceray, R., Mortality of the Early Developmental Stages of the Roach-*RUTILUS RUTILUS* (Linnaeus, 1758).

1975. Vest. Cs. Spol. Zool. (Czech.), 39, 91-93 (Charles University, Department of Systematic Zoology, Prague, Czechoslovakia)

Mortality of the early developmental stages was studied on five samples of roach embryos (*RUTILUS RUTILUS*) for a period of 50 days after hatching. In three of the samples kept in different temperatures (8.9 degrees C, 16.8 degrees C and 22.1 degrees C), mortality was highest in the sample kept at the lowest temperature and lowest in the sample kept at the highest temperature. An average temperature of 8.9 degrees C was found unsuitable for a satisfactory development of the roach. At this temperature, the swim bladder of the embryos filled with difficulty and, hence, their locomotion was slow and their food was greatly reduced. Even a transfer of these early developmental stages from the low to a higher temperature (16.8 degrees C) on the 15th day after hatching did not prevent a 100% mortality. Of the two surviving samples of roach embryos kept at 16.8 degrees C and 22.1 degrees C respectively, the rate of mortality was considerably faster in the sample kept at the higher temperature. A marked increase of mortality started in all samples of roach larvae at approximately the same time, i.e., within the first days after the complete resorption of the yolk sac. Results were compared with those obtained by other authors, and was the critical period of development discussed. (Auth)

<102>

Chang, B.D., and T.R. Parsons, Metabolic Studies on the Amphipod *AMPHIROPS CAHILLI* in Relation to its Tropic Position in the Food Web of Young Salmonids.

1974. Jour. Fish. Res. Bd. Can., 32, 243-247 (University of British Columbia, Institute of Oceanography, Vancouver, British Columbia, Canada)

The marine amphipod *AMPHIROPS CAHILLI* was studied as part of the natural food of young salmon and as a potential organism for aquaculture projects. It was shown to be an omnivore capable of eating seaweed, diatoms, fish pellets, and fish. It survived well under eurythermal and euryhaline conditions but grew best (14% of body weight per day) at a salinity of 28 ppt and 20 C. Growth efficiency was between 19 and 34%, depending on the size of animal and temperature. (Auth)

<103>

Chernova, V.I., The Rate and Level of Metabolism in Fishes of Different Ecological Groups.

1974. Jour. Ichthyol., 14, 272-278 (All Union Research Institute for Marine Fisheries and Oceanography, Moscow, USSR)

Oxygen consumption of the Baltic cod (*GADUS MORhua*) was higher at 10 C than at 5 C. Data on the level and rate of metabolism of the cod was compared with that from published sources concerning the metabolic parameters of other species of fish. Parameters of regression equations obtained from measurement of metabolism at the optimum temperature for each species were used. It was concluded that the metabolic level of marine fish depended on the mobility of the fish, water temperature, and geographic location. Within the limits of the optimum environmental temperatures of the species, metabolic level increased as the temperature increased. Fluctuations in metabolic level were almost indiscernible in stenothermal species, slight in fish of northern latitudes, and different by a factor of five to six throughout the season in fish of southern latitudes. (ST)

<104>

Cheney, D.P., The Influence of Temperature, Dose Level and Morphology on the Uptake of Hydrogen 3 Labeled Thymidine by Reef Corals.

1974. Part of Cameron, A.N. et al. (Eds.), Proceedings of the Second International Symposium on Coral Reefs held on board the R.V. Marco Polo, June 22, 1973. The Great Barrier Reef Committee, Brisbane, Australia, (p. 69-75) (Hilo College, Science Division, Hilo, HI)

The rate of H 3-labeled thymidine uptake by reef corals conformed with seven day acclimation temperatures and up to 4 C over ambient for incubation temperatures of 25 to 33 C. Uptake optima were greatest at normal ambient temperatures and did not conform with acclimation temperature until incubation times exceeded three hours. Shorter incubation periods produced flat or broad responses. These data suggested that, for the corals studied, short-term or transitory temperature fluctuations should have little influence in modifying the rate of DNA synthesis while long-term deviations from ambient may lead to significant reductions in DNA synthesis activity and probably growth. (ST)

<105>
Cherry, D.S., K.L. Dickson, and J. Cairns, Jr.,
Temperature Response of Fish at Different Levels
of Acclimation.

1974. Assoc. Southeast. Biol. Bull., 21, 46-47
(Virginia Polytechnic Institute and State
University, Blacksburg, Va)

Temperature preference and avoidance trials were conducted with 20 fish species from six families, Salmonidae, Cyprinidae, Catostomidae, Ictaluridae, Centrarchidae, and Percidae. Most species occupied various trophic levels in two rivers that received thermal effluent discharged from a fossil fuel power plant. Fish were collected by seine in heated and unheated areas of each system and held in controlled temperature aquaria prior to testing. Trials were conducted for fish acclimated at 3 C increments from 12 to 30 C. Preference temperature increased for all species as acclimation temperature increased and was at a maximum for each species tested at its highest level of acclimation. Bass (*MICROPTERUS PUNCTATUS*), NICHOTERUS DOLOMITI, catfish (*ICTALURUS PUNCTATUS*), and sunfish (*LEPOMIS MICROCHIRUS*, *LEPOMIS CYANELLUS*) preferred the warmest temperature, followed by several species of cyprinids. Species of trout preferred the lowest temperature. Temperature tolerance ranges, as determined by the avoidance temperature limits above and below ambient, varied between fish groups. Generally, warm water species (centrarchids and ictalurids) had wide ranges in temperature tolerance while cold water species (salmonids) had narrow ranges. (Auth)

<106>

Cherry, D.S., K.L. Dickson, and J. Cairns, Jr.,
Temperatures Selected and Avoided by Fish at
Various Acclimation Temperatures.

1975. Jour. Fish. Res. Bd. Can., 32, 485-491
(Virginia Polytechnic Institute and State
University, Blacksburg, Va)

Temperatures selected and avoided by 13 fish species, evaluated at decreasing increments of 3 C from 30 to 6 C, declined as the acclimation temperature decreased from summer to winter. As acclimation levels declined the difference between acclimation and selected temperatures increased for centrarchids and cyprinids, whereas the difference between these two temperatures increased for trout above and below the 18 C level of acclimation. Bluegill (*LEPOMIS MICROCHIRUS*) and spotted bass (*MICROPTERUS PUNCTATUS*) selected the highest temperatures at all acclimation levels, followed by channel catfish (*ICTALURUS PUNCTATUS*), green sunfish (*LEPOMIS CYANELLUS*), smallmouth bass (*MICROPTERUS DOLOMITI*), spottin shiner (*NOTROPIS SPILOPTERUS*), and other cyprinids. Rainbow (*SALMO GAIRDNERI*) and brook (*SALVELINUS FONTINALIS*) trout selected the lowest temperatures. A linear regression of the selection vs. the acclimation temperature was plotted for cyprinids, centrarchids, and salmonids. As the acclimation temperature was lowered, temperatures avoided decreased and the difference between the upper and lower avoidance range increased at each acclimation level. Eurythermal species, centrarchids, ictalurids, and most cyprinids, generally had a range difference of at least 10 C or more between the upper and lower avoidance temperature at each acclimation level. (Auth)

<107>

Cherry, D.S., K.L. Gathie, and R.S. Harvey, The
Effects of Thermal Addition on Bacterial
Populations in Flowing Aquatic Systems.

1974. Assoc. Southeast. Biol. Bull., 21, 46
(Virginia Polytechnic Institute and State
University, Blacksburg, Va; Clemson University,
Clemson, SC; Savannah River Ecology Laboratory,
Aiken, SC)

Over a period of two years, total plate counts and diversity of heterotrophic bacteria were determined at monthly intervals from a natural stream, two artificial streams and two outdoor ponds. Water for artificial systems was drawn from the natural stream. One pond was heated 3 to 5 C above ambient stream temperature. Temperature elevations resulted in increased total plate counts in each system. Bacterial diversity increased at temperatures ranging between 15 and 22 C. Diversity was reduced at temperatures above or below these limits, and changes were observed in bacterial genera present. The number of genera present was greater in the heated system when ambient temperatures were low. Therefore, the effects of thermal addition were observed to be enrichment at low ambient temperatures, and to be detrimental at high ambient temperatures in terms of diversity and stability of bacterial populations. (Auth)

<108>

Chinnayya, S., Oxygen Consumption of *CARIDINA*
SEBENI (Decapoda: Atyidae) in Relation to
Temperature, Starvation and Size.

1974. Bateria (Ind.), 43, 151-164 (Marathwada
University, Department of Zoology, Aurangabad,
India)

The rate of oxygen consumption of the decapod, *CARIDINA SEBENI*, was studied in relation to temperature, starvation and body size. The rate of oxygen consumption increased and Q10 values decreased with increasing temperatures of 10, 25 and 32 C. The effect of starvation on O2 consumption in two different size groups was followed for 14 days at the three temperatures. With starvation, there was a decrease in the weight of the animals and in unit oxygen consumption. Q10 values decreased with increasing weight during the first 13 days; on the 14th day of starvation the trend was reversed at temperatures between 10 and 27 C. The rate of O2 consumption was high in small animals. (Auth) (57)

<109>

<109>

Chisholm, S.W., R.G. Stross, and P.A. Hobbs, Environmental and Intrinsic Control of Filtering and Feeding Rates in Arctic DAPHNIA.

1975. Jour. Fish. Res. Bd. Can., 32, 219-226 (State University of New York, Department of Biological Sciences, Albany, NY; California State University, Department of Biology, San Diego, CA)

Filtering and feeding rates of DAPHNIA HYDRODORPPIANA at Point Barrow, Alaska were measured as a function of temperature, food density, animal length, and time of day. The functional relationship between feeding rate and food density followed the hyperbolic pattern typical for filter feeders. DAPHNIA HYDRODORPPIANA was found to have comparatively high filtering capabilities at its temperature optimum (around 11°C), with filtering rate increasing with length according to the equation $F = .456L^{1.317}$. The exponent of this equation was found to be a function of temperature, and the coefficient a function of food density. A bimodal diel rhythm in feeding rate was found in this species in experiments where the animals were held under constant conditions. Feeding rates were maximum at 1800 and 2400, the time of day when the temperature cycle in the ponds passes through the near daily temperature, which is optimum for feeding in D. HYDRODORPPIANA. Thus the timing of the rhythms may serve to maximize the daily food gathering ability of this species. (Auth)

<110>

Chittleborough, R.G., Environmental Factors Affecting Growth and Survival of Juvenile Western Rock Lobsters PARULIUS LONGIPES (Wilmer-Edwards).

1975. Australian Jour. Mar. Freshwater Res., 26, 177-196 (CSIRO, Division of Fisheries and Oceanography, Western Australia, Australia)

Growth rate of western rock lobsters, PARULIUS LONGIPES, increased with temperature up to a maximum of 26°C above which growth rate and survival declined. (ST)

<111>

Chun, D., J.K. Chung, S.Y. Seol, and R. Ink, VIBRIO PARAEHOLYTICUS in the Republic of Korea.

1974. Amer. Jour. Tropical Med. Hyg., 23, 1125-1130 (Kyungpook National University, Agricultural College, Taegu, Korea)

The presence of VIBRIO PARAEHOLYTICUS in marine sediments and organisms was closely related to water temperature. The organism could not be isolated from the marine environment when the water temperature was 10°C or lower. A rise in isolation rate paralleled a rise in water temperature during the summer months. (ST)

<112>

Clady, R.D., Early Survival and Recruitment of Smallmouth Bass in Northern Michigan.

1975. Jour. Wildlife Management, 39, 194-200 (Michigan Department of Natural Resources, Institute for Fisheries Research, Ann Arbor, MI)

Survival for six life-history stages from egg to fall fingerling was estimated for the 1967, 1968, and 1969 cohorts of smallmouth bass (MICROPTERUS DOLOMIEUI) in Katherine Lake in the Upper Peninsula of Michigan near the northern limit of the species range. The percentages of egg potentials that were deposited on nests were low (15-34 percent). Survival between egg deposition and the postlarval stage was consistent in all years

(26 to 33 percent). Although there was no correlation between first-year survival of the 1967 to 1969 year classes and temperature, there was a significant correlation between strength of the 1959 to 1966 year classes (as estimated from adjusted population numbers at age 4 and air temperatures during the first summer of life. Since dominant year classes produced in the three years (1959, 1963, and 1966) which had the warmest June to October temperatures contributed greatly to the correlation, the discrepancy between the 1959 to 1966 and 1967 to 1969 data probably resulted from the lack of overall average or above-average temperatures during any year of the latter period. (Auth)

<113>

Cochran, R.C., and F. Engelmann, Environmental Regulation of the Annual Reproductive Season of STRONGYLOCENTROTUS PURPURATUS (Stiasson).

1975. Biol. Bull., 144, 393-401 (University of California, Department of Biology, Los Angeles, CA)

A rise of ocean temperature above 17°C (in June) was found to coincide with cessation of gamete production and storage in a subtidal population of sea urchins, STRONGYLOCENTROTUS PURPURATUS whereas those maintained at 13°C retained gametes for nearly two months longer. Spawning was terminated in the laboratory by three weeks at 19°C at a time when sea urchins in the field spawned actively. A long-day photoperiod of 14L:10D failed to inhibit spawning of animals kept at 13°C. Ten weeks of 13°C failed to initiate reproduction in animals started in the summer months. Neither short-day (10L:14D), nor long-day (14L:10D) affected reproductive activity in the laboratory at 13°C. (PC)

<114>

Cohen, A.J., Comparative Studies of Growth, Development, and Environmental Variations in Atlantic, Pacific and Gulf Coast Isolates of the Green Alga EUTEROMORPHA Link.

1974. Ph.D. Thesis, Washington University, 816 p. (Washington University, Seattle, WA)

Adult thallus morphology of the green alga, EUTEROMORPHA sp., was dependent upon temperature, photoperiod, and media composition. Variations in size, shape, and arrangement of cells within species limits were dependent upon growth rate and thallus form and therefore affected by the above factors. Variations in early development were consistent within isolates but could not be related to species or environmental conditions at collection sites. Growth responses to a variety of media, temperature, photoperiods, and salinities were not related to species or collection sites, although general culture vigor increased with increasing northern collection sites on the Atlantic and Pacific coasts. (ST)

<115>

Cole, R.A., An Ecological Evaluation of a Thermal Discharge: Summary of Early Postoperational Studies.

1973. MSU-IR-72-73-0012.0; 55 p. (Michigan State University, Institute of Water Research, East Lansing, MI)

Early postoperational data on the ecological effects of the Detroit Edison Power Plant on Lake Erie are summarized. No conclusions are drawn. (ST)

<116>

Coles, S.L., A Comparison of Effects of Elevated Temperature Versus Temperature Fluctuations on Reef Corals at Kahu Point, Oahu.

1975. Pacific Sci., 29, 15-19 (Hawaii Electric Company, Environmental Department, Honolulu, HI)

Bottom temperature and the condition of live corals in the vicinity of the discharge plume from the Hawaiian Electric Company Kahu Generating Station Oahu, Hawaii, were monitored August-December 1973. Mortality to *POCILLIPODA HEANDRINA*, the most thermally sensitive species of the area, was no greater under conditions of various thermal enrichment near the living reef fringe in the discharge area (1 to 2 m depth) than in an area (4 to 5 m depth) more distant from the discharge. Sublethal coral damage was more pronounced near the discharge, but was mostly limited to loss of zooxanthellar pigment which was restored following yearly ambient temperature maxima. Although bottom temperatures in the discharge area continually varied 3 to 4 C within minute periods during every low tide, live corals seldom encountered temperatures exceeding 31 C. The limited damage that occurred to live corals indicates that upper absolute temperatures are more critical in producing coral damage than are short-term temperature shocks near lethal limits. (Auth)

<117>

Colwell, R.N., and P.N. Netrick, Survival of Human Pathogens in the Marine Environment.

1975. Annual Report to the Office of Naval Research; 23 p. (University of Maryland, Department of Microbiology, College Park, MD)

The survival characteristics of selected bacteria and human enteric viruses were studied under controlled laboratory conditions and field conditions. Temperature rather than salinity, of the water was the more critical factor determining loss of viral infectivity; the higher the temperature (4, 15, 25 C), the more rapid the loss of viral infectivity. Of the three enteroviruses tested, Coxsackie B-5 virus was the most stable; ECHO-6 virus was intermediate; and polio 1 was the least stable virus. In situ studies using free-flowing estuarine water yielded similar results. Attempts to isolate human enteroviruses from Chesapeake Bay waters were negative. Results obtained from in situ survival studies of selected bacteria were not consistent. Bacteria appeared to survive better at high rather than low water temperatures. (ST)

<118>

Connell, H.U., The Biology of the Crust Forming Alga *SCYTOSIPHON LOMENTARIA* (Phaeophyceae) from the Eastern Coast of Virginia.

1974. Ph.D. Thesis, Kent State University, 162 p. (Kent State University, Kent, OH)

The growth rate of the primary filament of the brown alga, *SCYTOSIPHON LOMENTARIA*, was higher at 23 C than at 10 C. At the same temperature, long day photoperiods resulted in a higher growth rate than short day photoperiods, but these differences were significant only at 10 C. Filaments formed diacoid plants earlier at 23 C than at 10 C. Cold temperatures were required for growth of the macrothalli after induction by short day photoperiods. These results with respect to macrothalli production were substantiated by field experiments. (ST)

<119>

Cook, T.R., and C.E. Goldman, Degradation of Anionic Detergents in Chesapeake Bay.

1974. Chesapeake Sci., 15, 52-55 (University of Maryland, Department of Microbiology, College Park, MD)

Anionic detergents added to samples of water from Chesapeake Bay were degraded during laboratory incubation. The following substances were biodegradable: sodium dodecyl sulfate, sodium dodecylbenzene sulfonate (DBS), and three commercial laundry products. Oxidation of DBS, which was accompanied by O₂ uptake, occurred only with initial concentrations less than 25 ppm. The rate of DBS decomposition was maximal at 25 to 30 C and decreased with lower incubation temperatures. (Auth)

<120>

Copeland, B.J., and T.J. Bechtel, Some Environmental Limits of Six Gulf Coast Estuarine Organisms.

1974. Cont. Marine Sci., 18, 169-204 (North Carolina State University, Department of Zoology, Raleigh, NC)

Literature and data analyses of six sports and commercially important species occupying Gulf coast estuaries were made utilizing a computerized sorting technique. Data relating to catch versus environmental characteristics were collated from literature references and data files of several state and federal laboratories. Catch ratios, reflecting catches above a threshold value, were computed and sorted into temperature, salinity, seasonal and location classes and into various interaction categories. Gross temperature, salinity, location and season ranges and optima were established for menhaden (*BREVOORTIA PARTURUS*), sand trout (*CYNOSCION REGANII*), blue crabs (*CALLINectes sapidus*), white shrimp (*PENAEUS SETIFERUS*), pink shrimp (*PENAEUS DUROSSINI*) and brown shrimp (*PENAEUS AZTECUS*). The temperature range and temperature of optimum catch were: menhaden, 0 to 40C and 25 to 35 C; sand trout, 5 to 30C and 20 to 30 C; blue crabs, 0 to 40C and 10 to 35C; white shrimp, 10 to 40C and 20 to 30C; pink shrimp, 5 to 30C and 20 to 30C; and brown shrimp, 15 to 35C and 20 to 35C. (Auth) (ST)

<121>

Cornick, J.W., and J.E. Stewart, Red Crab (*GERON QUINQUEDEMS*) and Snow Crab (*CHIRONOMYTES OPILIO*) Resistance to Infection by the Lobster Pathogen *AEROCOCCUS VIRIDANS* (var.) *NOBARI*.

1975. Jour. Fish. Res. Bd. Can., 32, 702-706 (Department of the Environment, Fisheries and Marine Service, Halifax Laboratory, Halifax, Nova Scotia, Canada)

The lobster pathogen, *AEROCOCCUS VIRIDANS*, was nonpathogenic for the red crab, *GERON QUINQUEDEMS*, at 5, 10, and 15 C and for the snow crab, *CHIRONOMYTES OPILIO*, at 5 C. The resistance of these crab species is discussed in relation to their potential as reservoirs of infection. *GERON QUINQUEDEMS* was acclimated to water temperatures up to 18 C without excessive mortality. (ST)

<122>

<122>

Contant, C.C., Temperature Selection by Fish - A Factor in Power-Plant Impact Assessments.

1975. COSP-740820; STI/POB/378; IAEA-SR-187/11; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 575-597) (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Current information from the literature on thermal preference and avoidance temperatures of fish species is summarized.

Electrofishing surveys near the Bell Bus Power Station on the Clinch River, Tennessee, indicated that several freshwater fish, notably the gizzard shad (*Dorosoma cepedianum*) were attracted to heated effluent in early spring but were dispersed when the heated discharge was terminated. Acoustic temperature telemetry indicated that wild largemouth bass (*Micropterus salmoides*) have a final temperature preference of about 27 C. Knowledge of species-specific temperature preference and avoidance, along with an understanding of abundance and composition of local fish populations at a power plant site, should be used in designing thermal discharges which will have a minimal impact on fish populations. (Auth) (ST)

<123>

Contant, C.C., Responses of Bass to Natural and Artificial Temperature Regimes.

1975. Part of B.H. Stroud and H. Clepper (Eds.), Proceedings of a Symposium on Black Bass Biology and Management held in Tulsa, Oklahoma, February, 1975. Sport Fishing Institute, Washington, D.C. (p. 272-285) (Oak Ridge National Laboratory, Oak Ridge, TN)

Data are summarized from the literature on the responses of the centrarchid basses to water temperature. The temperature requirements for spawning, incubation, feeding and digestion, growth, metabolism and swim speeds, thermal tolerances, temperature selection, and fishing success of largemouth bass (*Micropterus salmoides*) and smallmouth bass (*Micropterus dolomieu*) are given. The effects of thermal effluents from nuclear or fossil-fuel power plants on the population dynamics and management of these fish species is considered. (CCC)

<124>

Contant, C.C., Cold Shock: Tolerable Temperatures and Guidance for Power Plants.

1974. Trans. Amer. Nuclear Soc., 18, 47-48 (Oak Ridge National Laboratory, Ecological Sciences Division, Oak Ridge, TN)

Instantaneous temperature decreases from a series of warmer temperatures to 16 C (catfish) or 17 C (bass) showed rapid increases in susceptibility of shocked fish to predation by unshocked predators when the temperature differentials exceeded about 6 C. Tests with slower rates of temperature decrease indicated that while 2.0 and 2.5 C/min. still induced selective predation, rates of 1.5 C/min and below did not. The author suggests that siting studies for power plants should examine the cold-shock

potential of local or migratory aquatic species (some are more susceptible than others). To minimize cold-shock damage, discharges should be designed with minimum warm water volumes accessible to fish during the cool months; the amount of temperature change should not be increased in the winter; multiple units using the same discharge can avoid complete cooldowns; shutdown for maintenance could be timed to avoid cold shock to particularly susceptible species; cooling water pumps could be shut off concurrent with loss of condenser steam to cause slow dissipation of already heated water. (RPC)

<125>

Contant, C.C., and S.S. Talmage, Thermal Effects.

1975. Jour. Water Poll. Control Fed., 47, 1646-1711 (Oak Ridge National Laboratory, Oak Ridge, TN)

The 1974 literature on thermal effects was reviewed under the following categories: reviews; power plant studies; producers; consumer reproduction, development, morphology, distribution, thermal tolerance, growth, feeding, activity, oxygen metabolism, temperature and other stresses; decomposers including diseases; and beneficial uses. Many of the studies are summarized in tabular form. (ST)

<126>

Contant, C.C., S.S. Talmage, R.P. Carrier, and B.W. Collier, Thermal Effects - Annotated Bibliography of the 1974 Literature.

1975. ORNL-ETIS-75-28; 160 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

The bibliography contains 570 scientifically indexed references on thermal effects on aquatic organisms from the 1974 literature. The articles are indexed by title, author, keywords, taxonomic name, subject category and geographic location. This bibliography forms the basis of the thermal effects review by C.C. Contant and S.S. Talmage in the Journal of the Water Pollution Control Federation. (ST)

<127>

Craig, P.C., and V.A. Sculin, Movements and Growth of Arctic Grayling (*Thymallus arcticus*) and Juvenile Arctic Char (*Salvelinus alpinus*) in a Small Arctic Stream, Alaska.

1975. Jour. Fish. Res. Bd. Can., 32, 689-698 (Aquatic Environment Ltd., Crossfield, Alberta, Canada)

Adult arctic grayling, *Thymallus arcticus*, entered a small arctic stream near Prudhoe Bay, Alaska, shortly after ice breakup and left after spawning. Juvenile grayling also entered soon after breakup and many remained throughout the summer. Grayling fry emerged from the gravel in late June or early July and remained until freeze-up in mid-September. Small numbers of arctic char, *Salvelinus alpinus*, juveniles also entered the stream to feed. The growth rate of graylings was among the fastest recorded for arctic populations. (Auth) (ST)

<128>

Craig, W.J., Jr., Physiological Ecology of the Concomal Crabs, *POLYONYX GIBBESII* Baig and *PIPIHIA CHARTOPTERANA* Stimpson.

1974. *Oecologia (Ger.)*, 15, 235-244 (University of South Carolina, Belle W. Baruch Institute for Marine Biology and Coastal Research and the Department of Biology, Columbia, SC)

The relative temperature tolerances of juvenile and adult stages of the crabs *POLYONYX GIBBESII* and *PIPIHIA CHARTOPTERANA* collected near Georgetown, South Carolina were determined. Both larval and adult *POLYONYX* were less resistant to high temperature (35C) than were *PIPIHIA*. Among adults no difference in mortality between the sexes of *POLYONYX* was noted. In *PIPIHIA*, male crabs were markedly more resistant. *POLYONYX* could not withstand 10C for more than a few days. Following warm acclimation at 25C the Q10 values of the two species were similar at higher temperatures (20 to 30C), but as the temperature decreased *PIPIHIA* had a significantly higher metabolic rate. A study of the relative abundance of the two crabs in the Georgetown area characterized *POLYONYX* as a more southerly distributed species. (ST)

<129>

Crawford, E.A., and P.J. Housher, DNA Studies of a Chesapeake Bay Population of the Tunicate *MOLGULA HANNAHATENSIS* (DeKay) (Ascidacea).

1974. *Chesapeake Sci.*, 16, 208-211 (Old Dominion University, Department of Biology, Norfolk, VA)

Gonadal development and total gonadal DNA of *MOLGULA HANNAHATENSIS* were studied. Evidence of atrophication and of phagocytosis of residual gametes was found during histological examination. Colorimetric estimations of gonadal DNA indicated that at least two spawning peaks occurred during the summer and suggested that egg release was suppressed by water temperatures above 20 C. Ovulation occurred as the water temperature increased to about 10 C in the period January to May. A second spawning probably occurred in June. (Auth) (ST)

<130>

Crawshaw, L.I., Temperature Selection and Activity in the Crayfish, *ORCONECTES INNUIS*.

1974. *Joar. Comp. Physiol.*, 95, 315-322 (John B. Pierce Foundation Laboratory and Yale University, School of Medicine, New Haven, CT)

Selected temperature and activity were continuously monitored from crayfish (*ORCONECTES INNUIS*) placed in a thermal gradient exposed to the natural photoperiod. The crayfish avoided temperature extremes in the gradient, but did not prefer a particular temperature. During the night the crayfish were active, and selected a mean water temperature of about 22 degrees C. During the day the crayfish were inactive, and selected a mean water temperature of about 18 degrees C. (Auth)

<131>

Crawshaw, L.I., Twenty-Four Hour Records of Body Temperature and Activity in Bluegill Sunfish (*LEPCHEUS MACROCHIRUS*) and Brown Bullheads (*ICTALURUS NEBULOSUS*).

1975. *Comp. Biochem. Physiol.*, 51a, 11-18 (Yale School of Medicine, New Haven, CT)

Dorsal muscle temperature and activity were continuously monitored from bluegill sunfish and brown bullheads placed in a thermal gradient exposed to the natural photoperiod. The bluegill showed increased activity during the day, while the bullheads were more active at night. Both species of fish maintained a relatively constant body temperature during different levels of activity and phases of the photoperiod. (Auth)

<132>

Crippen, R.W., Some Thermal Effects of a Simulated Extralimnetic Regime on Marine Plankton.

1974. Ph.D. Thesis, University of Maine, 113 p. (University of Maine, Orono, ME)

Six species of diatoms, various life stages of seven species of zooplankters, and the demersal eggs of a fish were subjected to laboratory simulations of the maximum thermal regime predicted for the Maine Yankee Atomic Power Plant. Each organism was tested from the ambient temperature(s) (AT) at which they occurred naturally. These ranged from 3 to 20 C. The simulated thermal regime (STR) consisted of a nearly instantaneous temperature rise (usually 14 C) above AT followed by a controlled return to AT over a 3-hr period. *CHAETOCEROS LACINIOSUS*, which suffered a complete mortality, was the only diatom species sensitive to the STR from a 3 to 15 C AT. *CHAETOCEROS LACINIOSUS* and *SKELETONEMA COSTATUS*, not sensitive to the STR from an AT of 15 C, were sensitive from an AT of 20 C; although mortalities were not complete, the lag phase preceding exponential growth in treated cultures was usually prolonged. The zooplankters and fish eggs tested from AT's of 3, 5, and 10 C were not sensitive to the STR. However, zoea of the decapod crab *CANCER IRROBATUS*, not sensitive to the STR from a 10 C AT, were sensitive from a 15 C AT. The data suggested that other factors, including crowding, salinity, and duration of exposure, may have complicated the zoea results at the 15 C AT. Nauplii of the calanoid copepod, *EUTIMORPHA HERDMANI* were all killed when tested from a 20 C AT, but not from a 10 C AT. Females of the archiannelid, *DINOPHILUS CONKLINII* were tested from an AT of 20 C with inconclusive results, which suggested these organisms may be sensitive to the STR from this AT. Polychaete metacanthodes and juveniles, the most tolerant group tested, showed no sensitivity to the STR from AT's ranging from 3 to 20 C. (Auth)

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<133>

Cullinney, J.L., Larval Development of the Giant Scallop *PLACOPCTES NAGILLIANICUS* (Gmelin).

1974. Biol. Bull., 147, 321-332 (Harvard University, Cambridge, MA)

Sexually mature giant scallops, *PLACOPCTES NAGILLIANICUS*, from Isles of Shoals, New Hampshire, spawned at 14 and 16 C. In the laboratory, spawning occurred from 10 to 15 C. Development from the zygote to the swimming gastrula took 30 to 40 hr at 12 C. The straight hinge veliger stage was reached in four days at temperatures between 12 and 16 C. Veligers reared at 15 C reached the pediveliger stage in 20 days and the first spat was observed on the 35th day. Veligers reared at 19 C suffered a mass mortality when approximately half grown. (57)

<134>

Cullinney, J.L., Comparative Larval Development of the Shipworms *BANKIA GOWLDI* and *TEREDO NAVALIS*.

1975. Marine Biol. (W. Ger.), 29, 245-251 (Harvard University, Cambridge, MA)

Larvae of the shipworms, *BANKIA GOWLDI* and *TEREDO NAVALIS* were reared in the laboratory at various temperatures and salinities. Spawning of *B. GOWLDI* occurred at temperatures of 17.5 to 30 C; *T. NAVALIS* spawned at lower temperatures. *TEREDO NAVALIS* larvae were released at temperatures from 13 to 30 C. Both species released offspring at salinities of 20 and 30 ppt. In the laboratory at 25 C and 30 ppt salinity the free-swimming lives of *B. GOWLDI* and *T. NAVALIS* were 25 and 15 days, respectively. Incubated larval development of *T. NAVALIS* was estimated to be five days at 25 C. (57)

<135>

Cauliffe, J.P., and N.J. Kennish, Shell Growth Patterns in the Hard-Shell Clam.

1974. Underwater Naturalist, 8, 20-24 (Rutgers University, Department of Geology and Marine Science Center, New Brunswick, NJ)

Daily growth increments were observed in cross-sections of outer shell layers of the clam, *MYTIDUS MYTIDUS*. Primary control on increment width was found to be temperature although other factors such as food supply may also have been important. This deposition of shell may be interrupted for a period from one to several days by conditions causing high levels of stress such as freezing weather, storms, extreme deep tides, or spawning. Freezing winter weather caused the most severe breaks even in clams from a depth of 25 ft. Many breaks occurred concurrently with rapidly decreasing water temperatures resulting from abrupt shutdowns of the Oyster Creek New Jersey, Nuclear Power Plant, or rapidly increasing temperatures associated with abrupt renewal of plant operations. The net effect was to lower growth rates of clams within range of the heated effluent. Spawning patterns may also be upset. (57C)

<136>

Currie, J.R., A.W. Helter, and R.D. Layton, A Model for Simulating River and Reservoir Temperatures with Applications for Anadromous Fish Management.

1974. WRI-26; OHS-1-820-082; 195 p. (Oregon State University, Water Resources Research Institute, Corvallis, OR)

A computer simulation model for continuously predicting reservoir and downstream temperatures and mass flows for a single high dam was developed. The model was applied to the proposed 145,000 acre-ft reservoir on the Calapooya River at Melley, Oregon, to provide information on anadromous fish production. It was found that the river temperatures downstream from the proposed reservoir could not be maintained within the optimum range for Pacific salmon. It was also found that the temperatures of the reservoir withdrawals would have a negligible effect upon river temperatures beyond 20 miles downstream from the dam site. (57)

<137>

Cvancara, V.A., Effect of Elevated Water Temperature on the Survival of Young-of-the-Year Fresh Water Teleosts.

1973. Amer. Zoologist, 13, 1299 (University of Wisconsin, Eau Claire, WI)

The effect of elevated water temperature on seven species of young-of-the-year teleosts collected from the main channel of the Mississippi River was studied. The species included *LEPOMIS MICROCHINUS*, *POGOPONIA CEPIDIANUS*, *MOXOSTEUS ALEUTICUS*, *CARPIOIDES CARPIO*, *STICHOSTEUS SALMOIDES*, *ICTALURUS NELAS*, and *APLOSTICTEUS GRUNNIUS*. Although temperature tolerance varied from species to species, all species could withstand temperatures of at least three degrees C higher than ambient. The least tolerant species was *L. MICROCHINUS*, while the most tolerant species was *I. NELAS*. (Auth) (57)

<138>

Dadswell, H.J., A Physical and Biological Survey of La Grande River Estuary, James Bay, Quebec.

1974. Can. Field-Naturalist, 98, 477-486 (The Huntsman Marine Laboratory, St. Andrews, New Brunswick, Canada)

As part of a preliminary, three day survey of the La Grande River estuary, Canada, the temperature, salinity, and fauna present at several stations were noted. Temperatures ranged from 6 C in the bay area to 20 C in the river mouth. The aquatic fauna was a mixture of boreal and subarctic marine species with some freshwater representatives. The benthic and epibenthic deepwater marine fauna had a subarctic character and was dominated by *HYDRA OCULATA*, *POGOPONIA PERNOTA*, *ATYLLUS CANTABRIGIENSIS*, and *STENOPODUS QUADRICOCCUS*. The shallow water inshore fauna contained some boreal elements such as *GAMMARUS OCEANICUS*, *MONOCLODUS EOCANADENSIS*, *CASTORSTYX ACULEATUS*, and various corophiids. In general, the fauna changed from a rare and depauperate state in the freshwater river channel to a moderately abundant and diverse fauna in both the shallow and deeper marine situations. (57)

(139) Sudaill, R.J., Distribution, Ecology, and Postglacial Dispersal of Certain Crustaceans and Fishes in Eastern North America.

1976. National Bureau of Natural Sciences (Canada) Publications in Zoology no. 11 (Quebec Marine Laboratory, New Brunswick, Canada)

Upper lethal temperatures for the crustaceans, *STYSIS STILICTA* and *STREPTILLA CALANOPTERIS* were 29.1°C and 30.5°C, respectively. *STYSIS* acclimated and survived over a range of 2 to 37°C, its thermal tolerance rising significantly with acclimation to higher temperatures. A 10°C increase in acclimation temperature for *STREPTILLA* raised its upper lethal limit only by 2°C. Salinity experiments yielded similar results. Salinity tolerance of *STYSIS* was reduced by high temperatures, particularly at low salinities. At higher salinity acclimation levels this effect was negligible. Raising temperatures lowered the salinity resistance of *STREPTILLA* and prior acclimation to higher salinities did not raise the tolerance level. A mortality of 100% in *STYSIS* occurred when freshwater 2°C-acclimated animals were left in a lighted room at salinities as low as 10 ppt after only 24 hr. At 2°C, the LD50 was at 22.5 ppt salinity over 7 days in the dark. General observations in the field and during experiments indicated that immature oysids were more tolerant than adults to high temperatures and less tolerant to high salinities but it was impossible to consider this factor in these experiments due to a shortage of animals. (BPC)

(140) Suse, R.F., and P.J. Vornberg, The Influence of Cyclic Summer Temperatures on the Respiratory Rates of Three Species of Salt Marsh Invertebrates.

1971. Amer. Zoologist, 11, 1291-1292 (University of South Carolina, Columbia, SC)

The influence of cyclic changes in temperature and light on the metabolic response of two intertidal zone crustaceans, *PARAPETUS STREPTILUS*, the mud crab, and *SCILLA PUILLATOR*, the sand fiddler crab, was studied. In the field during the summer these animals experienced temperature variations as great as 14°C. In the laboratory the animals were acclimated to thermal regimes of 15 to 25°C and 20 to 30°C and light-dark cycles of 10 hours and 10 hours. Oxygen uptake rates were determined at various acclimation temperatures and at various thermal points. Species differences were noted. At certain thermal regimes the metabolic response differed between animals acclimated to constant thermal regimes. The influence of these changes on the energy budget of a species was described. (Leth) (ST)

(141) Daniels, R.A., and J.T. Sawyer, The Biology of the Leach *STREPTILLA LUGUBRIS* Infesting Blue Crabs and Catfish.

1975. Biol. Bull., 100, 193-198 (College of Charleston, Department of Biology and Grace Marine Biological Laboratory, Charleston, SC)

The life history of *STREPTILLA LUGUBRIS* is described based upon a quantitative study of the leach from white catfish, *ICTALURUS CATUS*, and blue crabs, *CALLINectes sapidus*, from the estuaries of Charleston, South Carolina. The seasonal abundance of the leach was inversely correlated with water temperature which ranged from 4°C in January to 29°C in July. The greatest increase in the leach population occurred during December. Throughout the year, but especially in October and November, leaches were encountered on the carapace of the blue crab. (ST)

(142) Barnson, R.H., Temperature Effect on Sodium and Chloride Movements in Larval *AMBYSTOMA GRACILE*.

1974. Comp. Biochem. Physiol., 50A, 159-163 (Oregon State University, Department of Zoology, Corvallis, OR)

Unidirectional sodium and chloride fluxes and net potassium loss were measured on larval *AMBYSTOMA GRACILE* acclimated to 5, 15, and 25°C. Measurements were also made on animals after acutely increasing or decreasing their temperature 10 or 20°C. Sodium and chloride unidirectional fluxes were not similarly affected by a 10 or 20°C increase in temperature. The rate of potassium loss varied significantly with temperature. Results are discussed in the light of postulated sodium-cation and chloride-anion exchanges. (Leth) (SB)

(143) Evans, R.W., and L.D. Jensen, Zooplankton Entrapment at Three Mid-Atlantic Power Plants.

1975. Jour. Water Poll. Control Fed., 47, 2130-2142 (Benningsen, Durbin and Richardson, Economics Division, Santa Barbara, CA; Ecological Analysis, Inc., Baltimore, MD)

The principal objective of the research was to examine quantitatively, in the field, zooplankton entrainment by representative thermal power plants with once-through cooling water systems operating on a lake, a river and an estuary. Emphasis was confined to measuring the immediate effect on zooplankton motility of intake temperature, temperature rise, and chlorination during entrainment, as well as the delayed effect of condenser and discharge canal passage on their distribution. Population changes between the intake, the discharge, and receiving water were studied for estimation of survival of entrained zooplankton. These studies suggested that, under certain conditions, zooplankton motility during passage through condenser cooling systems of three mid-Atlantic power plants may be controlled by a combination of ambient temperature, temperature rise, and mechanical stress characteristics at each power plant site, as well as chlorination levels when applied. (ST)

<188>

<188>

Davis, G.E., Phase II: Temperature Requirements of Salmonids in Relation to Their Feeding, Bioenergetics, Growth and Behavior.

1974. OWSR Completion Report; 24 p (Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR)

Model stream ecosystems were used to evaluate the effect of a moderate increment of temperature change (6 C) on the survival, growth and production of juvenile chinook salmon, *Oncorhynchus tshawytscha*, and on the abundance of the stream invertebrates. Growth rates were not greatly different between the heated and control stream but, because of higher survival rates, values of annual production were markedly greater in the control than in the heated stream. The abundance of food organisms, especially the mayflies and stoneflies, was greater and the number of kinds was greater in the control than in the heated stream. Laboratory studies defined relationships between rates of growth and food consumption for juvenile steelhead trout, *Salmo gairdneri*, kept at ambient and at elevated (3 and 6 C) fluctuating temperatures during different seasons. Decelerating curvilinear relationships were defined in most experiments. At low rates of food consumption temperature increase reduced growth rates. As consumption rate increased curves defined for control and elevated temperatures tended to converge. Food consumption rates of trout in a natural stream were estimated by comparing the fishes growth rates with those of fish kept in the laboratory at known rations. Results suggested that if food availability remained unchanged, increase of temperature above normal seasonal temperatures would decrease growth rates of trout in their natural environment. (JSTN)

<185>

Boys, P.G., and E.T. Carside, Lethal Levels of pH for Brook Trout, *Salvelinus fontinalis* (Mitchill).

1975. Can. Jour. Zool., 53, 639-641 (Dalhousie University, Department of Biology, Halifax, Nova Scotia, Canada)

Fingerling brook trout, *Salvelinus fontinalis* were subjected to acute and chronic pH stress for various periods of 10 000 min in a series of dilutions of sulfuric acid of sodium hydroxide at 10 and 20 C after acclimation at 15 C and pH 6.8. Lethal limits of pH were estimated to be pH 3.5 and 9.8 at both temperatures. There were no observable differences in the resistance times at lethal pH stresses between test temperatures. The order of death was not significant in relation to length or weight of the fish. (Auth)

<186>

de Ciechanowski, J.D., and G. Weiss, Distribution of Eggs and Larvae of the Hake *Merluccius merluccius* in the Shelf Waters off Argentina and Uruguay in Relation to the Anchovy, *Engraulis anchoita* and to the Environmental Factors.

1974. Physis, 33(86), 185-198 (Instituto Marino Biológico, Mar del Plata, Argentina)

The eggs of the hake in shelf waters off the Argentinean and Uruguayan coasts were found at temperatures of 8.2 to 18.7 C and at salinities of 33.1 to 34 ppt. Most eggs occurred between 15 and 18 C. In summer and autumn highest densities of larvae were found at 18 to 19 C; in winter they were found at 12 to 16 C. As the spawning season advanced, the reproduction area was displaced to the north. (ST)

<187>

de Jonckheere, J., P. Van Dijck, and H. Van de Voorde, The Effect of Thermal Pollution on the Distribution of *Sargelia fouleri*.

1975. Jour. Hyg., 75, 7-13 (Katholieke University, School of Public Health, Leuven, Belgium)

SARGELIA FOULERI, the causative agent of primary amoebic meningoencephalitis, was isolated only from a thermally polluted canal. It was absent in all other samples taken from a nearby thermally polluted canal, stream, two lakes, reservoirs and water supply and distribution networks. Other amoebae able to grow at 42 C were found. (ST)

<188>

de Kinkelin, P., and H. Le Barce, Fish Rhabdovirus. II. In Vitro Properties of Spring Viraemia of Carp Virus.

1974. Ann. Microbiol. (Fr.), 125 A, 113-124 (Institut National de la Recherche Agronomique, Laboratoire d'Ichtyopathologie, Thiverval-Grignon, France)

Spring viraemia of carp (SVC) virus grown in fathead minnow cells showed good replication between 10 and 25 C, the only difference being speed. Optimum replication was at 21 C. Virus growth did not induce interferon in fathead minnow cells. Virus infectivity was stable in sodium at 4 C but was readily inactivated in water at 18 C. Heating at 45 C for 15 min destroyed 99% of its infectivity. The virus was also grown in *EPITHELIOMA PAPULOSUM CARPIO* and brown bullhead. (ST)

<149>

DeGraeve, G.S., and J.B. Reynolds, Feeding Behavior and Temperature and Light Tolerance of *NYSSIS BELICTA* in the Laboratory.

1975. Trans. Amer. Fish. Soc., 104, 390-397 (Great Lakes Fishery Laboratory, Ann Arbor, MI)

Live specimens of *NYSSIS BELICTA* from Lake Michigan were held for one year in the laboratory to determine feeding behavior and tolerance to light and temperature. *Nyssids* fed by moving with rapid, horizontal jerking movements toward food as it settled toward the bottom and by swimming slowly, upside down, to gather particles floating on the surface. Scavenging was common. Starting at 5° C temperature increases of 1° C per day and 1° C per minute resulted in TL values of 20.5 C and 20.8 C, respectively. With a rise of 1° C per day movement and feeding increased noticeably at 15 to 16 C, but stress was not visibly evident until temperatures reached 20 to 21° C. Mortality increased rapidly above 13 C. In a thermal gradient tank ranging from 5 C at the bottom to 19 C at the top, *nyssids* preferred the bottom temperature. (Auth) (ST)

<150>

Dussel, A., and C. Peres, Effect of Temperature on Fish Metabolism.

1973. Ann. Inst. Michel Pacha (Fr.), 5, 20-27 (Laboratory of Maritime Physiology, Tamaris-sur-mer, Villeurbanne, France)

The effect of temperature on fish metabolism is reviewed. Optimum temperatures, acclimation, adaptation, and seasonal and daily variations in environmental factors resulting in changes in enzyme levels are discussed. (ST)

<151>

Dussert, H.G., Tolerance Differences and Interspecific Competition in Three Members of the Amphipod Genus *GAMMARUS*.

1974. Hydrobiol. Bull., 8, 109 (University of Amsterdam, Institute of Taxonomy-Zoology, Amsterdam, Netherlands)

In a series of experiments with *GAMMARUS PULEX*, *G. DUEBENI DUEBENI*, and *G. DUEBENI CELTICUS* populations, pure and mixed populations were tested for tolerance to several temperature salinity combinations. All species tolerated a temperature of 5 C better than higher temperatures of 10 or 15 C and the middle salinity range (1‰ for *G. PULEX* 1‰ and 10‰ for *G.D. CELTICUS* and *G.D. DUEBENI*) better than the lower or higher salinities. In nearly all conditions tested *G. PULEX* had a lower survival rate than the other species. (ST)

<152>

Denton, J.E., and M.K. Yousef, Seasonal Changes in Hematology of Rainbow Trout, *SALMO GAIRDNERI*.

1975. Comp. Biochem. Physiol., 51A, 151-153 (University of California, Institute of Environmental Stress, Santa Barbara, CA)

A study on hematology of *SALMO GAIRDNERI* was conducted to test whether or not seasonal changes are due to changes in water temperature. Although water temperature was

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sustained about the same throughout the study, seasonal changes were evident in hemoglobin, hematocrit, serum proteins, mean cell volume, mean cell hemoglobin and mean cell hemoglobin concentration. Water temperature did not seem to be responsible for variations in hematology of rainbow trout. Diet, metabolic adaptations and activity were suggested as probable causes of seasonal changes. (Auth)

<153>

Bethlefsen, V., Seasonal Fluctuations in Two Parasitic Copepods *HYTILICOLA INTERSTITIALIS* Steyer and *NOBIOLICOLA INSIGNIS* Akrivillius.

1970. Ber. dt. Wiss. Konn. Bonnforsch. (Ger.), 23, 376-392 (Institut für Rosten- und Rinnenforschung der Bundesforschungsanstalt für Fischerei, Hamburg, German Federal Republic)

Fluctuations in the populations of two parasitic copepods living in the blue mussel (*MYTILUS EDULIS*) in the German North Sea were studied. The numbers of *HYTILICOLA INTERSTITIALIS* and the percentage of infected mussels underwent parallel seasonal fluctuations, minima occurring in winter, maxima in summer. The proportion of female *H. INTERSTITIALIS* with egg sacs was high in summer and low in winter. More juveniles were found in winter than in summer. The sex ratio did not undergo marked seasonal fluctuations. Population density of *NOBIOLICOLA INSIGNIS* was highest in summer, increasing rapidly when water temperatures rose to 10 C. Females with egg sacs were found only when water temperatures were higher than 10 C. Males were absent in winter. *NOBIOLICOLA INSIGNIS* was not an abundant species. (ST)

<154>

Devadoss, P., On the Occurrence of Juvenile Oil Sardine, *SARDINELLA COMIGERY* Vol. in the Inshore Waters of Bombay.

1973. Indian Jour. Fish., 20, 230-236 (Central Marine Fisheries Research Institute, Bombay, India)

The occurrence of young oil sardines in large proportions in the inshore waters of Bombay in winter, of some years may be due to a fall in temperature. During the winter months of 1966 to 1970 the temperature fluctuated between 23.2 and 26.1 C. In December 1970 and January 1971 it fell to 19.4 and 21.6 C and large numbers of sardines were observed. Salinity remained constant and at 35 ppt. (ST)

<155>

Diaz, R.J., Effects of Brief Temperature Increases on Larvae of *MYTILUS LATERALIS* (Mollusca: Bivalvia).

1975. Jour. Fish. Res. Bd. Can., 32, 1870-1872 (Virginia Institute of Marine Science, Gloucester Point, VA)

Temperature increases of 10, 15, and 20 C for 30 min significantly increased 48-hr mortality of *MYTILUS LATERALIS* larvae. Growth of surviving larvae was temporarily decreased only by a 20-degree temperature increase. No interaction was found between age of larvae when exposed and mortality after brief temperature increases. (Auth)

<146>

<146>

McIvor, B.D., J.C. Pope, and S.J. Bolden, Environmental Influences on the Survival of North Sea Cod.

1970. Part of Blaxter, J.B.S. (Ed.), The Early Life History of Fish. Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1971. Springer-Verlag, Berlin-Heidelberg (Fishes Laboratory, Lowestoft, England)

The increase in year class strength of cod in the North Sea since 1963 was attributed to the recent cooling tendency observed in this area. It was suggested that low sea temperatures during both the time of spawning and larval drift act by maximizing the proportion of eggs which hatch, by enhancing the chance of a match between hatching and production, and by optimizing the metabolic range of the species. (37)

<157>

Rianiani, P., Reproductive Cycle and Gonadal Changes in the New Zealand Rock Oyster *CRASSOSTREA GLOMERATA*.

1970. New Zealand Jour. Mar. Freshwater Res., 8, 39-65 (Ministry of Agriculture and Fisheries, Fisheries Research Division, Wellington, New Zealand)

The annual reproductive cycle of the New Zealand rock oyster, *CRASSOSTREA GLOMERATA*, is described. Gametogenesis began in July and August and follicles ripened during the spring months of October and November. Maximal development took place in November with most oysters in spawning condition in December and January. Major spawning took place in January or February depending upon water temperature, and continued until the end of March. Following spawning, gonadal regression set in. (both) (37)

<158>

Bukhtiyeva, Ye.N., Spawning Grounds of Common Pike-perch (*LUCIOPERCA LUCIOPERCA* (L.)) and Volga Pike-perch (*LUCIOPERCA VOLGENSIS* (Gmelin)) in the Ural River.

1973. (A.N. Severtsov Institute of Evolutionary Morphology and Animal Ecology, Moscow, USSR)

From 1966 to 1969 the development of juvenile fish of the Ural River, USSR, was studied. Pike-perch and Volga pike-perch spawned in the second half of April and beginning of May at a temperature of 10.0 to 15.5 C. Both species spawned at the same time and in the same spawning grounds. The largest spawning grounds were along the sandy, sparsely vegetated shallows of Indoborsky and Krasnyy yary. Spawning grounds were found from Guryev to Chapayev (595 km) (37)

<159>

Doe, T.P., and D.C. Stefan, Several Environmental Factors Influencing the Distribution of the Freshwater Polychaete, *HAUSTORIA SPICIOSA* Ledy.

1970. Chesapeake Sci., 15, 235-237 (Ichthyological Associates Inc., Pottstown, PA)

The freshwater polychaete, *HAUSTORIA SPICIOSA* Ledy, is reported from the Schuylkill River in southeastern Pennsylvania for the first time near the type-locality

since 1850. This polychaete appears to have a wide range of tolerance for environmental parameters such as dissolved oxygen content (1.0 to 10.0 ppm), depth (0.3 to 16.0 m), pH (6.7 to 8.0), and water temperature (2.8 to 20.3 C). An environmental factor which may limit its distribution is the requirement for fine particulate material in the substrate for the construction of the tube in which it lives. (both)

<160>

Bellina, A., Environmental Dependence of the Main Parameters of the Respiratory Function in Fishes Differing in their Activity and Oxygen Requirement.

1970. Jour. Ichthyol., 10, 122-132 (Institute of Physiology, Siberian Department, Novosibirsk, USSR)

Changes in the rate of gas exchange, ventilation volume, the coefficient of uptake of oxygen from water and the frequency of respiratory movements in pike-perch (*LUCIOPERCA LUCIOPERCA*), ide (*LEUCISCUS IDUS*), and pike (*ESOX LUCIUS*) during a reduction of oxygen concentration from 12 to 0.2 mg/l and at water temperatures of 5, 10, 15 and 20 C were studied. In all three species an increase in temperature caused an increase in the maximum value of the ventilation volume, an increase in the coefficient of utilization corresponding to the maximum ventilation volume and also an increase in the number of respiratory movements made by the fish to pump a unit of volume of water. Fish were temperature acclimated prior to experimentation and tested in the resting and active state. Species differences were noted. The oxygen concentration below which there was a reduction in the rate of gas exchange depended on experimental conditions and on the fish species. An increase in temperature led to a shift of this point into the range of higher oxygen concentrations. (37)

<161>

Bellina, V.A., Effect of Environmental Conditions on the Main Parameters of the Respiratory Function in Fish Having Different Mobility and Oxygen Requirement.

1970. Vopr. Ikhtiol., (USSR), 10, 103-155 (Institute of Physiology, Siberian Department, Novosibirsk, USSR)

Absolute values and changes in the rate of respiratory metabolism, ventilation volume, coefficient of O₂ utilization from water and respiration rate of pike (*ESOX LUCIUS*), ide (*LEUCISCUS IDUS*), and pike-perch (*LUCIOPERCA LUCIOPERCA*) were measured at rest and during increased activity at decreasing oxygen concentrations from 12 to 0.2 mg/l and at water temperatures of 5, 10, 15, and 20 C. Ide were most tolerant to low oxygen concentrations and pike-perch were least tolerant. (37)

<162>

Bellina, V.A., The Rate of Basal Metabolism in Fish.

1973. Jour. Ichthyol., 13, 430-438 (Institute of Physiology, Siberian Department, Novosibirsk, USSR)

Values for the basal metabolism at different temperatures of several species of fish differing in their degree of mobility and oxygen requirements are given. (37)

<153>
Dooly, U., Preliminary Investigations on
Phytoplankton from the West Coast of Ireland.

.97). Brit. Phycol. Jour., 8, 79-94 (University
College, Department of Botany, Galway, Eire)

The phytoplankton of a sheltered inlet of
Galway Bay on the west coast of Ireland was
investigated in the winter and summer of
1971. The diatom flora, of just over 70
species was acrotic in character and changed
from a *THALASSIOSIRA-SKELETON* flora in
winter to a *CEPHELOPS* flora in early May
before reverting to a *SKELETON* flora later
in the month. The dinoflagellate flora of 17
species was largely oceanic and became
prominent only in summer. An annotated list
is given with temperature and salinity ranges
for each species. Size reduction in many of
the diatoms indicates that the inlet has a
closed community. The origins of the flora
are mainly boreal but *BRIDGESIIA BRIDGESII*
var. *STREPTUM* (Hansen) Grun is an abundant
species in winter. This, together with the
presence of temperate oceanic species,
indicates that the offshore flora is derived
from more than one body of water. (Auth)

<146>
Dorfan, D., G. Willson, and J. Kelly, First
Report of the Blackspot Tonguefish, *SYNGNATHUS
PLACATUS* L., in New Jersey Waters.

1976. Bull. N.J. Acad. Sci., 19, 7 (Monmouth
College, Department of Biology, East Long Branch,
NJ)

A single specimen of a blackspot tonguefish
was collected on October 25, 1973 in a haul
from Oyster Creek, New Jersey. The usual
range for this species is in offshore waters
from Florida to North Carolina. Water
temperatures in Oyster Creek are heightened
during operation of a nuclear power plant
which discharges heated effluent into the
creek. Water temperature, salinity, and
dissolved oxygen content at time of
collection were 19 C, 21.2 ppt and 7.5 mg/l,
respectively. (ST)

<145>
Jensen, N., and P. de Kinkelin, Mortality and
Interferon Production in Rainbow Trout
Experimentally Infected with Ectrod Virus: Role
of Temperature.

1976. Ann. Rech. Vet. (Fr.), 5, 365-372 (INRA,
Laboratory of Ichthyopathology, Thiverval
Grignon, France)

Infection of Ectrod virus, the causative
agent of virus haemorrhagic septicaemia (VHS),
into rainbow trout, *Salmo gairdneri*, resulted
in high levels of circulating interferon and
mortalities at both 15 and 10 C. Placing
healthy fish in water with infected fish
provoked mortalities only at 10 C. Interferon
synthesis was earlier at 15 C than at 10 C.
This fact agreed with the hypothesis that
interferon synthesis produces resistance of
trout to the disease when water temperature
rises above 10 C. (Auth) (ST)

<144>

Briedack, U., and B.I. Bents, Glycerophospholipid
Content and Composition of Trout (*SALMO GAIARDNERI*)
POWELLIS B.; Brain.

1975. Jour. Thermal Biol., 1, 7-10 (University
of Toronto, Department of Zoology and Bristol
College, Mississauga, Ontario, Canada)

Trout (*SALMO GAIARDNERI*) were acclimated
to 5 and 19 C and the amounts and composition
of diacylglycerophosphatidyl choline
(diacylgPC), alk-1-acylglycerophosphatidyl
choline (alk-1-acylgPC),
diacylglycerophosphatidyl ethanolamine
(diacylgPE) and
alk-1-acylglycerophosphatidyl
ethanolamine (alk-1-acylgPE) in the brain
were determined. At both acclimation
temperatures diacylgPC occurred in the
greatest and alk-1-acylgPC in the least
amount. Almost 100% of the phospholipid was
ethanolamine based. The amount of
phospholipid present was the same at the two
acclimation temperatures. There was an
increase in the proportion of long chain
poly-unsaturated fatty acids in the GPC
fraction at the low acclimation temperature.
The fatty aldehyde composition of GPC was
similar to the in other fish in season.
(Auth)

<147>

Budley, R.G., and A.W. Hipper, Survival of
Largemouth Bass Embryos at Low Dissolved Oxygen
Concentrations.

1975. Trans. Amer. Fish. Soc., 104, 122-126 (New
York Cooperative Fishery Unit, Cornell
University, Ithaca, NY)

The low oxygen concentrations that
significantly decreased survival of
largemouth bass (*Micropterus salmoides*)
embryos incubated at three temperatures in
both stationary and moving containers were
identified. Embryos developed and hatched at
oxygen concentrations as low as 1.0, 1.1, and
1.3 mg/liter at temperatures of 15, 20, and
25°C, respectively, but concentrations below
2.0, 2.1 and 2.8 mg/liter significantly
lowered survival. At oxygen concentrations
below 1.0 mg/liter, survival during the
prehatching period was higher incubation than
among unincubated embryos; however, hatched embryos
suffered nearly complete mortality during
hatching at all oxygen concentrations.
Although results were not consistent between
experiments, survival after hatching was
better at 25 C than at 15 or 20 C at all
dissolved oxygen concentrations. (Auth) (ST)

<140>

Dufour, A.P., Bacterial Species of the Coliform
Group: Their Significance in Marine Environments.

1975. Ph.D. Thesis, University of Rhode Island
(University of Rhode Island, Kingston, RI)

The survival characteristics of coliform
bacteria were examined in seawater and
seawater-sewage mixtures. At 0 C, bacteria
in a naturally occurring sewage population
survived longer than composite populations of
PSEUDOMONAS AERUGINOSA and *AEROMONAS* sp. used
for purposes of comparison; at 20 C the
opposite was true. In a natural sewage
sample mixed with seawater and held at 4 C,
P. AERUGINOSA had the longest time interval
to 10% survival, followed by *KLEBSIELLA* sp.,
enterococci, *ENTEROBACTER* sp., *ESCHERICHIA*
COLI, and *AEROMONAS* sp. At 20 C, *P.*
AERUGINOSA and *KLEBSIELLA* sp. again had the
longest survival times followed by *AEROMONAS*
sp., *ENTEROBACTER* sp., *E. COLI* and
enterococci. (ST)

<169>

<169>

Buena, J.C., and A.L. Davies, The Effects of Temperature and Photoperiod on Antifreeze Production in Cold Water Fishes.

1976. Jour. Exp. Zool., 190, 89-97 (University of Notre Dame, Department of Biology, Notre Dame, IN)

The effect of temperature and photoperiod of the circannual cycle of antifreeze production of fish that inhabit subzero waters in winter was investigated. Fish collected from subzero waters were acclimated to various temperature and photoperiod regimes. Only the combination of a long photoperiod and warm temperature resulted in the disappearance of antifreeze from the serum, thus providing for an efficient fail-safe system. The time necessary for the complete loss of the macromolecular antifreeze ranged from 3 to 5 wk. When summer fish were acclimated to various combinations of temperature and photoperiod, low temperatures resulted in the production of antifreeze regardless of the photoperiod. Serum Na⁺ and Cl⁻ levels were significantly higher in cold acclimated than in warm acclimated fish. In general, fish collected from more northerly latitudes had lower serum freezing points than the same species from warmer, more southerly waters. There seemed to be a genetic difference between populations of *NOPIABCHUS PUPPUSCHUS* from Achitka, Alaska and San Simon, California, since the California fish were unable to produce antifreeze when acclimated to cold temperatures. (Auth)

<170>

Barrett, C.W., and U.D. Pearson, Drift of Macroinvertebrates in a Channel Carrying Heated Water from a Power Plant.

1975. Hydrobiologia (Dord.), 46, 33-43 (North Texas State University, Department of Biological Sciences, Denton, TX)

Benthic invertebrates existed at lower densities on the bottom of a channel receiving cooling water from a steam electric generating station than in the reservoir (North Lake, Texas). No organisms were found in the channel during summer months when water temperatures reached 42.2 C. The most abundant organisms drifting from the channel were *CHIRONOMUS* larvae which probably were drawn from the reservoir, through the condensers of the power plant, and down the effluent channel. The serious drift rate for *CHIRONOMUS* larvae occurred in August while the minimum rate occurred in December. *CHIRONOMUS* larvae exhibited a diurnal periodicity in drift corresponding to their slightly emergence from bottom sediments in the reservoir. (Auth) (ST)

<171>

Swaraknath, S.K., O.C.V. Berlia, and B.S. Pandian, The Influence of Temperature on Oxygen Consumption in the Larvae of *TOXOSTYCHITES SPILIMPHUS* (Diptera: Calicidae).

1975. Jour. Medical Entomol., 11, 742 (American College, Postgraduate Department of Zoology, Madurai, India)

The rate of oxygen consumption of the dipteran larva, *TOXOSTYCHITES SPILIMPHUS*, tested at 20 C after acclimation at 20 C was 8% higher than when tested at 21 C following acclimation at 33 C. The rate at 33 C

acclimated larvae tested at 33 C was 54% lower than that of 20 C acclimated larvae tested at 33 C. The O₂ uptake at 20, 25, 30, and 33 C acclimation increased with temperature increase. Consumption increased by 70% from 20 to 25 C, 20% from 25 to 30 C and 57% from 30 to 33 C. The lower increase from 25 to 30 C may be attributed to the habitat temperature which ranges from approximately 25 to 30 C. (Auth) (ST)

<172>

Murphy, B.J., Food Preference and Growth of Young Grass Carp in New Zealand.

1976. Fisheries Research Publication No. 223; New Zealand Jour. Mar. Freshwater Res., 8, 341-350 (Ministry of Agriculture and Fisheries, Fisheries Research Division, Dunedin, New Zealand)

Food selectivity of young grass carp, *CYPRINUS CARPIO* L., held in outdoor ponds, decreased with increasing temperature and size of fish. In winter at a mean temperature of 9 C the fish ate very little, but only the most highly preferred species of weed. At higher spring and summer temperatures (20 to 23 C) the fish ate their body weight of preferred weed species/day. Growth was slow in winter and rapid in summer. (ST)

<173>

Effler, W.B., and J.B. Bryce, Thermal Discharge Studies on the Great Lakes: The Canadian Experience.

1975. COM-740820; STI/PUB/378; IAEA-SM-187/56; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 371-388) (Ontario Hydro, Toronto, Canada)

To meet the economic growth of the province, Ontario Hydro has a construction program which relies heavily on the CANDU system for generating electricity. It is planned to use the Great Lakes for once-through cooling, and the Provincial Government guidelines are outlined. At new and proposed stations and heavy-water plants, cooling water will be withdrawn via an off-shore submerged intake and discharged as to the lake surface at or near the shoreline. A phenomenological model has been developed from on-site measurements which predicts thermal plumes under a range of conditions. Large physical models of sites now solve problems of temperature distribution. Biological studies at the Pickering site indicated that benthic fauna diversity was consistently but not significantly lower in the immediate discharge area. Seasonal variation in diversity was low, however, suggesting that community stability was not reduced. Fish populations were dominated by the brown bullhead, which had a short residence time in the heated area. Periphyton growth was enhanced by increased currents and temperature. At the Bruce site, most fish species were attracted to the Douglas Point discharge in the spring and summer months but left in summer when temperatures exceeded their fiscal preference. In winter, most cold- and warm-water species migrated from the shoreline. Benthic fauna populations decreased slightly, possibly due to hydrogen sulphide released from the heavy-water plant. A feasibility study on the use of waste water for promoting crop growth indicates that the economics critically depend on the distance between the generating station and area to be heated. (Auth)

<176>

Spaul, W., Long-Term Observations of Mortality of Irradiated Fish at Different Temperatures.

1978. Rad. Res., 59, 132 (Tokyo University, Zoological Institute, Faculty of Science, Tokyo, Japan)

Molt fish, *ONYCHIAS LATIPES*, were irradiated with X-rays at daily doses of 25, 50, 100, or 200 R at high (23 to 29 °C) or low (below 15 °C) temperatures and median survival times of fish and accumulated doses for 50 percent mortality were calculated. Fish accumulated higher doses before death at the lower temperatures. (ST)

<175>

Sporens, L.A., and T.I. Boydanova, Eurythermic Bacteria Belonging to the Genus *PSUEDOMONAS*.

1978. Mikrobiologiya (USSR), 43, 102-106 (Institute of Microbiology, Moscow, USSR)

The optimum growth temperature of *PSUEDOMONAS* sp. isolated from mountain springs in the USSR at water temperatures of 40 to 50 °C was 45 to 50 °C. The highest temperature at which growth occurred was 50 to 60 °C. (ST)

<176>

El-Masoun, A.A., Laboratory Studies on the Direct Effect of Temperature on *BOLINUS TRUNCATUS* and *STOMPHALIA ALEXANDRINA*, the snail intermediate hosts of Schistosomiasis in Egypt.

1978. Folia Parasitol., 21, 181-187 (National Research Center, Bilharziasis Research Laboratory, Cairo Egypt)

Results of comprehensive laboratory experiments on the direct effect of temperature on the embryonic development, growth, sexual maturity, survival and reproduction of *BOLINUS TRUNCATUS* and *STOMPHALIA ALEXANDRINA*, the two snail intermediate hosts of schistosomiasis in Egypt are presented. The results of the study have their basic implication in the fields. For an economical and effective control of the disease, molluscicides should be applied before the breeding season which is markedly influenced by water temperature. (AUTH)

<177>

Elliott, J.W., Weight of Food and Time Required to Satisfy Brown Trout, *Salmo trutta* L.

1975. Freshwater Biol., 5, 51-64 (Freshwater Biology Association, Ambleside, England)

Brown trout, *Salmo trutta*, of different weights (range 8 to 358 g) were fed to satiation at 15 different water temperatures (range 3.8 to 21.6 °C). Both the weight of the trout and the water temperature affected the maximum weight of food consumed in a meal, and the relationship between the three variables was well described by a multiple regression equation which can be used to estimate the value of weight of food for trout of different weights at different temperatures between 3.8 and 21.6 °C. The satiation time can also be estimated from a multiple regression equation for trout of different weights at temperatures between 6.8 and 18.1 °C. Estimates from the multiple

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regression equations were applicable to a wide range of food organisms with the exception of larvae of *Trematode* (annelurans). Appetite (measured by voluntary food intake) varied with temperature and was greatest between 11.3 and 18.0 °C. From comparisons with the results of other workers, the maximum amount of food consumed in a meal appears to provide sufficient calories for both the daily metabolic requirements and the daily maintenance requirements of a trout between 3.8 and 18.0 °C, but not above 18.0 °C. (AUTH)

<178>

Ngel, B.W., E.R. Davis, D.E. Smith, and J.W. Angelovic, The Effect of Salinity and Temperature on the Ion Levels in the Hemolymph of the Blue Crab, *Callinectes sapidus*, Rathbun.

1978. Comp. Biochem. Physiol., 89A, 259-266 (National Marine Fisheries Service, Atlantic Estuarine Fisheries Center, Beaufort, NC)

An investigation was conducted to measure the effects of salinity (5 and 35 ppt) and temperature (12, 20, and 28 °C) on the regulation of Na(+), K(+), Cl(-), Mg(++) and anhydrous positive substance (N.P.S.) in the hemolymph of the blue crab, *Callinectes sapidus*. Salinity and temperature interacted to cause significant changes in the levels of Na(+), Cl(-), Mg(++) and N.P.S. Na(+) tended to be related directly to temperature at high salinity, Cl(-) was unaffected by temperature at high salinity, and both were related inversely and non-linearly at low salinity. The levels of K(+) were unaffected by temperature at either salinity. These data indicated that Na(+) and Cl(-) levels are regulated by different mechanisms at high and low salinity and the mechanism of regulation is thermally influenced. (AUTH)

<179>

Erskine, V.Ya., Variability of the Number of the Vertebrae in Spawning Populations of Benthos Eating Whitefish *Coregonus lavaretus* (L.) of the Kola Peninsula.

1978. Vopr. Ikhtiol., (USSR), 18, 955-967 (A.N. Severtsov Institute of Evolutionary Morphology and Animal Ecology, Moscow, USSR)

The variability in vertebrae number of whitefish in Chus Lake, USSR, was studied. Whitefish with small numbers of vertebrae (60 to 62 vertebrae) were thought to have been spawned in warmer waters, where growth is rapid, than whitefish with greater numbers of vertebrae (64 to 66 vertebrae). (ST)

<180>

Pan, S.C., W.H. Li, Y.C. Wang, and Y.P. Pan, Studies on the Agarophytes. I. The Optimum Growth Temperature of the Carpogone Germlings of *Gracilaria* *sp.* and the Seasonal Growth of the Sporlings.

1978. Act. Bot. Sin. (China), 16, 24-30 (Sun Yat-sen University, China; Shan-jiang College of Fisheries, China; South China Sea Institute of Oceanology, China)

Carpogone germling of the marine alga, *Gracilaria* *sp.*, cultured at different temperatures in enriched sea water showed a maximum growth rate at 25 °C. In addition, the germlings demonstrated a marked ability to withstand temperature as high as 35 °C. A field survey indicated that sporlings withstand the high temperature summer months when vegetative growth is completely damaged. (ST)

<181>

<181>

Pedersen, A.V., Feeding Characteristics and Predation Impact of CHAOSORUS (Diptera, Chaoboridae) Larvae in a Small Lake.

1978. Limnol. & Oceanogr., 20, 250-258
(University of Toronto, Institute for Environmental Studies, Toronto, Ontario, Canada)

Feeding rates of CHAOSORUS ANTHICUS and CHAOSORUS TRIVITTATUS larvae generally increased with temperature, prey density, and larval size and varied with prey type. Test temperatures used were 5, 10, 15 and 20 C. Temperature had no effect on feeding rates of old fourth instar C. TRIVITTATUS larvae. There was a significant though unexplained variability in the day-to-day feeding rates among individual chaoborids. Estimated mean percentage of standing crop of prey eaten by CHAOSORUS was: 24 for copepod nauplii, 31 for DIAPYCNUS TIBELLII, 9% for DIAPYCNUS KUBAI, and 48 for DIAPYCNUS KUBAI. CHAOSORUS predation on Seneca Lake zooplankton appears to be reduced by seasonal and spatial segregation of predator and prey and by size incompatibility. (Auth)

<182>

Pell, P.R., Dispersal in the Gemmules of the Marine Sponge, HALICLOWA LOOSABOPPI, with a Note on the Gemmules of HALICLOWA OCULATA.

1978. Biol. Bull., 187, 333-351 (Connecticut College, Department of Zoology, New London, CT)

Gemmules of the marine sponge, HALICLOWA LOOSABOPPI, collected in the Mystic estuary, Connecticut, did not germinate at 20 C unless held at 5 C for four or more weeks. Gemmules did not germinate at either 5 or 10 C. However, germination occurred within two to three weeks at 15 C and within one to two weeks at 20 C. At 25 C germination appeared to be accelerated by approximately 24 to 48 hr compared to that occurring at 20 C. Gemmules germinated at 30 C, but this temperature appeared to be less favorable than 20 or 25 C. Slightly higher temperatures inhibited germination and continuous exposure to 34 C appeared to be lethal. The reproductive period of HALICLOWA LOOSABOPPI in the Mystic estuary extended from late May through July and that of HALICLOWA OCULATA in Fishers Island Sound extended from March through June. Gemmule formation in H. LOOSABOPPI is evidently a means for surviving adverse environmental conditions in the estuary. (ST)

<183>

Peng, S.Y., and W. Van Winkle, The Effect of Temperature and Salinity on the Heart Beat of CRASSOSTREA VIRGINICA.

1975. Comp. Biochem. Physiol., 50A, 473-476
(University of Connecticut, Marine Research Laboratory, Poquat, CT; Oak Ridge National Laboratory, Oak Ridge, TN)

CRASSOSTREA VIRGINICA from New Jersey and Connecticut were acclimated to low salinities in the laboratory. Heart beat was measured at various temperature-salinity combinations to evaluate the ability of oysters to acclimate to the low salinity levels. Time of acclimation (4 to 5 vs 18 hr) to low

salinities did not significantly affect recovery of heart beat for either stock. Heart beat of New Jersey oysters above 10 degree C was less inhibited following a gradual (3 to 4 days) decrease in salinity (to 5 and 10 ppt) than following an abrupt decrease in salinity. Rate of acclimation to lower salinities appears to be less than 5 ppt per day. Heart beat of Connecticut oysters showed a maximum at intermediate salinities (14 and 19 ppt) at 20 and 30 degrees C, but heart beat was relatively insensitive to salinity at 5 and 10 degrees C. Similar, although less conclusive, results were obtained with New Jersey oysters. (Auth)

<184>

Pickles, D.H., J.C. Montgomery, and E.V. Hanf, Jr., Effect of Temperature on Tolerance to Dissolved Gas Supersaturation of Black Bullhead, ICTALURUS NELAS.

1978. BNL-SA-5175; CONF-781033-1; Part of Proceedings of a Workshop on Gas Bubble Disease held in Richland, Washington, October 8, 1978 (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Black bullhead, ICTALURUS NELAS, were acclimated to 8, 12, 16, and 20 degrees C in Columbia River water, and were tested at each of the acclimation temperatures to determine acute tolerance to dissolved atmospheric gas tensions in excess of equilibrium saturation. The data were subjected to probit analysis and mean 96-hour TL 50 values were 126.7% of equilibrium saturation at 8 degrees C, 125.1% at 12 degrees C, 123.8% at 16 degrees C, and 124.8% at 20 degrees C, indicating a slightly elevated tolerance at the lowest test temperature. These values, while indicating a statistically significant difference in tolerance, do not indicate an ecologically significant effect of temperature on acute tolerance of black bullhead in the range of temperatures tested. (Auth)

<185>

Fisher, T., Oxygen Uptake of the Solitary Tunicate STYELA PLICATA as a Function of Body Size, Temperature, and Oxygen.

1975. Part of Cech, J.J., Jr., et al. (Eds.), Respiration of Marine Organisms, Proceedings of the Marine Section of the First Maine Biomedical Science Symposium held in Augusta, Maine, March 14-15, 1975. Research Institute of the Gulf of Maine (TRIGOM), South Portland, Maine, (p. 72-84), 211 p. (Duke University Marine Laboratory, Beaufort, NC)

The active, acclimatized metabolic rate of STYELA PLICATA was estimated from measurements of oxygen consumption at field temperatures (10 to 29 C). Below 20 C the Q10 averaged 4. Between 20 and 30 C the Q10 averaged 1.6 and approached 1 near 30 C, indicating a relative temperature insensitivity and minimally increased maintenance costs for individuals acclimatized to higher summer temperatures. A sharp drop in metabolic rate indicated that the lower lethal temperature for this species lay between 5 and 10 C. (ST)

<104>

Fletcher, R.L., Studies on the Brown Algal Families Valoniaceae and Scytosiphonaceae.

1978. Brit. Phycol. Jour., 9, 218 (Polytechnic of North London, London England)

VALPSIA CLAVATA (Herv. in Book.) Crossan frut. and MICROSPONGIUM GELATINOSUM Reinke (pro parte) were shown in field and lab studies to be crustose phases in the life histories of PETALONIA PASTIA (O. P. Wall.) Kuntze and SCYTOSIPHON LOMENTARIA (Lyngh.) Link, respectively. The crustose and erect blade phases are facultative expressions determined principally by daylength and temperature. Short-day/cool temperature conditions favored erect blade production while long-day/warm conditions favored crust production. Erect blade development of PETALONIA FILIFORMIS (Batt.) Kuntze and PETALONIA ZOSTEROPOLIS (Reinke) Kuntze was initiated primarily from basal filanestous thalli. No crustose phase was observed in the former species while VALPSIA SPONGIOCAPPA Batt. PETRODERMA MACULIPORUM (Wollay), VALPSIA VERUCOSE (Breusch.) J-ag. possessed only crustose phases. (RFC)

<107>

Fonds, N., N. Rosenthal, and D.P. Alderdice, Influence of Temperature and Salinity on Embryonic Development, Larval Growth and Number of Vertebrae of the Garfish, BELONE BELONE.

1978. Part of Blaxter, J.H.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1973. Springer-Verlag, New York (Netherlands Institute of Sea Research, Texel, Netherlands)

Eggs of the garfish, BELONE BELONE, were incubated at 13 different salinity-temperature combinations (salinity: 10 to 25 ppt, temperature: 9 to 20 C) and data were collected on rate of embryonic development, survival to hatching and larval size. Hatching took place 866 hr after fertilization at 19.2 C and 240 hr at 20 C. Survival of eggs and larvae was greatest at 17.4 to 19.4 C and 31 to 37 ppt salinity. Size of newly hatched larvae decreased with increasing incubation temperatures and salinities, yolk-sac size was inversely correlated with body size. Embryonic growth and larval growth (mm/day) showed a linear increase with temperature. Growth of fish in mg/day showed an exponential increase with temperature. Mean vertebral number reached a minimum at 21.2 C and 41.1 ppt salinity. (auth) (ST)

<108>

Fonds, N., and G. Van Duurt, The Influence of Temperature and Salinity on Development and Survival of Goby Eggs (Pisces, Gobiidae).

1978. Hydrobiol. Bull., 8, 110-115 (Netherlands Institute of Sea Research, Texel, Netherlands)

The distribution of POMATOSCHISTUS MICRIPS, P. MINUTUS, and P. PICTUS in estuaries and shallow coastal waters of the North Sea is limited by both temperature and salinity. POMATOSCHISTUS MICRIPS, the most euryhaline species, is found in warmer shallow inshore waters and estuaries. POMATOSCHISTUS PICTUS is probably better adapted to the lower temperature and lower density of benthic food at greater depth offshore. POMATOSCHISTUS MINUTUS, a semi-euryhaline species, is found in estuaries and coastal water.. (ST)

<109>

Ford, B.F., J.C. Van Olst, J.B. Carlberg, B.E. Dorfand, and B.L. Johnson, Biochemical Use of Thermal Effluent in Lobster Culture.

Not given. San Diego State University Center for Marine Studies Contribution No. 3; Part of Proceedings of the 6th Annual Meeting of the World Mariculture Society: 15 p. (San Diego State University, Department of Biology, San Diego, CA)

Larvae and juveniles of the American lobster, HOMARUS AMERICANUS, were cultured in thermal effluent from the San Diego Gas and Electric Company's Encina Power Plant in Carlsbad, California and in sea water warmed to the same temperature. Larvae were cultured individually and in mass rearing systems at constant temperatures of 18.5 and 21.6 C; juveniles were cultured at a constant temperature of 22.1 C. Growth and survivorship of larvae and juveniles were essentially equal under the two culture conditions. In order to assess the combined effects of temperature and water chemistry, juveniles were cultured individually and in mass rearing systems in effluent at varying temperatures (mean temperature 22 C) and in lagoon water at ambient temperatures (mean temperature 19 C). The juveniles reared individually in effluent for ten months had significantly higher survival and attained a mean size 11.6 percent larger than did those in lagoon water. Juveniles cultured in mass rearing systems for six months attained a mean size 15.5 percent larger than those in lagoon water. Results indicated that growth in thermal effluent was more rapid than in sea water of ambient temperature.

<110>

Fraizier, A., A Study of the Accumulation of Soluble and Insoluble Forms of Pu 59 by Marine Mollusc and Fish (MYTILUS EDULIS and BLENNIUS PHOLIS). I. Effects of Temperature and Light on Species-Pollutant Interactions.

1978. CRA-7-4630(1); 43 p. (Commissariat a l'Energie Atomique, Centre de La Hague, Departement de Protection, Cherbourg, France)

The interactions between marine mollusc and fish (MYTILUS EDULIS and BLENNIUS PHOLIS) and Pu 59 were studied as a function of the physico-chemical (soluble or insoluble) forms of the radionuclide in sea-water, and physical parameters of the environment (temperature and light). It was observed that changes in environmental conditions modified exchanges between species and pollutant, whatever its physico-chemical nature. Besides variation of contamination kinetics, these environmental changes resulted in a decrease of Pu 59 accumulation whenever they led to slower metabolic activities; an increase of the contaminating capacity of the insoluble forms, as compared with soluble forms, was also noticed. Passive processes of adsorption of the radionuclide might occur; a partial rejection process was observed, especially with insoluble compounds. (auth)

<191>

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Pralick, R.A., and A.C. Mathieson, Physiological Ecology of Four POLYSIPHONIA Species (Rhodophyta, Ceratales).

1975. Marine Biol. (U. Ger.), 29, 29-36

(University of New Hampshire, Department of Botany and the Jackson Estuarine Laboratory, Durham, NH)

Photosynthesis and respiration of four species of the marine red algal genus POLYSIPHONIA were evaluated under a variety of light, temperature and salinity conditions. The manometric results were compared with the local distribution and abundance of each species. The species can be separated into two distinct categories based on their overall distribution and temperature optima: (1) cold water plants (P. LAMOSA and P. ELONGATA), with peak photosynthesis at 21 to 28 C, but with active photosynthesis as low as 5 C; (2) plants with warm-water affinities (P. NIGRESCENS and P. SUBTILISSIMA), having photosynthetic optima at 27 to 30 C, and exhibiting little or no photosynthesis below 10 C. The plants from the first group exhibited thermal injury at temperatures of 25 C and showed a narrow tolerance to low salinities during periods of high temperatures. The plants from the second group showed thermal injury at 30 C and had a wider tolerance to low salinities. The horizontal distribution of the four POLYSIPHONIA species within the Great Bay Estuary System of New Hampshire was primarily governed by their tolerances to high temperatures and low salinities. The temperature optimum for each of the species corresponded to its particular estuarine distribution. Thus, P. SUBTILISSIMA, having the highest temperature optimum, penetrated furthest into the Estuary, while P. LAMOSA, having the lowest temperature optimum, was restricted to the more coastal stations. There was a good correspondence between the lateral distribution patterns and the manometric results. (Auth)

<192>

Frank, L.H., and R.E. Meyer, Behavioral Thermoregulation in Hypophysectomized and Sham-Operated Rainbow Trout, SALMO GAIRDNERI.

1978. Behavioral Biol., 11, 101-108 (Western Washington State College, Bellingham, WA; University of Florida, Gainesville, FL)

A double-yoked control procedure was used to investigate the thermoregulatory behavior of hypophysectomized and sham-operated rainbow trout, SALMO GAIRDNERI. Each experimental and yoked control triad was tested simultaneously over a 20 min period on each of 5 successive days. A significant increase in response rate occurred over days resulting in a significant decrease in the mean environmental water temperature. However, an increase in temperature variability was observed over days. No significant differences were found between the hypophysectomized and sham-operated trout with respect to response rate, number of reinforcements, mean temperature, or temperature variability. The findings suggested an apparent neutrality of the hypophysis in the temperature regulation of trout, and supported the contention that trout will learn to regulate water temperature when given the opportunity to do so. (Auth)

<193>

Frank, P.W., Latitudinal Variation in the Life History Features of the Black Turban Snail TEGULA PUSILLALIS (Prosobranchia: Trochidae).

1975. Marine Biol. (U. Ger.), 31, 181-192

(University of Oregon, Department of Biology, Eugene, OR)

At higher latitudes along the west coast, USA, the herbivorous intertidal snail, TEGULA PUSILLALIS, lived longer, grew more slowly, but attained a larger size than those further south. To the north, age distributions were less predictable and not stationary. Differences were explained by either a primary temperature effects joined with increased hazards to planktonic larvae in the north, or by the results of a combination of interactions between intensity of predation, population density and food supply. Growth rates of transplanted individuals suggested a genetic basis for the latitudinal differences. (Auth)

<194>

Fry, J.C., and D.G. Staples, The Occurrence and Role of BDELLOVIBRIO BACTERIOVORUS in a Polluted River.

1978. Water Res., 8, 1029-1035 (University of Wales Institute of Science and Technology, Department of Applied Biology, Cathays Park, Cardiff, Wales)

BDELLOVIBRIO BACTERIOVORUS occurred in a polluted river in numbers averaging, over an 18 month period, 10 to 100 parasites/ml. The parasite was not able to grow at river temperatures or host concentrations below about $10(\pm 6)$ to $10(\pm 7)$ bacteria per ml and even at these had a doubling time of only 24 to 48 h. The results have indicated that the parasite was not important in reducing the bacterial population of the river studied. (Auth)

<195>

Fryer, J.W., and D.M. Ogilvie, Temperature Selection Response of Atlantic Salmon, SALMO SALAR, and Rainbow Trout, SALMO GAIRDNERI, after Exposure to Pentobarbital.

1978. Comp. Gen. Pharmacol., 5, 111-116 (University of Alberta, Department of Zoology, Edmonton, Alberta, Canada)

Atlantic salmon, SALMO SALAR, acclimated at 20 C and exposed to a 300 mg/l dose of pentobarbital for 15 and 20 min, selected mean temperatures which were significantly lower than untreated salmon during a four hour period following exposure to the drug. Rainbow trout, SALMO GAIRDNERI, acclimated at 10 and 20 C and exposed to a 480 mg/l dose of pentobarbital for periods of time ranging from 10 to 40 min, selected mean temperatures which were significantly higher than untreated trout for two to four hours following exposure to the drug. (Auth)

<196>

Feersteren, H.C., B.H. Nakawa, R.K. Price, and H.D. Wellik, Toxicity of Selected Sulfhydryl Collectors to Rainbow Trout.

1974. Trans. Soc. Mining Eng., 256, 337-341 (South Dakota School of Mines and Technology, Department of Metallurgical Engineering, Rapid City, SD)

Median lethal concentrations of pure and commercially available ethyl xanthate, isopropyl xanthate, amyl xanthate, diethyl dithiophosphate, dibutyl dithiophosphate, and isopropyl ethylthiocarbamate for rainbow trout were established utilizing static bioassays. The following conclusions were drawn: (1) The median lethal concentration of Aeroxanthate 325 (sodium ethyl xanthate) was 14 to 16 ppm at 12 C; (2) The median lethal concentration of Z-8 (sodium ethyl xanthate) was 13 to 15 ppm at 12 C; (3) The median lethal concentration of Z-3 (potassium ethyl xanthate) was 15 to 17 ppm at 12 C; (4) The median lethal concentration of pure potassium ethyl xanthate was 15 to 20 ppm at 8 C and 12 C, 1.8 to 2.0 ppm at 16 C, and 1.5 to 1.8 ppm at 20 C; (5) The median lethal concentration of Aeroxanthate 343 (sodium isopropyl xanthate) was 18 to 20 ppm at 12 C; (6) The median lethal concentration of Z-11 (sodium isopropyl xanthate) was 18 to 20 ppm at 12 C; (7) The median lethal concentration of Aeroxanthate 350 (potassium amyl xanthate) was 70 to 80 ppm at 12 C; (8) The median lethal concentration of pure potassium amyl xanthate was 70 to 75 ppm at 12 C; (9) The median lethal concentration of Sodium Aerofloat was 400 to 410 ppm at 12 C and 310 to 330 ppm at 16 C; (10) The median lethal concentration of pure potassium diethyl dithiophosphate was 800 to 825 ppm at 12 C; (11) The median lethal concentration of Aerofloat 238 was 500 to 625 ppm at 12 C; (12) The median lethal concentration of pure potassium disocobutyl dithiophosphate was greater than 1000 ppm at 12 C; (13) The most toxic constituent of commercially available dithiophosphates was hydrogen sulfide; (14) The median lethal concentration of Z-200 (isopropyl erythionocarbamate) was 45 to 48 ppm at 12 C; (15) The median lethal concentration of pure isopropyl ethylthiocarbamate was 40 to 45 ppm at 12 C. (Auth) (ST)

<197>

Fujii, T., K. Nasuda, T. Ishiyama, G. Kobayashi, and G. Asa, A Consideration on the Relation Between Oceanographic Conditions and Distribution of Bristol Bay Sockeye Salmon *Oncorhynchus nerka* (Walbaum) in the Eastern Bering Sea, with Special Reference to Its Poor Return in 1973.

1974. Bull. Fac. Fish. Hokkaido Univ. (Jap.), 25, 215-229 (Hokkaido University, Faculty of Fisheries, Hokkaido, Japan)

The small inshore run of Bristol Bay, Alaska, sockeye salmon and its low density offshore was attributed to the effects of unfavorable environmental conditions in the marine life stage reinforced by high sea fisheries and a low density of spawners. Using data obtained since 1963, the extent of distribution and species and age composition of Bristol Bay salmon were analyzed in relation to temperature and salinity conditions of the

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Eastern Bering Sea. Since 1970, water temperatures in the eastern Bering Sea and in Bristol Bay were 1 to 3 C lower every summer than in previous years. Changes in species composition of salmon were found in offshore areas; chum salmon are distributed evenly in the southern part of the eastern Bering Sea where formerly sockeye salmon prevailed. The water temperature of the sea area along the Alaska peninsula where juveniles migrate was unusually cold in 1971. (ST)

<198>

Gallagher, B.J. (Ed.), Energy Production and Thermal Effects.

1974. CONF-7309117: Proceedings of a Symposium held in Oak Brook, Illinois, September 10-11, 1973. Linnetics, Inc., Milwaukee Wisconsin; 194 p. (Linnetics, Inc., Milwaukee, WI)

Twenty papers, primarily emphasizing thermal effects abatement and increased power plant efficiency were presented. Topics discussed included factors affecting federal research, economic aspects and social responsibility as related to public policy, methods and systems for cooling discharges and their effect on biota, beneficial uses of waste heat, reviews of site studies, and a mathematical model for predicting ecological effects. Eight papers were selected and abstracted separately for the data base. (ST)

<199>

Gallagher, S.B., and G.K. Reid, Reproductive Behavior and Early Development in *LITTORINA SCABRA* *ANGULIPEDA* and *LITTORINA IRRORATA* (Gastropoda: Prosobranchia) in the Tampa Bay Region of Florida.

1974. Malacologia Rev., 7, 105-125 (12250 6th St. E., Treasure Island, FL)

Reproduction in *LITTORINA SCABRA* *angulifer* and *LITTORINA IRRORATA* was studied in the Tampa Bay, Florida, area. In both species copulation and spawning were correlated with lunar phases and daily tidal rhythms. Reproductive activity in *L. S. ANGULIPEDA* was seasonal, there being little or none from November and May. In *L. IRRORATA* reproductive activity was sporadic and spawning was greatest during spring and summer. Copulation in *L. IRRORATA* occurred in most months but was rare in winter. One spawning was noted in January. It was found that water must be present for release of spawn by *L. S. ANGULIPEDA*; deprivation of access to water disrupted spawning and caused a loss of viable spawn. Mortality due to water deprivation was higher among gravid females than among asexual and nongravid females of *L. S. ANGULIPEDA*. Subjecting snails of both species to the constant environment of laboratory experimental tanks disrupted but did not stop reproductive activity. Cooperative studies of individuals of both species from marsh grass (*Spartina*) habitats with those from seawalls revealed that snails attained greater size in the former community. *L. S. ANGULIPEDA* females released a greater amount of spawn and over a longer period of time in the marsh grass habitats than on seawalls. Development from fertilized egg to the swimming veliger stage was similar in both species but, at 26 to 28 C, took only 27 to 40 hr in *L. IRRORATA* as compared to 4 days in *L. SCABRA ANGULIPEDA*. (Auth)

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<200>

Gallaway, B.J., and K. Strawn, Seasonal Abundance and Distribution of Marine Fishes of a Hot-Water Discharge in Galveston Bay, TX.

1974. Cont. Marine Sci., 18, 71-117 (Texas A & M University, Agricultural Experimental Station, Department of Wildlife Science, College Station, TX)

Biological and hydrological data were collected one each month January 1969 to December 1969 at 11 offshore (trawl) and 6 beach (seine) stations in the discharge area of the P.M. Robinson Generating Station at Galveston Bay, Texas. During all but hot months, most fishes appeared attracted to the effluent. During hot weather, they generally avoided the uncooled effluent in the immediate discharge area. Water temperature decreased rapidly with distance from the outfall. The heated water flowed at the bottom rather than top of the water column during 2 of the 24 collecting trips. A few Gulf menhaden (during 1 of the 2 temperature inversions) and sea catfish were killed in the summer by heat. The lowest elevated temperature a species avoided was 30 C by the gulf menhaden. Most species were abundant in water up to 33 to 35 C. Sea catfish and Atlantic croaker did not strongly avoid the effluent until temperature exceeded 37 and sand seatrout and striped mullet were collected in 40 C water. The observed detrimental effects on the fish fauna in the discharge area of the power plant operating at either the 900 or 1465 mw capacity were negligible and restricted to hot months. Beneficial and potentially beneficial aspects were indicated during most months. Most fishes would not avoid the immediate discharge area if June to September effluents were cooled a few degrees before reaching Galveston Bay. Fishes are best served by no cooling of effluent during the remainder of the year. (Auth)

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Gallaway, B.J., and K. Strawn, Seasonal Abundance and Distribution of the Blue Crab, *CALLINectes sapidus* Rathbun, in the Discharge Area of the P.M. Robinson Generating Station, Galveston Bay, Texas.

1975. Texas Jour. Sci., 26, 185-202 (Texas A & M University, Department of Wildlife Science, College Station, TX)

Seasonal abundance and distributional patterns of the blue crab, *CALLINectes sapidus* were determined in an area of Galveston Bay, Texas, influenced by a hot-water discharge from the P.M. Robinson Generating Station. Temperature, conductivity, dissolved O₂ levels and biological samples of the blue crab were collected once each month (1968) to (1969) at 11 offshore trawl and six beach seine stations. The blue crab was more abundant at the mouth of the discharge canal than in other areas during most months of each year. Factors attracting blue crabs to the mouth of the discharge canal included a constant food supply of entrained organisms and favorable water temperatures during most months. During hot months they probably avoided the hottest water except for feeding. Based on abundance and distributional patterns, the discharge from the station had no detrimental effects on this species. (Auth)

<202>

Gannon, J.R., Effect of Thermal Inputs on the Populations of Fish and Macroinvertebrates in the Wabash River.

1973. PH-224056; 118 p. (DePauw University, Greencastle, IN)

The distribution of fish and macroinvertebrate populations near two electrical generating stations located on the Wabash River were examined during the summer and early fall for six years. Fish responded readily to changing thermal conditions and concentrated in areas of the river which provided temperature close to their optimum. Although most species reacted behaviorally to the altered thermal conditions, only two groups appeared to be affected permanently as populations. Flathead catfish (*PYLODICTILUS OLIVARIS*) responded to higher temperatures with enhanced reproductive success which increased population density two or three times. Redhorse (*MOXOSTOMA EPIZEPHURUS* and *M. SPELVECEPS*) are more thermally sensitive and population densities are likely to be reduced with higher temperatures. Complicating factors include the fact that several species of fish, including redhorse and sauger (*STIZOSTEDION COMMERSONI*), appear to rely upon recruitment from tributaries to sustain the populations. Longterm changes in the density of other species were not detected. (ND)

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Garcia, S., Biology of *PENAEUS DUORABUS NOTIALIS* off the Ivory Coast. 4. Relation Between Distribution and Environmental Conditions. Study of Variations of Sex-Ratio.

1974. Doc. Sci. Cent. Rech. Oceanogr. Abidjan ORSTOM, 5, 1-39 (ORSTOM, Abidjan, Ivory Coast, Africa)

The analysis of the geographic and bathymetric distribution of *PENAEUS DUORABUS* and, particularly *P.D. NOTIALIS* off Ivory Coast and in its whole distribution area lead to the definition of the adult ecological requirements temperature, salinity, grain size and sediment composition, organic matter and the importance of the thermocline in the bathymetric distribution. The population structure study showed: (1) variations of size with depth, (2) variations of sex ratio, with size, depth and seasons. (Auth)

<204>

Geddes, H.C., Studies on an Australian Brine Shrimp, *PARASTENIA SIETZIANA* Sayce (Crustacea: Anostraca): I. Salinity Tolerance.

1975. Comp. Biochem. Physiol. 51, 553-560 (University of Adelaide, Department of Zoology, Adelaide, South Australia)

The Australian brine shrimp has an extremely wide salinity tolerance. Lower and upper LD50 values for animals acclimated to a series of salinities at 18 C were 6.2 and 267 ppt. The upper salinity tolerance was considerably lowered at high temperatures. (ST)

<205>

Gee, J.W., and J.T. Davey, The Larval Development and Infectivity of *HYTILICOLA HYTILICOLA* (Copepoda: Copepoda) Parasitic in *HYTILUS EDULIS*.

1974. Parasitology, 69, 14 (Institute for Marine Environmental Research, Plymouth, England)

The rate of development of embryos of the copepod, *HYTILICOLA HYTILICOLA*, parasitic in the mussel, *HYTILUS EDULIS*, was a function of temperature. In vitro hatching mortality was estimated at 10% at optimal temperatures and salinities. The duration and mortality of the two nauplii stages were also a function of temperature and salinity. At this stage as salinity reaches the lower tolerance limits mortality increased rapidly with a decrease in temperature. The first copepodite was the infective stage. Infectivity in vitro in experimental studies was estimated at 10%. The parasite passed through four copepodite stages before becoming adult. Again development was a function of temperature with availability of food and parasite density probably exerting a controlling influence. The mortality during development from one week after infection to maturity (11 weeks at 16 C) was 75%. (ST)

<206>

Geletia, Yu.V., Distribution of *CALANUS PACIFICUS* and *C. SINICUS* (Calanoida, Calanidae) in the Northwest Pacific with Respect to Water Temperature.

1974. Zool. Zh. (USSR), 53, 1775-1779 (Institute of Marine Biology, Far East Research Center, Vladivostok, USSR)

In the Northwest Pacific the copepods, *CALANUS PACIFICUS* and *CALANUS SINICUS* occurred at water temperatures of 9 and 15 C and 15 to 19 C, respectively. During diurnal migrations individuals of both species may migrate into warmer or colder waters. (ST)

<207>

Gentry, J.B., C.T. Garten, Jr., F.G. Howell, and W.H. Smith, Thermal Ecology of Dragonflies in Habitats Receiving Reactor Effluent.

1974. CONF-740820; STI/PUB/378; IAEA-SM-187/12; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 563-574) (Savannah River Ecology Laboratory, Aiken, SC)

On the Savannah River Plant in the southeastern United States both the numbers of individuals and the species of dragonfly nymphs are reduced when thermal effluent from a nuclear reactor is received by a stream or pond. Surviving genera belong to the sub-family Libellulinae. Mortality is complete for the remaining families and sub-families. Some species are probably eliminated by the direct effects of increased water temperature. Others are reduced in numbers, or eliminated indirectly owing to habitat alterations. Nymphs in the thermal effluent stream and ponds survive extended periods in relatively constant water

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temperatures interrupted by short periods of sudden temperature changes and water-level fluctuations. Dragonfly nymphs from the thermally stressed streams have a higher thermal tolerance than nymphs from natural streams. Higher thermal tolerance is reflected by a significantly higher critical thermal maximum (CTM) and a higher lethal temperature (LT) at different acclimation temperatures. Acclimation temperature, habitat and body size are significant variables in determining thermal tolerances of nymphs from natural and heated aquatic environments. High acclimation temperatures lead to higher thermal performances while lower acclimation temperatures encourage acclimations through a wider range of temperatures. Mechanisms permitting the survival of dragonfly populations under thermally stressed conditions may include both physiological acclimatization to higher temperatures and directional selection for higher thermal tolerance. (Auth)

<209>

Gorking, S.D., Reproductive Temperature Tolerance of a Desert Pupfish.

1975. Technical Progress Report, July 1, 1975 to June 30, 1976. Arizona State University (Arizona State University, Department of Zoology, Tempe, AZ)

Preliminary reproductive temperature tolerance tests on the desert pupfish indicate very minimal breeding success at 20 and 22 C when compared to breeding success at 28 C. (ND)

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Gibbons, J.W., R.R. Sharitz, F.G. Howell, and W.H. Smith, Ecology of Artificially Heated Streams, Swamps and Reservoirs on the Savannah River Plant: The Thermal Studies Program of the Savannah River Ecology Laboratory.

1975. CONF-740820; STI/PUB/378; IAEA-SM-187/13; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 389-400) (Savannah River Ecology Laboratory, Aiken, SC)

The thermal studies program at the ARC's Savannah River Plant in South Carolina is summarized. Since cooling towers are not in use, heated effluents from nuclear reactors have been discharged into aquatic ecosystems since 1953. This created a variety of thermal habitats with temperatures ranging from normal for the area to above 50 C. Temporary shutdown of two reactors has provided an opportunity to study long-lasting effects of thermal loading once heated effluent is removed. Natural aquatic areas served as controls for the thermal field studies. The environmental effects of the thermal effluents are not confounded by synergistic effects as chemical releases into the ecosystems are minimal. Studies have been undertaken in a variety of thermal habitats (both aquatic and terrestrial) and at all levels of biological organization from the individual to the community in order to extend understanding of ecosystem responses to thermal alteration. (Auth) (ST)

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<219>

Gibson, C.F., T.O. Thatcher, and C.W. Apts. Some Effects of Temperature, Chlorine and Copper on the Survival and Growth of the Coon Stripe Shrimp, *PANDALUS DAVIES*.

1975. BSWL-SA-5388; 16 p. (Batelle Memorial Institute, Pacific Northwest Laboratories, Ecosystems Department, Richland, WA)

A series of bioassay and growth rate experiments were conducted on coon stripe shrimp, *PANDALUS DAVIES*, to determine the LC_{50} value for heat, the LC_{50} values for chlorine and copper, and the effects of sublethal concentrations of these materials on their growth rate. The Critical Thermal Maxima for three size groups: 1 to 2g, 3 to 7g, greater than 7g, ranged from 26.3 C to 31.8 C depending on shrimp size and rate of temperature increase. Bioassays (96-hour) at 10 C, 15 C, and 20 C were conducted, using chlorine, copper, and chlorine plus copper as the toxicant. Growth was measured for one month at temperatures between 10 C and 25 C. The greatest growth occurred at 16 C. Growth of the shrimp held at 16 C while being exposed to sublethal concentrations of both copper and chlorine was studied. Copper at a concentration of 0.041 mg/l effectively retarded the growth of (1-2g) coon stripe shrimp at 16 C over a one-month period. Chlorine at a concentration of 0.18 mg/l was lethal to (1-2g) coon stripe shrimp at 16 C and reduced their growth at 0.08 mg/l over a one-month period. (Auth) (SD)

<211>

Gilmore, G.H., S.H. Ray, and D.W. Aldrich, Growth and Mortality of Two Groups of Oysters, (*CRASSOSTREA VIRGINICA* Gmelin), Maintained in Cooling Water at an Estuarine Electric Power Generating Station.

1975. TSMU-SC-75-207; 67 p. (Texas A & M University, Department of Marine Sciences, Galveston, TX)

Growth and mortality of oysters with high and low levels of the fungal parasite, *LABYRINTHOMYXA NABINA*, were measured during 1972 in (1) 0.1 ha ponds receiving a continuous flow of heated water from an electric power plant, (2) the power plant intake canal, and (3) the power plant discharge canal. Pond oysters had less cumulative mortality than intake or discharge canal oysters, regardless of *LABYRINTHOMYXA* infection. Only pond oysters with both high and low levels of infections gained in biomass by the end of the study. Oysters in the intake canal decreased in biomass and those placed in the discharge canal during warm weather died within six weeks. During this period water temperatures in the discharge canal reached 30.5 C and salinities remained below 5 ppt. Discharge canal temperatures averaged 6 to 6.9 C higher than in other areas and reached 31.0 C in September. Oysters held in the ponds grew as well as or better than oysters from a natural reef in Galveston Bay. The accumulation of heavy metals by the oysters is discussed. (Auth) (ST)

<212>

Ginsburger-Vogel, T., Temperature and Sexual Differentiation in Crustacea.

1975. Bull. Soc. Zool. France, 100, 99-115 (CMR5, Laboratory Genet. Evol. Biol., Gif-sur-Yvette, France)

The influence of temperature on sexual differentiation in Crustacea was reviewed. Studies citing the role of temperature in sex determination in *DAPHNIA MAGNA*, sexual differentiation in Cladocera, preferential elimination of the sex chromosome during meiosis in the copepod *CYCLOPS VIRIDIS* and determination of sex ratio are included (ST)

<213>

Ginsburger-Vogel, T., Temperature-Sensitive Intersexuality and Its Determinism in *ONCHESSTIA GAMBARELLA* Pallas.

1975. Intern. Anis. Kingd. Springer Verlag, 106-120 (Not Given)

Studies were conducted on the temperature-sensitive intersexuality and its determinism in the amphipod, *ONCHESSTIA GAMBARELLA*. Results showed that thelygony and intersexuality were sensitive to temperature elevation. Further experiments demonstrated that temperature influences occurred during oogenesis or embryonic development, but not during sexual organogenesis. Intersexuality depended on the presence and the action of an epigenetic feminizing factor which was temperature-sensitive. (RM)

<214>

Girisch, H.B., and H.G. Dennert, Synchronization Experiments on the Migration of *GAMMARUS ZADDUCHI* and *GAMMARUS CHEVREUXII*.

1975. Bijdragen Tot de Dierkunde (Neth.), 45, 20-38 (University of Amsterdam, Institute of Taxonomy-Zoology, Amsterdam, Netherlands)

Activity of *GAMMARUS ZADDUCHI* at 14 C was threefold that at 8 C. Downstream migrants of *GAMMARUS CHEVREUXII* doubled with a rise in temperature from 8 to 14 C. A quick rise in temperature caused an increase in activity of *G. CHEVREUXII* which returned to normal only with a drop to the initial 7.5 C. (BPC)

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Gjosaeter, J., K. Hansen, B. Saetre, and T. Sæstergaard, Investigations at the Spawning Grounds of Capella in 1974.

1974. Fiskea Ravet (Nor.), No. 3, 15-19 (Fiskeridirektoratets Havsforskningsinstitutt, Bergen, Norway)

The temperature at the spawning grounds of capella varied between 2.5 and 3.5 C. The greatest quantities of eggs were found on coarse bottom at depths between 15 and 50 m. (ST)

<216>

Goldberg, S., Ecological Aspects of Salinity and Temperature Tolerances of Some Reef-Dwelling Gorgonians from Florida.

1973. Carib. Jour. Sci., 13, 173-177 (University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, FL)

Optimal, marginal and terminal extremes for salinity and temperature were determined for each of six species of reef-dwelling gorgonians. Upper and lower death points ranged from 31.0 to 36.5 °C and 13.0 to 17.5 °C, respectively. Comparisons were made with scleractinian tolerances, and it was concluded that although both groups have similar temperature ranges, gorgonians are somewhat more stenohaline. Examples of ecological restriction by thermal and saline extremes are discussed. (Auth) (ST)

<217>

Contalzer, J.C., Critical Thermal Maxima and Upper Lethal Temperatures for the Calanoid Copepods *ACARTIA TONSA* and *ACARTIA CLAUSSI*.

1974. Marine Biol. (W. Ger.), 27, 219-223 (National Marine Water Quality Laboratory, Narragansett, RI)

The critical thermal maxima (CTM) and upper lethal temperatures (ULT) for *ACARTIA TONSA* and *ACARTIA CLAUSSI* are shown in graphic form. Tolerance to higher temperature increased with increasing acclimation temperatures (5, 10, 15, 20 °C) for both species. The CTM values for different populations of *A. TONSA* covered a wider range than those for *A. CLAUSSI*, suggesting a relatively better capacity of the former species to survive increases in the acclimation temperatures. This may be related to the ability of *A. TONSA* to adapt to a wide range of temperatures in the field (-1 to 32 °C). The CTM for *A. TONSA* and *A. CLAUSSI* from St. Hope Bay, Mass., following acclimation at 20 °C were greater than 35 °C and 28 °C respectively. The CTM for *A. TONSA* from Puerto Rico and Biscayne Bay, Fla., following acclimation at 20 °C were greater than 37 °C. Differences between ULT and CTM for *A. TONSA* from tropical and subtropical areas were very narrow suggesting that in warm climates this copepod lives close to its upper lethal temperature limits. (ST)

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Gordon, R.S., and P.H. Chow, Unusual Patterns of Aerobic Activity Metabolism in Fishes.

1974. Amer. Zoologist, 14, 1258 (University of California at Los Angeles, Los Angeles, CA)

Rates of oxygen consumption at various swimming speeds were determined in two species of marine fish, the goatfish, *MULLOIDICHTHYS SIMONIS*, and the jack mackerel, *TRACHURUS SYRNETHICUS*. Metabolic rates of adult goatfish at 25 °C were independent of swimming speed up to 2.6 body lengths/sec. Above this speed, swimming could only be sustained for 5 to 10 min and there was a sharp rise in oxygen consumption. Metabolic rates in adult jack mackerel increased with activity at test temperatures of 10, 15 and 20 °C. At low swimming speeds (0.9 body lengths/sec) oxygen consumption rates increased with increasing temperature. At higher speeds (2.6 and 3.7 body lengths/sec) oxygen consumption rates were independent of temperature. (Auth) (ST)

<219>

Grabda-Kazubka, S., *CLIBOSTOMUS COMPLANATUS* (Rudolphi, 1819) and *ECCLIBOSTOMUS HETEROSTOMUS* (Rudolphi, 1809) (Trematoda, Clibostomatidae), Their Occurrence and Possibility of Acclimatization in Artificially Heated Lakes in Poland.

1974. Acta Parasitol. Polonica, 22, 285-293 (Polish Academy of Sciences, Department of Parasitology, Warsaw, Poland)

Metacercariae of the trematode *CLIBOSTOMUS COMPLANATUS* were recorded for the first time in Poland. Specimens were found in a perch (*PERCA FLUVIATILIS*) and a roach (*RUTILUS RUTILUS*) from a heated lake receiving effluent from an electric power station. This was the most northern documented site of this parasite in Europe. Descriptions of this species and of adult *ECCLIBOSTOMUS* collected from its final host, the grey heron are given. (ST)

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Graham, J., Spawning in *LITTORINA LITTOREA* (L.) (Gastropoda: Prosobranchiata).

1975. Jour. Exp. Mar. Biol. Ecol. (Neth.), 18, 185-196 (Marine Science Laboratories, Royal Bridge, Salem; University of the West Indies, Kingston, Jamaica)

Data on the amount of 'spaw' of *LITTORINA LITTOREA* held in the laboratory for varying periods of time during the breeding season have been used for an analysis of the pattern of egg production. There is good evidence for seasonality of breeding in the population studied, and there are both diurnal and longer time scale fluctuations in spaw output. There is a strong indication of a lunar/tidal rhythm in spawning, but this is not conclusively proved. A limited number of experiments have failed to show any effect of temperature fluctuations on spawning, and there is no evidence of the entrainment of a rhythm when the snails are brought into the laboratory. (Auth)

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Greene, E.L., Experiments and Observations on the Feeding Behavior of the Freshwater Leech *EPISOBELLIA OCTOCULATA* (L.) (Hirudinea: Epitoniidae).

1974. Arch. Hydrobiol. (Ger.), 74, 87-99 (State University of New York, Morrisville, NY)

Feeding activity of the leech *EPISOBELLIA OCTOCULATA* was observed under a variety of laboratory conditions. Capture of one or two chironomid larvae per day occurred through chance contact. Substrate type affected feeding efficiency to a greater extent when leeches were small. Feeding continued at water temperatures as low as 2 °C and stabilized between 7 °C and 12 °C. Endogenous rhythms were not evidenced but light did influence activity to some degree. Leeches remained active throughout a wide range of environmental conditions. (Auth)

<222>

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Greensley, G.G., and R.Y. Wirta, Some Physiological Effects of Near-Maximum Growth Temperatures on an Obligately Psychrophilic Marine Bacterium.

1975. Can. Jour. Microbiol., 21, 811-818 (Oregon State University, Department of Microbiology and School of Oceanography, Corvallis, OR)

The heat inactivation of the obligately psychrophilic marine bacterium Ant-300 was investigated in terms of glucose uptake, the oxidation of glucose to CO₂, and permeability control. At 13 C, the maximum temperature for growth, and at slightly higher temperatures, CO₂ evolution decreased with time during the oxidation of exogenously supplied glucose. The decrease in CO₂ evolution appeared to be a result of heat-induced restrictions on glucose uptake. Leakage of intracellular metabolites apparently contributed to the cells decreased ability to take up glucose at elevated temperatures. A consequence of these heat-induced changes seemed to be the acceleration of cell starvation. (Auth)

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Price, C.D., and V.R. Gibson, Occurrence, Viability and Significance of Hatching Eggs of the Calanoid Copepod LABIDOCERA AESTIVA.

1975. Marine Biol. (N. Ser.), 31, 335-337 (Woods Hole Oceanographic Institution, Woods Hole, MA)

Eggs of the copepod, LABIDOCERA AESTIVA, were observed in both laboratory and field to hatch at water temperatures of 11 to 18 C in the spring after overwintering in bottom sediments. (NPC)

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Griffith, J.S., Annelus Formation and Growth of Tigerfish, HYDROCYNUS VITTATUS, in Lake Bangweulu, Zambia.

1975. Trans. Amer. Fish. Soc., 104, 499-505 (Fisheries Research Division, Department of Fisheries Zambia, Zambia, Africa)

The validity of scale analysis for aging tigerfish, HYDROCYNUS VITTATUS Castelnau, was assessed by examining the timing and cause of check formation on scales from fish collected in Lake Bangweulu, Zambia, Africa. Discontinuities in circuli that appeared to be valid annuli formed on all scales in September when water temperature was rising rapidly after dropping to 18 C. Spawning checks formed on scales of some fish in January. Male and female tigerfish grew at similar rates. Some females reached an age of 11 years but male tigerfish, which matured one and sometimes two years earlier, seldom lived longer than 8 years. (Auth)

<225>

Grimes, C.B., Entrapment of Fishes on Intake Water Screens at a Steam Electric Generating Station.

1975. Chesapeake Sci., 16, 172-177 (University of North Carolina, Institute of Marine Science, Morehead City, NC)

To investigate entrapment of fish, traveling intake water screens were sampled monthly in 1969 and 1970 at a steam electric power station near Crystal River, Florida. Samples contained 73 species representing 81 families; the majority of individuals were juveniles or weak-swimming species. There was an inverse relationship between intake

water temperature and catch. Highest mortalities occurred with the first cold temperatures of winter and later with lowest water temperatures. Comparison of catch-per-unit-effort during daylight and darkness in 1970 showed monthly catch-per-hour for dark sampling approximately equal to or greater than for light. Greatest disparities between day and night sampling occurred simultaneously with coldest water temperatures. (Auth)

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Guillard, R.R.L., E.J. Carpenter, and B.E.P. Reimsma, SKELETONA HEVZELII sp. nov., a New Diatom from the Western Atlantic Ocean.

1974. Phycologia, 13, 131-138 (Woods Hole Oceanographic Institution, Woods Hole, MA)

A newly discovered species of diatom, SKELETONA HEVZELII, isolated from the Western Sargasso Sea, had a maximum growth rate of three divisions/day at 27.0 C. (ST)

<227>

Guseva, T.V., The Ecology of Spawning and Embryonic Development of the Sea Zander, LUCIOPERCA MARINA Cav.

1974. Izv. Akad. Nauk Turkm. SSR Ser. Biol. Nauk, 2, 87-91

Spawning of the sea zander, LUCIOPERCA MARINA, began at a water temperature of 11.5 C and was intensified at 13 to 15 C. Spawning occurred on stony substrates. At a mean water temperature of 14.7 C the incubation period was 12 to 17 days. The possibility of artificial spawning is discussed. (ST)

<228>

Guthrie, J.E., D.R. Prowse, and D.P. Scott, Assessment of Nuclear Power Plant Waste Heat Utilization for Freshwater Fish Farming.

1975. AECL-4924; 87 p. (Atomic Energy of Canada Limited, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba, Canada)

The feasibility and economic potential of aquaculture are discussed and the commercial prospects for intensive fish farming in Canada are examined. The major environmental parameters, particularly water temperature, which affect fish farming in Canada are reviewed. Fish must be reared for marketing on a schedule similar to that used for a beef cattle feedlot operation. This requirement implies a uniform rate of production which can be achieved by manipulation of the food feeding rate and the fishes' environmental temperature. However, it has not been economically feasible to heat the water supplied to a fish rearing facility. The condenser cooling water from a CANDU nuclear power station, such as Pickering in Ontario, is an abundant source of warm water at a constant temperature suitable for intensive aquaculture. The quantity of condenser cooling water discharged from one 600 MW(e) reactor could, potentially, be used to achieve an annual production of at least 12 Gg (12,000 tonnes) of rainbow trout. There are several potential difficulties associated with the use of a nuclear power station's cooling water for aquaculture. Therefore, the feasibility of using nuclear power station condenser cooling water for intensive aquaculture must be demonstrated on a pilot-plant scale before attempting any commercial venture. A pilot plant or demonstration module is described. (Auth)

<229>

Guthrie, R.K., D.S. Cherry, and P.S. Harvey, The Influence of Thermal Addition on *PLAIOBACTERIUM LUTESCENS* from Aquatic Environments.

1974. Assoc. Southeast Biol. Bull., 21, 59-59 (Clemson University, Clemson, SC; Virginia Polytechnic Institute and State University, Blacksburg, VA; Savannah River Ecology Laboratory, Aiken, SC)

In laboratory tests *PLAIOBACTERIUM LUTESCENS* became the predominant bacterial type in water from unpolluted systems following thermal addition. When temperature was increased in water from polluted sources, *P. LUTESCENS* increased in numbers and became a major component of the bacterial populations. In laboratory tests, the numbers of *ESCHERICHIA COLI* and *STREPTOCOCCUS PARVOCALIS* (common sewage bacteria) were observed to decrease in proportion to the increase in *P. LUTESCENS* numbers after thermal addition. Similar results were observed when water from four different aquatic systems was tested. A greater amount of organic material present in the water reduced the predominance of *P. LUTESCENS*; however, this effect did not overcome the influence of thermal addition which increased the growth of this bacterium. These results indicate that this method may be useful for reduction of undesirable microbial populations in water supplies, without use of chemical additives. (Auth)

<230>

Guthrie, R.K., D.S. Cherry, and P.L. Singleton, The Influence of Thermal Loading and Die-Off Rates of *ESCHERICHIA COLI* in Sewage.

1974. (Clemson University, Clemson, SC; Virginia Polytechnic Institute and State University, Blacksburg, VA)

ESCHERICHIA COLI and *STREPTOCOCCUS PARVOCALIS* have been reported to decrease in aquatic systems subjected to thermal loading. These decreases were accompanied by an increase in numbers of *PLAIOBACTERIUM LUTESCENS*. Sewage effluent from primary treatment was tested in a laboratory system to determine whether a similar pattern of population changes would occur. Sewage effluent was inoculated with *P. LUTESCENS* to produce a count of 3×10^6 (E+) per ml. One test system was maintained at 24 to 26 C as a control. A duplicate system was maintained at 30 to 32 C to detect the effect of thermal loading. Plate counts were taken at two day intervals to determine total counts, and counts of *P. LUTESCENS*, *E. COLI* and *S. PARVOCALIS*. Selective and differential media were used to detect the presence of enteric pathogens. In thermally loaded systems, the numbers of *E. COLI* and *S. PARVOCALIS* decreased as numbers of *P. LUTESCENS* increased. In the control system, all counts remained relatively stable during the test period. Mechanisms possibly involved and the effects on enteric pathogens were studied. Results indicate potential utility of this system for removal of enteric organisms from water and waste water. (Auth)

<231>

Rakkila, K., and A. Niemelä, Effects of Oil and Emulsifiers on Eggs and Larvae of Northern Pike (*Esox lucius*) in Brackish Water.

1973. Aqua Pennica, 44-59 (University of Turku, Archipelago Research Institute, Turku, Finland)

Toxicity of oil emulsifiers to larvae of northern pike, *Esox lucius*, was increased by temperature increases from 10 to 16 or 17 C. Salinity was 5.0 ppt. (RPPC)

<232>

Hall, C.A.S., Models and the Decision Making Process: The Hudson River Power Plant Case.

1974. BNL-19203; COMP-740734; 19 p. (Brookhaven National Laboratory, Upton, NY)

Analyses of power plant effects on Hudson River striped bass are presented. Effects are discussed under the following headings: life history patterns of estuarine-dependent organisms; computer model of striped bass life history; computer models of power plants for studies on effects of impingement, entrainment, and thermal and chemical effluents on fish; effects of loss of progeny on fisheries; and decision-making results based on model results. (ST)

<233>

Hammerschmidt, P.C., The Use of Fishes in Cages as Biological Monitors of the Quality of Water Passing Through a Power Plant.

1973. M.S. Thesis, University of California, 120 p. (University of California, San Diego, CA)

Florida pompano, *TRACHINOTUS CAROLINUS*, pinfish, *LAGodon rhomboides*, Atlantic croaker, *MICROPOGON undulatus* and black drum *POGONIAS CHROMIS* were maintained as in situ biological monitors in cages placed in the intake canal and cooling lake of the Houston Lighting and Power Company's Cedar Bayou Electric Power Station near Baytown, Texas. Red drum, *SCIAENOPS OCELLATA* were raised in cages placed in 0.1-ha pond receiving heated discharge water from the power plant. Periodic samplings allowed determination of survival, growth and condition of all caged fish. Survival of fish placed in cooling lake cages was good, but all fish placed in intake canal cages died in late November and early December, 1972 due to an undetermined toxic substance present in the cooling water. All species grew slowly during the low fall and winter temperatures, but part of this slow growth may have been due to irregular feedings. Red drum in two cages increased in weight from 414 to 596 and 418 to 608 g, respectively, during a 195-day period. Their condition values ranged from 1.58 to 1.88. This growth is less than wild red drum of comparable size, but condition values are much greater. Hydrological data was taken almost every day at each cage location. (Auth)

<234>

Hammond, R., The Culture, Experimental Taxonomy, and Comparative Morphology of the Planktonic Stages of Norfolk Astolytoids (Polychaeta: Syllidae: Autolytinae).

1975. Zool. Jour. Linn. Soc., 54, 299-320 (Scaldbek, Norston, Holt, Norfolk, United Kingdom)

North Norfolk plankton species showed a well-marked gradation in seasonality, apparently related to water temperature. The sexual stages in North plankton comprised two species found only in winter and spring (*PROCEPHEA PRISMATICA* and *AUTOLYTUS ALEXANDRI*), one found all year but mainly in spring (*P. COMBUTA*), one from late spring to early autumn, (*A. BRACHYCEPHALUS*), and two found only in summer (*PROCEPHEA HALLEZIANA* and *A. PLANGERRANSI*); the relationship between seasonality, xogeography, and water-temperature is briefly discussed. (ND)

(235)

(235)

Bennett, T., and R.T. Carls, Regulation of Oxygen Consumption by Incident Illumination in Embryonated Ova of Atlantic Salmon *SALMO SALAR* L.

1975. *Comp. Biochem. Physiol.*, 52a, 277-284 (Dalhousie University, Department of Biology, Halifax, Nova Scotia, Canada)

Although temperature as an experimental variable was not independently significant, oxygen consumption by ova of Atlantic salmon, *SALMO SALAR*, during intermediate and advanced stages of embryonic development was generally greater at 10 C than in comparable environments at 5 C. (STC)

(236)

Hanson, L.G., E.L. King, Jr., J.W. Howell, and A.J. Smith, A Culture Method for Sea Lamprey Larvae.

1974. *Progressive Fish Culturist*, 36, 122-128 (U.S. Fish and Wildlife Service, Hammond Bay Biological Station, Millersburg, MI)

A laboratory method for raising sea lamprey, *PETROMYZON MARINUS*, larvae from fertilized eggs is presented. The effects of type of food, feeding rate, stocking density and temperature were examined. Increased stocking densities and low water temperatures reduced growth and survival rates. (Auth) (ST)

(237)

Hanson, W.D., The Fishery of a Missouri Reservoir Receiving Thermal Effluent.

1974. *Proc. Ann. Conf. S.E. Assoc. Game Fish Com.*, 27, 722-734 (Missouri Department of Conservation, Columbia, MO)

The fishing pressure, rate of fishing success, and the hook-and-line yield of Thomas Hill reservoir, a lake receiving cooling water for a steam-powered electric generating plant were determined. Fishing pressure averaged 18.2 μ /acre/year during the study. There was a yearly average of 4.9 fishing trips/acre. Anglers averaged 3.9 fish/trip. The average yearly harvest was 21.7 fish or 13.5 lb/acre. About 37 percent of all fish caught were taken in the warm water discharge area (one of five coveau areas) and primarily during the winter when this arm of the lake remained unfrozen. Most of the largemouth bass and stocked northern pike were caught during the winter in this area. Influx of fish into this phytoplankton production. High numbers of small gizzard shad were also present. Fish moved out of the area in summer when water temperatures rose above 32 C. Turbidity had a marked influence upon the fishery. (ST)

(238)

Hare, G.W., and W.D.B. Burt, Abundance and Population Dynamics of Parasites Infecting Atlantic Salmon (*SALMO SALAR*) in Trout Brook, New Brunswick, Canada.

1975. *Jour. Fish. Res. Bd. Can.*, 32, 2069-2078 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada; University of New Brunswick, Department of Biology, Fredericton, New Brunswick, Canada)

Ten species of parasites (8 helminth, 1 annelid, 1 mollusc) were collected from 375 juvenile Atlantic salmon (*SALMO SALAR*) in Trout Brook, N.B., during May-November 1970 and 1971. The most commonly occurring parasites were the monogenean *DISCOCOELES SAGITTATA* (infecting 37.7% of the fish examined), the digenest *CREPIDOSTOMUM*

PABIONIS (40.5%), the nematode *STELLIOSCOLOUS TENUISSIMA* (97.9%), and a glochidium (22.0%). Intensity of infection (mean number of parasites for all fish examined) of *C. PABIONIS* and *S. TENUISSIMA* was independent of host age and sex, and of *D. SAGITTATA* was independent of age, but male salmon were more heavily infected than females. The intensity of infection of these parasites showed no interactions between host age and season nor between host sex and season. The abundance of the parasites showed marked seasonal changes: *D. SAGITTATA* was most abundant in summer and autumn. *C. PABIONIS* and *S. TENUISSIMA* were most abundant in spring, and the glochidium was most abundant in autumn. Relationships between changes in parasite maturation and in seasonal abundance indicated annual cycles of infection. (Auth)

(239)

Hargreaves, P.E., and B.B.L. Gaillard, Structural and Physiological Observations on Some Small Marine Diatoms.

1974. *Phycologia*, 13, 163-172 (University of Rhode Island, Graduate School of Oceanography and Department of Botany, Kingston, RI; Woods Hole Oceanographic Institution, Woods Hole, MA)

The responses to temperature and salinity and the requirements for vitamins were determined for clones of four new and two previously described species of diatoms isolated from different marine areas. All cultures grew until the temperature reached at least 31.5 C, the highest attainable in the apparatus. Low temperature limits and salinity ranges are given. (ST)

(240)

Harnsworth, R.V., Artificial Cooling Lakes as Unique Aquatic Ecosystems.

1974. Part of Gallagher, S.J. (Ed.), *Proceedings of a Symposium on Energy Production and Thermal Effects* held in Oak Brook, Illinois, September, 10-11, 1973. Linnetics, Inc., Milwaukee, Wisconsin (Linnetics, Inc., Milwaukee, WI)

The aquatic ecosystem in essentially closed-cycle cooling lakes is discussed. Data from studies on physical properties, water chemistry, planktonic and benthic communities, bacteria, the fishery resource, parasites and diseases of artificial cooling lakes is reviewed. Basic research needs are outlined. Artificial cooling lakes are suggested as a viable and economic alternative to alternate cooling methods such as cooling towers. (ST)

(241)

Harvey, R.S., Temperature Effects on Growth and Respiration Rates of *DOLABIA AMERICANA* (Ephemeroptera).

1974. *Assoc. Southeast Biol. Bull.*, 21, 60 (Savannah River Ecology Laboratory, Aiken, SC)

The mayfly, *DOLABIA AMERICANA*, common in upper Three Runs Creek, South Carolina, is being studied to determine the effects of seasonal changes in temperature on population growth rates and the effects of slight elevations in water temperature on the respiration rates of maturing males and females. Growth and respiration rates of the population increased with body weight and water temperature. Females were generally larger than males, but there was no significant difference in rates of respiration between the genders. (Auth) (ST)

<282>

Bartlingh, J., Oxygen Consumption and Temperature Selection of Ruffish.

1975. S. African Jour. Sci., 71, 90-91 (Rand Afrikaans University, Johannesburg, South Africa)

In a temperature gradient, summer and winter acclimated LABEO VUSPATUS selected the temperature to which they were adapted. LABEO CAPPUSIS showed no temperature preference. Summer and winter acclimated individuals showed similar rates of oxygen consumption. When exposed to temperature shocks of 5°C, L. VUSPATUS showed greater over- and undershoots of oxygen consumption than L. CAPPUSIS. (ST)

<283>

Gauss, R., Effects of Temperature on Proteins, Enzymes and Isoenzymes from Organs of the Fish BRONCHUS ANABUS Bloch II. Influence of the Adaptation Temperature on Brain.

1975. Zool. Anz., Jena, 198, 262-270 (Zoologisches Institut der Universität Kiel, Lehrstuhl für Vergleichende Physiologie und Tierpsychologie, Kiel, Germany)

Activity of acetylcholinesterase from the brain of BRONCHUS ANABUS showed a compensatory dependence on adaptation temperature. The activity in fish acclimated to 10°C was 60% higher than in those acclimated to 20°C. Activity of electrophoretic fractions was also dependent on adaptation temperature. Isoenzymes of 20°C-adapted animals were the most stable to heat. The activity of LDH and its isoenzymes from fish brain were also dependent on adaptation temperature. LDH activity was highest from fish adapted to 10°C. (BPC)

<284>

Gauss, R., Effects of Temperature on Proteins, Enzymes and Isoenzymes from Organs of the Fish BRONCHUS ANABUS Bloch I. Influence of the Adaptation Temperature on White Dorsal Muscle.

1975. Zool. Anz., Jena, 198, 283-291 (Zoologisches Institut der Universität Kiel, Lehrstuhl für Vergleichende Physiologie und Tierpsychologie, Kiel, Germany)

Activity of lactate dehydrogenase (LDH) from white dorsal muscle of BRONCHUS ANABUS acclimated to 20°C was higher than that of 12°C-adapted fish. A gain in resistance of LDH to heat inactivation was observed in fish acclimated to 20°C. Electrophoresis of soluble proteins showed a band in that from the 12°C-animals not found in fish acclimated to 0 or 20°C. Extinctions were higher in the 20°C fish. Proteins were more heat-resistant from 12°C-acclimated fish than from either 20°C- or 0°C-acclimated fish. Heat resistance of soluble protein fractions differed with acclimation temperature. (BPC)

<285>

Haves, P.B., J. Conaghan, and J.P. Spencer, Environmental Effects of the Heated Discharges from Bradwell Nuclear Power Station, and of the Cooling Systems of Other Stations.

1975. COMP-780820; STI/PUB/370; IAEA-SM-187/1; Part of the Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 823-880) (Central Electricity Generating Board, Environmental Studies Group, Planning Department, London, England; Central Electricity Generating Board, Marine Biological

Laboratory, Pavley, Southampton, England)

Biological investigations undertaken before and after the installation of the Bradwell Nuclear Power Station on the Blackwater River, England, are reviewed. Mean monthly increases in temperature at several sites near the outfall were between 0.2 and 1.7°C. Selected marine organisms are listed and the local oyster industry is described. The possible effects on organisms entrained in the cooling systems are discussed and a successful fish handling system attached to screens is explained. The problem of fish shoals is considered. The authors maintain that in many cases warmed discharges from power stations cannot be considered thermal pollution. (ST)

<286>

Hayes, J., Seasonal Changes in the Population Structure of CULEX PIPPIENS QUINQUEFASCIATUS Say (Diptera: Culicidae): Study of an Isolated Population.

1977. Ph.D. Thesis, University of Texas, 115 p. (University of Texas Health Science Center, School of Public Health, Houston, TX)

In an isolated population of CULEX QUINQUEFASCIATUS maintained near Houston, Texas, all life stages were present throughout the year. Egg production was slow during the coldest weather. A yearly rhythm in sex ratio was detected such that during colder months females predominated; during warmer months males were most abundant. Development time (egg to adult) took 10 days in August and 40 days in January. Prolonged development due to cold weather and a preponderance of females in winter probably enhanced survival during cold weather. The population reached high levels when temperatures reached a seasonal peak. (ST)

<287>

Healey, R.C., Dynamics of Exploited Whitefish Populations and Their Management with Special Reference to the Northwest Territories.

1975. Jour. Fish. Res. Bd. Can., 32, 827-880 (Department of the Environment, Fisheries and Marine Service, Freshwater Institute, Winnipeg, Manitoba, Canada)

As part of a study of the dynamics of lake whitefish (COREGONUS CLYPEAPOINIS) populations in Canadian lakes, growth rates of unexploited populations in relation to climate were examined. Populations were divided into groups according to the number of degree days above 5.5°C in the region where they occurred. Poorer growth was shown by populations living where degree days exceeded 1220°C. Best growth was in the range 890 to 1220°C. Where degree days were fewer than 890°C growth was a little lower than best growth. It was concluded that the lake whitefish is a cold-adapted species, growing best in the central and northern parts of its range and poorest in the southern, warmer parts of its range. Whitefish populations responded to exploitation by increasing their growth rate. (ST)

<248>
<249>

Smith, S.J., Seasonal Changes in Frequency of the "Yellow" Morph of the Isopod, *SPHARZONIA PUGICARINA*.

1974. Heredity, 32, 299-307 (University of Edinburgh, Department of Zoology, Edinburgh, Scotland)

The frequency of the yellow body color phenotype in relation to temperature was studied in isopods in the Tyne estuary, Scotland. The yellow form is controlled by a single dominant gene; grey is the recessive condition. Frequency of the yellow form declined over the October to January period and increased in frequency over the January to March period. These two periods were characterized by water temperatures estimated to be 4 to 12°C and below 4°C, respectively, and low salinities. Experimental comparisons of the survival of yellow and non-yellow non-yellow survived better and at 0°C and low salinity yellow survived better. Frequency data over a three year period were analyzed and a theory of natural selection based on differences in growth rates between the two morphs is suggested. (ST)

<249>

Soldinger, R.C., Growth of Hybrid Sunfish and Channel Catfish at Low Temperatures.

1975. Southern Illinois University, Fisheries Research Laboratory and Department of Zoology, Carbondale, IL)

The growth of hybrid sunfish (male bluegill, *LEPOMIS MICROCHINUS* x *L. CYANELLUS*) and channel catfish (*ICTALURUS PUNCTATUS*) below 15°C was determined in ponds on natural food and in cages on artificial food. In all cases, the hybrids gained weight, while the channel catfish lost weight. (Auth)

<250>

Weiss, D.B., and A.W. Knight, The Influence of Temperature on the Energetics of the Carnivorous Stonefly Nymph, *ACROBUTIA CALIFORNICA* (Plecoptera: Perlidae).

1975. Ecology, 56, 105-116 (University of California, Department of Water Science and Engineering and Ecology Graduate Group, Davis, CA)

Eight constant temperature baths, maintained at increments of 2°C, were used in the laboratory to evaluate rates of growth, food consumption, and egestion of the carnivorous stonefly nymph, *ACROBUTIA CALIFORNICA*. Experimental temperatures were adjusted seasonally to approximate environmental levels. Growth remained constant over the lower temperature range for each experimental period, then decreased rapidly in the upper portion of the temperature range. Food consumption, respiration, and assimilation efficiency increased with increasing water temperature. Energy budgets illustrate the pattern of energy utilization over the experimental temperature ranges evaluated. At temperatures approximating environmental levels, assimilation efficiency was approximately 86%, whereas gross and net growth efficiencies were 33% and 81% respectively. Metabolic losses accounted for approximately 50% of the food consumed. These yearly mean values, however, vary considerably with temperature and stage of nymph development. Optimal temperature ranges for *A. CALIFORNICA* nymphs were estimated to be 16 degrees to 22 degrees C in summer, 10 degrees to 18 degrees C in fall, 6 degrees to 12 degrees C in spring. Growth rates determined in the laboratory are compared with those in the field. (Auth)

<251>

Neip, C., A Comparison Between Models Describing the Influence of Temperature on the Development Rate of Copepods.

1976. Biol. Jaarb. Belangen (Belg.), 42, 121-125 (Rijksuniversiteit Gent, Laboratorium voor Morfologie en Systematiek der Dieren, Gent, Belgium)

Four mathematical expressions relating development time to temperature are compared. All four yield good predictions of the development rate of the copepod *TACHIDIUS SYCIPES*. The use of the equation of Belohradek is criticized. It is concluded that the power equation $B = aT^b$ gives the best approximation of development rate. (Auth)

<252>

Hollowell, J.W., The Ecology of Populations of Buce, *LEUCISCUS LEUCISCUS* (L.), from Two Tributaries of the River Eze, Herefordshire, England.

1976. Freshwater Biol., 8, 577-604 (Natural Environment Research Council, Water Pollution Research Laboratory, Stevenage, England)

Although a seasonal cycle of feeding activity was observed in dace, *LEUCISCUS LEUCISCUS*, from Llynfi and the River Lugg, England, no correlation between temperature and feeding activity could be established. Spawning of both populations occurred in March or April. (BPC)

<253>

Goodrickson, G.E., and R.L. Hestilla, Hydrology and Trout Populations of Cold Water Rivers of Michigan and Wisconsin.

1976. Trans. Wis. Acad. Sci., Arts, Lett., 62, 181-193 (U.S. Geologic Survey, Madison, WI)

Statistical multiple-regression analyses showed significant relationships between trout populations and hydrologic parameters. Parameters showing the higher levels of significance were temperature, hardness of water, percentage of gravel bottom, percentage of bottom vegetation, variability of streamflow and discharge per unit drainage area. Trout populations increased with lower levels of annual maximum water temperatures, with increase in water hardness, with increase in percentage of gravel and bottom vegetation, with increase in discharge/unit drainage area, and with decrease in variability of streamflow. Some hydrologic parameters were significant when evaluated collectively, but no parameter, by itself, showed a high degree of correlation with trout populations in regression analyses that included all the streams sampled. (Auth) (ST)

<254>

Reeschauss-Brunner, G., Experiments on the Possibilities and Course of Infections with *SALMONELLA ENTERITIDIS* and *SALMONELLA TYPHIMURIO* in Fresh Water Fish.

1974. Zentralbl. Bakteriell. Parasitenkd. Infektionskr. Hyg. Erste Abt. Orig. Reihe B Bsp. Praev. Med., 158, 412-431 (Bavarian Biological Experimental Institute, Munich, German Federal Republic)

Freshwater fish maintained in water contaminated with enteric bacteria and fed contaminated meat were susceptible to bacterial infection. In feeding tests with *SALMONELLA ENTERITIDIS* in Cyprinidae at water temperatures of 9 to 12 C, the pathogens were detectable in the intestine of tench, *TINCA TINCA*, after 40 days and in the gut of a carp, *CYPRINUS CARPIO*, after 60 days. At a water temperature of 16 to 17 C, the bacteria were found in the intestine of a carp 110 days after feeding. No limit to the survival of *S. ENTERITIDIS* in poikilothermic organisms after intralymphatic injection of a bacterial suspension could be demonstrated. (ST)

<255>

Nickman, H., and D.N. Klarer, The Effect of the Discharge of Thermal Effluent from a Power Station on the Primary Productivity of an Epiphytic Algal Community.

1975. Brit. Phycol. Jour., 10, 81-91 (University of Alberta, Department of Botany, Edmonton, Alberta, Canada)

The discharge of thermal effluent from a power station showed an increase in the standing crop size of the epiphyton associated with *SCIRPUS VALIDUS*. As a result the mean primary productivity, as measured by the C-14 method, increased primarily because of the large spring and summer maxima caused by *ORODONOTUS* and *SPINOCTRA*. *EPITHENIA TUBICIDA*, *NOUGETIA*, *AMPHIPLEURA PELLUCIDA*, *WITSCHEIA PONTICOLA* and *SHOPLADIA GIBBA* were apparently detrimentally affected by the thermal effluent. The algal populations in the nonheated areas did not appear to be photosynthesizing at optimum temperatures, while the continuous flow of heated water appeared to cause a decrease in photosynthetic efficiency of the algae in the heated area. (Auth)

<256>

Nickman, H., and D.N. Klarer, The Growth of Some Epiphytic Algae in a Lake Receiving Thermal Effluent.

1974. Arch. Hydrobiol. (Ger.), 74, 403-436 (University of Alberta, Department of Botany, Edmonton, Alberta, Canada; Glasgow University, Glasgow University Field Station, Department of Zoology, Rowardennan, Drymen, Glasgow, Scotland)

The growth of 12 algal species epiphytic upon *SCIRPUS VALIDUS* was investigated in Lake Albion, Canada. Many of the species investigated showed a preference for either areas of the lake receiving thermal effluent or unaffected areas. The longer growing season was responsible for extending the spring series of *ACHNANTHES MINUTISSIMA*,

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ORODONOTUS sp., *COMPTONIA PARVULUM*, *DIASTOMA ELONGATUM*, *FRAGILARIA CAPUCINA* and *FRAGILARIA VAUCHERIAE* and extending the autumn series into the winter months of *STIGROCLONIUM TENUE*, and similarly *COCCONEIS PLACENTULA* and *COMPTONIA GRACILE* through the winter into the spring. These large populations also coincided with the time when the concentrations of the dissolved ions was highest. The growth of *EPITHENIA TUBICIDA* and *NOUGETIA* sp. was detrimentally affected by the thermal effluent. The preference for either heated or non-heated areas did not correspond with a change in temperature alone but this preference was ultimately caused by an influx of thermal effluent into the lake. (Auth)

<257>

Nigashi, T., and N. Akera, Catches and Ecology of Glass Eels in the Water near the Sea Shore in the Vicinity of the Hiki River Mouth, Fujisawa-shi, Japan.

1975. Bull. Coll. Agric. Vet. Med. Hiroshima Univ. (Jap.), 32, 252-261 (Hiroshima University, College of Agriculture and Veterinary Medicine, Laboratory of Fishery Resources, Tokyo, Japan)

A positive correlation was observed between water temperature (13 to 18 C) and number of eels caught in the shore area near the mouth of the Hiki River, Japan. Migration occurred from early November through the middle of April. (NPC)

<258>

Nirata, H., An Attempt to Apply an Experimental Microcosm for the Mass Culture of Marine Rotifer, *BRACHIONUS PLICATILIS* Muller.

1974. Mem. Fac. Fish., Kagoshima Univ. (Jap.), 23, 163-172 (Kagoshima University, Faculty of Fisheries, Kagoshima, Japan)

In mass cultures a lower feeding ratio (83%) was observed for the marine rotifer, *BRACHIONUS PLICATILIS*, at the highest temperature used, 24.6 C, than that at 21.1 C (100%). Feeding ratio equaled the amount of yeast supplied in grams times 100/total body weight of rotifer (in grams). (NPC)

<259>

Nirata, H., Studies on the Daily Rhythms of Feeding Activity in Fish, Especially in Goldfish, *CARASSIUS AURATUS* (Linnaeus).

1973. Mem. Fac. Fish., Kagoshima Univ. (Jap.), 22, 1-18 (Kagoshima University, Faculty of Fisheries, Kagoshima, Japan)

A diurnal feeding activity was found in several species of fish, including goldfish. From fall to early spring peak feeding activity of goldfish occurred a few hours before maximum temperatures were recorded. In early winter, the feeding activity gradually stopped as water temperatures approached 8.5 C. Hibernation occurred shortly thereafter. Feeding was initiated in early spring at about 10.0 C. (ST)

<260>

<260>

Hirayama, K., and T. Kusano, Fundamental Studies on Physiology of Rotifer for Its Mass Culture. II. Influence of Water Temperature on Population Growth of Rotifer.

1972. Bull. Jap. Soc. Sci. Fish., 38, 1357-1363
Nagasaki University, Faculty of Fisheries,
Nagasaki, Japan; Taiyo Fisheries Co., Ltd.,
Chiyoda-ku, Tokyo, Japan)

The influence of water temperature on the time interval from hatching to 50% survival, fecundity, net reproduction rate, intrinsic rate of population increase and mean generation time was studied using the rotifer, *BRACHIONUS PLICATILIS*. The intrinsic rate of increase was highest at 27 C. However the most desirable temperature for mass production of the rotifer appeared to be 25 C. (ST)

<261>

Hiroi, O., N. Yasukawa, and T. Suetake, Studies on the Retention of Gametes in Salmonid Fishes. Part 2: On the Storage of Chum Salmon *ONCORHYNCHUS KETA* Sperm.

1973. Sci. Rep. Hokkaido Salmon Hatchery, 27, 39-44 (Hokkaido Salmon Hatchery, Chitose, Japan)

Sperm of the chum salmon, *ONCORHYNCHUS KETA*, were collected during a spawning run up the Chitose River in November and stored at 15.0, 2.0, 3.5 plus or minus 1.5, and -9.0 plus or minus 9.0 C. Spermatozoa stored at 15.0, 8.0, and 3.5 plus or minus 1.5 C were motile for 2, 6 and 11 days, respectively. No motility was shown by sperm stored at -9.0 plus or minus 9.0 C after one day. Sperm stored at 8.0 C for four days could fertilize 99.34% of eggs stored for one day at 8.0 C in Ringers solution. When eggs etc. 4 for one and four days at 8.0 C were inseminated with sperm kept for four and seven days at 3.5 plus or minus 1.5 C, fertilization rates of 96.9 and 53.8%, respectively, were obtained. (ST)

<262>

Hongman, W.J., Vital Activity Parameters as Related to the Early Life History of Larval and Post-Larval Lake Whitefish (*COREGONUS CLUPEAFORMIS*).

1974. Part of Blaxter, J.H.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Coastguard Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1973. Springer-Verlag, New York (Virginia Institute of Marine Science, Gloucester Point, VA)

Larval lake whitefish, *COREGONUS CLUPEAFORMIS*, preferred temperatures between 12 and 17 C when acclimated at 6, 11, and 14.5 before testing. Direct avoidance occurred at 20 to 23 C, with heat narcosis and death above 24 C. No change in temperature preference was apparent with increase in size from 12.6 to 24.9 mm. (ST)

<263>

Hockess, L., E. Penaz, and N. Prokes, The Volume of Milt, Quantity and Quality of Sperm in *COREGONUS PELED* (Gmelin, 1788) from Pond Culture.

1974. Zool. Listy., 23, 367-380 (University School of Agriculture, Chair of Fisheries and Hydrobiology, Brno, Czechoslovakia; Academy of Science, Institute of Vertebrate Zoology, Brno, Czechoslovakia)

Males of *COREGONUS PELED* produced sperm during a six to eight week period in November and December when air and water temperatures underwent a considerable drop. Females became ripe within a few days after air temperature dropped permanently below freezing and water temperature dropped below 2 C. (ST)

<264>

Hodson, P.V., and J.B. Sprague, Temperature-Induced Changes in Acute Toxicity of Zinc to Atlantic Salmon (*SALMO SALAR*).

1975. Jour. Fish. Res. Bd. Can., 32, 1-10 (University of Guelph, Guelph, Ontario, Canada)

Three groups of Atlantic salmon (*SALMO SALAR*) parr were acclimated to water temperatures of 3, 11, and 19 C. When exposed at their acclimation temperature to lethal concentrations of zinc, cold-acclimated salmon survived longer than warm-acclimated salmon. However, the threshold lethal concentration (LC50) of zinc was highest for salmon at 19 C, i.e. there was less toxicity at the high temperature. At test temperatures lower than prior acclimation temperatures, survival times in zinc were longer but the threshold LC50 was lower, i.e. fish were less tolerant of zinc. The opposite results were seen at temperatures above prior acclimation temperatures. The threshold LC50 may be predicted by the equation $LC50 = 1.9611 - 0.1473 T_a + 0.8699 T_e - 0.0415 T_e(T_e + 2) + 0.00004 T_a T_e(T_e + 3)$, where T_a = temperature of acclimation and T_e = temperature of exposure. In polluted rivers, zinc concentrations may be most damaging to fish populations during the winter months. Measured concentrations of zinc and copper in the Miramichi River, New Brunswick, Canada, were highest in winter when estimated toxicity of metal was also greatest. (Auth)

<265>

Kofer, R., N. Ladurner, A. Gatteringer, and W. Weiser, Relationship Between the Temperature Preference of Fishes, Amphibians and Reptiles, and the Substrate Affinities of Their Trypsins.

1975. Jour. Comp. Physiol., 99, 345-355 (University of Innsbruck, Institute of Zoophysiology, Innsbruck, Austria)

The apparent Michaelis constant of crude trypsin preparation of several species of fish, five amphibians and three reptiles were determined at 15 and 30 C and at the temperature preference of each species. The affinity of the trypsin isozymes for DL-BAPA was correlated with the temperature preference of the species. The affinity of trypsins in vertebrates with a high temperature preference was generally lower than in species with a low temperature preference. The aquatic cyprinids possessed trypsins with a much higher affinity than those of other vertebrates. In fish and frog tadpoles the K_m was independent of experimental temperature over a wide range. (Auth) (ST)

<266>
Hoffman, B.S., F.J. Dunham, and P.V. Kelly,
Effects of Water Temperature and Housing
Conditions upon the Aggressive Behavior of the
Lobster *Homarus americanus*.

1975. Jour. Fish. Res. Bd. Can., 32, 713-717
(Dalhousie University, Department of Psychology,
Halifax, Nova Scotia, Canada)

Lobsters, *Homarus americanus*, were more
aggressive at 10 C than at 5 C. At 10 C,
animals housed communally, and those in
physical isolation with visual contact, were
less aggressive in a test situation than
lobsters housed with no physical or visual
contact. (Auth)

<267>
Robinson, R.E.P., and C.P. Kleiner, Effects of
Constant and Fluctuating Temperatures on Survival and
Development Rates of Embryonic and Larval Yellow
Perch, *Perca flavescens* (Mitchill).

1974. Part of Blaxter, J.H.S. (Ed.), The Early
Life History of Fish, Proceedings of an
International Symposium held at the Dunstaffnage
Marine Research Laboratory of the Scottish Marine
Biological Association at Oban, Scotland, May
17-23, 1973, (p. 437-448). Springer-Verlag, New
York (U.S. Environmental Protection Agency,
National Water Quality Laboratory, Monticello,
NY; U.S. Environmental Protection Agency,
National Water Quality Laboratory, Duluth, MN)

The effects of 24 treatments of constant or
rising temperatures (3.1 - 25.4 C) on survival
of yellow perch embryos of known age were
determined in continuous-flow incubators. The
median times to attain seven morphological
stages and physiological events in living
embryos and larvae were also observed at
eight constant temperatures (3.1 - 19.7 C).
Early embryonic stages (before neural keel)
tolerated constant temperature exposures from
3.1 to 19.9 C. The median tolerance limits
(TL50) for normal hatch of older embryonic
stages (after neural keel) were 7.0 and 22.9
C. The lower TL50 of swim-up larvae was 9.8
C. The optimum range of swim-up larvae was
only 13.1 to 18.2 C when embryos were reared
at constant incubation temperatures after
fertilization. Survival of swim-up larvae at
higher temperatures was limited only by
embryonic survival. Optimum yields of
swim-up larvae (66 to 85%) were produced when
initial incubation temperatures (8.9 to 10.0
C) were increased 0.5 - 1.0 C/day (range 8.9
- 24.3 C). Rising temperature regimes also
favored shorter hatching periods and lower
incidence of abnormalities at hatch. Mass
hatch occurred in 5 days at 19.7 C and in 51
days at 5.0 C. Hatching followed
commencement of branchial respiration above
1.3 C, but was morphologically premature at
lower temperatures. Larval swim-up occurred
on the day of hatch above 13 C, and within
two days at lower temperatures. Unfed larvae
survived 15 days at 19.8 C and 65 days at 5.3
C. The median period between swim-up and
mortality of unfed larvae was 9 days at 19.8
C and 21 days at 10.5 C. Total length of
normal larvae at mass hatch varied from 4.7
to 6.6 mm. Mean lengths were 5.1 - 6.3 mm at
7.1 to 13.1 C, 5.6 to 5.8 mm at 16.1 to 20.0
C, and 5.1 to 5.2 mm at 5.0 and 22.1 C.
Effects of incubation temperatures on total
hatch, median time to hatch, and size at mass
hatch of *PERCA FLAVESCENS* were compared to *P.*
FLUVIATILIS. The data tend to support the
theory that *P. FLAVESCENS* and *P. FLUVIATILIS*
may be conspecific. (Auth) (ST)

<268>
Holland, W.E., Thermal Tolerances of Fish from
Habitats Receiving Heated Effluent from a Nuclear
Reactor.

1974. Assoc. Southeast Biol. Bull., 21, 62
(Savannah River Ecology Laboratory, Aiken, SC)

Differences in thermal tolerances were found
in mosquitofish (*Gambusia affinis* Girard)
collected from areas differently affected by
thermal loading. The habitats included (1) a
cooling reservoir, (2) a stream presently
receiving heated effluent, (3) a thermal
recovery stream and, (4) a shallow pond used
as a control. Differences in thermal
tolerances were found at acclimation
temperatures of 16, 20, 24, 28, 32, and 36 C
with either the Critical Thermal Maximum or
Death Point as the criterion for heat
tolerance. Differences in thermal tolerances
between male and female fish at all locations
necessitated separate analysis for each sex.
Although statistically different ($P > .05$),
thermal tolerances exist between localities,
these differences are small and of between
localities, these differences are small and
of questionable biological and ecological
concern. *Gambusia* are found living at
temperatures exceeding 39 C; given the enzyme
biochemistry present in these fish,
evolutionary adaptation to even higher
temperatures is limited. (Auth)

<269>
Hollifield, R.L., and R.V. Dinock, Jr.,
Interaction of Temperature and Salinity on Crab
Metabolism.

1974. Amer. Zoologist, 14, 1259 (Wake Forest
University, Winston-Salem, NC)

Metabolism was measured for *PARAPROCTUS*
HERBERTI acclimated to temperatures and
salinities of 10 C and 30 ppt, 10 C and 5
ppt, 23 C and 30 ppt, and 23 C and 5 ppt.
Measurements were made at experimental
salinities of 40, 30, 15, and 5 ppt at both
25 C with a Gilson differential
respirometer. Significant interaction
between temperature and salinity occurred.
For animals acclimated to 23 C and 30 ppt,
highest metabolic rates occurred at low
experimental salinity at 25 C test
temperature. The same animals tested at 10 C
had highest metabolism at high salinity.
After low temperature acclimation metabolism
was higher at low salinity under all
experimental conditions. Temperature
acclimation had the most consistent effect on
metabolism at low acclimation salinity and
high test temperature. Q10 varied with
salinity. Sexual differences occurred only
in animals acclimated to 23 C and 5 ppt and
tested at 25 C. Females exhibited
significantly lower metabolic rates than did
males under these conditions. (Auth)

<270>

<271>

Hollifield, K.L., and R.V. Dimock, Jr., The Effect of Temperature-Salinity Interactions on the Metabolism of the Intertidal Crab *PANOPAEUS HERBSTII*.

1974. Jour. Elisha Mitchell Soc., 90, 110 (Not Given)

Oxygen consumption measurements were made on *PANOPAEUS HERBSTII* at various combinations of temperature and salinity. Crabs were acclimated to four conditions: 10 C and a salinity of 30 ppt, 10 C and 5 ppt, 23 C and 30 ppt, 23 C and 5 ppt. The metabolic rates of these animals were determined at each of four salinities (40, 30, 15, and 5 ppt) at 10 C and 25 C. Results indicated a significant interaction between temperature and salinity. In crabs acclimated to 23 C and 30 ppt the highest metabolic rates occurred at low experimental salinities when the test temperature was 25 C. The same animals at 10 C had the highest rates at high salinities. After low temperature acclimation, the metabolic rates for animals acclimated at low salinity under all experimental conditions were higher than those of animals acclimated to high salinity. Temperature acclimation had the most consistent effect on metabolism at low salinity acclimation and high test temperatures. Q10 values varied with salinity. Sex affected metabolism only in animals acclimated to 23 C and 5 ppt and tested at 25 C. Females exhibited depressed rates under these conditions. Size interacted with metabolism under only two sets of conditions. After acclimation to high temperatures and salinities, small animals had higher rates at high test temperatures. Larger animals had higher rates after acclimation to high temperatures and low salinities at low test temperatures. (Auth)

<271>

Holmes, D.W., V.M. Douglass, and R.T. Lackey, Pond and Cage Culture of Channel Catfish in Virginia.

1974. Jour. Tenn. Acad. Sci., 49, 74-78 (Virginia Polytechnic Institute and State University, Blacksburg, VA)

Channel catfish, *ICTALURUS PUNCTATUS*, cultured in cages in farm ponds did not feed until water temperature reached 26 C in June. As water temperature increased, food consumption increased. Growth varied considerably between ponds and was influenced by water temperature, disease, and number of times per day the fish were fed. (ST)

<272>

Holsapple, J.G., and L.E. Foster, Reproduction of White Perch in the Lower Hudson River.

1975. N.Y. Fish & Game Jour., 22, 127-127 (Texas Instruments, Inc.)

Information on reproduction of the white perch (*MORONE AMERINCUS*), derived from data collected between river miles 40 and 60 of the Hudson River estuary in 1972, is presented and compared with that in the published literature. The estimated average number of eggs spawned ranged from 20,676 for 1-year-old fish to 135,289 for 9-year-old fish. Among age 2 fish, less than 20 percent of the males and none of the females were sexually mature. At age 3, all males and 75 percent of the females had reached sexual maturity. Spawning activity during 1972 was most intense in early June when water temperatures were between 18 and 20 C. (Auth)

<273>

Holt, R.A., J.E. Sanders, J.L. Egan, J.L. Fryer, and R.S. Pilcher, Relation of Water Temperature to *FLAVIBACTER COLUMNARIIS* Infection in Steelhead Trout (*Salmo gairdneri*), Coho (*Oncorhynchus kisutch*) and Chinook (*O. tshawytscha*) Salmon.

1975. Jour. Fish. Res. Bd. Can., 32, 1553-1559 (Oregon State University, Department of Microbiology, Corvallis, OR)

The effect of water temperature upon mortality from experimental infection by *FLAVIBACTER COLUMNARIIS* and on mean time to death was investigated in juvenile steelhead trout (*Salmo gairdneri*), coho salmon (*Oncorhynchus kisutch*), and spring chinook salmon (*Oncorhynchus tshawytscha*). Eight temperatures increasing from 3.9 to 23.2 C by increments of 2.8 C were studied. Fish were infected by direct contact method whereby a suspension of the pathogen was added to the water. It was found that at temperatures ≤ 9.4 C and below, no deaths due to the experimental infection with *F. COLUMNARIIS* occurred. At 12.2 C mortality varied from 4 to 20 % among the three species, and increased progressively with increasing temperature to 100% in steelhead trout and coho salmon at 20.5 C, and 70% in chinook salmon at that temperature. With all three salmonid species, an inverse linear relationship was found between water temperature and the log 10 of the mean number of days from exposure to death. This means that as the temperature increased above 12.2 C the disease process was progressively accelerated, resulting in a minimum time to death at 20.5 or 23.3 C and a maximum at 12.2 C. The results indicate that under the conditions of these experiments, columnaris disease in salmonids was completely suppressed by water temperatures of 9.4 C or below. (Auth)

<274>

Holtz, R.B., R. Lee, and A.A. Benson, Fatty Acid Composition of Membranes from *CALANUS HYPERBOREUS* and *CALANUS PACIFICUS*.

1974. Jour. Amer. Oil Chem. Soc., 51, 520A (Ohio State University, Columbus, OH; University of Georgia, Athens, GA; Scripps Institution of Oceanography, San Diego, CA)

The fatty acid compositions of discrete subcellular fractions obtained from calanoid copepods living in different temperature regimes were compared. *CALANUS HYPERBOREUS* were collected in the Arctic living at a temperature of 1 to 3 C. *CALANUS PACIFICUS* was collected near Vancouver, British Columbia, Canada, at an average temperature of 12 C. Homogenates of both organisms were made, and their subcellular components were separated by density gradient ultracentrifugation. A plasma membrane enriched fraction and an enriched mitochondrial fraction from both species were obtained with about the same relative purity as determined by marker enzyme assays and electron microscopy. Analysis of fatty acid compositions showed that plasma membranes from *C. HYPERBOREUS* are higher in concentrations of polyunsaturated fatty acids, especially C:22:6, than those from *C. PACIFICUS*. Further fractionation of lipids from *C. HYPERBOREUS* into neutral and polar lipids showed that the phospholipids contained a greater relative percentage of other polyunsaturated fatty acids. (Auth)

<275>

Holub, W.J., K. Wilsson, J. Pietarski, and S.J. Slinger, Biosynthesis of Lecithin by the CDP-Choline Pathway in Liver Microsomes of Rainbow Trout, *SALMO GATRODONTI*.

1975. Jour. Fish. Res. Bd. Can., 32, 1633-1637 (University of Guelph, Department of Nutrition, College of Biological Science, Guelph, Ontario, Canada)

The enzymatic synthesis of lecithin from CDP-choline (C18) was characterized in microsomal preparations from the livers of rainbow trout (*SALMO GATRODONTI*). Optimal activity was obtained with the addition of 1,2-diglyceride and Mg to the incubation medium. There was a 290% stimulation in cholinephosphotransferase activity when the incubation temperature was raised from 15 to 37 C. The results indicate that the CDP-choline pathway is operative in the formation of lecithin in the liver of rainbow trout. The possible function of this reaction in the acclimation of fish to environmental temperature is discussed. (Auth)

<276>

Horsfall, W.R., Heteromorphic Development of Aedes Mosquitoes Reared at Abnormal Temperatures.

1974. Ann. Zool. Penn. (Ph.), 11, 224-236 (University of Illinois, Department of Entomology, Urbana, IL)

High temperature inhibited expression of male features of northern mosquitoes of the genus *Aedes*, but did not inhibit those of the female. Descriptions are given of the modifications exhibited by the normally male-producing component when reared at constant temperatures between 21 and 28 C. Resulting adults were heteromorphic in degree of maleness according to temperature. (ST)

<277>

Horsfall, W.R., Effect of Simulated Seasonal Thermal Conditions on Hatching of Eggs of a Univoltine Mosquito.

1974. Ann. Entomol. Soc. Wash., 67, 991-992 (University of Illinois, Chicago, IL)

For a high rate of hatching of the mosquito, *Aedes stimulans*, 90 days at 4 C was found adequate with maximum hatching from any sequence involving 30 days at 21 C (representing summer) and 180 or more days at 4 C (representing winter). (RPC)

<278>

Horton, D.B., and D.W. Bridges, A Study to Predict the Effects of Thermal Additions in the Bay River and Housa River Area of North Carolina.

1973. OORT-004-NC; 63 p. (Research Institute of the Gulf of Maine (THIGOM), South Portland, ME)

A baseline study was described of temporal and spatial variations in temperature, salinity, dissolved oxygen, and density and species composition of macrobenthic invertebrates in the Housa River estuary prior to construction of a steam electric generating station. The thermal tolerance of endemic biota including spot (*LEIOSTOMUS XANTHUS*), croaker (*MICROPOGON UNDULATUS*), American shad (*ALOS A SAPISSIMA*), Atlantic menhaden (*BREVOORTIA TYRANUS*), blue crabs (*CALLINectes sapidus*), and Carolina clam (*VANGIA CUNEATA*) was also estimated by applying the critical thermal maximum (CTM) technique. The CTM of menhaden was used to construct a model for predicting when thermal additions as from a power plant would endanger estuarine fish. During the summer when normal shallow water temperatures are 30 to 32 C, thermal additions must be carefully controlled so that temperature increases across a power plant heat exchanger would be limited to 3 to 5 C. (Auth)

<279>

Hoss, D.E., Energy Requirements of a Population of Pinfish *LAGODON RHOMBODES* (Linnaeus).

1974. Ecology, 55, 848-855 (National Marine Fisheries Service, Atlantic Estuarine Fisheries Center, Beaufort, NC)

Biomass and rates of metabolism were estimated for a population of pinfish, *LAGODON RHOMBODES*, in the Beaufort River estuary, North Carolina. This information was used to estimate the routine energy requirements of the pinfish population and to relate these energy requirements to primary productivity in the estuary. Population estimations of larval, juvenile, and adult pinfish were made over a 2 year period. Peak biomass occurred during March-April when both larval fish and juvenile-adult fish were at maximum numbers. Routine metabolism was measured at 10 and 15 C for larval fish and at 5, 10, 15 and 20 and 33 C for juvenile-adult fish. In general, the rate of metabolism for both large and small fish increased with temperature up to 33 C. Metabolism-weight coefficients calculated from the data for juvenile-adult fish were lower than values for pinfish reported by other investigators. The yearly routine energy requirement of the pinfish population was estimated to be $1.1 \times 10^{10} (2 \pm 9)$ calories. This annual requirement was compared to total estuarine primary productivity with the assumption of 10% and 20% net growth efficiency for the estuarine system. At 10% efficiency the pinfish would require 0.9% and at 20% they would require 0.4% of the total energy available to secondary consumers. (Auth) (WD)

<280>

<280>

Ross, D.E., L.C. Costom, J.P. Baptist, and D.W. Engel, Effects of Temperature, Copper and Chlorine on Fish During Simulated Etrainment in Power-Plant Condenser Cooling Systems.

1975. CONF-740820; STI/PDB/378; IAEA-SM-187/19; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 519-527) (National Marine Fisheries Service, Atlantic Estuarine Fisheries Center, Beaufort, NC)

Conditions of etrainment were simulated in the laboratory to investigate the effects of thermal shock, the combined effects of thermal shock and copper, and the combined effects of thermal shock and chlorine on the survival of larval fish. A cycling acclimation temperature was found to reduce the effects of thermal shock on larval plaifish, *LACODON BROWNOIDES*. Survival of plaifish held for 24 hours in water containing 1.0 ppm copper prior to the thermal shock was significantly reduced at shock temperatures of 12 and 15 C above acclimation temperatures. Flounder, *PARALICHTHYS* sp.; Atlantic menhaden, *BREVOORTIA TYRANNUS*; and striped mullet, *MUGIL CEPHALUS* safely withstood limited exposure to 0.3 ppm chlorine at ambient temperature (up to 5 min for mullet and flounder, and up to 7 min for menhaden). Reductions in survival occurred at exposures longer than the above, and further reductions occurred with the addition of heat. Survival was reduced still further at chlorine concentrations of 0.5 ppm, in some cases at ambient temperatures. The experiment indicated that the interaction between heat and chlorine is synergistic. (Auth)

<281>

Rooston, A.H., and D. Cyr, Thermoacclimatory Variation in the Haemoglobin Systems of Goldfish (*CARASSIUS AURATUS*) and Rainbow Trout (*SALMO GAIREDNERI*)

1974. Jour. Exp. Biol., 61, 455-461 (Brock University, Department of Biological Sciences, St. Catharines, Ontario, Canada)

Significant increases in total haemoglobin concentration, and microhaematocrit values were associated with acclimation of rainbow trout and goldfish to increased temperature. Goldfish held at 2 C were characterized by two haemoglobin components, whereas those acclimated to 20 and 35 C exhibited three. Five haemoglobin variants were observed in trout at 2, 10 and 18 C. The data provided evidence that both species selectively alter the concentrations of specific haemoglobin fractions during the thermoacclimatory process. (Auth)

<282>

Howe, A.B., and P.G. Coates, Winter Flounder Movements, Growth, and Mortality off Massachusetts.

1975. Trans. Amer. Fish. Soc., 104, 13-29 (Department of Natural Resources, Division of Marine Fisheries, Sandwich, MA)

From 1960 to 1965, 12,151 winter flounder (*PSEUDOPLEURONectes AMERICANUS*) were tagged with Petersen tags at 21 locations off Massachusetts. Returns through 1971 totaled 4,440 or 36.5%. Ratio of females to males at tagging was 2.3. Movements north of Cape Cod were relatively localized and confined to inshore waters, whereas south of Cape Cod, flounder seasonally dispersed in a southeastward direction generally beyond the territorial limit; movements appeared to be related to water temperature. Little mixing occurred between Georges Bank and inshore areas. Growth of fish north of Cape Cod, south and east of Cape Cod, and on Georges Bank was described by "Walford lines" developed from tagging data. In 1964 apparent rates of exploitation, natural mortality, and annual total mortality were 0.20%, 0.273, and 0.474 respectively, for fish released in Vineyard and Nantucket Sounds. (Auth)

<283>

Habbs, C., and C. Bryan, Effect of Parental Temperature Experience on Thermal Tolerance of Eggs of *HEMIDIA AUDEUS*.

1974. Part of Blaxter, J.B.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1973. Springer-Verlag, New York (University of Texas, Department of Zoology, Austin, TX)

Thermal tolerance of eggs of the silverside, *HEMIDIA AUDEUS*, was shown to be influenced by prior temp experience of the parent. A 9 C difference in parental acclimation temp resulted in an upward shift in thermal tolerance of eggs from the higher of two parental acclimation groups. This shift, measured in terms of the thermal range at which gastrulation would occur, was of the order of one degree C. However, a reversal occurred when the thermal stress, used to define the range, was maintained after gastrulation. That is, the thermal tolerance range of eggs from the higher parental temp acclimation was displaced downward by approximately two degree C, in comparison with the range obtained for eggs from the lower parental acclimation group. This phenomenon is not likely to involve temp shock; eggs exposed to sublethal thermal stresses and returned to optimal temps showed high survival, despite being subjected to two thermal shocks in such transfers. (Auth)

<284>

Hudson, R.L., Field. Culture and Ultrastructural Studies on the Marine Green Alga *ACROSIPHONIA* in the Puget Sound Region.

1974. Ph.D. Thesis, University of Washington, 254 p. (University of Washington, Seattle, WA)

Effects of light intensity, photoperiod, temperature and experimentally produced damage on vegetative growth of gametophytes of several species of *ACROSIPHONIA* collected from Puget Sound were studied. Vegetative growth of a gametophyte was best at 10 to 15 C and was prevented at 20 C.

<285>

Hutchinson, R.S., The Effect of Temperature and Salinity on Calcium Uptake by the Blue Crab, *CALLINectes sapidus* SMITH 1955.

1974. Chesapeake Sci., 15, 237-240 (Belle S. Baruch Coastal Research Institute and University of South Carolina, Department of Biology, Columbia, SC)

Adult blue crabs were exposed to various concentrations of cadmium (0.0001 ppm; 0.11 ppm, 0.2 ppm, 10 ppm, and 11.14 ppm Cd) in sea water at different thermosaline regimes (10, 20, 30 C and 30 ppt, 20 ppt, 10 ppt, 5 ppt). Concentration and rates of uptake of cadmium were greatest at low salinities and higher temperatures with major sites of localization in gill, hepatopancreas and carapace. Claw muscle was comparatively low in cadmium. (Auth)

<286>

Syland, J.R., Analysis and Control of Thermal Pollution.

1974. EPA-430/1-74-010 (U.S. Environmental Protection Agency, Office of Water Program Operations, Cincinnati, OH)

The report is a training course manual with 31 outlines concerning thermal pollution. Topics included are sources of thermal pollution; effects on various organisms; physical and chemical changes from temperature; monitoring techniques; temperature prediction theories; heat dissipation; and thermal pollution control methods. References are included on each topic. (Auth)

<287>

Iheda, T., Nutritional Ecology of Marine Zooplankton.

1974. Mem. Pac. Fish., Hokkaido Univ., 22, 1-97 (Hokkaido University, Faculty of Fisheries, Hokodate, Japan)

Rates of respiration and ammonia-nitrogen excretion and the chemical composition (nitrogen, carbon and hydrogen) of zooplankton collected from tropical, subtropical, temperate and boreal waters were studied in relation to their body size and habitat temperature. One hundred-twelve species were studied for respiration, 81 species were studied for ammonia-nitrogen excretion, and 111 species were studied for chemical composition. Both rates of respiration and ammonia-nitrogen excretion correlated with body weight and habitat temperature. The ratio of oxygen respired and nitrogen excreted in the form of ammonia was related to habitat temperature. The percentage of carbon and hydrogen, but not nitrogen, increased with a decrease in habitat temperature. The proportion of organic matter in the body decreased with increasing habitat temperature. Tropical zooplankton did not survive long under starvation conditions due to loss body weight and high metabolic rate. (ST)

<288>

<288>

Inhof, G., The Effect of Temperature and Photoperiod on the Life Cycles of Several Freshwater Pelmatozoans.

1973. Malacologia (G.B.) (Tug.), 14, 393-395 (University of Vienna, Zoology Institute, Vienna, Austria)

Groups of four species of lymnaeids and planorbids reared under constant temperature conditions of 11, 17 and 23 C showed some capacity for active growth regulation in relation to temperature within the range prevailing during the warm season. Growth was slower at 11 C. This capacity was developed during early postembryonic growth. Above specific threshold values there was no correlation between temperature level and the intensity of spawning. Photoperiodism did not influence growth, but lengthening of daylight stimulated spawning in lymnaeids, and in planorbids when combined with a rise in temperature. Growth and reproduction continued steadily under constant conditions, but distinct activity periods existed in the field which could be duplicated in the laboratory by imitating the natural course of seasonal climatic conditions. (ST)

<289>

Irvin, D.W., Temperature Tolerance of Early Developmental Stages of Dover Sole, *SOLEA SOLEA*.

1974. Part of Blaxter, J.H.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1973. Springer-Verlag, New York (Ministry of Agriculture, Fisheries and Food, Fisheries Laboratories, Port Erin, Isle of Man)

Aspects of temperature tolerance were investigated in successive developmental stages of the Dover sole, *SOLEA SOLEA*, including the egg, yolk-sac larva, feeding larva and larvae at metamorphosis. Eggs incubated at constant temperatures within a defined zone of temperature tolerance showed equivalent survival over 5-day periods of exposure. Continued exposure yielded a significant relation between all such temperatures and time to 50% mortality. Upper and lower lethal temperature limits (96-hr LD50) were estimated for larval stages. Temperature tolerance increased during development up to metamorphosis at which point it corresponded closely with that of juvenile fish. (Auth)

<290>

Ishibashi, B., Feeding, Starvation and Weight Changes of Early Fish Larvae.

1974. Part of Blaxter, J.H.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1973. Springer-Verlag, Berlin-Heidelberg (Tokyo University of Fisheries, Tokyo, Japan)

TILAPIA SPARRMANII larvae began feeding on day two at 30 C, day three at 27 C and day four at 24 C. Body weight increased after hatching due to water uptake and first feeding occurred at maximum weight. (ST)

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Shida, Y., A. Nakayasu, and H. Kadota, Temperature-Salinity Effects Upon the Growth of Marine Bacteria.

1974. Part of Colwell, R.R. and Horita, R.Y. (Eds.), Effect of the Ocean Environment on Microbial Activities, Proceedings of the Second United States-Japan Conference on Marine Microbiology held in Baltimore, Maryland, August 25-30, 1972. University Park Press, Baltimore, Maryland, (p. 80-91). (Kyoto University, Department of Fisheries, Kyoto, Japan)

Increased incubation temperatures resulted in an increase in the minimum and optimum salinities for the growth of several bacterial strains isolated from seawater and from solar salts. However, a similar effect was not observed for several strains from marine mud and for *VIBRIO PARAEHOLYTICUS*. The uptake of C-14 glutamic acid by cells of a moderate halophile, *FLAVOBACTERIUM* and cells of a marine bacterium, *PSEUDOMONAS* sp., in various salinities was influenced by the growth temperature but not by the incubation temperature during substrate uptake. The minimum salinity for the uptake of substrates by resting cells increased as the growth temperature of the cells was increased. The salinities required for the uptake of C-14 serine and C-14 proline were not influenced by either the growth or test temperature, although these amino acids were equivalent to glutamic acid in supporting the growth of this organism. The concentration of NaCl below which cell suspensions of an extreme halophile, *BREVIBACTERIUM* sp., lost viability was increased when the temperature of the suspension was increased. This was in contrast to the behavior of a marine pseudomonad and of a moderate halophile. The salinities below which loss of turbidity and release of UV-absorbing substances occurred were not influenced by temperature in any of the test organisms. The results suggested that the observations concerning the influence of temperature on the minimum and optimum salinities for growth could be best explained in terms of alterations in transport activity. (Auth)

<292>

Ivanov, B.G., and Ya.I. Starobogatov, Subtropical Freshwater Shrimp *MACROBRACHIUM HIPPOBENSE* (De Haan) (Palaemonidae) in Ponds near Moscow.

1974. *Ekologiya*, 5, 83-85 (Zoology Institute, Leningrad, USSR)

The subtropical freshwater shrimp, *MACROBRACHIUM HIPPOBENSE*, was successfully introduced into cooling ponds of a state regional electric power plant near Moscow, USSR. Water temperatures of the cooling ponds are generally 10 C higher than other waters of the same latitude. (ST)

<293>

Jackson, J.R., Jr., and R.W. Castenholz, Fidelity of Thermophilic Blue-Green Algae to Hot Spring Habitats.

1975. *Limnol. & Oceanogr.*, 20, 305-322 (University of Oregon, Department of Biology, Eugene, OR)

Inocula of river water and sediment from the Yellowstone Plateau, Wyoming, and the Willamette Valley, Oregon, were incubated in photoautotrophic media at 18, 35, and 45 C. Many blue-green algal species developed at 35 C with inocula from numerous habitats. The 45 C temperature promoted the growth of blue-green algae in samples taken downstream from a source of hot spring or possibly heated industrial waters, but not in samples from pristine waters above hot spring

discharges. Most of the 45 enrichments (*SYNCHROCOCCUS*, *HAETIGOCLEADUS*, and *OSCELLATORIA*) also grew when the culture temperature was raised to 50 and 55 C. The hot spring origins of certain species were determined by their known occurrence in nearby hot springs and by the decrease in cell density with distance downstream from hot spring effluents. The dilution with time and distance was partially a result of death, since tests indicated the lethal effect of light on these cells in cold river water. Nevertheless, spring cells were still recoverable from 2-liter water samples 20 to 10 km from the point of input and occasionally at distances of over 100 km. Samples from waters of Everglades National Park (35 to 40 C) also contained several species of blue-greens algae that have a growth temperature optimum of over 45 C have a high fidelity to hot spring habitats (or artificially heated waters) in temperate or colder climates, but maintenance populations of some species may become established elsewhere in warmer areas. (Auth)

<294>

Jackson, J.R., Distribution and Abundance of Shrimps, Crabs, and Fishes in the Cooling Lake of the Cedar Bayou Electric Power Station.

1974. M.S. Thesis, Texas A & M University, 137 p. (Texas A & M University, College Station, TX)

Distribution and abundance of shrimp, crabs and fish in the cooling lake of the Cedar Bayou Electric Power Station were determined from August, 1972 to August, 1973. Samples were taken from five trawl and trammel stations twice monthly. Cooling water is taken from Cedar Bayou and Tabbs Bay downstream from the plant. The water is pumped through the station's condensers (designed rise in temperature of 11.1 C) and discharged through an 8.45 km canal into 1053 ha cooling lake. After entering the cooling lake, the heated water takes four to five days to pass over a weir into Trinity Bay. Data on water temperature, salinity, turbidity, dissolved oxygen are given. Twelve of the 42 species collected comprised over 90% of the catch. Three species, white shrimp (*PENAEUS SETIFERUS*), grass shrimp (*PALAEOMONES POCIO*), and Atlantic croaker (*MICROPOGON UNDULATUS*) comprised 77.7% of all individuals collected. Fluctuation in abundance and distribution of species within the cooling lake was dependent upon heated effluent temperature, season of the year, salinity and substrate composition. Shrimp, crabs, and fish tended to concentrate in the warm water at station 1 during the cold weather months and disperse to the cooler water in the hot months. Exceptions were brown shrimp and young-of-the-year spot and Atlantic croaker which avoided the high temperature station. Grass shrimp concentrated in SPARTINA beds. Fish displayed size distribution by temperature preference. Reproduction of grass shrimp and sea catfish (*ARIUS FELIS*) was observed. High temperatures in excess of 35.0 C were detrimental to postlarval and young-of-the-year fish in the discharge canal and station 1 area. The continuous flow of warm water may have induced longer breeding seasons for bay breeders. Periods of growth were variable among species. (Auth) (ST)

(294)

Jankowski, J.C., Thermal Pollution Influence on the Aquatic Ecosystem.

1974. Part of Gallagher, B.J. (Ed.), Proceedings of a Symposium on Energy Production and Thermal Effects held in Oak Brook, Illinois, September 15-17, 1973. Limnatics, Inc., Milwaukee, Wisconsin (Saint Joseph's Calumet College, East Chicago, IL)

The effects of thermal pollution on the aquatic ecosystem are briefly reviewed. Considered are effects on thermal tolerances, migration and spawning and embryonic development of fish; lake stratification; and oxygen supply. Future research needs are outlined. (57)

(296)

Jelencic, O., and S. Keches, The Metabolism of Cesium 137 in *MYTILUS GALLOPROVINCIALIS* Lam.

1974. Bapp. P.-V. Reun., Coun. Intl. Explor. Sci. Mer Mediterran. (Monaco), 22, 49 (Center Marine Research Institute, Tivoli, Yugoslavia)

Temperatures of 10 and 20 C did not markedly influence the rate of cesium 137 uptake by mussels. However, both temperature and salinity influence the concentration ratios, with the ratios being inversely related to salinity and directly related to temperature. Juveniles exhibited the highest rates of uptake and concentration ratios. Most of the cesium 137 was accumulated by the soft tissues. (57)

(297)

Jessop, B.N., Investigation of the Salmon (SALMO SALAR) Smolt Migration of the S.J. Salmon River, New Brunswick, 1966-72.

1975. Can. Fish. Mar. Serv. Resource Dev. Branch Marit. Res. Tech. Rep. Ser. Mart, 75, 1-58 (Department of the Environment, Fisheries Marine Service, Halifax, Nova Scotia, Canada)

Between 1966 and 1972 a counting fence was used near the mouth of the Big Salmon River, New Brunswick, Canada, to collect data on the timing and duration of Atlantic salmon smolt migration, and on smolt numbers, sizes, sex ratios and ages. Smolt migration began each year between May 7 and 29 and ended between June 15 and July 13. Timing of the smolt run was related to water level and water temperature. Large variations in age composition of migrating smolts were evident. (57)

(299)

Johnson, L., Distribution of Fish Species in Great Bear Lake, Northwest Territories, with Reference to Zooplankton, Benthic Invertebrates, and Environmental Conditions.

1975. Jour. Fish. Res. Bd. Can., 32, 1909-2004 (Department of the Environment, Fisheries and Marine Service, Freshwater Institute, Winnipeg, Manitoba, Canada)

Benthic invertebrates in Great Bear Lake are most highly concentrated in the upper 20 m. Densities between 20 and 100 m are low: below 100 m only *HYSTIS BELICTA* and *HYDROPHALUS QUADRICOCCUS* exist at measurable densities. All benthic organisms

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exhibit a high degree of patchiness. Lake trout, *Salvelinus namaycush*, and N. *quadriconus* are two species that inhabit the lake at all depths (3-400 m) and temperatures (13.2 C for N. *quadriconus* and 15 C for S. *namaycush*). Whitefish, *Coregonus clupeaformis*, inhabit only the bays, seldom being caught in water over 20 m deep. The distribution of whitefish is considered to be restricted mainly by the density of benthic organisms. Three species are confined to the periphery of the lake, *Stizostedion vitreum*, *Lota lota*, and *Catostomus commersoni*. Two species, *Coregonus plumbosus* and *Percopsis omiscomaycus*, are present in the headwaters and Great Bear River but have not been able to establish themselves in Great Bear Lake. Extreme oligotrophy is considered to have had the effect of reducing species diversity. (Auth)

(299)

Johnson, S.K., Temperature Change as a Cause of Bait Shiner Death.

1974. PDDL-P2; 3 p. (Texas A & M University, Department of Wildlife and Fisheries Sciences, Texas Agricultural Extension Service, Fish Disease Diagnostic Laboratory, College Station, TX)

The effect of temperature change on golden shiner minnows was tested by raising their water temperature from 15.5 C to 24 C over periods of 10 min., 1 hr. or 8 hr. One group was exposed to a sudden temperature change of 8.5 C. It was found that the more rapid the temperature change, the higher the mortality rate. Fish placed directly from water at 15.5 C into water at 24 C had a death rate of 36.4%. Loss was reduced by tempering the fish for various periods. (57)

(300)

Johnson, S.K., Effects of Temperature Change on Brown Shrimp Postlarvae.

1974. PDDL-S2; 2 p. (Texas A&M University, Department of Wildlife and Fisheries Sciences, Texas Agricultural Extension Service, Fish Disease Diagnostic Laboratory, College Station, TX)

Pontla-val brown shrimp, *Penaeus aztecus*, did not experience acute adverse effects when suddenly or gradually exposed to a temperature change of 6.1 C. (57)

(301)

Johnstone, I.N., Factors Affecting the Morphological Variability in the Green Algal Genus *DRAPARWALDIA* Bory 1808.

1974. Ph.D. Thesis, University of Kansas, 196 p. (University of Kansas, Lawrence, KS)

Light intensity, temperature, and day-length were found to affect the phenotypic development of the alga, *DRAPARWALDIA SALISBURGII* and eight *DRAPARWALDIA* sp. isolates to such an extent that they were not recognizable as the same genus. (EPC)

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Jones, L., B. Alderson, and B.L. Howell, Progress Towards the Development of a Successful Rearing Technique for Larvae of the Turbot, *SCOPHTHALMUS MAXIMUS* L.

1973; 1974. Part of Blaxter, J.H.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1973. Springer-Verlag, Berlin, Germany (Fishes Laboratory, Lowestoft, England; Fisheries Laboratory, Port Erin, Isle of Man)

Successful rearing experiments are described and discussed in relation to turbot larval survival for commercial cultivation. Turbot larvae were hatched from eggs obtained at sea from wild fish and from a spawning stock which had been held in the Lowestoft Laboratory for three years. At sea the incubation temperature could not be controlled and rose from 9 to 14 C; in the laboratory the eggs were incubated at 12 C. After hatching, rearing was carried out at temperatures of between 13.5 and 18 C. (BD)

<303>

Jones, D.R., J.W. Kicewich, and O.S. Sanford, Evaluation of the Swimming Performance of Several Fish Species from the Mackenzie River.

1974. Jour. Fish. Res. Bd. Can., 31, 1641-1647 (Department of Zoology, University of British Columbia, Vancouver, British Columbia, Canada)

Critical velocities of 17 species of fish from the Mackenzie River, Canada, were determined from increasing velocity tests in both field and laboratory, and the effects of critical velocity of different acclimation temperatures and of temperature shock were examined. In five species the relation between fatigue time and swimming speed was investigated. Critical velocity data from 10 species were analyzed by solving the regression equation $V = K(L^e)$ (where V = critical velocity in cm/s, L = fork length, K = constant, e = exponent). Neither acclimation to different temperatures nor temperature shock over a range of plus or minus 7 degrees C from acclimation temperature had a significant effect on critical velocity. Intraspecific variation was unrelated to maturity, sex or condition factor. From a graphical presentation of body length vs. maximum flow rate allowable in a 100 s culvert, it appears that culvert flow rates should be kept below 30 to 40 cm/s to allow successful passage of most mature individuals of migratory species. (Ath)

<304>

Jones, F.R.N., and P. Scholes, The Effect of Low Temperature on Cod, *GADUS MORhua*.

1974. Jour. Cons. Int. Explor. Mer., 35, 258-271 (Fisheries Laboratory, Lowestoft, England)

Cod held at controlled temperatures below 2 C for 40 days in normal sea water (32 to 34 ppt S) showed an increased freezing point depression and chloride content of their blood plasma. Muscle water content decreased suggesting that at least part of the blood plasma changes were due to dehydration. Cod kept in low salinity water 7 to 8 ppt at low temperature showed a decreased freezing point depression and chloride content of their blood plasma. Muscle water content increased and the fish gained weight although they were not fed, suggesting that at least part of the blood plasma changes were due to hydration. There was no evidence to show that these changes were due to osmoregulatory failure. Cod survived for at least 80 days when held at 0 C and did not die when subjected to colishock from 4 to 0 C. The results suggest that the distribution of cod in arctic waters and the capture of dead cod in the North Sea during severe winters is unlikely to be related to a lethal effect of low temperature. Other experiments indicated that very (10 C) low salinity 7 to 8 ppt sea water may be lethal for cod, which suggested that their distribution in the Baltic Sea could be restricted during the summer. The effect of low temperature on cod is discussed in relation to condition factor, parasitism by *LEISHMANIA*, photoperiod, freezing resistance, and the aggregation of cod at fronts between warm and cold water masses in the Svalbard area. (Ath) (ST)

<305>

Jones, M.B., Synergistic Effects of Salinity, Temperature and Heavy Metals on Mortality and Osmoregulation in Marine and Estuarine Isopods (Crustacea).

1975. Marine Biol. (W. Ger.), 30, 13-20 (University of Liverpool, Department of Marine Biology, Port Erin, Isle of Man)

Mortalities at 10 C were generally higher than those at 5 C for two groups of isopods having low mortalities in 100% seawater with 10 and 20 ppm Cd, Zn and Pb but showing an increase in the toxicities and a reduction of LT50 values of these metals with a decrease in salinity. Marine species were *IDOTEA BALTICA*, *I. NEGLECTA*, *I. SHANGHAIATA*, and *EURYDICE PULCHRA*. Estuarine species were *JAZZIA ALBIPRONIS* and *J. NORDMANNI*. Cadmium had no significant effect on the osmoregulation of *I. BALTICA* and *I. SHANGHAIATA* in 100 and 80% seawater at 5 C, but Cd significantly lowered the blood osmotic concentration of *I. NEGLECTA* in 80% seawater. (BFC)

<304>

Jones, T.L., Species Composition, Distribution and Abundance of Macrozooplankton in the Intake and Discharge Areas after Construction and Operation of the Cedar Bayou Electric Power Station.

1975. M.S. Thesis, Texas A & M University, 217 p. (Texas A & M University, College Station, TX)

From January 2, 1971 through May 19, 1972, 549 zooplankton samples were taken in the intake and discharge areas of the Cedar Bayou Electric Power Station in order to determine what effects the first seventeen months of plant operations might have on Trinity Bay and adjacent areas. These data were compared to pre-operational data to identify changes in species composition, distribution and abundance. Samples were taken every two weeks with a 0.5 m plankton net. Most species examined increased in abundance in Cedar Bayou after beginning operations, with brachyuran zoaea and ANCHOA MITSCHILLI showing a significant increase. High abundances of PHTHOLOSTHEUS ABRAEUS zoaea, OGYRIDES LYRICOLA zoaea, PLEUROLA zoaea as well as the occurrence of several less frequent species, were correlated to high salinity values recorded during 1971. The significant decrease in abundance of METEORUS PATRUS from 1970 to 1971 was felt to be related to the increased salinity. Heavy freshwater runoff as a result of large quantities of rainfall during parts of 1970 and 1972 were directly correlated to high abundances of cladocerans and corixidae in the discharge area. Changes in abundance of some species of animals was felt to be influenced, at least partially, by the disappearance of RUPPIA HABITONIA beds in the discharge area. Generally, it appeared that, with the exception of Cedar Bayou, the power plant had little effect on the zooplankton in the study area, with most changes resulting from natural alterations in the estuarine environment. (auth) (ST)

<307>

Jorgensen, C.B., On Gill Function in the Mussel MYTILUS EDULIS L.

1974. Ophelia, 13, 187-232 (Universitetsparken, Zoophysiology Laboratory, Copenhagen, Denmark)

Small food particles moved along the ciliary tract inside the marginal food groove of MYTILUS EDULIS at mean rates that varied from 0.21 mm/sec at 5°C to 0.60 mm/sec at 20°C. (ST)

<308>

Janchis, O.B., On the Biology of DACTYLOGYRUS NASALIS Strelkov et Ka Ky, 1968.

1974. Parazitologiya (USSR), 8, 205-207 (State Research Institute, Lacustrine and Fluvial Economy, Leningrad, USSR)

DACTYLOGYRUS NASALIS, a stenothermic psychrophilous parasite of young carp fish, occurred in autumn and winter at a water temperature of 2 to 14°C. It occurred on the body and fin surfaces of young larvae and on the gills and in the nasal cavities of older larvae. (ST)

<309>

Jungblath, J.H., The Distribution and Ecology of BYTHINELLA DUNKERI COMPRESSA (Frauenfeld 1856) (Mollusca: Prosobranchia).

1973. Verh. Int. Ver. Limnol., 18, 1574-1585 (Not Given)

Populations of BYTHINELLA DUNKERI COMPRESSA were concentrated in the Vogelsburg at altitudes of more than 500 m in deciduous forests where temperatures differed from the less populated coniferous forest open land areas. Similar conditions coincided with distribution in the Rhone. In relation to the history of the Vogelsburg flora and to the rotation of cleared woodland and afforestation, the distribution of this mollusc must have been due to seasonal water temperature variations. (BPC)

<310>

Juracek, E., Lake Sangchris: Case History of an Illinois Cooling Lake.

1974. Part of Gallagher, B.J. (Ed.), Proceedings of a Symposium on Energy Production and Thermal Effects held in Oak Brook, Illinois, September, 10-11, 1973. Linnetics, Inc., Milwaukee, Wisconsin (Commonwealth Edison Company, Chicago, IL)

The history of Lake Sangchris and legal controversies concerning the environmental impact of thermal effluents from Kincaid generating station are presented. Past and present environmental studies including fishkills from unknown causes, primary and secondary productivity and chemical pollution are discussed. (ST)

<311>

Kanep, S.V., Characteristics of Growth and Sexual Maturation of Whitefish COREGONUS LAVARETUS (L.) in Waters of USSR.

1974. Vopr. Ikhtiol., (USSR), 14, 1053-1065 (State Research Institute, Lake, River and Fishery Industries, Leningrad, USSR)

Whitefish of the northern and northwestern USSR were characterized by slow development, delayed maturation and low productivity. Growth rates were accelerated and sexual maturation was reached earlier in southern waters; however, adult fish were smaller. (ST)

<312>

Karep, S.V., Comparative Productivity of Certain Whitefishes.

1974. Srovnitel'naya Produktivnost' Rikotorykh Sigovykh Ryb Rybnoe Khozaystvo (USSR), No. 4, 26-27 (Goskhimiz, USSR)

The dependence of the age of sexual productivity on the heat content of residence waters for four species of whitefish is given in the form of equations of regression. Half of all factors affecting the attainment of sexual productivity depended on the amount of heat in the water. Cisco possessed a high growth rate and reached sexual maturity at two to three years of age. (ST)

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Kasinathan, P., K. Govidan, and R. Natarajan, Notes on the Spawning and Hatching of Three Species of Marine Gastropods.

1978. Malacology: Rev., 7, 133-138 (Mar. Biol. Soc. Annamalai University, Cent. Adv. Study in Mar. Biol., Porto Novo, Tamilnadu, India)

Specimens of *DISTORTIBIUM CAMPBELLINUS*, *NASSA DORSATA* and *STYDATTINA VELDM* were collected from the Porto Novo coast of India during January 1971 and February 1972, from trawl catches at a depth of 15 to 20 fathoms. In the laboratory the snails were placed in glass troughs with aerated seawater that varied in salinity from 30 to 35‰ and in temperature from 27 to 31°C. For each species, a description is given of the spawning process, the egg masses produced, and the development of the larvae. (Auth)

<314>

Kasschau, R.B., The Relationship of Free Amino Acids to Salinity Changes and Temperature-Salinity Interactions in the Red Flat Snail *NASSARIUS OBSOLETUS*.

1975. Comp. Biochem. Physiol., 51A, 391-399 (University of Texas System Cancer Center, R.D. Anderson Hospital and Turner Institute, Houston, TX)

NASSARIUS OBSOLETUS tolerated salinities as low as 12 psu at both 10 and 25°C. Hemolymph sodium and potassium determinations showed *N. OBSOLETUS* to be an osmoconformer which is able to concentrate potassium. In both 10 and 25°C acclimated snails, the primary amino acids involved with salinity change were taurine, glutamic acid and aspartic acid. The total FAA pool and component amino acids were found in higher concentrations in 10°C acclimated animals at all salinities. (Auth)

<315>

Katz, L.B., Laboratory Studies on Diet, Growth, and Energy Requirements of *PSEUDOLUS HYPEROCLITUS* (Linnaeus).

1975. Ph.D. Thesis, University of Delaware, 81 p. (University of Delaware, Newark, DE)

The growth and energy requirements of *PSEUDOLUS HYPEROCLITUS* offered diets of animal material, plant material and detrital material were studied under laboratory conditions. The results of the study indicated that this species could not be sustained under diets of plant or detrital material. Growth rates of fish fed various ratios of animal material indicated that optimum conversion efficiency at 20°C occurred at a ration of approximately 15% of body wt/day. Comparisons of laboratory growth rates with previously estimated rates in the field demonstrated that higher growth rates occurred in the laboratory. A model of energy utilization in Canary Creek, Lewes, Delaware, based on laboratory findings, estimated that the energy requirements, for maintenance of the Canary Creek population of *P. HYPEROCLITUS*, totaled 4185 calories/H(2)/day. Energy requirements for the observed summer production in Canary Creek was estimated to be approximately 850,000 calories/H(2) over a 70 day period. (Auth)

<316>

Kearns, G.C., Host Finding by *HYSTEROHELLA SOLLEAZ*, a Monogenean Shistosome Parasite of the Common Sole (*SOLEA SOLLA*).

1978. Proc. Challenger Soc., 2, 227 (University of East Anglia, School of Biological Sciences, United Kingdom)

The free-swimming life of *HYSTEROHELLA SOLLEAZ*, a monogenean shistosome parasite of the common sole, *SOLEA SOLLA*, lasted 9 to 14 hr. at 17°C and 20 to 30 hr. at 7°C. If invasion of the host does not take place, the parasite dies. (ST)

<317>

Kellner, R.B., Development and Survival of Sex Chromosomal Genotypes. Studies of Embryonic Killifish (*OSTEIAS LATIPES*) Under Normal Conditions and Under Environmental Stress.

1973. Ph.D. Thesis, State University of New York, 151 p. (State University of New York, Downtown Medical Center, NY)

Embryos of the killifish, *OSTEIAS LATIPES*, of known genotype were incubated at selected temperatures from 5 to 40°C. The YY and XY (maternal Y and paternal X) sex chromosome genotypes were not as viable as the XX and XY (maternal X and paternal Y) at 20 to 32.5°C, inclusive. This difference was most pronounced at the extremes of 17.5 and 35.0°C. Most deaths occurred at gastrulation. In another study, embryos were stressed by a temperature shock (from 30 to 35°C). The XY genotype was less viable than the XX when stress was begun prior to gastrulation, but both genotypes survived equally well when stress was delayed until after gastrulation. The YY was also able to survive better than the XY when stress was delayed until after gastrulation. (ST)

<318>

Kelso, J.B.H., and C.E. Binas, Summer Distribution of the Nearshore Fish Community near a Thermal Generating Station as Determined by Acoustic Census.

1975. Jour. Fish. Res. Bd. Can., 32, 1409-1418 (Department of the Environment, Fisheries and Marine Service, Great Lakes Biology Laboratory, Canada Centre for Inland Waters, Burlington, Ontario, Canada)

The relation between thermal plumes and fish abundance and distribution was studied at the Pickering Nuclear Generating Station, Lake Ontario, using simultaneous digital echo counting and temperature monitoring systems during summer thermal stratification of the lake. Fish relative abundance varied from 20.8/10,000 meters cubed to 1.037/10,000 meters cubed and both these extreme density estimates occurred in the 7.5 to 12.5-m depth shell. Also, changes in distribution of the nearshore community were apparent during the study period, July to October. The fish community in July was pelagic and selected 10 to 11°C and 18 to 16°C. That same community later appeared to become segregated into benthic and pelagic communities. Thermal plumes, either well defined or diffuse, appeared to have little effect on the pelagic community either because fish were not available to elevated temperatures by habitat selection or because fish failed to respond to increased surface temperatures. (Auth)

<319>

Kendall, A.W., Jr., and J.W. Pointjev, Geographic and Hydrographic Distribution of Atlantic Menhaden Eggs and Larvae along the Middle Atlantic Coast from 97 U.S. Fish Cruises, 1945-1946.

1974. Fishery Bull., 72, 317-335 (National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Sandy Hook Laboratory, Highlands, NJ; National Marine Fisheries Service Atlantic Estuarine Fisheries Center, Beaufort, NC)

Atlantic menhaden, *BREXIDONIA TYPHUS*, eggs and larvae were collected during eight ichthyoplankton cruises from December 1965 to December 1966. On each cruise two were made with a Gulf V plankton net at 92 stations along 18 transects from the coast to the edge of the continental shelf from Martha's Vineyard, Mass., to Cape Lookout, N.C. Larvae resulting from a protracted spawning season were taken throughout the year. Eggs were taken over the middle of the shelf in fall. Seasonal shifts in geographic pattern of larvae indicated spawning started in summer off New Jersey and New York, became widespread in the Middle Atlantic Bight in fall, and continued into winter off North Carolina. Larvae were equally distributed in shallow (0 to 15 m) and deep (16-300 m) tows during night and day. Larvae occurred over a water temperature range from 0 to 25 C and a salinity range of 14 to 36 ppt. Most larvae were taken at temperatures between 15.0 and 18.5 C. Seasonal distribution of larvae suggests some of the annual variation in year classes may be due to cold-related mortality of larvae entering middle Atlantic estuaries in late fall. (Auth)

<320>

Kennedy, V.S., W.R. Fossenberg, N. Castagna, and J.A. Hershby, *BREXIDONIA TYPHUS* (Mollusca: Bivalvia): Temperature-Time Relationships for Survival of Embryos and Larvae.

1974. Fishery Bull., 72, 1163-1166 (University of Maryland, Chesapeake Biological Laboratory, Solomons, MD; Virginia Institute of Marine Science, Eastern Shore Laboratory, Wachapreague, VA)

To estimate the effects of entrainment of *BREXIDONIA TYPHUS* embryos and larvae in the cooling-water systems of stream-electric power plants, a thermal gradient apparatus was used. Cleavage stages, trochophore larvae and straight-hinge veliger larvae were subjected to 11 different temperatures for 8 different time periods. Temperatures ranged from 17.4 to 33.1 C; time intervals ranged from 1 to 360 min. There was a direct relationship of mortality with temperature increase and, at higher temperatures, with increase in time exposure. As the class aged, temperature tolerance increased, with cleavage stages most sensitive to higher temperature and straight-hinge larvae least sensitive. Multiple regression analysis of percentage mortality on temperature and time produced estimating equations that allow prediction of percentage mortality under different conditions of temperature and time exposure. Entrainment of *B. TYPHUS* embryos and larvae in cooling systems of power plants should be as short as possible to keep mortality to a minimum. (Auth)

<321>

Fennish, H.J., and R.R. Olsson, Effects of Thermal Discharges on the Microstructural Growth of *BREXIDONIA TYPHUS*.

1975. Environ. Geology, 1, 41-64 (Rutgers University, Department of Geology, New Brunswick, NJ)

The effects of thermal discharges from the Oyster Creek Nuclear Generating Station at Passaic Bay, New Jersey, are recorded in the microstructural growth of *BREXIDONIA TYPHUS*, a common coastal marine pelecypod. The analysis of the shell microstructure shows that this bivalve acts as an effective monitor of the environmental conditions existing in the marine waters adjacent to the power station. Many physiological and environmental events such as spawning, winter freeze shocks, summer heat shocks, thermal shocks, tidal cycles, and major storms are clearly recorded in the shell microstructure. The exact time of occurrence of these events can be determined by counting daily growth increments backwards from the outer shell margin of freshly killed individuals. Microstructural growth patterns reflect in Passaic Bay specimens indicate that these pelecypods were affected mainly by temperature extremes, temperature variations, tides, type of substrates, and age. Growth patterns in specimens from areas surrounding Oyster Creek (affected by thermal effluent) are significantly different from those from other bay localities (unaffected by thermal effluent) *BREXIDONIA TYPHUS* within approximately a 1.6 km radius of Oyster Creek show a lower summer growth rate (10 percent to 15 percent lower) and a greater number of growth breaks (2 to 6 per class) than those away from the creek. The lower summer growth rates occur in bivalves subjected to the effluent because the added heat during the summer months causes water temperatures to exceed a critical threshold for optimum growth in the species. The greater number of growth breaks takes place, in turn, because many of the breaks (thermal shock breaks) are generated by rapidly fluctuating temperatures associated with abrupt shutdowns, massive load reductions and rapid removal of operations following shutdowns or load reduction periods at the nuclear power station. In addition, the effluent may be upsetting natural spawning events in the class when abrupt changes in power station operations overlap with spawning periods. In this respect, spawning may be precluded by sharp temperature changes which result in physiological shocks to the animal. (Auth)

<322>

Kove, R.P., Conditions of the Development of Plankton Algae Population Series in the Eastern Main Canal and the Tisza.

1974. Tisza, (Hung.), 9, 161-162 (Not Given)

The role of temperature in the development of a population series of algae dominated by *CHLORELLA* species at the beginning of each year since 1969 in the Eastern Main Canal (Hungary) has not been clarified but has been assumed to be important. In some cases, various algal populations coincided with temperature increases while in others, temperatures were decreasing. (RPC)

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<323>

Khalanski, S., Studies Carried Out in France on the Ecological Consequences of Open-Circuit Cooling in Thermal Power Stations.

1975. CONF-763029; STI/PDB/378; IAEA-SM-187/36; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 851-877) (Electricite de France, Direction des Etudes et Recherches, Chatou, France)

Studies carried out during the last ten years on the effects of open circuit power plant cooling systems on aquatic organisms are summarized. (ST)

<324>

Kikuchi, S., and S. Uki, Technical Study on Artificial Spawning of Abalone, Genus *HALIOTIS*. I. Relation between Water Temperature and Advancing Sexual Maturity of *HALIOTIS DISCUS* SAWAH Iino.

1974. Bull. Tokyo Reg. Fish. Res. Lab., 33, 69-78 (Not Given)

Abalones were cultured in the laboratory at six different water temperatures ranging from 8 to 22 C. Best growth occurred at 17 C. Sexual maturity was closely related to water temperature. Theoretically the lowest temperature at which sexual maturity could be reached was 7.6 C. (ST)

<325>

Kikuchi, S., and S. Uki, Technical Study on Artificial Spawning of Abalone, genus *HALIOTIS*. II. Duration of Fertility Related to Temperature.

1974. Bull. Tokyo Reg. Fish. Res. Lab., 49, 73-75 (Not Given)

The duration of fertility of abalone eggs and sperm was studied at temperatures ranging from 9 to 26 C. Highest fertility (fertilization rate greater than 80%) at 26.2, 17.3 and 13.6 C lasted approximately one, three, and four hours, respectively. Materials kept at 9 C showed low fertility throughout the experiment. Thus, at field temperatures high fertility lasted for one to three hours after spawning. (ST)

<326>

Filgen, B.H., Artificial Spawning and Hatching Techniques for Blacktail Redhorse.

1974. Progressive Fish Culturist, 36, 174 (Nicholls State University, Department of Biological Sciences, Thibodaux, LA)

Artificial spawning and hatching techniques for blacktail redhorse, *MOXOSTOMA PORCILLUM* are presented. Hatching occurred at eight days, swim-up stage at 12 days, and fry fed on yeast at 16 days. Optimum temperature for culture was 20 C. (Auth)

<327>

Sin, B.K., and T.S. Ko, Studies on the Bearing of Blue Crab, *PORTUNUS TRITUBERCULATUS* (Hiers).

1974. Bull. Fish. Sci. Dev. Agency, Pusan, (Korea), 13, 93-102 (Fisheries Research and Development Agency, Pusan, Korea)

For growth studies, crabs of 6.7 or 6.9 cm carapace width, and 36.3 or 37.2 g body weight, on average, were used. The survival studies utilized crabs of 458.6 g average weight. There was no difference in growth at densities of 5 individuals/m² and 10/m²; the former grew to 11.11 cm carapace width and 160.4 g body weight, and the latter to 10.99 cm and 154.1 g. Survival rate of individuals at these densities was 18.8% and 10.6% respectively. Survival with individual feeding was 81.6%, but there were no differences in growth between bass fed and individually fed specimens. There were 1 or 2 periods of ecdysis during the 105 days of feeding. The most suitable size for rearing is considered to be 6.6 cm carapace width, and 38.8 g body weight. Survival rate of fed individuals in survival studies was 76.7% and in non-fed individuals 60.0%. Crabs died at water temperatures of approximately 5 C. (Auth)

<328>

Sin, I.B., and J.Y. Jo, Bearing of the Early Stage of the Eel-*ANGUILLA JAPONICA*.

1974. Bull. Korean Fish. Soc., 7, 179-186 (Pusan Fisheries College, Pusan, Korea)

The optimum temperature for early culture stages of the eel, *ANGUILLA JAPONICA*, was 30 C. An equation for the growth rate over a 10-day period at temperatures between 20 and 30 C is given. (ST)

<329>

Sin, I.B., and S.J. Park, An Observation of Water Quality and Red Water in Still Water Fish Ponds.

1974. Bull. Korean Fish. Soc., 7, 69-78 (Pusan Fisheries College, Pusan, Korea)

Red water in Korean fish ponds was caused by the death of the blue-green alga *SYNECHOCYSTIS AQUATILIS* when water temperatures reached 30 to 33.5 C. High fish mortality followed. (ST)

<330>

Sirk, S.L., The Effects of Hypoxia on Certain Blood and Tissue Electrolytes of Channel Catfish, *ICTALURUS PUNCTATUS* (Bafraesque).

1974. Trans. Amer. Fish. Soc., 103, 593-600 (Southern Illinois University, Department of Zoology, Carbondale, IL)

Hypoxia in channel catfish, *ICTALURUS PUNCTATUS*, produced an acidosis characterized by an increase in blood lactate, a decline in blood pH, and a shift in electrolyte levels among fluid compartments. The pattern appeared to be influenced by season or temperature. Plasma osmolality dropped below control levels in June (temperature, 22 C) and remained depressed after 36 hr of recovery. In August (temperature, 26 C) plasma osmolality fluctuated at levels above control values and had not returned to normal after 48 hr. The data indicated that electrolyte imbalance persists for many hours after blood lactate has declined to control levels and this imbalance may limit the fish's ability to tolerate further stress. (ST)

<331>

Kitchell, J.P., J.P. Koence, B.V. O'Neill, B.H. Shagart, J.J. Hagmaron, and P.S. Booth, Model of Fish Biomass Dynamics.

1974. Trans. Amer. Fish. Soc., 103, 786-798
(University of Wisconsin, Laboratory of Limnology, Madison, WI; Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

A model of fish biomass dynamics was developed based on principles of physiology, population biology, and trophic ecology. The model is designed to incorporate measurable parameters for simulating seasonal changes in a natural population. All parameters were implemented for the bluegill (*LEPOMIS MACROCHIRUS*) and simulation results compared with independently derived laboratory and field data. Applications of the model to thermal enrichment problems are given as an example of future potential uses. (Auth)

<332>

Kititsina, L.A., Effect of Heated Water Discharge of Thermal and Nuclear Power Plants on Invertebrates of Cooling Ponds.

1973. Gidrobiol. Zh. Akad. Nauk. Ukr. (USSR), 9, 104-120 (Institute of Hydrobiology, Kiev, Ukraine, USSR)

The literature on the effects of thermal effluents from power plants on the quantitative development of fauna is reviewed. The biology and production of invertebrates in cooling ponds and the accumulation of metals and radioactive substances in aquatic organisms in heated areas are considered. The need for further studies to elucidate the reaction of aquatic organisms at all levels to heat is noted. (ST)

<333>

Kititsina, L.A., Effect of Hot Effluent from Thermal and Nuclear Power Plants on Invertebrates in Cooling Ponds.

1973. Hydrobiological Jour., 9, 67-79 (Not Given)

Through a summary of reported effects of thermal effluents from power plants on cooling pond invertebrates, the author details a number of recommendations to minimize those that are adverse. The 111 references include research on the development, abundance and biomass of whole populations, mechanical effects of entrainment, effects on primary and secondary pollutants, effects on size, reproduction, life cycles, growth and development rates of individuals, species diversity, fouling organisms and prevention methods, and beneficial uses. The survey reviews research done in the USSR, Poland, Bulgaria, Hungary, England, Scotland, France, and the United States. (RFC)

<334>

Kititsina, L.A., and N.L. Pidgaiko, Production of *POSTOGAMMARUS ROBUSTOIDES* Grinn. in Reservoir-Cooler of the Karakhoran State Regional Electric Power Station.

1974. Gidrobiol. Zh. Akad. Nauk. Ukr. (USSR), 10, 30-37 (Institute of Hydrobiology, Ukrainian SSR, Kiev, USSR)

The production of two *POSTOGAMMARUS ROBUSTOIDES* populations was estimated in

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sections of a reservoir receiving cooling water from the Karakhoran electric power station, USSR. Age structure of the population in the heated section changed over to two months earlier than that in the control area. Production of *P. ROBUSTOIDES* in the heated zone reached a peak in spring; the control one peaked in summer. Under heated conditions the annual biomass was reproduced five times a year and under control conditions, four times a year. (ST)

<335>

Klarer, D.W., and E. Hickman, The Effect of Thermal Effluent Upon the Standing Crop of an Epiphytic Algal Community.

1975. Intl. Rev. Gesamte Hydrobiol. (Ger.), 60, 17-62 (University of Edmonton, Glasgow University Field Station and Department of Botany, Alberta, Canada)

The investigation of epiphyton associated with *SCIRPUS VALIDUS* Vahl. in Lake Nabaran commenced in May 1971 and continued until the end of August 1972. Seven stations encompassing heated, partially and non-heated areas of the lake were investigated. From July 1971 until the termination of the investigation water temperature, dissolved oxygen and water chemistry were monitored. There were no large variations in these parameters except for water temperature and dissolved oxygen levels among the stations. However, there were increases in the dissolved silica, nitrate-nitrogen and phosphate-phosphorus levels during the autumn and winter months at the heated stations while at a partially heated station only dissolved silica and nitrate-nitrogen increased. The epiphyton at all stations showed a spring maximum, a summer minimum, and a maximum in the late summer/early autumn. The spring dominants at all stations were *FRAGILARIA CAPUCINA* and *DIASTOMA FLONGICORNIS*. During the late summer/early autumn maximum diatoms were dominant at the non-heated stations while chlorophytes species were dominant at the heated stations. The heated water caused a decrease in the number of species and a corresponding increase in the importance of a few species at the heated stations. The major impact of the heated water, however was an extension of the period of open water and the corresponding increase in mean yearly standing crop size in the heated area. (Auth)

<336>

Klein Breteler, W.C.A., Laboratory Experiments on the Influence of Environmental Factors on the Frequency of Moulting and the Increase in Size at Moulting of Juvenile Shore Crabs, *CARCINUS MAEULIS*.

1975. Neth. Jour. Sea Res., 9, 100-120 (Netherlands Institute of Sea Research, Texel, Netherlands)

Temperature influenced the time interval between molts of juvenile shore crabs. Although no significant influence on size increase/molting was found, crabs kept at 15 C were significantly heavier than those kept at 20 C. With restricted feeding growth was less retarded at a low than at a high temperature. (ST)

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Kline, D.L., Coastal COLICOIDES of North Carolina: Species Composition, Seasonal Incidence, and Distribution Within Salt Marshes.

1975. Ph.D. Thesis, North Carolina State University, 166 p. (North Carolina State University, Raleigh, NC)

Thirteen species of COLICOIDES were collected over a two year period from a coastal North Carolina area. Seasonal peaks in abundance were noted. Catch size of *C. NOTLUSIS* and *C. PUMENS* were correlated with date, temperature, vegetation and percentage of tide salt marshes were flooded. (ST)

<338>

Knight, A.W., and H.A. Simmons, Factors Influencing the Oxygen Consumption of Larval *NECHOMIA SERRICORNIS* (Say) (Megalopectera: Corydalidae).

1975. Comp. Biochem. Physiol., 51A, 117-123 (University of California, Department of Water Science and Engineering, Hydrobiology Laboratory, Davis, CA)

The oxygen consumption of larval *NECHOMIA SERRICORNIS* was evaluated over a range of 10 to 35 C in all seasons. There appeared to be little, if any, seasonal acclimation to temperature. Recently hatched larvae differed little from large larvae in respiratory response to temperature and season. However, the response of large larvae was greater at 10 to 20 C than at 25 to 35 C. The influence of temperature and season on respiration was compared between *N. SERRICORNIS*, an inhabitant of summer-cold streams, and *CORYDALUS CORVATUS*, an inhabitant of summer-warm streams. Respiration increased with test temperature between 10 and 25 C. Seasonal differences did exist above 25 C with summer larvae having the highest level of respiration at 30 C, while fall larvae had the highest rate at 35 C. (Auth) (ST)

<339>

Knox, R.P., Alteration of Lipid Content of Tissues and Gonosomatic Indices of White Crappie by Thermal Additions in Thomas Hill Reservoir, Missouri.

1973. M.S. Thesis, University of Missouri; OMR-B-039-MO; 98 p. (University of Missouri, School of Forestry, Fisheries and Wildlife, Columbia, MO)

There was no difference in lipid content of gonads and muscle tissue of white crappie from the hot water and control arms of Thomas Hill Reservoir, Missouri. In the gut and liver, lipid levels were significantly lower in fish from the hot water arm compared to those from the control arm. Fish from the hot water arm significantly had lower gonosomatic indices. (ST)

<340>

Knutzen, J., and O. Skelberg, Water and Pollution Problems with Nuclear Power Plants.

1973. INIS-mf-1648; 22 p. (Borsk Institutt for Vannforskning, Oslo, Norway)

Field observations and experimental investigations with species and populations from Oslofjord, Norway, confirmed previous evaluations that cooling water discharge from a nuclear power plant would be detrimental to aquatic organisms. Measurable effects on primary production, the composition of plankton populations, and the mating and mortality of crustaceans and fish were found with temperature increases of a magnitude expected from thermal effluents. (ST)

<341>

Kobayashi, N., Studies on the Effects of Some Agents on Fertilized Sea Urchin Eggs, as a Part of the Cases for Marine Pollution Bioassay I.

1973. Publ. Seto Mar. Biol. Lab., 21, 109-114 (Doshisha University, Biological Laboratory, Kyoto, Japan)

A rise in temperature of more than 3 C above the usual summer water temperature high of 28 C reduced rates of fertilization and cleavage of sea urchin (*ANTHOCIDARIS CRASSISPINA*) eggs and increased polyspermy and cytolysis. Fertilization did not occur at temperatures above 37 C. (ST)

<382>

Kolehmainen, S.E., P.D. Martin, and P.B. Schroeder, Thermal Studies on Tropical Marine Ecosystems in Puerto Rico.

1975. COMW-740420; SSI/PUB/378; JAEA-SR-187/18; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 809-822) (Puerto Rico Nuclear Center, Radioecology Division, Mayaguez, Puerto Rico)

Studies have been conducted on zooplankton, micro- and macrobenthos, turtle grass (*Thalassia testudinum*) beds, mangrove communities and fish fauna in the vicinity of a 310-MW fossil-fuel-power-generating plant that has been operating for two decades. The temperatures in the heated effluent varied from 35°C in the winter to 40°C in the summer, or 10°C above the ambient water temperature. Organisms in Guayanilla Bay are also exposed to hydrocarbons and heavy metals discharged by the nearby petrochemical and chemical plants. The additional effects of elevated temperatures on the organisms have been determined by comparing the communities in the thermal plume to those near the cooling water intake area which has the same chemical pollutants as the plume but does not have elevated temperatures. Results indicated that about 95% of zooplanktons were killed in the condensers and in the discharge canal. Further mortality occurred in the plume within 100 m from the mouth of the discharge canal. At this point the temperatures were still 8°C above the ambient. With a 1 to 6°C increase in temperature, species diversity and biomass were higher than at ambient temperatures. This was assumed to be a result of increased nutrient content of water due to the decomposition of killed plankton. During a period when large volumes of water at ambient temperatures were pumped through a new power-generating unit, it was observed that most of the mortality was due to the relatively long exposure (18 min) to the elevated temperatures in the discharge canal rather than the short (4 sec) exposure in the condensers, or the mechanical damage in the water pumps. Species diversity of foraminiferans was lower in the thermal plume than in control areas. Benthic sessile organisms were nearly non-existent in the Bay. Benthic macroorganisms were not found in areas where water temperature on the bottom was 5°C above the ambient. Turtle-grass biomass was lower in the thermal plume than in control areas. The upper lethal thermal maximum was determined to be between 35 and 36°C. Species diversity and biomass of sessile organisms living on the prop roots of mangroves were not affected below 34°C. Biomass of this community was highest between 5°C and 7°C above ambient and the number of species was inversely related to the temperature above 35°C. Despite the chemical pollutants, there were more species living on the prop roots in Guayanilla Bay at the control area than in Jobos Bay (on the south coast of Puerto Rico), which is without high levels of pollution. Species diversity of fish in the heated area of Guayanilla Bay was similar to that of the inner, turbid part of Jobos Bay. The number of fish species in the heated area was 28 compared with 53 in control area. The species most tolerant to elevated temperature were bluegreen algae, mangrove trees, certain molluscs, crabs, and fish, all of which had populations living at 37°C or higher. The most sensitive organisms were red and brown algae, coelenterates and echinoderms. Thermal maxima of individual species were 1 to 2°C higher than reported for the same species in the subtropics. (Auth)

<383>

Korovin, V.A., and N.P. Sitkevich, Growth and Chemical Composition of Juvenile Carp (*Cyprinus Carpio* L.) in Relation to the Quality of the Parents and Temperature Conditions in Nursery Ponds.

1973. Jour. Ichthyol., 13, 543-549 (Planning and Technological Institute, Siberian Animal Husbandry Research, Novosibirsk, USSR)

The effect of water temperature and the quality of the spawners on the growth and fat content of juvenile (*Cyprinus Carpio*), were investigated. A combination of environmental (temperature) and genotypic factors has the maximum effect on growth rate juveniles from parents of the best quality have growth advantages under any conditions. The chemical composition of the underyearlings and yearlings is wholly determined by heredity. The process of lipid accumulation proceeds uniformly during the first summer. Losses of weight and of reserve lipid during the overwintering period proceed less intensively in the elite juveniles than in their 1st and 2nd class cohorts. The data obtained demonstrate the need for selection in carp brood stocks. (Auth)

<384>

Foval'chuk, T.V., Ecology of the Amphipod *Postogammarus Chassus* (C.O. Sars) in the Kiev Reservoir.

1974. Glacobiol. Akad. Zh. Nauk. Ukr. (USSR), 10, 82-84 (Institute of Hydrobiology, Ukrainian SSR, Kiev, USSR)

The amphipod, *Postogammarus Chassus*, appears on submerged aquatic vegetation in early spring when the water temperature reaches 13.5 to 15.8°C. Maximum abundance is reached in late August and early September. In the fall it moves into coxes where it winters. Optimum water temperature is 18 to 22°C. (ST)

<385>

Kremer, B.P., Mannitol Metabolism in the Marine Brown Algae *Fucus Serratus*.

1975. Zeit. Pflanzenphysiol. (Ger.), 74, 255-263 (University of Köln, Botanical Institute, Köln, West Germany)

Kinetic studies on C-14 photosynthesis in *Fucus Serratus* provided evidence that mannitol is significantly stronger C-14 labelled after photosynthesis at 22°C than at 8°C. At lower temperatures phosphate esters as precursors in the pathway of mannitol biosynthesis show higher percentage labelling. After pulse labelling by photosynthesis in C-14 bicarbonate (10 min) and subsequent light periods from 10 min to 3 hr the insoluble fraction is rather slowly labelled. In the soluble fraction percentage labelling of mannitol amounts to a constant level of 95% of total C-14 labelling. Under these conditions mannitol content shows no remarkable changes. During subsequent dark periods, however, specific activity of C-14 mannitol decreases continuously, whereas the total amount of C-14 TCA cycle intermediates increases. From these data it is concluded that mannitol serves as a quickly available substrate of respiration in brown algae. (Auth)

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Kryachkova, V.N., Effect of Temperature and Trophic Conditions on the Duration of Development in Cladocera.

1973. Gidrobiol. Akad. Zh. Nauk. Ukr. (USSR), 9, 69-79 (Belorussian State University, Minsk, USSR)

The rate of embryonic and postembryonic development of Cladocera at different temperatures was approximately described by the Knight's normal curve. (57)

<347>

Katuradze, A.N., Characteristics of the Spawning Population and Reproduction of the Pike-Perch *LUCIOPELCA LUCIOPELCA* (L.) of the Danube Delta and Waters of the Danube Area.

1974. Vopr. Ikhtiol., (USSR), 18, 445-453 (Azov-Black Sea Research Institute of Marine Fisheries and Oceanography, Odessa, USSR)

Pike-perch in the Danube delta, USSR, began spawning at a water temperature of 10 to 11 C and 10 to 15 days later than the pike-perch in the Danube region, where spawning began at a water temperature of 8 C. In the delta the spawning period was shortened and all age groups spawned at the same time. (57)

<348>

Kelitova, V.A., and V.D. Tabunkov, Ecology, Reproduction, Growth and Productivity of the Population of Scallop *PIZUCHOPECTEN YESSOEVSIIS* (Dysodonta, Pectinidae) in the Busset Lagoon (Aniwa Bay).

1974. Zool. Zh. (USSR), 53, 1767-1774 (Institute of Oceanology, Moscow, USSR)

Spawning of the scallop, *PIZUCHOPECTEN YESSOEVSIIS* in Busset lagoon, Aniwa Bay, USSR, took place from early July to mid-August at a water temperature of 16 to 17 C. (57)

<349>

Kuo, C., and C.E. Nash, Recent Progress on the Control of Ovarian Development and Induced Spawning of the Grey Mullet (*MUGIL CEPHALUS* L.).

1975. Aquaculture, 5, 19-29 (Oceanic Institute, Waimanalo, HI)

The paper describes some past and current work for the control and regulation of ovarian development and induced spawning of the grey mullet (*MUGIL CEPHALUS*). It reports on the induction of ovarian maturation out of season by manipulation of photoperiod and temperature cycle, and recommends conditions of constant temperature control at 21 C and photoperiod of 6L/18D for the best results using fish with oocytes in the refractory period. It also recommends salmon pituitary gonadotropin SG-G100 as the best ovulating agent for reliable results, but suggests further research with alternative gonadotropins and steroids. The paper describes some recent progress with the latter. (Auth)

<350>

Kuo, C., C.E. Nash, and Z.N. Shehadeh, The Effects of Temperature and Photoperiod on Ovarian Development in Captive Grey Mullet (*MUGIL CEPHALUS* L.).

1974. Aquaculture, 3, 25-41 (Oceanic Institute, Waimanalo, HI; Department of Fisheries FAO, Rome, Italy)

Onset of vitellogenesis for the grey mullet, *MUGIL CEPHALUS*, is timed by the environmental conditions. A retarded photoperiod, irrespective of preconditioning photoperiod, plays a dominant role in stimulating oocyte growth. Temperature regulates vitellogenesis towards functional maturity. The combination of retarded photoperiod (6L/18D) and constant temperature of 21 C is the most effective for the completion of vitellogenesis of oocytes to functional maturity. Regular injections of pregnant mare's serum gonadotropin (PMSG) at 1 IU/g body weight are effective in initiating vitellogenesis. (UD)

<351>

Kutty, M.N., and N. Setumaran, Influence of Upper and Lower Temperature Extremes on the Swimming Performance of *TILAPIA MOSSAMBICA*.

1975. Trans. Amer. Fish. Soc., 104, 755-761 (Madurai University, Department of Biological Sciences, Madurai, India)

TILAPIA MOSSAMBICA (mean size: 13 cm) acclimated to 30 C in fresh water and forced to swim at current speeds of 36, 66, and 82 cm/s in Blazka's activity apparatus failed to swim at 39.7, 38.4, and 37.0 C respectively, when the temperature of ambient water was gradually increased from the acclimation temperature. The lower critical temperatures of swimming failure at the same three swimming speeds were 17.4, 18.8, and 19.8 C, respectively. The pattern of swimming failure at the critical temperature was similar to that at critical ambient oxygen concentrations. At both the upper avoidance temperature of *T. MOSSAMBICA* in relatively quiet water was much lower than the upper critical temperatures of swimming failure. Since such failures do not incapacitate the fish from further performance and since the critical temperatures can be considered as points in a temperature gradient in running water, it appears that these temperatures are indicative of a thermal avoidance in running water. (Auth)

<352>

Kutuzov, A.N., Repeated Spawning of White Breams *BLICCA BJORKERVA* (L.) in the Sviyazh Bay of the Kuibyshev Reservoir.

1974. Vopr. Ikhtiol., (USSR), 18, 1025-1028 (Kazan State University, Department of Vertebrate Zoology, Kazan, USSR)

White breams, observed over a two year period, spawned twice a year. The initial spawning in May was interrupted by cold temperatures. Spawning resumed in April and continued until late June or July. The second spawning was initiated by an increase in water temperature which reached 12 C. (57)

<353>

Kawatani, Y., T. Nishii, and S.T. Wada, Growth and Maturation of Japanese Pearl Oysters Reared in Tanks in Winter.

1974. Bull. Natl. Pearl Res. Lab. (Jap.), 18, 2118-2129 (Not Given)

Japanese pearl oysters were reared in tanks in winter at temperatures of 18, 18, 22, 26, and 30 C. The test animals gained more underwater weight in the high water temperature tank than in the low one. The daily increase of underwater weight per animal in the tanks of 22 C, 26 C, and 30 C nearly corresponded to that in natural sea water from summer to autumn. The change of the meat weight, however, was complicated probably because it is related to maturation and spawning. With the results of the histological observation of gonads of test animals, mature or spawned individuals were observed in the higher water temperature tanks. Although induction of artificial spawning and fertilization were not conducted, gonad development of pearl oysters, for artificial spawning might be induced by this method in winter. (Auth) (ND)

<354>

Kuusi, W., Embryonic Development, Early Growth, and Seriotic Variation in Rainbow Trout (SALMO GAIREDNERI) Exposed to Combinations of Light Intensity and Temperature.

1975. Jour. Fish. Res. Bd. Can., 32, 397-402 (Ministry of Natural Resources, Fish and Wildlife Research Branch, Sault Ste. Marie, Ontario, Canada)

Lowest mortality rates of rainbow trout (SALMO GAIREDNERI) embryos were obtained at temperatures of 7 and 10 C and light intensities of 0.2 and 20 lux. Temperatures of 3 and 15 C and an intensity of 400 lux were near the thresholds for development. Eggs exposed to 0.2 lux required 111 days to reach 50% hatch at 3 C, but 26 days at 15 C; those exposed to 20 lux, 97 days at 3 C and 25 days at 15 C. Growth rates of rainbow trout 185 days after hatch were significantly different ($P < 0.05$) at 10 and 3 C, and 20, 2 and 0.2 lux. The fastest growth occurred at 10 C and 2 lux, and the lowest growth at 3 C and 0.2 lux. For increment of body weight it was about 23.8%/day of initial weight and 6.6% at 3 C. At light intensities of 20, 2, and 0.2 lux the rate per day was 24.7, 17.2, and 11.2%, respectively. However, increases in length occurred at a much reduced rate. Variations in numbers of vertebrae, gill rakers, and fin rays were positively correlated with the embryonic development rate. Longer incubation periods were usually associated with more seriotic elements, regardless of the environmental factors involved. (Auth)

<355>

Kuusi, W., Effects of Temperature on Development and Survival of Rainbow Trout, SALMO GAIREDNERI, in Acid Waters.

1975. Jour. Fish. Res. Bd. Can., 32, 493-497 (Ontario Ministry of Natural Resources, Fish and Wildlife Research Branch, Sault Ste. Marie, Ontario, Canada)

Differences in mortality of rainbow trout (SALMO GAIREDNERI) embryos were significant (P less than 0.05) when the eggs were exposed to 5, 10, and 15 C and pH levels from 3.0 to

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6.0. No embryos survived at pH values below 4.49, regardless of the temperature. The median lethal pH values for rainbow embryos were 4.75 and 5.52 at temperatures of 10 and 5 C, respectively. Differences in lethal pH values for fingerling rainbow trout were significant (P less than 0.05) when trout were exposed to four test water temperatures (5, 10, 15 and 20 C) and two acclimation temperatures (10 and 20 C). The median lethal pH values of fingerling trout were positively related to the test water temperatures and ranged from 3.86 to 4.49. Resistance of yearling trout to acid waters was higher than that of fingerlings. (Auth)

<356>

Swik, J.R., and J.C.H. Carter, Population Dynamics of Limnetic Cladocera in a Beaver Pond.

1975. Jour. Fish. Res. Bd. Can., 32, 341-346 (University of Waterloo, Department of Biology, Waterloo, Ontario, Canada)

The three cladocerans in a small, shallow, predation free beaver pond near Georgian Bay, Canada, had basically different seasonal cycles. CERIODAPHNIA QUADRANGULA was a predominantly summer species, DAPHNIA ANBIGUA was summer and autumnal, while BOSMINA LONGICORNIS occurred in relative abundance throughout the entire year. In the laboratory no eggs were produced by any species at 6 C. At 10 C, B. LONGICORNIS and C. ANBIGUA produced a few eggs. CERIODAPHNIA QUADRANGULA embryos developed most rapidly in the 16.5 to 25 C range. The lower temperature limit for development appeared to be above 10 C. BOSMINA LONGICORNIS development was slower than the other two species over most of the experimental range (from 6 to 30 C), but this species probably had the greatest tolerance for cold water. Over most of the upper range of temperatures the duration of embryonic development of D. ANBIGUA fell midway between that of the other two species. (ST)

<357>

Kylstra, C.D., and P.L. Bunker, Marine Environmental Interaction with an Offshore Nuclear Power Plant.

1974. Trans. Amer. Nuclear Soc., 18, 45-46 (University of Florida, Gainesville, FL)

An energy flow simulation model of an open-ocean ecological system was coupled to a simulation model of an offshore nuclear power plant. The state variables in the model were concentrations of phytoplankton, zooplankton, organic detritus, and microbes, nekton and benthic invertebrates, and phosphorus. The resulting changes in the discharge region relative to the intake side of the water temperature, amount and activity of life in each of the four state variables, as well as the amount and activity of life, were obtained as a function of time. The activity of life increased from 40 to 80% in the discharge region, as the warmer communities lived at a faster pace than their cooler neighbors. Since the total amount of biomass in the warm community decreased only slightly (approximately 95% of the reference natural system), and since no lethal temperatures were approached, the quantity of life was improved in the test situation. (ND)

<358>

<358>

Landry, R.E., The Relationship Between Temperature and the Development of Life Stages of the Marine Copepod *ACARTIA CLAUDI* Giesbr.

1975. Limnol. & Oceanogr., 20, 854-857
(University of Washington, Department of Oceanography, Seattle, WA)

The durations of life stages of the marine copepod *ACARTIA CLAUDI* relative to egg development time were consistently maintained when these animals were cultured with excess food at 10, 15, and 20 C. Seasonal acclimation effects, which have been shown to affect the egg development of *A. CLAUDI*, carried through an entire generation. At 20 C, copepods collected when the water was cold (12 C, spring) produced offspring that developed faster at every stage than the offspring from copepods collected during the fall (18 C). Development time for the other two groups (10 and 15 C) increased with decreasing temperature. Generation time or the development time of any postembryonic stage can be calculated from life history data at one temperature and the relationship between egg development at other temperatures regardless of the effect of acclimation. (Auth) (SD)

<359>

Landry, R.E., Seasonal Temperature Effects and Predicting Development Rates of Marine Copepod Eggs.

1975. Limnol. & Oceanogr., 20, 838-840
(University of Washington, Department of Oceanography, Seattle, WA)

Egg development rates of the marine copepod *ACARTIA CLAUDI* are affected by the temperature history of the female parent. The eggs from animals collected during winter (8 to 10 C) having significantly faster development rates under summer conditions (15-20 C) than those collected during summer (18-20 C). Adaptation of winter-acclimated animals to summer conditions is a slow process requiring longer than 1 generation at 20 C. Egg development rates of different species of marine copepods from the arctic to the tropics could also be related to temperature by different functions. When the effects of metabolic depression at the low and high limits of copepods' temperature range are considered, the data support the proposal that the relative rates of egg development for nine species of arctic-temperature marine copepods, *A. CALANUS SUPERCILIOSUS*, *C. GLACIALIS*, *C. PENNACRICUS*, *DISCAUDATUS*, *TEMORA LONGICORNIS*, *EURTEMORA HYBRIDOIDES*, *NETIDIA LONGA*, *PSEUDOCALANUS MINUTUS* follow a common temperature function. (Auth)

<360>

Langford, T.E., The Emergence of Insects from a British River, Warmed by Power Station Cooling-Water Part II. The Emergence Patterns of Some Species of Ephemeroptera, Trichoptera and Megaloptera in Relation to Water Temperature and River Flow, Upstream and Downstream of the Cooling-Water Outfalls.

1975. Hydrobiologia (Den.), 87, 91-133
(Freshwater Biology Unit, Batcliffe-on-Soar, Nottingham, England)

Although temperature increases reached 8 C, maximum water temperatures reached 28 C, total degree-hours were up to 24% more during spring and there was a four-week advance in degree-hour accumulation; there was no evidence of a pattern of early emergence of Ephemeroptera or Trichoptera downstream from cooling water outfalls of Ironbridge A and B Power Stations on the River Severn. Emergence of most species occurred at 12 to 28 C with no evidence of the high temperatures of 1970 having caused changes in the normal emergence patterns. (RFC)

<361>

Langford, T.E., and J.R. Daffern, The Emergence of Insects from a British River Warmed by Power Station Cooling-Water. Part I-The Use and Performance of Insect Emergence Traps in a Large, Spate-River and the Effects of Various Factors on Total Catches, Upstream and Downstream of the Cooling-Water Outfalls.

1975. Hydrobiologia (Den.), 86, 71-114 (Central Electricity Research Lab., Freshwater Biology Unit, Batcliffe-on-Soar, Nottingham, England)

During a program of research on the fauna of the River Severn around Ironbridge Power Station, the emergence patterns of resident insect species were studied upstream and downstream of the cooling-water outfalls. Upstream temperatures during 1970 and 1971 reached maxima of 22 C and 20.6 C respectively, while downstream maxima were 27.8 C and 23.4 C. The main cause of elevated temperatures downstream was cooling-water from Ironbridge A Power Station. Analysis of trap catches showed that the total numbers of Ephemeroptera species and of individuals were greater in certain types of trap but that catches of Trichoptera were less related to trap type. The total emergence period varied during 1969, 1970 and 1971 irrespective of the elevated temperatures and both Ephemeroptera and Trichoptera continued to emerge during and after water temperatures as high as 26 to 27.8 C and as low as 11 C in June. There was some relationship between emergence rates, river level (flow) and temperatures, but evidence suggests that river level was the most significant factor. Temperature increases in the Severn, caused by normal operations at Ironbridge A and by sporadic operations at Ironbridge B, did not have significant effect on the total numbers and overall emergence period of Trichoptera, Ephemeroptera and Megaloptera downstream of the outfalls. Also the species-composition of trap catches was very similar both upstream and downstream of the power stations. The emergence periods of individual species are described in a second paper. (Auth)

<362>

Lapin, Yu. S., Variability of the Number of Vertebrae and Larval Myomeres in the White Sea Herring *CLUPPEA HARENGUS PALLASI VARIS-ALII* in Connection with its Ecology.

1974. *Vopr. Ikhtiol.*, (USSR), 18, 546-557 (A.N. Severtsov Institute of Evolutionary Morphology and Animal Ecology, Moscow, USSR)

An investigation of the White Sea Herring *CLUPPEA HARENGUS PALLASI VARIS-ALII* established that, with respect to the number of myomeres, the larval herring from the Kandalaksha Gulf in the White Sea (USSR) are similar to the larval herring of the North Atlantic, and the larvae from Omega Gulf in the White Sea do not differ from the larvae of the Pacific herring from the Sea of Okhotsk. The population of White Sea herring, which combines features of both subspecies, the Atlantic is heterogeneous. The great variability of the White Sea herring progeny, with respect to number of vertebrae, is regarded as a consequence of the differences in feeding, maturation and spawning of the parental populations and different temperature and salinity during incubation. (auth)

<363>

Lasserre, P., and J.L. Gallis, Osmoregulation and Differential Penetration of Two Grey Mullet, *CHLON LABROSUS* (Risso) and *LIZA BAHADA* (Risso) and *LIZA BAHADA* (Risso) in Estuarine Fish Ponds.

1975. *Aquaculture*, 5, 323-388 (University of Bordeaux, Institute of Biology and Marine, Arcachon, France)

Grey mullet ponds situated in Arcachon Bay on the western Atlantic coast of France, display contrasting mesohaline habitats. The pattern of osmoregulation of *C. LABROSUS* and *L. BAHADA* exhibiting differential penetration of fish ponds was investigated. Key variables of salinity and temperature were considered. The tolerances to low salinity and temperature were considered. The dynamics of variation in plasma osmotic pressure and major plasma electrolytes (Na, Cl, K) were studied in terms of: gradual adaptation to a decreasing salinity gradient; effects of a long-term adaptation in freshwater; and effects of low temperatures on seawater adapted fish. Both species could adapt to a wide range of salinities; however, while *L. BAHADA* showed a good hypoosmotic regulation, with no alteration in plasma concentration over a wide range of salinity and after a long stay (5 mo.) in freshwater *C. LABROSUS* could not live for long periods of time in a wholly freshwater habitat. Both field samples obtained from thick-lipped grey mullets forced to stay in a freshwater pond and experimentally adapted fish showed, after 3 mo., an unequivocal decrease in plasma Na and Cl, and plasma osmolality decreased to the same extent; this pattern of no compensation will eventually, cause death. The inability of *C. LABROSUS* to develop a long-term hypoosmoregulation in freshwater is referred to salinity preferences which probably limit the upstream penetration of this species. Plasma osmolality and major electrolytes (Na and Cl) increased in cold a C seawater. This response might be due to a reduced ability of grey mullets to osmoregulate in cold waters. In the poly-mesohaline ponds, winter drop in temperature (4 to 6 C) causes grey mullets to migrate to the meso-oligohaline ponds where the mean temperature is more elevated (8 C) and temperature changes less rapid (6-9 C). (auth)

<364>

Lassiter, R.R., Modeling Dynamics of Biological and Chemical Components of Aquatic Ecosystems.

1975. EPA-660/3-75-012; 54 p. (U.S. Environmental Protection Agency, Southeast Environmental Research Laboratory, Athens, GA)

Submodels of several processes common to aquatic ecosystems were developed or adapted from previously existing ones. Included are submodels for photosynthesis as a function of light and depth, biological growth rates as a function of temperature, dynamic chemical equilibria, feeding and growth, and various types of losses to biological populations. The submodels for biological growth rates as a function of temperature, was fit to published data on growth rates of the green alga, *CHLORELLA* sp., and growth of four species of aquatic snails. (ST)

<365>

Latimer, D.L., The Toxicity of 30-minute Exposures of Residual Chlorine to the Copepods *LIHNOCALANUS MACRURUS* and *CYCLOPS BICUSPIDATUS THOMASI*.

1975. N.S. Thesis, University of Wisconsin (University of Wisconsin, Department of Zoology, Milwaukee, WI)

The calculated TL50 values of residual chlorine for *CYCLOPS BICUSPIDATUS THOMASI* at 10, 15, and 20 C were 10.68, 15.61, and 5.76 mg/l, respectively. For *LIHNOCALANUS MACRURUS* at both 5 and 10 C, the calculated TL50 was 1.54 mg/l. The toxicity of chlorine to *CYCLOPS* was observed to markedly increase when temperature was increased from 15 to 20 C. TL5 and TL1 statistics were calculated as estimates of safe levels for 30-minute exposures to residual chlorine. Based on the TL5 values, the proposed safe levels for 30-minute exposures to *CYCLOPS* and *LIHNOCALANUS* were 0.5 and 0.9 mg/l, respectively. Based on the TL1 values, the proposed safe levels for 30-minute exposures to *CYCLOPS* and *LIHNOCALANUS* were 0.1 and 0.7 mg/l, respectively. These predicted safe levels roughly coincide with the levels of residual chlorine typically found in power plant effluents. (BPC)

<366>

Lawrence, J.H., The Effect of Temperature-Salinity Combinations on the Functional Well-Being of Adult *LYTECHINUS VARIEGATUS* (Lamarck) (Echinoidea, Echinoidea).

1975. *Jour. Exp. Mar. Biol. Ecol.* (Neth.), 18, 271-275 (University of South Florida, Department of Biology, Tampa, FL)

The activity coefficient (1000/righting time in sec) was measured to indicate the functional state of *LYTECHINUS VARIEGATUS* after exposure to combinations of temperature (22, 28, and 34 C) and salinity (25, 30, 35, and 40 ppt). Environmental levels of these variables were 30, 33 C and 34, 35 ppt. The results indicated that the species lives closer to the upper than lower lethal limits temperature and salinity. The maximal activity coefficient (18 plus or minus 8) was at 28 C and 35 ppt. A reduction in salinity was probably responsible for a recent mass mortality of the echinoid reported in the eastern Gulf of Mexico. (auth)

<367>

<367>

Lawrence, J.M., Temperature Tolerances of Tropical Shallow-Water Echinids (Echinodermata) at Elat (Red Sea).

1973. Israel Jour. Zool., 22, 143-150 (University of South Florida, Department of Biology, Tampa, FL)

The temperature tolerances of ECHINOMETRA NATHAEI, DIADEMA SETOSUM, TRIPNEUSTES GRATILLA, and ECHINOTHELYS CALANABIS were ascertained by measuring the time required for inverted individuals to right themselves after exposure to a range of temperatures (12 to 35 C) for varying periods of time. Ability to recover from exposure to an experimental temperature (27 C). E. NATHAEI and D. SETOSUM are functionally more eurythermal than T. GRATILLA or E. CALANABIS, E. NATHAEI was most tolerant to high temperatures. In all cases, the sea urchins were more tolerant to high temperatures. In all cases, the sea urchins were more tolerant of temperatures below than above environmental temperature. (Auth)

<368>

Lehmann, E.J., Thermal Pollution. Part 2. Biological Effects (A Bibliography with Abstracts).

1975. NTIS/PS-75/219: 176 p. (National Technical Information Service, Springfield, VA)

One hundred seventy one abstracts are presented covering the effects of heated effluents on fish, microorganisms, and plants in both fresh and salt water. Included are the effects on growth, ecology, metabolism, heat tolerance, and productivity. (ND)

<369>

Leighton, D.L., The Influence of Temperature on Larval and Juvenile Growth in Three Species of Southern California Abalones.

1974. Fishery Bull., 72, 1137-1145 (University of California at San Diego, Scripps Institution of Oceanography, La Jolla, CA)

Larvae of the abalones HALIOTIS RUPESCENS, HALIOTIS CORBOGATA, and HALIOTIS PULGENS displayed most rapid growth and best survival at 15 to 18, 18 to 21, and 20 to 23 C, respectively. Survival of larvae and postlarvae was poor above these optimal ranges. However, juveniles three months to one year old were tolerant of a broader temperature range. The warm-water species, HALIOTIS PULGENS, increased in shell length at an average rate of 88 μ per day at 26 C. Mean shell elongation rates were 77 and 68 μ per day in HALIOTIS RUPESCENS and in HALIOTIS CORBOGATA at their respective optima. (Auth)

<370>

Lester, R.J.G., and J.B. Adams, GYRODACTYLUS ALEXANDERI: Reproduction, Mortality, and Effect on its Host GASTEROSTEUS ACULEATUS.

1974. Can. Jour. Zool., 52, 827-833 (University of British Columbia, Department of Zoology, Vancouver, British Columbia, Canada)

Individual flukes of the monogenetic trematode GYRODACTYLUS ALEXANDERI, maintained at 15 C on isolated fish (GASTEROSTEUS ACULEATUS LEITHUS), gave birth to only two daughters, the first after an average of 1.6

days, and the second after 6.9 days. For at least 20 generations, the first daughter was produced every 1.6 days without cross-fertilization occurring. Maximum longevity at 15 C was 28 days, but reached 71 days at 7 C. The mean life expectancy of flukes away from fish was 1.8 days at 15 C. This was shortened in the presence of young sticklebacks which preyed on the GYRODACTYLUS. One to 13% of flukes survived slow changes in salinity. Fish heavily infested with G. ALEXANDERI died. Of 67 fish, 25 to 35 mm in length and carrying over 150 flukes, 54 died, compared with only 33 to 174 fish carrying fewer flukes. Deaths were not associated with infections of protozoa, fungi, or bacteria. (Auth)

<371>

Lett, P.P., A.C. Kohler, and D.B. Fitzgerald, Role of Stock Biomass and Temperature in Recruitment of Southern Gulf of St. Lawrence Atlantic Cod, *GADUS MORhua*.

1975. Jour. Fish. Res. Bd. Can., 32, 1613-1627 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

A multivariate approach was used to elucidate the simultaneous effects of temperature and estimated parent stock biomass on the recruitment mechanism of Gulf of St. Lawrence cod (*GADUS MORhua*). The second order effects of temperature and estimated stock biomass were key factors in determining egg abundance levels. In addition, egg abundance was closely related to the growth rate of cod. The numbers of larvae increased with the interaction of temperature with egg abundance but decreased with the interaction of egg abundance and time. The most important step in the recruitment mechanism occurs during the juvenile stage, the degree of density dependence being related to total biomass of the adult cod stock. A system simulation was constructed amalgamating the equations of early life history of cod with the effects of exploitation on stock biomass. Regular 12-yr oscillations were demonstrated at low levels of catch, while the population became more stable at higher fishing efforts in the absence of environmental effects. The optimal fishing mortality for the Gulf of St. Lawrence cod was found to be $F_{sub 0.4}$ with a maximum sustainable yield and 42,000 metric tons. (Auth)

<372>

Lewis, W.H., Paracyclops SAIBIRINI n. sp. (Copepoda: Cyclopoida) from Thermal Waters in Rotorua.

1974. New Zealand Jour. Mar. Freshwater Res., 8, 275-281 (University of Auckland, Department of Zoology, Auckland, New Zealand)

PARACYCLOPS SAIBIRINI is described. Although it does not conform precisely to the generic description, reasons for placing it in PARACYCLOPS are given. The species appears to be confined to thermal waters in the Rotorua district of the North Island of New Zealand, the type locality having temperature of around 30 C and a pH of 7.0. (Auth) (ND)

<371>

Lewis, W.H., P.C. Heidinger, W.L. Kirk, V. Chapman, and E. Johnson, Food Intake of the Largemouth Bass.

1974. Trans. Amer. Fish. Soc., 103, 277-280
(Southern Illinois University, Fisheries Research Laboratory and Department of Zoology, Carbondale, IL)

Bass weighing 200 to 400 g were held at 18 and 27 C and force fed gizzard shad equivalent to 3.0 to 4.1 percent of their body weight. At two hr intervals following feeding autopsies were made. The average time of digestion (time required for the stomach to empty) was 20 hr at 27 C and 30 hr at 18 C. (ST)

<374>

Leynaud, G., and J. Allardi, Effects of a Thermal Discharge into a River on the Movement of Fish Populations.

1975. COMPT-740920; STY/P08/370; IAEA-SG-107/34; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 401-408) (Centre Technique du Genie Rural, des Eaux et des Forêts, Division Qualite des Eaux, Pêche et Pisciculture, Paris, France)

To assess the effects of thermal discharges on fish populations a study was carried out in the Seine at the Montesson Thermal Power Station in collaboration with Electricite de France. Regular catches were made in the discharge channel of the power station using electrofishing and lobster pots. Labelling and subsequent re-catching in the Seine, with the assistance of amateur fishermen, made it possible to trace certain movements. The numbers caught in the discharge channel were subject to considerable variations (maxima in spring and autumn, minima in winter and summer), as was the composition of the populations (increase in the proportion of Cyprinidae during hot periods). Barbel (*BARBUS HAASI*) disappeared during hot periods, whereas black bass (*MICROPTERUS SALMOIDES*) became more frequent when the water temperature was high. Some invertebrates (*Gammaridae*) also disappeared during the summer. Efforts are being made to determine more precisely the overall ecological impact of the increase in water temperature. (Luth)

<375>

Libert, V., Ecophysiological Investigations of the Temperature and Dehydration Resistance of Trichoptera Larvae.

1974. Sitzungsber. Oesterr. Akad. Wiss. Math. Naturwiss. Kl. (Aus.), 181, 163-190 (Not Given)

The coma-inducing temperature increased 3 C and the lethal temperature increased 1.5 C in warm adapted (24 C) trichopteran larvae (*ACRYPPIA PAGETANA*, *LIMNOPHILOS IANTHODES* and *HYDROPSYCHE ANGUSTIPENNIS*) as compared to cold adapted (11 C) larvae. *ACRYPPIA PAGETANA* and *LIMNOPHILOS IANTHODES* exhibited more heat resistance than *HYDROPSYCHE ANGUSTIPENNIS*. As heat death approached that K content of the larvae remained stable but the Na content dropped sharply. (ST)

<376>

Lightner, D.V., B.E. Salzer, and B.S. Wheeler, Gas-Bubble Disease in the Brown Shrimp (*PENAEUS AZTECUS*).

1974. Aquaculture, 4, 81-24 (National Marine Fisheries Service, Gulf Coastal Fisheries Center, Galveston Laboratory, Galveston, TX)

Gas-bubble disease in larval and juvenile brown shrimp (*PENAEUS AZTECUS*) is described. Stage 2 protozoal, larval brown shrimp developed the disease after being placed in water warmed from 22 to 28.0 C in a closed heater that did not allow excess gas to escape. Juvenile brown shrimp developed gas-bubble disease after being held in a pressure tank for 35 hr. The pressure in the tank had been maintained at 2545 mm Hg with compressed air. The implications of the finding that shrimp are susceptible to gas-bubble disease are discussed in relation to shrimp culture activities, particularly those that use heated water. (Luth)

<377>

Lind, O.T., B.J. Venables, H. Symon, and B.I. Lukins, The Relationship of Electric Power Station Thermal Circulation to Biological Productivity of Reservoirs.

1974. OERT-8-091-TEX; PB-238 375/OBP; 114 p. (Baylor University, Waco, TX)

Phytoplankton photosynthesis was measured from May 1971-July 1972. Three depths at both the cool intake and warmed discharge of a steam electric station were sampled. Thermal circulation produced no measured negative effects at temperatures below 40 C. Photosynthetic carbon uptake was significantly greater in samples collected from and incubated at the warmed discharge than samples from either site and incubated at the cooler intake. At temperatures greater than 40 C, a significant depression in photosynthesis occurred. There was no significant effect on growth, reproduction, or metabolism of the largemouth bass (*MICROPTERUS SALMOIDES*). The Ostracode (*CYPRIDOPSIS VIGOR*) from the warmed discharge actively avoided temperatures greater than 30 C. Mean oxygen consumption rate was positively linearly correlated with increasing temperatures (15 to 35 C). Mean carbon dioxide production was high and was positively linearly correlated with temperature to 30 C. Reduction of the ingestion rate above 30 C was significant. (Luth)

(378)

(378)

Linder, D.F., The Culture of Marine Fish and Their Use as Biological Monitors of Water Quality in Ponds Receiving Heated Discharge Water From a Power Plant.

1974. M.S. Thesis, Texas A & M University, 385 p. (Texas A & M University, College Station, TX)

In a study designed to monitor the quality of water discharged by the Cedar Bayou Electric Power Station near Baytown, Texas, and to determine the potential benefits of using heated effluents in aquaculture, pinfish, *LAGODON RHOMBODES*; spot, *LEIOSTOMUS XANthurus*; Atlantic croaker, *MICROPOGON undulatus*; black drum, *Pogonias cromis*; red drum, *Sciaenops ocellatus*; Atlantic spadefish, *Chaetodon pinnatus*; striped mullet, *Mugil cephalus*; white mullet, *Mugil curema*; and southern flounder, *Paralichthys lethostigma*, were reared in 0.1 ha ponds receiving a constant flow of water from the plant discharge canal. In addition, two unstocked ponds received unfiltered water from the discharge canal. Temperature, conductivity, and dissolved oxygen were monitored daily in the ponds and fish were sampled periodically to determine growth, survival, condition, and length-weight relationships. Pond flooding with subsequent sizing and/or escape of fish populations complicated the interpretation of survival data for the first seven months of the study. Survival of all species except striped mullet (87.5 to 85.2%) was poor (0.2 to 37.3%). Survival of pinfish and black drum was affected by bacterial skin infections, whereas poor survival of white mullet and Atlantic spadefish was attributed to extremely low salinities at the time of initial stocking. A toxic substance entered the ponds through the water supply in late December and resulted in mortalities of sheepshead minnow, *Cyprinodon variegatus*; mosquitofish, *Gambusia affinis*; sailfin molly, *Poecilia latipinna*; pinfish; Atlantic croaker; and red drum. No dead striped mullet or southern flounder were observed during the time of this fish kill. Growth of pinfish, Atlantic croaker, and spot was better than that reported from field observations. White mullet exhibited growth similar to that reported for wild individuals but red drum did not grow so well as those from natural populations. Growth rate decreased after November as water temperatures declined. After pond flooding, food conversion values were seldom less than 2.00. Heavy metals and pesticides present in the effluent water did not appear to increase significantly in fish tissue through time. (Auth) (ST)

(379)

Hippincott, B.L., The Effects of Fluctuating Water Levels on the Reproductive Success of Eastern Chain Pickerel, *Esox niger* LeSueur.

1975. Ph.D. Thesis, Lehigh University, 130 p. (Lehigh University, Bethlehem, PA)

The eastern chain pickerel, *Esox niger* LeSueur, was studied to determine the effects of water level fluctuation and variation on its reproductive success during the spring spawning periods of 1972 and 1973. Differences in the life history of the pickerel were noted as compared to those reported in the literature. The influence of vegetative substrate and habitat was evaluated. The fluctuation and variation schedules used in this study simulated those projected as minimum, average, and maximum for a proposed pumped storage generating project. In 1972, spawning initially occurred in all three simulated conditions between May 15 and May 22, with spawning

occurring first in the control pond. The water temperatures ranged between approximately 15 to 17 and 22 C during this period. These temperatures were significantly higher than the threshold spawning temperature of 8.3 C that is reported in the literature. The degree of reproductive success, as measured by the numbers of fry recovered, correlated positively with the amount of vegetative substrate in each pond. Spawning initially occurred between May 8 and May 18 in 1973. For the second year, spawning occurred first in the control pond. Water temperatures ranged from the middle 13 to 15 C during the spawning period. The positive correlation between reproductive success, as measured by the numbers of fry recovered, and the amount of vegetative substrate in the ponds was reproduced during the second year of study. A significant observation was made during the last netting operation of 1973. Six recently hatched pickerel fry were taken during the third week in October indicating that a fall spawn had occurred. (Auth) (ND)

(380)

Lin, B.K., and E.L. Valford, Mid-Life Temperature-Transfer Effects on Life-Span of Annual Fish.

1975. Jour. Gerontology, 30, 129-131 (University of California, Department of Pathology, Los Angeles, CA)

The annual fish, *Cyprinobius biellottii*, when transferred from 20 to 15 C at slightly less than the midpoint of its lifespan (light months old), lived longer than control fish held at 15 and 20 C and than fish transferred from 15 to 20 C at the same time. (ST)

(381)

Llewellyn, L.C., Spawning, Development and Distribution of the Southern Pigmy Perch *Macropodus australis australis* Gunther from Inland Waters in Eastern Australia.

1974. Australian Jour. Mar. Freshwater Res., 25, 121-189 (Inland Fisheries Research Station, Narrasdera, New South Wales, Australia)

Southern pigmy perch were bred in ponds on three occasions when water temperatures rose above 21-0 C at the surface and 19-3 C at the bottom during the months of September and October. Flooding was found not to be necessary as a breeding stimulus. Eggs were demersal, transparent, spherical, telolecithal and essentially non-adhesive; possessed a cluster of oil globules; varied from 1.16 mm to 1.35 mm in diameter; and were scattered randomly during spawning. They hatched after between 2 days 18 hr and 3 days 7 hr at temperatures fluctuating between 15.8 C and 25.3 C. The length of the recently hatched larvae varied between 3.18 and 3.92 mm. The pre-larval stage terminated at 5 days 23 hr at temperatures between 15.8 and 23.7 C. The largest adult recorded was 63 mm in length and weighed 3.48 g. Marked color difference occurred between the sexes as the breeding season approached, the males possessing bright red fins with black edges. Fecundity of the females varied from 506 eggs at 40 mm length and 0.86 g weight to 4217 eggs at 63 mm length and 3.49 g weight. The gonosomatic index rose to 11.4 and 4.7 in females and males respectively prior to breeding. Fish 6 months, 18 months and 30 months old from a pond reached 3.0, 3.8 and 4.7 ca, respectively. (Auth) (ST)

<382>

Loeb, W.J., and C.H. Gordon, Strobilation in the Chesapeake Bay Sea Nettle, *CHRYSAORA CHRYSAORA* IV. Tissue Levels of Iodinated High Molecular Weight Component and WIF in Relation to Temperature Change-Induced Behavior.

1975. Comp. Biochem. Physiol., 51A, 37-42 (Naval Research Laboratory, Ocean Sciences Division, Washington, DC)

CHRYSAORA CHRYSAORA polyps must be exposed to winter-like conditions to be potentiated to strobilate. Transfer of polyps from 26 to 20 C evoked a large, transient increase in the concentration of the iodinated high molecular weight component, and a slight, transient increase in neck-inducing of the iodinated high molecular weight component, and a slight, transient increase in neck-inducing factor (WIF)-active material in homogenized polyp tissues. Sufficiently chilled C. *CHRYSAORA* polyps strobilate soon after they are warmed. Transfer of chilled polyps from 20 to 26 C evoked a large, transient increase in the concentrations of both iodinated high molecular weight component and WIF-active material in homogenates of polyp tissues. The data suggested that polyps are enabled to strobilate when tissue levels of iodinated high molecular weight component and WIF are high. These substances appeared to exert their influence close to the time at which strobilation is initiated. (Act)

<383>

Logan, D.T., and D. Hauser, Diversity of Marine Invertebrates in a Thermal Effluent.

1975. Jour. Inter Poll. Control Fed., 47, 415-423 (University of Delaware, College of Marine Studies, Lewes, DE)

Four stations were sampled at the Delmarva Power and Light Company coal-fired, steam-generating plant on Indian River, Delaware, to determine the effect of a thermal effluent on an estuarine benthic community. A difference in species composition, an increase in relative numbers of a pollution indicator organism, and reduction in species number and in the total number of organisms in the effluent were noted. The periods of highest diversity and equitability corresponded to that of the lowest numbers of species and individuals and highest effluent temperatures. Throughout the year an area of unusually high diversity existed in the thermal effluent at the south of the discharge canal. The possibility that communities in the mouths of thermal effluent canals, subject to intermittently severe environments, may be in a noninteractive, pioneer state is considered. (ST)

<384>

Long, G.E., P.H. Duran, H.O. Jeffords, and D.H. Weldon, An Application of the Logistic Equation to the Population Dynamics of Salt-Marsh Gastropods.

1974. Theor. Popul. Biol., 5, 450-459 (Washington State University, Department of Zoology, Pullman, WA)

A logistic equation for population growth, with modifications for environmentally influenced changes in habitat carrying capacity and species intrinsic growth rate, satisfactorily simulated density levels of real populations of herbivores. The model assumes that carrying capacity is a function of incident solar energy while intrinsic growth rate is a function of temperature and salinity. *CHRYSAORA* and *ASSINIA* from Mission Bay, San Diego, California were tested. (Bath) (BD)

<385>

Lough, P.G., A Reevaluation of the Combined Effects of Temperature and Salinity on Survival and Growth of Bivalve Larvae Using Response Surface Techniques.

1975. Fishery Bull., 73, 86-94 (Oregon State University, School of Oceanography, Corvallis, OR)

The combined effects of temperature and salinity on larval survival and growth of *CRASSOSTREA VIRGINICA*, *MYTILUS EDULIS*, and *MYTILUS LATERALIS* as reported in the literature were critically examined using response surface techniques. The late veliger larvae generally have a greater tolerance to both temperature and salinity than the developing embryos. Each species shows its own characteristic change in temperature-salinity tolerance as it develops and approaches the range normally tolerated by the adults as it matures. Maximum growth of the veliger larvae required higher temperatures and somewhat higher salinities than maximum survival. Differences in temperature-salinity ranges estimated for maximum survival and growth were significantly different for all three species. In each case growth showed a significant temperature-salinity interaction. Response surface plots are given for early larval survival and late veliger survival and growth. Inferences of tolerance studies are made to the fields of pollution and aquaculture. (Bath)

<386>

Love, G.A., Effect of Temperature Change on the Heart Rate of *CRASSOSTREA GIGAS* and *MYA ARENARIA* (Bivalvia).

1974. Proc. Malacological Society London, 41, 29-36 (University of Manchester, Department of Zoology, Manchester, England)

The relationship between the temperature change (plus or minus five C from acclimated) in the mantle cavity, the pericardial cavity and the heart rate of two bivalves, *CRASSOSTREA GIGAS* and *MYA ARENARIA*, was investigated using electronic recording techniques. The gills act as a heat exchanger, the rate of temperature change being dependent on the rate of water and blood flow. Heart rate was dependent on the temperature of the bathing fluid but, during sudden changes of temperature, there was a significant relationship between heart rate and mantle cavity temperature. It was suggested that thermoceptors, possibly in the mantle tissue, play an important role in respect of the immediate response to temperature change. (BD)

<387>

<387>

Lowe, R.E., R.E. Ford, and A.L. Cameron, Seasonal Abundance of CULEX Species near Cedar Key, Florida.

1975. Mosquito News, 35, 118-119 (Insects Affecting Man Research Laboratory, Agr. Res. Serv., USDA, Gainesville, FL)

Studies were performed to determine the seasonal abundance of CULEX species in the Gulf of Mexico, near Cedar Key, Florida (ND)

<388>

Lowe, R.E., Environmental Requirements and Pollution Tolerance of Freshwater Diatoms.

1974. EPA-670/8-74-005; 340 p. (Bowling Green State University, Bowling Green, OH; National Environmental Research Center, Cincinnati, OH)

Data on the environmental requirements and pollution tolerance of 100 freshwater diatoms was compiled from 48 references. Parameters considered are: temperature and geographical distribution, pH, nutrients, salinity, organic pollution tolerance, current, habitat, and seasonal distribution. (ND)

<389>

Lowe, R.E., Reproductive Ecology of Oyster Toadfish (OPSAEUS TAU) in Charlestown Pond, Rhode Island.

1975. Ph.D. Thesis, University of Rhode Island, 135 p. (University of Rhode Island, Kingston, RI)

In this investigation several aspects of the general reproductive ecology, the importance of guarding the eggs and fry against predation, and the role of fanning in waste removal and maintaining adequate oxygen levels among oyster toadfish were studied. Field and laboratory studies were carried out from May through early November of 1970 through 1974 in Charlestown Pond and at the University of Rhode Island. Clay drainage tile, 28.5 cm long and 10.2 cm internal diameter, were provided for spawning sites and trapping was done with Chesapeake Bay crab pots. Toadfish actively entered the traps in early May after surface temperatures reached approximately 10 C and continued until late October or early November when surface temperatures were between 10 and 15 C. Spawning began about May 20 when surface temperatures reached 16 to 17 C and terminated about July 10 to 15 when surface temperatures were approximately 23 C in the vicinity of the tiles. The reproductive season of 1972 was divided into two spawning periods; the first terminated between June 8 and 11 and the second beginning between June 23 and 27. (Auth) (ND)

<390>

Loebke, R.W., The Culture of Some Marine Fishes in Ponds Receiving Heated Discharge Water from a Power Plant.

1973. M.S. Thesis, Texas A & M University, 212 p. (Texas A & M University, College Station, TX)

Florida pompano (TRACHINOTUS CAROLINUS), Atlantic croaker, (MICROPOGONUS UNDULATUS), black drum (POGONIAS CHROMIS) red drum (SCIAENOPS OCELLATA) and striped mullet (MUGIL CEPHALUS) were cultured during 1972 in a series of 9.1-ha ponds receiving a constant supply of heated discharge water from Houston Lighting and Power Company's Cedar Bayou Electric Power Station near Baytown, Texas to test the quality of water passing through the power plant and to investigate the potential benefits associated with thermal effluents in relation to mariculture. These species were periodically sampled to determine survival, growth and condition. Several saltmarsh fishes were also cultured to determine whether water quality was sufficient to permit reproduction. Hydrological data was taken daily in the ponds. Most saltmarsh species reproduced in the ponds. Survival was good for black drum and striped mullet (69 and 78%, respectively). Florida pompano suffered complete mortality when water temperatures dropped below 15 C. Atlantic croaker and red drum suffered heavy mortality when an undetermined toxic substance passed through the power plant. Length-weight relationships were determined for all species; standard length-total length conversion equations were calculated for all species except Florida pompano. Food conversion ranges and mean condition values were established. (Auth) (RFC)

<391>

Lusare, P., and S. Gorzo, Larval Development of the Crustacean Lanthidae RHIPHA VERUCOSA (Froskal, 1975) Under Laboratory Conditions.

1972. Boll. Pesca Piscic Idrobiol, 27, 185-209 (Laboratory Sfrattamento Biologia Laguna, CNR, Lesina, Yugoslavia)

The larval stages of RHIPHA VERUCOSA were reared in the laboratory from hatching to the 1st-stage crab. There are four zoeal stages and one megalops under laboratory conditions; the larval, as well as the mutation of the functional appendages, are described. The effects of feeding, temperature and salinity on larval development are emphasized and data about reproduction and fecundity in the experimental conditions of the laboratory are described. (ND)

<392>

Lusare, P., and P. Villani, Intensive Reproduction of PENAEUS KERATHURUS (Froskal, 1975) under Controlled Conditions and Culture in Brackish-Water.

1974. Rapp. P.-V. Reun., Cons. Int. Explor. Sci. Mer. Mediterran., (Morocco), 22, 9 (Laboratory Sfrattamento Biologia Laguna, CNR, Lesina, Italy)

At an average temperature of 27 plus or minus 2 C and salinity 35 of PENAEUS KERATHURUS eggs hatched after 12 hours. Young larvae ate phytoplankton and later stages consumed the nauplii of ARTEMIA SALINA. Post-larval specimens were transferred into cages in the lagoon and into tanks to test artificial and natural diets. In the brackish water the prawns grew quickly as long as the temperature was high. The environmental conditions that affect the survival and the development of larval stages are discussed. (Auth) (ND)

(393)
Saretta, J.W., "Metabolization 'in Vitro' of Glucose C-14 and Total Lipids of the Tissues of the Blue Crab, *CALLINectes SAPIDUS*, Acclimated at Different Temperatures."

1971. *Ann. Zool. Biol. Par.*, U.S. (Braz.), 15, 126-134 (Instituto de Biologia Marinha da Universidade de São Paulo, Brazil)

The isolated viscous muscles, gills, and hepatopancreas from the blue crab, *CALLINectes SAPIDUS*, had the capacity to metabolize "in vitro" labeled glucose C-14. The metabolization of labeled glucose was greater in the gills, followed by the hepatopancreas and finally the muscle tissue, in both 10 and 25°C acclimated animals. There was a greater quantity of total lipids in the muscles, hepatopancreas and gills in the animals acclimated at 10°C, rather than the animals acclimated at 25°C. The lipogenic activity in all tissues, except from gill tissue, is higher in the animals acclimated at 25°C. In animals at 10 and 25°C, the lipogenic activity was higher in the gills, then the muscles, and finally the hepatopancreas. (42)

(394)
MacKievie, P.W., and D. Desautels, Fish Viruses-Survival and Inactivation of Infectious Pancreatic Necrosis Virus.

1974. *Jour. Fish. Res. Bd. Can.*, 32, 1267-1273 (Department of the Environment, Fisheries and Marine Service, Halifax Laboratory, Halifax, Nova Scotia, Canada)

The survival of infectious pancreatic necrosis (IPN) virus under conditions pertaining to its retention in the laboratory, and its inactivation by several physical and chemical means were examined. The virus was stable following storage in several media at 4°C in the laboratory. The resistance of IPN virus to both physiological and nonphysiological pH as well as to heat (60°C) provided evidence of the oral-fecal route in the epidemiology of IPN. (57)

(395)
MacLaren, J.W., Review of Heated Discharge Management and Control Alternatives: Once-Through Systems in Large Water Bodies.

1975. EPS 1-WP-75-4 (James P. MacLaren Limited, Willowdale, Ontario, Canada; Water Pollution Control Directorate, Environmental Protection Service, Environment Canada)

The report presents a review of current literature and foreign legislation dealing with heated discharges from thermal power plants. Management and control alternatives are discussed, with particular reference to the problems associated with once-through cooling systems discharging into large water bodies. Topics discussed include the environmental effects of cooling systems on aquatic biota, alternative designs for intakes and cooling systems, methods for the prediction and monitoring of environmental effects of heated discharges, and research needs. Past and existing standards and regulations for temperature control in other countries are critically reviewed. Recommendations are made concerning the selection of power plant sites, pre-operational and operational surveys, the development of criteria for heated discharge regulation, intake and outfall design, and alternative cooling systems. (Auth)

(396)
Saxe, E.W., Oxygen Consumption of the Clam, *HAZELYSIA OPIMA*, in Relation to Environmental Conditions.

1975. *Broteria (Ind.)*, no. 33-58 (Marathwada University, Department of Zoology, Aurangabad, India)

The oxygen(2) consumption in *HAZELYSIA OPIMA* was studied in relation to environmental changes and physiological factors like body size, salinity, temp, pH, oxygen(2) tension, low tide, starvation and diurnal rhythm. The oxygen(2) consumption was increased with increasing body size and varied with the temp within the temp range studied. The regression coefficient of size metabolism curves decreased with increasing temp. The unit oxygen(2) consumption had increased with decreasing body wt. The rate of oxygen(2) consumption increased with temp and varied with it. The smaller clams were found to be more sensitive to changes in temp than the larger ones. The values of Q10 decreased with increasing body size at all temps studied. The decrease was more conspicuous at lower temp. This decrease being more marked in smaller clams than in larger ones. (8) It was observed that the increase in oxygen(2) consumption was surface area dependent near habitat temp 30.0°C though an intermediate condition was observed at 20.0°C and 38.0°C. (Auth) (52)

(397)
Hann, W., The Importance of Temperature for the Feeding Quotient of Rainbow Trout.

1974. *Zaf. Fischwirtschaft*, 21, 90-91 (Institute für den Binnenfisch., Bundesforschungsanst. Fisch., Palisale, German Federal Republic)

The production of rainbow trout, *Salmo gairdneri*, in ponds and tanks is influenced by numerous factors, two of the most important being water quality and water temperature. The latter determines the feeding inclination of the fish, and, by this, the amount of food which should be supplied. As different kinds of food will produce varying rates of growth, the concept of the feeding quotient (FQ) has been introduced. This figure gives an indication of the quantity of food which is converted to a specific fish weight. The author shows that using dried food, FQ is between two and three; and under especially favourable conditions it can even be under two. (Auth)

(398)
Vanner, R.W., and C.N. Devese, Early Embryology of the Fathead Minnow *PIMEPHALES PROMELAS* Rafinesque.

1974. *Anat. Rec.*, 180, 99-110 (Loyola University, Biology Department, Chicago, IL)

The fathead minnow, *PIMEPHALES PROMELAS* (Rafinesque), has been laboratory bred and the early embryos staged and described. At 23°C the embryo requires 33 hours to reach the 13-somite stage. This period of early embryonic development has been divided into 12 stages. The description of each of these stages is accompanied by photographs. (Auth)

<199>

<199>

Warcov, B.C., Jr., Entrapment of Organisms at Power Plants, with Emphasis on Fishes - An Overview.

1975. Part of Sells, S.B. (Ed.), Fisheries and Energy Production: A Symposium. D.C. Heath and Company, Lexington, Massachusetts, (p. 83-106), 217 p. (RUS Corp., C.W. Rice Division, 1910 Cochran Road, Pittsburgh, PA, 15222)

An overview of the recent information available on entrainment, specifically on fish eggs and larvae, is presented. The components of inner-plant mortality (thermal, mechanical and biocidal effects) are discussed, with emphasis on recent data on mechanical damage. Sampling considerations for entrainment studies as well as philosophies and suggestions for reducing entrainment losses are presented. Recommendations include siting in non-productive areas and using closed cooling systems to achieve lower intake volumes. In the future, alternative strategies may include the raising of condenser temperature changes while lowering the intake water volume. (Auth) (P)

<199>

Warren, A.G., Oxygen Consumption and Some Metabolites in Dorsal Muscle of IDUS IDUS During Starvation.

1975. Zool. Anz., Jena, 198, 210-218 (Institute of Biological Sciences, Laboratory of Zoophysiology, Bucharest, Romania)

Oxygen consumption of whole fish, IDUS IDUS, and metabolites of dorsal muscles, were measured in fed and starved animals at 5, 15 and 25 C. At 25 C there was a decrease in oxygen consumption of starved fish and a depletion of dorsal muscle metabolites. This effect was not observed at 5 C. The author suggested that a mechanism is present which enables IDUS IDUS to tolerate longer periods without nutrition at low temperatures. (Auth) (S)

<199>

Warkel, R.P., Aspects of the Physiology of Temperature Acclimation in the Lippet ACHETA LIATULA Carpenter (1944): An Integrated Field and Laboratory Study.

1974. Physiol. Zool., 47, 99-109 (University Federal do Grande Norte, Institute Biology Marinha, Natal, Brazil)

Integrated laboratory and field studies were used to examine the metabolic rate versus temperature curve for the lippet, ACHETA LIATULA. Heart rate, respiration rate, reproductive condition and seasonal variations in heart rate, effect of body size on heart rate and air and sea surface temperature measurements are reported. It is concluded that temperature acclimation may be responsible for only a portion of observed seasonal variation, food availability and the annual reproductive cycle being other important factors. The presence of a rotational component in absence of such a component from the curves of animals acclimated in the laboratory indicated that temperature is not the only factor influencing field populations to give the observed differences. (Auth)

<199>

Warkling, L.L., Toxicity of 2-(Digeranylanilino)-Ethanol, a Candidate Selective Fish Toxicant.

1974. Trans. Amer. Fish. Soc., 103, 736-742 (U.S. Fish and Wildlife Service, Fish Control Laboratory, La Crosse, WI)

The chemical, 2-(digeranylanilino)-ethanol, was tested in the laboratory and in outdoor plastic pools to determine the toxicity to a variety of cold- and warmwater fish. The toxicant is more toxic to carp (CYPRINUS CARPIO) than to other warmwater fish. The 96-hr LC50 (concentration producing 50% mortality) for carp is 0.0407 mg/liter, whereas that value for centrarchids ranges from 0.237 mg/liter for smallmouth bass (MICROPTERUS DOLOMIEUS) to 0.720 mg/liter for bluegill (LEPOMIS MACROCHIRUS). The toxicant is significantly less toxic (P = 0.05) to bluegill in cold water (12 C) than in warmer water (17 and 22 C), and it is more toxic in hard water than in soft water. Toxicity test with green sunfish (LEPOMIS CYANELLUS) show that the toxicant is significantly more toxic (P = 0.05) in high pH water (pH = 9.0) than in low pH water (pH = 6.0), and the toxicant detoxifies at a faster rate in pH 9 than in lower pH water. Some aquatic invertebrates are more resistant to the toxicant than fish. The chemical is a good candidate selective toxicant, but additional studies are needed to support a registration for its use. (Auth)

<199>

Warkling, L.L., Toxicity of the Synthetic Pyrethroid SBP-1382 to Fish.

1974. Progressive Fish Culturist, 36, 133 (U.S. Fish and Wildlife Service, Fish Control Laboratory, La Crosse, WI)

The pyrethroid SBP-1382 (5-benzyl-3-furyl ester of chrysanthemate) is highly toxic to fish and may be useful as a piscicide under conditions in which other toxicants are ineffective. The 96-hour LC50's (concentrations producing 50-percent mortality) ranged from 1 to 5 ug/l of pyrethrin for coho salmon (ONCORHYNCHUS KISUTCH), chinook salmon (ONCORHYNCHUS Tshawytscha), rainbow trout (SALMO Gairdneri), lake trout (SALVELINUS namaycush), brook trout (SALVELINUS fontinalis), carp (CYPRINUS CARPIO), white sucker (CATOSTOMUS commersoni), green sunfish (LEPOMIS cyanellus), bluegill (LEPOMIS macrochirus), and yellow perch (PERCA flavescens). Toxicity increased as temperature decreased, but was not influenced by changes in pH or water hardness. (Auth)

<199>

Warkling, L.L., and T.D. Bills, Toxicity of Potassium Permanganate to Fish and Its Effectiveness for Detoxifying Antiaxycin.

1975. Trans. Amer. Fish. Soc., 104, 579-583 (U.S. Fish and Wildlife Service, Fish Control Laboratory, La Crosse, WI)

The 96-hr LC50's for potassium permanganate (KMnO4) ranged from 0.750 mg/liter with channel catfish, ICTALURUS punctatus to 3.60 mg/liter with goldfish, CARASSIUS auratus, in laboratory tests. The toxicity of KMnO4 to fish was greatest in water of lower temperatures, in harder water, or in higher pH water. KMnO4 was effective for detoxifying the fish toxicant antiaxycin in laboratory waters of pH 6.5 to 9.5. The half-life for antiaxycin exposed to 1.0 mg/liter of KMnO4 ranges from 7 to 11 minutes in the different pH waters at 12 C. (Auth)

<405>

Martin, D.W., and J.W. Novotny, studies to determine methods for culturing three freshwater pondland fish species.

1975. FWS-660/7-75-017; 31 p. (U.S. Fish and Wildlife Service, North Central Research Investigations, Jackson, MS)

Recommended procedures for batch culturing of the cladoceran, *CYCLIPS BICOSPIDATUS*, and the copepod, *CYCLIPS BICOSPIDATUS*, are given. Cultures of *C. BICOSPIDATUS* maintained at 15°C were more productive than those at 10 or 20°C. At 15°C population density was reduced by decreased growth rates and increased time for development of each stage in the life cycle. Maximum standing crop of *CYCLIPS BICOSPIDATUS* were produced at 15°C. Development times for each major life stage of *C. BICOSPIDATUS* at temperatures of 5, 10, 15, 20 and 25°C decreased with increasing temperatures. *BOSCHMA LONGICORNIS* was not successfully cultured. (ST)

<406>

Martin, P.O., and J.W. Pates, A Comparison of Fish Faunas in a Highly Stressed and a Less Stressed Tropical Bay - Guayanilla and Jobos Bay, Puerto Rico.

1977. Proceedings of the 27th Annual Conference of the Southeastern Association of Game and Fish Commissioners (Puerto Rico Nuclear Center, Radiocology Division, Mayaguez, Puerto Rico)

Jobos and Guayanilla Bays are semi-enclosed bays on the south coast of Puerto Rico. Jobos Bay receives some small amounts of raw sewage from two small villages and some wastes from a sugar central. Guayanilla Bay receives some sewage from a town on one shore, hydrocarbon, heavy metals, and carbohydrate effluent from a petrochemical complex, and heat from an electrical power generating plant. Species diversity as indicated by the Shannon-Weaver index is higher in Jobos but the lowest values found in either bay are higher than those reported for normal temperate aquatic systems. Numbers of fish species are high (194 for Jobos and 91 for Guayanilla). The greatest similarity between the two bays is between Jobos Inner Bay which is turbid and receives some raw sewage and Guayanilla Thermal Cove which receives heated effluents up to 40°C (equals 524). (Auth)

<407>

Mathieson, A.C., and C.J. Davies, Seasonal Studies of Florida Sublittoral Marine Algae.

1975. Bull. Mar. Sci., 25, 44-65 (University of New Hampshire, Department of Botany, Durham, NH)

The seasonal occurrence and reproduction of the sublittoral seaweed populations at four Florida sites were described. A total of 180 taxa were collected, including 105 Rhodophyceae, 69 Chlorophyceae, and 26 Phaeophyceae. The two southern sites in the Florida Keys showed higher numbers of species than the two northern sites off the central West Coast of Florida. The red algae were the most diverse group at each site. Green algae were more numerous than brown algae at the two Florida Key sites. Several of the species recorded represent extensions of known distributional ranges. Peak numbers of species were recorded during the winter-spring, when various nutrients and low temperatures were apparent. The station with the widest temperature fluctuation showed the most dramatic seasonality. The monthly occurrence and reproduction of each seaweed at the four sites are summarized. (Auth)

<408>

May, R.C., Effects of Temperature and Salinity on Fertilization, Embryonic Development, and Hatching in *BAIRDIELLA ICISTIA* (Pisces: Sciaenidae), and the Effect of Parental Salinity Acclimation on Embryonic and Larval Salinity Tolerance.

1975. Fishery Bull., 73, 1-72 (Hawaii Institute of Marine Biology, Kaneohe, HI)

Eggs and larvae of the sciaenid fish *Bairdiella*, *BAIRDIELLA ICISTIA*, were obtained from fish reared in the laboratory by photoperiod manipulation and induced to spawn by hormone injections. The effects of temperature and salinity on fertilization, embryonic development, hatching, and early larval survival were studied with the material thus obtained, and the effects on gametes of parental salinity acclimation were also investigated. Fertilization took place over a wide range of temperatures (14 to 30°C) and salinities (10 to 55 ppt), but was completely blocked at salinities of 10 ppt and below. A low level of spermatozoan activity may have accounted for the lack of fertilization at low salinities. Successful embryonic development occurred between temperatures of approximately 20 and 30°C, and salinities of 15 and 40 ppt. The production of viable larvae was estimated to be optimal at a temperature of 24.5°C and a salinity of 26.6 ppt. An interaction of the two factors was apparent, development at high salinities being most successful at low temperatures and development at high temperatures being most successful at low salinities. The stage of maturity of the spawning female had a great influence on the overall viability of the eggs produced, as well as on their response to temperature and salinity. Adult *Bairdiella* reared sexually in dilute seawater with a salinity of 15 ppt, and the salinity tolerance of the eggs produced by these fish was unaltered. (Auth)

<409>

May, R.C., Effects of Acclimation on the Temperature and Salinity Tolerance of the Yolk-Sac Larvae of *BAIRDIELLA ICISTIA* (Pisces: Sciaenidae).

1975. Fishery Bull., 73, 249-255 (Hawaii Institute of Marine Biology, Honolulu, HI)

Eggs of the *Bairdiella*, *BAIRDIELLA ICISTIA*, were fertilized and incubated in various combinations of temperature and salinity, and the salinity and upper thermal tolerances of the yolk-sac larvae were determined. The upper thermal tolerance was enhanced by acclimation to high temperatures and low salinities. Acclimation to low salinities enhanced the lower salinity tolerance of larvae at 24 hours after exposure to test conditions, but an acclimation effect on the upper salinity tolerance was not apparent until 48 hours after exposure. Yolk-sac *Bairdiella* larvae are more tolerant than the embryonic stages and less tolerant than adults to extremes of temperature and salinity. (Auth)

<410>

<410>

Weyer, R., J. Jefferis, S. Nator, and B.S. Davidson, Bioenvironmental Effects Associated with Nuclear Power Plants: A Selected Bibliography (First Addendum).

1974. NRI-X-652 (Battelle Memorial Institute, Columbus Laboratories, Environmental Information Analysis Center, Columbus, OH)

Included in the Bibliography are several papers on thermal pollution, thermal effluents, thermal resistance of aquatic organisms and the effects of thermal shock and stresses on aquatic organisms. (ST)

<411>

McCain, J.C., and J.R. Peca, Jr., Effects of a Hawaiian Power Plant on the Distribution and Abundance of Reef Fishes.

1973. COM-73-11291; 22 p. (University of Hawaii, Honolulu, HI)

The Kahe Steam-Electric Generating Station's thermal discharge induced a change in the species composition of fishes in those areas where the plume normally reached the bottom. This shift appeared to be related to an increase in benthic algal standing crop which may support the large numbers of fish primarily acanthuridae. The species composition of fish in the deeper reef areas (greater than 7 meters depth) differed from that of shallower nearshore stations. The fish fauna of areas adjacent to large rocks, such as jetties, differed from that of reef areas. The thermal plume of the power plant induced a marked increase in fish standing crop directly at the outfall, due primarily to the increase in the numbers of herbivorous species. Fish standing crop estimates for the Kahe Point reefs generally agreed with such estimates from other Hawaiian reef areas, ranging from 450 kg/hectare nearshore to 1960 kg/hectare on the deeper reefs. This included the area directly adjacent to the plant discharge, where the biomass was estimated to exceed 5600 kg/hectare. (Auth)

<412>

McCarthy, J.P., Temperature Compensation in Protein and RNA Synthesis During the Intermolt Cycle of the American Lobster, HOMARUS AMERICANUS.

1975. Ph.D. Thesis, University of Rhode Island, 140 p. (University of Rhode Island, Kingston, RI)

The effect of the intermolt cycle on the pattern of thermal acclimation and the involvement of the molt cycle hormones in any observed differences in acclimation patterns were studied in the American lobster, HOMARUS AMERICANUS. Rates of incorporation of precursors into protein and RNA were chosen as measures of acclimation because (a) both were reported to change with acclimation and molt cycle conditions; (b) they provide specific information on changes in two important biochemical pathways; and (c) they provide general information on the changes in metabolism because of their central role in the synthesis of new enzymes and cellular components. Tissues of intermolt lobsters exhibited adaptive translational acclimation to altered temperature, with respect to leucine and uridine incorporation. Hepatopancreas and muscle from pre-molt lobsters exhibited no acclimation or inverse acclimation; pre-molt gill responded by adaptive rotational acclimation. Most of the adaptive alterations in the acute temperature response curves occurred within ten days of

transfer to the new temperature. The de novo pyrimidine biosynthetic pathway was demonstrated in Crustacea. Acclimation has little effect on the incorporation of C-14-biocarbonate into orotic acid in intermolt hepatopancreas and muscle; however, pre-molt tissue exhibited a pronounced negative adaptation. The incorporation of orotic 6-C-14- acid into RNA and the decarboxylation of orotic-carboxyl C-14 acid was demonstrated. Results indicated that there is considerable competition for nucleotides for purposes other than nucleic acid synthesis; this makes it difficult to interpret the effect of molt cycle and acclimation conditions on this portion of the pathway. Injection of saline extracts of eyestalk and supraesophageal ganglia from cold-acclimated lobsters into warm-acclimated animals caused an enhancement of leucine and uridine incorporation within 12 hours of injection. The reciprocal set of injections caused a depression of incorporation rates. It is suggested that there are two CNS factors regulating the metabolic response to warm and cold temperatures. Eyestalk extirpation in pre-molt lobsters resulted in no change in the non-adaptive response to temperature acclimation. However, intermolt lobsters accelerated in a pre-molt condition by eyestalk removal exhibited an adaptive response upon temperature acclimation. It is suggested that the non-adaptive response of pre-molt tissue is due to the inhibition in the production of the CNS acclimation factors as the animal enters into a pre-molt condition. The eyestalks appeared to play a necessary role in this inhibition. (Auth) (NO)

<413>

McColl, R.W., Self-Purification of Small Freshwater Streams: Phosphate, Nitrate, Ammonia Removal.

1974. New Zealand Jour. Mar. Freshwater Res., 8, 375-388 (Department of Scientific and Industrial Research, Ecology Division, Freshwater Section, Taupo, New Zealand)

Uptake of stream nutrients by organisms or sediments of the stream bed is affected by the nutrient loading to which the stream is accustomed. In a stream with nutrient-poor waters, added phosphate and ammonia were removed rapidly and efficiently at water temperatures within the range 7.5-15.0 degrees C on passing over a mat of filamentous algae and trapped sediment. Phosphorus uptake was greatest at 13 to 15 C but was as high as 62% of the initial concentration at the lowest temperatures (4.5 to 5.0 C). Ammonium was almost totally removed at intermediate temperatures (7.0 to 7.5 C) and 82% was removed at the lowest temperatures. Nitrate was removed less efficiently or not at all. In another stream where nutrients were abundant, phosphate and nitrate from a sewage outfall were not significantly removed by the stream bed flora up to 100 m downstream at summer temperatures. Sodium was used as an inert marker to measure the dilution of added nutrients or sewage effluent by the stream waters; electrical conductivity was rejected as a measure because it is influenced by photosynthesis. (Auth) (ST)

(414)
McDonald, D.E., H.O. Eiler, H.F. Bershard, and J. Kowalczyk, A Comparison of the Thermal Effects in the Mississippi River from Two Different Cooling Water Discharge Techniques at the Quad Cities Station.

1978. Part of Gallagher, S.J. (Ed.), Proceedings of a Symposium on Energy Production and Thermal Effects held in Oak Brook, Illinois, September 10-11, 1973. Limnetrics, Inc., Milwaukee, Wisconsin (University of Iowa, Department of Environmental Engineering, Iowa City, IA; Industrial BIO-TEST Laboratories, Inc., Northbrook, IL; Commonwealth Edison, Company, Chicago, IL)

Following discontinuation of a side-jet discharge and start-up of a diffuser pipe system at the Quad-Cities generating station on the Mississippi River virtually complete mixing of heated effluent with river water was achieved. The changes in the periphytic, benthic and fishery communities observed during the period of side-jet operation disappeared following start-up of the diffuser. Periphytic communities in the Illinois island area were similar to those observed upstream and the benthic population of the area shifted to forms indicative of normal river conditions. Those species of fish which had been displaced from the islands previously re-established themselves in the area and during the period August 1972 to January 1973 the Illinois island area exhibited the greatest species diversity and largest numbers of individuals of all locations sampled. (57)

(415)
McDonald, S.L.C., Behavior of the Snail *LYNAEA STAGNALIS* (L.) in Relation to Temperature.

1975. Ph.D. Thesis, University of Michigan, 283 p. (University of Michigan, Ann Arbor, MI)

The behavior patterns of *LYNAEA STAGNALIS* at optimal and elevated temperature regimes were studied. Results were: (1) for this *LYNAEA STAGNALIS* population, 20 C to 30 C was within the biological temperature range; within this range, 20 C and 25 C were optimal temperatures; 30 C, the upper limit of this range, approached the incipient lethal level; 35 C and 37.5 C were above this range and represented the resistance zone; (2) within the biological range, snails acclimated at the constant temperatures 20 C and 25 C and at the fluctuating temperature regime experienced similar behavioral responses; (3) within the resistance zone, the behavioral responses of snails, as well as their ability to survive elevated temperatures was determined by their acclimation temperature; those acclimated at the fluctuating temperature were better able to function and survive at these temperatures than were those acclimated at constant temperatures; (4) the percentage of total activity spent in pulmonary respiration increased with temperature elevations up to 30 C and then declined sharply as temperature increased above that level; (5) at higher temperatures, increases in such types of activity as creeping, gliding and resting were associated with specific behavior patterns in which pulmonary respiration occurred; (6) certain behavior patterns which appeared at temperatures above 30 C did not occur at 30 C and below; (7) other behavior patterns which occurred only infrequently at 30 C and below became more prevalent at temperatures above 30 C; (8) it was established that 30 C was the uppermost temperature to which *L. STAGNALIS* could be exposed and still maintain

the behavior patterns observed at temperatures less than 30 C; (9) the rate of change from one behavior pattern to another approximately doubled with a 10 C increase from 20 C to 30 C but declined as temperature increased further; (10) Q10's of 2 to 2.6 were observed for the rate at which animals changed from one behavior to another as the temperature was increased from 20 C to 30 C; and (11) among the variables studied, temperature change accounted almost entirely for significant changes in behavior, while light-dark, day, and individual snail differences were minimal in their effect. (auth)

(416)
McKay, D., C.E. Jenkins, and C.J. Tyson, Effect of Endotoxin on Resistance of the Freshwater Crayfish (*PANACRAEUS BICAHINATUS*) to Infection.

1973. Kass, E.H. and Sheldan, H.W. (Ed.), Part of Bacterial Lipopolysaccharides. The Chemistry, Biology, and Clinical Significance of Endotoxins., University of Chicago Press, Chicago, IL 304 p. (University of Adelaide, Department of Microbiology, Adelaide, South Australia)

The resistance of the freshwater crayfish (*PANACRAEUS BICAHINATUS*) to infection by *PSEUDOMONAS* sp. can be altered by prior injection of small amounts of lipopolysaccharide. Development and duration of the response is temperature-dependent and may be correlated with an increase in activity of phagocytic cells rather than an increase in titer of recognition factors free in the hemolymph. However, the increased activity of the cells may be measured only if the particle has been preopsonized with hemolymph. (auth)

(417)
McKeller, R.W., Jr., Metabolism and Models of Estuarine Bay Ecosystems Affected by a Coastal Power Plant.

1975. Ph.D. Thesis, University of Florida (University of Florida, Gainesville, FL)

Effects of coastal power plants on an adjacent estuarine bay ecosystem at Crystal River on the west coast of Florida were evaluated with measurements and models to help understand relationships and predict the consequences of adding an additional power plant. The energy circuit model included metabolism, migration, water exchange, and problems concerning interface of power plants and estuarine ecosystems. Field measurements were taken from the discharge and control effect of the power plant on ecosystem structure and function, especially production, community respiration and nutrient relations. Plankton populations dominated total metabolism in the discharge bay while benthic systems dominated in the control bays. Annual average gross planktonic production was 3.06 and 1.93 g O₂(2)/m²/day in the discharge and control bays, respectively. Annual average planktonic chlorophyll in the discharge bay (2.97 g/m³) was 34% higher than in the control bay (2.21 g/m³). Zooplankton respiration was between 3 and 9% of total planktonic respiration and between 0.5 and 1.5% of total community respiration. Power plant influences on total community metabolism was small with less than 10% difference in annual averages (5.22 and 5.58 g O₂(2)/m²/day in the discharge and control bays, respectively). Regeneration of inorganic nutrients and organic turnover rates were greater in the discharge bay. (auth) (50)

<818>

<818>

McLarney, W.O., D.C. Engstrom, and J.W. Todd, Effects of Increasing Temperature on Social Behavior in Groups of Yellow Bullheads (*ICTALURUS NEBULOSUS*).

1974. *Environ. Poll.*, 7, 111-119 (Woods Hole Oceanographic Institution, Woods Hole, MA)

Groups of two yellow bullheads (*ICTALURUS NEBULOSUS*), a socially complex fish, were kept in a 50-gallon aquaria and subjected to 1°C temperature increments every other day, over the range 24 to 33°C. Total activity, and with it the incidence of aggressive behavior, increased with temperature over the entire range, with one notable exception. At about 30°C activity decreased to a level below that observed at the lowest temperature studied. The mode, as well as the frequency, of aggressive behavior changed with temperature. Aggressive behavior units were divided into two categories--display or warning units (which do not result in injury to either fish) and damaging units (which frequently do cause injury). Starting at 30°C, the relative frequency of damaging units became much greater. It is suggested that this change in behavior is due to the loss of ability by yellow bullheads at high temperatures to distinguish individuals of their own species. A possible implication of this sort of phenomenon in natural ecosystems is discussed. (Auth)

<819>

McMahon, J.W., and A.E. Docherty, Effects of Heat Enrichment on Species Succession and Primary Production in Fresh-Water Plankton.

1975. CONF-740820; STI/PDB/378; IAEA-SM-187/48; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 529-546) (Atomic Energy of Canada Limited, Biology and Health Physics Division, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada)

Sublethal effects of heat enrichment were studied on a natural plankton community in a northern, temperate lake. Species composition and numbers of organisms were determined twice weekly on populations of phytoplankton and zooplankton subjected to artificial thermal loading in a polyethylene cylinder located in the lake. Thirty species of phytoplankton and 17 species of zooplankton were quantitatively studied during the summer period. During the mid-summer period lake and control temperature increased from 22.2 to 29°C. Water in the heated column reached a maximum of 5°C above ambient. Three Chrysophyceae - *DINOBRYON DIVERGENS*, *D. BAVARIUM* and *D. SOCIUM* and two Diatoms - *ASTERIONELLA FORMOSA* and *FRAGILARIA DUMINIERENSIS*, responded negatively to increased water temperatures in the late spring. Three Rotifera - *ASPLANCHNA* sp., *HEPATILLA COCHLEATIS* and *POLYARTHA MAJOR* increased significantly in numbers in the heated column. A Chlorophyta, *ANKISTRODESMEUS PALCATUS*, appeared in large numbers in the heated water in mid-summer. Carbon 14 primary productivity values might be regarded as accurate indices for evaluating thermal effects on phytoplankton. Increased primary productivity values in one instance, were correlated with increased numbers of *ANKISTRODESMEUS* while other high mid-summer values might be related to nanoplankton production, a group not studied here. Results are discussed in terms of normal seasonal succession patterns for fresh-water plankton and possible interactions between different environmental factors. (Auth)

<820>

McMahon, J.W., Effects of Artificially Elevated Water Temperature on the Growth, Reproduction and Life Cycle of a Natural Population of *PHYSA VISCATA* Gould.

1975. *Ecology*, 56, 1167-1175 (University of Texas, Department of Biology, Arlington, TX; Marine Biological Laboratory, Woods Hole, MA)

Growth, reproduction, and life cycle of the common pond snail, *PHYSA VISCATA*, were investigated in two natural populations in Lake Arlington north central Texas. One population was affected by heated discharge from a power plant. The autecology of the populations were very similar. Observed differences included a more rapid rate of growth of the second generation in the discharge area and a significant decrease in mean number of eggs per mass laid by the discharge population. (ST)

<821>

McNeely, D.L., and W.D. Pearson, Distribution and Condition of Fishes in a Small Reservoir Receiving Heated Waters.

1974. *Trans. Amer. Fish. Soc.*, 103, 518-530 (North Texas State University, Department of Biological Sciences, Denton, TX)

The effects of a thermal effluent on the distribution and condition of fishes were determined in a 330-ha reservoir in a northeastern Texas. Fish were collected at five stations with 41-m experimental gill nets and a 6.1-m seine every 2 weeks between May 1971 and June 1972. Water temperatures at the mouth of the effluent canal were highest (32.2°C) in July and were typically 3 to 8°C higher at this location than in other areas of the reservoir. Two forage species (Mississippi silverside, *NEREDIA AUREUS*, and pumpkinseed, *NOTEMIGON CRISTATUS*) were never found near the mouth of the effluent canal. White crappie (*POMOXIS ANNUALIS*), threadfin shad (*Dorosoma petenense*), and bluegill (*Lepomis macrochirus*) were rather evenly distributed over the entire reservoir during all seasons. The size and condition of fishes collected at the mouth of the effluent canal were not significantly different from those of fish collected at other stations in the reservoir, although the condition coefficients of channel catfish, river carp, or, gizzard shad, threadfin shad, and bluegill were lower than those reported for these species in other parts of the United States. The results suggest that in small reservoirs like North Lake the effects of a heated effluent on fish populations may be generalized over the entire body of water, particularly when a cool-water refuge area is present beneath the heated surface strata. (Auth)

<822>

Heinrich, A., Repartition de *CAULERPES PROLIFERA* (Forst.) LAMOURGUE sur les Cotes Continentales Françaises de la Méditerranée.

1974. *Extrait de Tethys*, 4, 843-856 (Université de Nice, S.E.R. Domaine Méditerranéen, Laboratoire de Biologie Générale, Parc Valrose, Nice Cedex, France)

The sub-tropical alga, *CAULERPES PROLIFERA*, is at the limit of its distribution area and is very localized along the French Mediterranean Coast. Water temperature appeared to be the prevailing factor of its distribution, with 13°C being the annual temperature of occurrence. (SD)

<423>
Veldria, J.W., J.J. Gift, and B.W. Petrosky, The Effect of Temperature and Chemical Pollutants on the Behavior of Several Estuarine Organisms.

1974. Ichthyological Associates, Inc., Bulletin 11; 21 p. (Ichthyological Associates, Inc., Middletown, DE)

Behavioral avoidance responses to temperature and to chlorine were determined under various conditions of salinity, light level, and level of dissolved oxygen over the annual range of temperatures found in the Delaware River estuary. Physiological responses in terms of metabolic rate and scope for activity were determined for different levels of salinity over the same annual range of estuarine temperatures. Since the study was multi-parameter, the data were subjected to multiple regression analysis to estimate avoidance temperatures, concentrations of chlorine which would be avoided, and active and resting metabolic rates. Tests were performed on the following organisms: white perch (*MORONE AMERICANA*), Atlantic silverside (*MENIDIA MENIDIA*), striped bass (*MORONE SALTILIS*), blue crab, (*CALLINectes sapidus*), mummichog (*FUNDULUS HETEROCLOTUS*), and grass shrimp (*PALAEOMONES PUGIO*). Acclimation (or test) temperatures were found to be the dominant factor influencing the response level in all these studies. However, the effects of the other variables under study significantly affected the response as well as the effect of acclimation temperatures. Further, these variables were found to interact such that the effects of the individual variables were not consistent. In several cases, these interactions were more important in determining the response level than the main effects of their components. (UD)

<424>
Nettes, W.P., Jr., A Study of the Reproductive Behavior, Embryology, and Larval Development of the Pygmy Sunfishes of the Genus *Epiplatys*.

1974. Ph.D. Thesis, University of Alabama, 139 p. (University of Alabama, University, AL)

Embryonic development times were 82 hours for *EPIPLATIS OREOFUSCUS* at 23 C, 65 hours for *E. EVERGLADEI* at 25.5 C, 72 hours for *EPIPLATIS* species at 23.5 C, and 110 hours for *E. ZOFATUM* at 21 C. (UD)

<425>
Vicks, D.W., W.R. Gaddy, and D. Rougeau, Influence of Water Temperature and Surface Characteristics on the Larvicidal Activity of Surface Treatments.

1974. Mosquito News, 34, 297-301 (University of Texas Medical Branch, Department of Preventive Medicine and Community Health, Galveston, TX)

The influence of temperature on the larvicidal efficacy of 8 petroleum derivatives was evaluated. Substantially higher mortality of all instars of *Aedes Aegypti* and *Culex quinquefasciatus* occurred at water temperatures of 26.6 C as compared to those of 21.1 C. This enhanced activity was a function of accelerated development. Effectiveness of these petroleum hydrocarbons against the larvae of both species was found to be greater in polluted water prepared with Perma laboratory chow than in distilled water. The higher mortality in polluted water was associated with a greatly reduced dissolved oxygen content. (Ath)

<426>
Middlebrooks, E.J., E.J. Casper, E.C. Casper, J.B. Reynolds, and D.B. Porcella, Effects of Temperature on the Toxicity to the Aquatic Biota of Waste Discharges: A Compilation of the Literature.

1973. PRWG-105-1; 170 p. (Utah State University, Utah Water Research Laboratory, Logan, UT)

Literature (1289 references) on the thermal pollution of aquatic ecosystems is compiled and evaluated to describe the temperature interaction with toxicity. The detailed indexing system employed makes the information accessible by author, toxicant, and test organism. The most pertinent literature is presented in summary tables for easy subject retrieval. (UD)

<427>
Sidersky, J.A., V.S. Kennedy, A.J. McElean, W.W. Boonenburg, and A.J. Gatz, The Thermal Requirements and Tolerances of Key Estuarine Organisms.

1974. Monitoring Agency Report No. W75-03944; OWT-A-001-UD; OWT-A-011-UD; 153 p. (University of Maryland, College Park, MD)

The upper temperature tolerances of estuarine bivalves and the effects of temperature on the respiratory metabolism of three Chesapeake Bay bivalves were studied. The effects of temperature on the activity and mortality of the Scyphozoan medusa, *CHRYSAURA QUINQUEFIDRA*, are reported. The abundance, diversity and seasonal patterns of estuarine fish populations are reported. Temperature-time relationships for survival of embryos and larvae of *MULLUS LATEALIS* and *MYXODONTOMUS MYXODONTOMUS* were studied. The effects of thermal shock on the activity rhythms in the hogchoker, *TRINectes maculatus* are discussed. The osmotic response of the blue crab, *CALLINectes sapidus*, to temperature and salinity stress is reported. (UD)

<828>

<828>

Miller, P.C., A Comparison of Short-Term Effects of Thermal Addition on Photosynthesis and Plant-Water Stress in Three Ecosystems.

1975. CONF-740020; STI/PUB/378; TAPA-SR-187/17; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 623-636) (San Diego State University, Department of Biology, San Diego, CA)

Some potential short-term responses of primary production and plant-water stress to thermal additions in arctic tundra at Barrow, Alaska, chaparral in southern California, and mangrove in south Florida are compared. The comparisons are made with a simulation model which was developed in field research in each ecosystem. The tundra has a short growing season with 24-hour daylight and sub-optimal temperatures. The chaparral has a potential 365-day growing season, limited by water in summer and cool temperatures in winter. Temperatures at the soil surface are supra-optimal in the summer. The mangrove has a 365-day growing season with sub-optimal temperatures in winter and supra-optimal temperatures in summer. Water is available throughout the year. In all three isolated systems, increasing air temperatures had greater effect than increasing ground surface temperature. Increasing both air and ground temperatures had effects similar to increasing air temperature alone. Mangroves showed the greatest changes in production, but chaparral showed the greatest changes in water stress with changing temperatures. Mangrove sensitivity occurs because they are active in the summer when supra-optimal temperatures occur. Chaparral is relatively inactive in the hot season because of the limitation by water. Arctic tundra plants are relatively insensitive to temperature at low temperatures, so that increasing temperatures in the low temperature range did not change production markedly. (Auth)

<829>

Nixon, J.F., Food and Feeding of the American Plaice (*Hippoglossoides platessoides* P.) on St. Pierre Bank and Cape Breton Shelf.

1973. Intl. Comm. Northwest Atlantic Fish. Redbook, III, 59-70 (ISTPM, Saint-Pierre and Miquelon, Newfoundland, Canada)

The diet of the American plaice varied with the season and the water temperature in which it lived. Seasonally, the plaice diet varied depending on the type and quantity of food available. Echinoderms formed the basis of the plaice food (70-95%) in cold and temperate waters (-1 to 4 C). The brittle stars made up the majority of food (88-95%) between 0 and 4 C, while the sea urchins also contribute and are still abundant in waters colder than 0 C. In warmer waters the percentages decreased. Protobranchia molluscs replaced the former group in the warmer waters (>4 C) covering St. Pierre Bank (63-72%). The same group was found at similar temperatures in Subdiv. 49a, but to a lesser degree, since the maximum percentage was between 0 and 2 C, where *Tolida nalis* and *Voluta* sp. were more abundant than Y.

THACIAEPORUS. Between 4 and 6 C the gastropods and Eulachinella (*CLIMACIDUM CILIATUM*) were more abundant. Other Eulachinella (*SEMPES* *CHOCALIDICUS* and mostly *CYTODARIA SILIQUA*) and Filibranchia (*CHARYS ISLANDICUS*) were also found in cold waters (from -1 to 2 C) in both regions. The polychaetes were ingested at high temperatures (>4 C) but in greater quantity off Cape Breton Island (close to 50%), replacing the Protobranchia molluscs. Crustaceans of small size (mysids, cumaceans, isopods, amphipods and euphausiids) and crabs were generally eaten in larger numbers in cold waters (-1 to 2 C). On St. Pierre Bank scudins were only eaten at low temperatures (-1 to 2 C). As for the fish, a distinction must be made between the sand lance and MYCTOPHYDID consumed in cold waters (-1 to 2 C) and the SCORPAENIDAE and PLEUROCENTRIDAE in warmer waters (mainly between 4 and 6 C). (WD)

<830>

Nires, D., On the High Percent of TILAPIA Males Encountered in Captive Spawning and the Effect of Temperature on this Phenomenon.

1974. Basidgah, 26, 3-11 (Fish Hatchery Ein Hanifratz, Israel)

Following observation of a high percent of males in captive spawning in TILAPIA NILOTIA, T. VULCANI, T. AUREA and T. SHIBANA the effect of temperature variations on the sex ratios of larvae during the days after hatching was investigated. Larvae were removed from 27 to 29 C incubators after hatching and placed either in a controlled aquarium at 27 C or an aquarium with a diurnal fluctuation from 21 C to 27 C for 5 to 8 days. Results indicate that 'cold' culture of T. NILOTIA reduces the percent of males, to 39%, but has little effect on the sex ratio in T. GALILAEA and T. VULCANI. The results do not provide an explanation for the easy cases of high proportions of males in hatchery-spawned batches. (Auth)

<831>

Nires, D., Y. Saak, and S. Shilo, Further Observations on the Effect of Salinity and Temperature Changes on MUGIL CAPITO and MUGIL CEPHALUS Fry.

1974. Basidgah, 26, 104-109; Aquaculture, 5, 110, 104-109 (Kibbutz Ein Hanifratz Fish Hatcheries, Ein Hanifratz, Israel; Ministry of Agriculture, Extension Service, Acre, Israel)

MUGIL CEPHALUS AND MUGIL CAPITO fry were subjected to sudden changes of salinity and temperatures. MUGIL CEPHALUS suffered high mortality when transferred from 28,600 agCl/l to 422 agCl/l. Survival was higher when they were transferred gradually through a range of salinities from 2640 to 90 agCl/l. MUGIL CEPHALUS suffered heavier losses when transferred from 6900 agCl/l at lower temperatures, (10 C) than at higher temperatures (17 C). MUGIL CAPITO, previously adapted to freshwater, survived when transferred from seawater to freshwater and vice versa at various temperatures. MUGIL CAPITO, recently caught, did not survive sudden changes of temperature and salinity. (WD)

<432>

Mishima, S., Latitudinal Distribution of Salmon at Longitude 157 degrees, 30 Min E in the Early Spring in the Northwestern North Pacific, 1971-1973.

1974. Bull. Faculty Fish., Hokkaido Univ. (Jap.), 25: 35-46 (Hokkaido University, Research Institute of North Pacific Fisheries, Hokkaido, Japan)

The latitudinal distribution of salmon species in the northwestern north Pacific Ocean and the relation between distribution and ocean environment is reported. The front of the subarctic boundary (convergence of temperature and salinity up to latitude 41 to 43 degrees N) divided the distribution of fish species. In the northern part of the front, sockeye, chum and pink salmon were found. In the southern part of the front, masu and other species were found. The southern limit of salmon distribution appeared to be correlated with a temperature lower than 10 C and a salinity less than 30 ppt. Pink and coho salmon were distributed primarily in the vicinity of the subarctic boundary from latitude 42 to 43 degrees N where temperatures were comparatively high. Chum salmon were more abundant from latitude 43 to 47 degrees N, but became sparsely distributed in the northern part of the sea. Sockeye salmon were abundant from south to north, but most abundant from latitude 43 to 48 degrees N. In the far north where temperatures were less than 2 C no salmon species were found. Two age groups of sockeye salmon were found in the northern part of the sea and three age groups dominated in the northern part. The former groups showed low maturity compared with the latter groups. Young sockeye, chum and small pink salmon were found close to the subarctic boundary where temperatures were comparatively high. Latitudinal distribution and growth rate appeared to be related to environmental conditions. (Auth) (ST)

<433>

Mitchell, D.S., and W.N. Tye, The Rate of Growth of *SALVINIA MOLESTA* (S. *Aspiculata* Auct.) in the Laboratory and Natural Conditions.

1975. Jour. Appl. Ecol., 12, 213-225 (University of Rhodesia, Department of Botany, Division of Biological Sciences, Salisbury, Rhodesia)

The growth of *SALVINIA MOLESTA* has been analysed under a range of artificial and natural environmental conditions. Growth was exponential. Mean relative growth rates as high as 21.64% per day in terms of increase in number of leaves and 17.16% per day in terms of dry weight increments were recorded. Doubling times under favourable growth conditions ranged from 4 to 10 days. Relative rates of growth were higher at higher light intensities and had an optimum at 10 C. Growth is reduced at 25 C and severely inhibited at 35 C. The rate of growth is also adversely affected by a decrease in nutrient availability. Under natural conditions on Lake Kariba, it is considered that nutrient availability is the factor most likely to limit the rate of growth of *SALVINIA* when other conditions are suitable for the establishment of permanent populations. (Auth)

<434>

Mitchell, R., The Evolution of Thermophily in Hot Springs.

1974. Quart. Rev. Biol., 49, 229-242 (Ohio State University, Zoology Department, Columbus, OH)

The origins of the blue-green algae of hot springs are uncertain, but the snails and flies that eat the algae, and the mites parasitic on the flies, probably evolved from species that lived in water-margin habitats. The wet shores of water margins are regularly warmed up to 40 C by the sun. Although the origins of many thermophiles are similar, each taxonomic group evolves to a characteristic temperature limit: bacteria greater than 95 C, blue-green algae less than 74 C, fungi and eukaryotic algae less than 60 C, and metazoans less than 50 C. The selective pressures operating on each population can be defined from evolutionary models, and various explanations tested. Prokaryotes might be driven to the highest temperatures by intracellular competition for resources in the water. Heterotrophs and chemotrophs tolerate up to the boiling point of water, but autotrophs have evidently reached some physicochemical limit at 74 C. When the fitness of individuals in a population of sexual organisms is averaged out by means of out-breeding, their evolutionary equilibria may be lower because it is determined in part by the laws of cooling that determine area-temperature relationships. In eukaryotic autotrophs the fixed supply of chemical resources, as well as area, is a determining factor. The maximum temperature tolerated by eukaryotic autotrophs is 10 C higher than that tolerated by herbivores, which evolve thermophily only by trading larger, cool, grazing areas of algal mat for smaller hot areas. (Auth)

<435>

Mitchell, R., Aspects of the Ecology of the Lamellibranch *NERCENARIA NERCENARIA* (L.) in British Waters.

1974. Hydrobiologia (Den.), 8, 124-138 (Central Water Planning Unit, Reading Bridge House, Reading, England)

The *NERCENARIA* population in Southampton water have become physiologically adapted to spawn at a lower temperature (18 C to 20 C) than is reported for this species in American waters (22 C or higher). (ND)

(436)
(436)

Moore, C.J., and D.T. Burton, Movements of Striped Bass, *MORONE SALTATILIS*, Tagged During Late Fall in Chesapeake Bay, Maryland.

1974. Part of Proceedings of the 35th Annual Meeting of the Association of Southeastern Biologists held in Savannah, Georgia, 1974; Assoc. Southeast Biol. Bull., 21, 295; Trans. Amer. Fish. Soc. (in press) (Academy of Natural Sciences of Philadelphia, Benedict Estuarine Laboratory, Philadelphia, PA)

Between October 27 and December 1, 1972 a total of 1,762 striped bass (*MORONE SALTATILIS*) were tagged and released in the vicinity of the Calvert Cliffs Nuclear Power Plant, Calvert County, Maryland. All fish were obtained from a pound net approximately five miles south of the Calvert Cliffs area. The majority of specimens ranging from 28 to 36 centimeters in total length. Results, based on 705 returns (88%), indicate: (1) striped bass 28 to 36 centimeters in total length are very active throughout the winter season, (2) striped bass that utilize the Calvert Cliffs area during the late fall travel throughout Chesapeake Bay during the winter months with the majority overwintering in the open water of the Chesapeake Bay in the Annapolis-Rock Hall area, (3) by the following spring these fish travel into the upper reaches of every major tributary of the Chesapeake Bay and (4) few striped bass of this size leave the Chesapeake Bay estuary. (Auth)

(437)

Moore, C.J., S.L.H. Fuller, and D.T. Burton, A Comparison of Food Habits of White Perch (*MORONE AMERICANA*) in the Heated Effluent Canal of a Steam Electric Station and in an Adjacent River System.

1975. Environ. Letters, 8, 315-323 (Academy of Natural Sciences of Philadelphia, Philadelphia, PA; Academy of Natural Sciences of Philadelphia, Benedict Estuarine Laboratory, Benedict, MD)

The frequency of food items found in the stomachs of white perch, *MORONE AMERICANA*, taken from the Patuxent River and the Chalk Point steam electric station effluent canal were similar throughout the year. Thirty-five percent of all white perch taken from the heated effluent canal contained small pieces of coal and clinders indicating active eating in the canal where fly ash and coal dust are found. Only 3% of the river specimens contained such items in their stomachs. (57)

(438)

Moore, C.J., General Ecology, Distribution and Relative Abundance of *MUGIL CEPHALUS* and *MUGIL CURRANA* on the South Texas Coast.

1974. Cont. Marine Sci., 18, 241-255 (University of Texas Marine Science Institute, Port Aransas, TX)

The general ecology, local distribution and relative abundance of the striped mullet, *MUGIL CEPHALUS*, and the white mullet, *MUGIL CURRANA*, in South Texas were studied during 1970-1971. White mullet may be found at

higher temperatures than striped mullet. The abundance of both species at the same collection site within a one month period, decreased at temperatures above 30 C; however, the relative abundance (percentage) of *M. CURRANA* increased at temperatures above 34 C. Striped mullet must have an upper critical temperature in the summer of approximately 37 C, although they can withstand temperatures above 40 C for short periods. (58)

(439)

Moravec, F., The Development of *PROCAHALLANUS LAEVICOCHUS* (Wedl, 1862) (Nematoda: Camallanidae).

1975. Vestník Cs. Spol. Zool. (Czech.), 35, 23-26 (Czechoslovak Academy of Sciences, Institute of Parasitology, Prague, Czechoslovakia)

The life cycle of the nematode *PROCAHALLANUS LAEVICOCHUS* (Wedl, 1862), a common and widely distributed parasite of African freshwater fishes is described. As determined experimentally, the first intermediate host is *MESOCYCLOPS LEUCKARTI* (Claus) (Copepoda). The copepod feeds on free first-stage larvae of the parasite. These enter its haemocoel by way of the intestine; after two molts they attain the third, infective stage. At 23 to 26 C of the water, development in the intermediate host lasts 6 days. Experimental infection of the fish species *CARASSIUS AURATUS* disclosed that these may be utilized by the nematode as reservoir hosts. In addition to descriptions and drawings of the individual nematode stages in the intermediate and definitive hosts (*CLARIAS LAIEHA*), several problems concerned with the development and morphology of *P. LAEVICOCHUS*, and the sources of infection with this parasite are discussed. (Auth)

(440)

Moravec, F., The Development of *PARACAHALLANUS CYATHOPHANTHI* (Maylin, 1923) (Nematoda: Camallanidae).

1974. Folia Parasitol., 21, 333-343 (Czechoslovak Academy of Sciences, Institute of Parasitology, Prague, Czechoslovakia)

The life-cycle of the nematode, *PARACAHALLANUS CYATHOPHANTHI*, a widespread and abundant intestinal parasite of fishes of the family Clariidae in Africa, was studied. At experimental infection, *MESOCYCLOPS LEUCKARTI* was found to serve as intermediate host. The larvae developed to the third stage in the body of the cyclops within 8 to 9 days at the temps of 23 to 26 C. The infective larvae possess a large yellow-brown buccal capsule of *PARACAHALLANUS* type and three small conical processes at the tip of tail. Apparently the definitive host acquired infection through the reservoir hosts (different small fishes) or more directly by swallowing the infected cyclops. All developmental stages of *P. CYATHOPHANTHI* described in detail and figured. The mode of the development of this parasite suggests close affinities between the genera *PARACAHALLANUS* and *SETILANUS*. (Auth)

<041>
Morita, R.Y., Temperature Effects on Marine Microorganisms.

1974. Part of Colwell, R.R. and Morita, R.Y. (Eds.), Effect of the Ocean Environment on Microbial Activities, Proceedings of the Second United States-Japan Conference on Marine Microbiology held in Baltimore, Maryland, August 24-30, 1972. University Park Press, Baltimore, Maryland, (p. 74-79). (Oregon State University, Department of Microbiology and School of Oceanography, Corvallis, OR)

The effect of temperature on marine bacteria was briefly reviewed. Background information on growth temperatures and thermosensitivity of marine bacteria, obligate psychrophiles, and the temperature-salinity interaction was given. (ST)

<042>
Morita, R.Y., and C.E. Beck, Low-Temperature Inhibition of Substrate Uptake.

1974. Part of Colwell, R.R. and Morita, R.Y. (Eds.), Effect of the Ocean Environment on Microbial Activities, Proceedings of the Second United States-Japan Conference on Marine Microbiology held in Baltimore, Maryland, August 24-30, 1972. University Park Press, Baltimore, Maryland, (p. 124-129). (Oregon State University, Department of Microbiology and School of Oceanography, Corvallis, OR)

The minimal temperature for growth of *ESCHERICHIA COLI* in nutrient broth was determined to be between 5 and 7 C. Respiration and amino acid uptake was measured at temperatures between 5 and 37 C. Since no growth occurred at 5 C it appeared that substrates were mainly used for energy of maintenance at this temperature. (ST)

<043>
Morris, I., R.E. Glover, and C.S. Yentsch, Products of Photosynthesis by Marine Phytoplankton: The Effect of Environmental Factors on the Relative Rates of Protein Synthesis.

1974. Marine Biol. (N. Ger.), 27, 1-9 (University College London, Department of Botany and Microbiology, London, England; University of Massachusetts Marine Station, Lancaster Station, Gloucester, MA)

A method is presented by which the gross pattern of photosynthetic carbon-dioxide fixation in marine phytoplankton can be determined. It depends on differential solvent extraction yielding an ethanol-soluble, a hot TCA-soluble (polysaccharide) and a residue (protein) fraction. Using this fractionation technique, the effects of various environmental factors on the pattern of photosynthesis by the marine diatom *PHAEODACTYLUS THICOSSETUM* (Bohlin) have been investigated. Low light intensities and increasing degrees of nitrogen limitation in a chemostat increase markedly the relative rates of protein synthesis. Growth of the alga at lower temperatures also increases the proportion of carbon incorporated into the protein fraction. This increased protein synthesis is generally at the expense of the polysaccharide fraction. Preliminary experiments have established the suitability of this fractionation method for natural populations of phytoplankton and have shown similar effects of light intensity on the relative rates of protein synthesis. (Auth)

<044>
Ross, S.A., The Responses of Plainhead Filefish *MOBOCAPTUS HISPIDIS* (Linnaeus), to Low Temperature.

1971. Chesapeake Sci., 10, 300-303 (Southeastern Massachusetts University, Department of Biology, North Dartmouth, MA)

Juvenile plainhead filefish, *MOBOCAPTUS HISPIDIS*, were collected from the Westport River, a southern New England estuary, during September and October of 1971. The critical thermal minima of filefish acclimated to 15 C was found to be 8.70 C. The mean lower lethal temperature of these fish was 5.63 C. It is suggested that these fish do not escape northern waters before cold temperatures overtake them in the fall. (Auth)

<045>
Mueller, B., and T. Neme, Comparative Studies on the Relation Between Temperature and Heart Rate in Japanese Eel (*ANGUILLA JAPONICA* T. et S.) and European Eel (*A. ANGUILLA* L.).

1973. Bull. Freshwater Fish. Res. Lab. (Jap.), 23, 87-103 (Swiss Federal Institute of Technology, Duesendof, Switzerland; Freshwater Fisheries Research Laboratory, Utsu, Tokyo, Japan)

The heart rates of *ANGUILLA JAPONICA* and *A. ANGUILLA* were investigated in relation to slow and rapid temperature changes between 3.1 and 36.3 C. The standard heart rates of *A. JAPONICA* and *A. ANGUILLA* were similar between 5 and 34 C, ranging from 5 to 50 beats per minute. From 33 to 36 C, the heart rate of the European eel rises sharply, while in the Japanese eel the increase is still moderate. Following a temperature shock from 15 to 3 C, the heart rate was almost immediately adjusted to the low temperature, and no acclimation process was observed. Both species exhibited the same heart rate pattern when subjected to low or high temperature shocks. The upper incipient lethal temperature was found to be 32 C in *A. ANGUILLA* and near 34 C in *A. JAPONICA*, when acclimated to 18 C. (Auth)

<046>
Mueller, B.A., Competition for Food and Other Niche Related Studies of Three Species of Salt Marsh Foraminifera.

1975. Marine Biol. (N. Ger.), 31, 339-352 (City University of New York and New York Institute of Technology, Department of Biology, Greenvale, Long Island, NY)

The niches of three species of salt-marsh foraminifera, *ALLOGROMIA LATICOLLARIS*, *BOSSALINA LEMI*, and *SPINOCULINA NYALINA* were assessed in the laboratory. The three species reproduced within the following ranges: temperature (10 to 33 C), salinity (12 to 45 ppt) and pH (5 to 10). *ALLOGROMIA LATICOLLARIS* had the shortest generation time (8 days), and rapidly reproduced over a broad temperature range (18 to 29 C). Temperature strongly influenced the reproduction of *SPINOCULINA NYALINA*; generation time gradually decreased from 60 days at 10 C to a minimum of 14 days at 30 C, close to the upper thermal limit for the species. Temperature less affected the reproduction of *BOSSALINA LEMI*. At lower and upper thermal limits (18 and 32 C), generation time was 65 days, while at 23 C (the thermal optimum) it was 40 days. (ED)

<447>
<447>

Yenro, I.G., The Effect of Temperature on the Development of Egg, Naupliar and Copepodite Stages of Two species of Copepods, CYCLOPS VICINUS Uljanin and EUDIPTONUS GRACILIS Sars.

1974. Oecologia (Ger.), 16, 355-367 (University of London, Chelsea College, Department of Zoology, London, England)

The development times of egg, naupliar, and copepodite stages of CYCLOPS VICINUS and EUDIPTONUS GRACILIS were studied at 5, 10, 15, and 20°C. Egg development durations varied from 266 hours at 5°C to 49 hours at 20°C for C. VICINUS and 392 hours at 5°C to 55 hours at 20°C for E. GRACILIS. Egg development duration was inversely proportional to temperature. Beyond the fourth copepodite instar, males developed faster than females at all temperatures for both species. There was little difference between naupliar and copepodite duration of development at 10, 15, and 20°C, but a marked difference between these and 5°C for C. VICINUS. EUDIPTONUS GRACILIS instar development duration decreased with increasing temperature. CYCLOPS VICINUS showed the ability for compensatory temperature acclimation. (UD)

<448>

Yenro, I.G., and R.W.G. White, Comparison of the Influence of Temperature on the Egg Development and Growth of DAPHNIA LONGISPINA O.F. Muller (Crustacea: Cladocera) from Two Habitats in Southern England.

1975. Oecologia (Ger.), 20, 157-165 (University of London, Chelsea College, Department of Zoology, London, England)

The influence of temperature (5, 10, 15 and 20°C) on the egg development and growth of DAPHNIA LONGISPINA was studied under laboratory conditions. Results showed an inverse relationship between egg development duration and temperature. All other factors (O₂, light, food availability, and population density) held equal, growth of females was positively related to temperature: the largest animals being those from cultures at the highest temperatures. (UD)

<449>

Burphy, D.J., and S.E. Pierce, Jr., The Physiological Basis for Changes in the Freezing Tolerance of Intertidal Molluscs: Response to Sub-Freezing Temperatures and the Influence of Salinity and Temperature Acclimation.

1975. Jour. Exp. Zool., 193, 313-322 (University of Maryland, Department of Zoology, College Park, MD)

Acclimation to either low temperature or high salinity increased the freezing tolerance of the intertidal mollusc, MODIOLUS DEMISSUS DEMISSUS (Dillwyn). Lethal freezing temperatures ranged from -5.11°C to -12.16°C when 45.4 ppt however, did not increase freezing tolerance above the value obtained at 33.9 ppt. Lethal freezing temperatures also ranged from -10.81°C to -13.76°C in winter mussels acclimated between 23°C and 0°C (34 ppt). Thermogram recordings of intact M. DEMISSUS exposed to various subfreezing temperatures indicated that freezing occurs extracellularly only. Consequently, freezing

mortality apparently results from cell dehydration as a critical amount of tissue water is lost as ice. Calorimetry on adductor muscles isolated from M. DEMISSUS acclimated to various salinities showed that increasing salinity acclimation increases freezing tolerance by reducing the amount of tissue water frozen and, thus, preventing the attainment of a lethal dehydration level. These calorimetric studies also suggested that the lack of further increases in freezing tolerance above a specific salinity acclimation may result from salt concentrations reaching a toxic level in the frozen tissue. On the other hand, calorimetry showed that the amount of tissue water frozen is independent of temperature acclimation. Thus, low temperature acclimation does not act to increase freezing tolerance by reducing the amount of tissue water frozen but, rather, acts through an unspecified mechanism to increase cellular tolerance to greater levels of dehydration and, possibly, to greater concentrations of toxic salts. (Auth)

<450>

Hansen, R.J., Food Habits of the Amargosa Pupfish in a Thermal Stream.

1975. Trans. Amer. Fish. Soc., 104, 536-554 (Arizona State University, Department of Zoology, Tempe, AZ)

Food habits of an Amargosa pupfish (CYPRINODON NEVADENSIS amargosae) population inhabiting a thermal stream were examined at monthly intervals from January 1972 to April 1973. Little variation in foods eaten during the year was observed in the 218 specimens examined. The diet was almost entirely a mixture of blue-green algae and detritus. Invertebrates were only a minor component due to their scarcity in the stream. The smallest fishes consumed some invertebrates but this habit changes as the relative length of the digestive tract rapidly increased. (Auth)

<451>

Wair, V.R., and M. Krishna Iyer, Quantitative Distribution of Copepods Salps and Doliolids (Pelagic Tunicates) in the Indian Ocean.

1974. Indian Jour. Marine Sci., 3, 150-154 (National Institute of Oceanography, Regional Center, Cochin, India)

The maximum density of the pelagic tunicates (COPELATES SALPS and DOLIOLIDS) was in the northwestern part of the Indian Ocean. Other areas of high densities were located off the coast of India and the northern part of the Bay of Bengal. North of the equator ocean surface circulation is directly related to seasonal monsoons and this affects the distribution of these pelagic tunicates. The effects of temperature, salinity and O₂ on the abundance of copepods populations, was studied by multiple regression analysis. Dissolved oxygen had the maximum influence on distribution followed by interactions of temperature, dissolved oxygen and salinity. (ST)

<852>

Nash, C.E., and C. Kuo, Hypotheses for Problems Impeding the Mass Propagation of Grey Mullet and Other Finfish.

1975. Aquaculture, 5, 119-133 (Oceanic Institute, Waianae, HI)

Problems which impede successful mass propagation of grey mullet (*MUGIL CEPHALUS* L.) larvae in hatcheries are reviewed. Individual hypotheses on the reasons for problems associated with oocyte quality, larval foods, bacterial contamination, environmental control and facility design are discussed. With respect to temperature, incubation times for both egg incubation and larval development are temperature dependent. Strict temperature control for the incubation of mullet eggs is important (optimum 22 C). (ND)

<853>

Nash, C.E., C. Kuo, and S.C. McConnell, Operational Procedures for Rearing Larvae of the Grey Mullet (*MUGIL CEPHALUS* L.).

1978. Aquaculture, 3, 15-28 (Oceanic Institute, Waianae, HI)

The best techniques developed to increase the survival of grey mullet (*MUGIL CEPHALUS*) larvae in the early and most delicate stages of development are described, and operational procedures recommended for successful mullet mass propagation are discussed. Following induced spawning of the adults with purified salmon gonadotropin or human chorionic gonadotropin, egg incubation optimum temperature is 22 C and effective temperature range is 10 to 28 C. Highest survival occurs between 21 to 24 C and hatching occurs about 36 hours following fertilization. (ND)

<854>

Nelson, D.H., Ecology of Anuran Populations Inhabiting Thermally Stressed Aquatic Ecosystems, with Emphasis on Larval *RANA PIPPIENS* and *BUFO TERRESTRIS*.

1978. Ph.D. Thesis, Michigan State University, 190 p.; TID-26692 (Michigan State University, East Lansing, MI)

Field and laboratory studies were conducted to determine the responses of anuran populations to thermally stressed aquatic ecosystems. Adult and larval amphibians were sampled in and around a cool area of a 67 ha reservoir that receives high temperature effluent from a nuclear production reactor on the Savannah River Plant (SRP) in South Carolina. Species diversity, relative abundance, seasonal occurrence and activity patterns were compared among dominant anurans inhabiting the area. These patterns for some species were compared with data from nearby unheated areas and analyzed in terms of the thermal gradient (16 to 35 C) extending the length of the reservoir's cool area. Larval *RANA PIPPIENS* and *BUFO TERRESTRIS* were measured for length and staged according to the level of development. Although larvae of five anuran species were removed from heated reservoir waters, abundance, species diversity and population density were inversely related to the degree of thermal loading sustained. Having the shortest developmental period, *B. TERRESTRIS* was most successful, although restricted to a single breeding migration yearly. Embryonic and

<852>

larval mortality in some hot areas exceeded 90 percent. Within the limits of thermal tolerance, however, growth of larval *B. PIPPIENS* and *B. TERRESTRIS* were both inversely related to temperature and directly related to periods of development. Although all embryonic *B. PIPPIENS* maintained in the laboratory at 35 C died within nine days, most specimens at 30, 25, and 20 C completed development through transformation. Specimens reared at higher temperatures (30 or 25 C) demonstrated reduced growth rates but increased developmental rates when compared to larvae reared at 20 C. Localized cool stream seepage create isolated microenvironments that allowed for marginal development of the most common anurans (*B. PIPPIENS* and *B. TERRESTRIS*) in the reservoir receiving supra-lethal levels of thermal loading (greater than 50 C). The adaptation to breeding during nocturnal rainfall conferred a double advantage to anurans breeding in thermally stressed waters. Both field and laboratory studies confirmed that temperatures maintained in excess of 34 C are lethal confirmed that temperatures maintained in excess of 34 C are lethal to eggs, embryos, and larvae of most anurans. Within tolerance limits, increased temperatures reduced growth rates but increased development rates. (Auth) (ND)

<855>

Nelson, J.T., R.G. Bowker, and J.D. Robinson, Rearing Pellet-Pod Largemouth Bass in a Raceway.

1978. Progressive Fish Culturist, 36, 108-110 (Bureau of Sport Fisheries and Wildlife, Hannoth Spring National Fish Hatchery, Hannoth Spring, AR)

Largemouth bass, *MICROPTERUS SALMOIDES*, fingerlings increased feeding activity with a rise in water temperature above 28.7 C, resulting in greater conditioning success than in years when temperatures remained below 28.7 C. (BPC)

<856>

Neves, R.J., Factors Affecting Fry Production of Smallsouth Bass (*MICROPTERUS DOLOMIEUXI*) in South Branch Lake, Maine.

1975. Trans. Amer. Fish. Soc., 104, 83-87 (University of Maine, Maine Cooperative Fishery Unit, Orono, ME)

The early life history of the smallsouth bass, *MICROPTERUS DOLOMIEUXI*, was studied for two summers (1971-1972) in South Branch Lake, Penobscot County, Maine, to determine what factors were affecting fry production. The spawning behavior of one male with two females is described. The major spawning period for both years occurred in May. A second spawning occurred in mid-June 1972 after a drop in water temperature. Eggs hatched between 4 and 5 days in early June; hatching during the second spawning period took 94 hours at a mean temperature of 19 C. Water temperature extremes during the 1972 period ranged from 14 C to 21 C; however, no adverse effects on eggs or fry were apparent following these extremes. Nesting success for the two spawning seasons was 67% and 77%, respectively, with an average of 3,983 fry rising off each nest. Nest fanning by males did not measurably increase egg survival but did reduce mortality of egg-fry. Egg mortality was highest in the nests of smaller males (less than 400 mm) with large egg deposits. A water level drop was considered the primary cause for the lower nesting success in 1971. (ND)

<457>

<457>

Revinstij, N.W., On the Spawning of Dab in the Northwest Atlantic.

1973. Tr. VNIRO, 93, 262-285 (All Union Research Institute for Marine Fisheries and Oceanography, Moscow, USSR)

The spawning of dab (*Limanda limanda*) in the Northwest Atlantic lasted from mid-March to September. The spawning grounds occupied almost the entire shallow zone (up to 100 m) which is sufficiently wide. The most intensive spawning in the Northwest Atlantic occurred in the 50-100 m layer off the south part of the Grand Newfoundland Bank, off St. Pierre, Banguereau, Middle, Emeronde and Georges Banks in May-July when the temperature ranged from -0.5 to 8.0 C in the off-bottom layer and from 0.8 to 14.0 C on the surface. The dab larvae and eggs were found in the same areas. It is very likely that the eggs and larvae drift within the Grand Newfoundland Bank area until they reach the fry stage due to gyres of low-speed currents. The eggs and larvae drifted on the main, to the south-west off Nova Scotia and the Georges Bank. (Auth)

<458>

Mihara, T., Physiological Studies of *Limnoria japonica* var. *ochotensis*.

1975. Hokkaido Fisheries Experimental Station, Scientific Reports, 17, 11-17 (Hokkaido Wakkanai Fisheries Experimental Station, Hokkaido, Japan)

Photosynthesis and respiration of young sporophytes of the brown algae, *Limnoria japonica* var. *ochotensis* in culture were measured by using the manometric method in order to study the effect of temperature, light intensity and salinity. Photosynthesis measured at a light intensity of 10 klux varied at different temperatures. The optimum temperature of photosynthesis was between 8 and 15 C and the maximum value was obtained at 10 C. Respiration quotient (RQ) at this situation was from 0.94 to 1.03. At a temperature of 15 C the compensation point was 130 lux and the saturation point 10 klux with the value of net photosynthesis of 45.0 $\mu\text{mol/mg dry wt/hr}$. The optimum salinity at this situation was between 28.00 ppt and 36.00 ppt. Photosynthesis increased during the growth of young sporophytes derived from the 1-year-old and 2-year old plants. The result showed that the higher value is always obtained in the descendant derived from the 1-year-old plant. (Auth)

<459>

Wini, A.J., and P.W.W. Bevanish, Bioenergetics and Growth of Largemouth Bass (*Micropterus salmoides*) in Relation to Body Weight and Temperature.

1974. Can. Jour. Zool., 52, 487-496 (University of Guelph, Department of Zoology, Guelph, Ontario, Canada)

Changes in growth and proximate to body composition of largemouth bass (*Micropterus salmoides*) were examined for fish of 8 to 150 g., between 18 and 30 C. For most weights, growth of fish (grass/day) was highest at 25 C, and lowest in fish at 18 C. This was attributable in part to a higher satiation (maximum) feeding level at 25 C. For a fixed level of feeding, growth rate (percentage wet weight/day) was highest for fish held at 18 C. Lipid content (percentage wet weight) increased with feeding level and was highest at 18 C. Moisture content varied inversely with lipid. Protein and ash content did not vary appreciably with temperature, body weight, or feeding level. Maintenance requirement of bass, expressed grass/day was about twice that lost during food deprivation, but only slightly different when expressed as kilocalories/day. Energy requirements for nonfecal losses were estimated as 10% of intake energy at all feeding levels. Standard metabolism accounted for 50% of intake energy near maintenance, but only 10% at the satiation feeding level. Growth requirements increased from zero at maintenance to 40% of intake energy at satiation feeding. (Auth)

<460>

Milnes, G., and T. Hallqvist, Thermal Effects on Marine Biota in Experimental Systems.

1975. COMP-740820; STI/PUB/378; IAEA-SA-187/24; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 439-518) (Norwegian Institute for Water Research, Oslo, Norway)

The first part of the paper describes marine benthic communities that have been studied in artificial channels. Natural fjord water was used with ambient temperature in one channel and with ambient temperature plus a 4 C increase in another channel. A shift in the algal communities to greater dominance by green and blue-green algae was observed in the heated channel. Among the animal species the amphipod, *Ampelisca* *dispar*, was found only in the unheated channel. From March 8 to December 9, 1973, the increase in biomass in the algal dominated communities was the same in both channels, or slightly less in the warmer, but after December 9 the growth was greatest in the warmer channel. The shrimp *Stomatopoda* *dispar* had greatest growth in the warmed channel. The measurement of carbon assimilation of natural phytoplankton from the Oslofjord at different temperatures is as incubator is described. The experiments were carried out at different times of the year. It was shown that the effect of temperature on the productivity varied during the year, although, a 2 C temperature increase always stimulated the production. In winter there was a clear tendency for temperature increases of both 2 and 6 C to give higher productivity than a 4 C increase. In May and August the productivity increased with temperature up to 4 C above the carrying temperature. (Auth)

<861>
Worland, R.L., and H.S. Wella, Impact of Altolid or Selected Members of an Aquatic Ecosystem.

1975. Environ. Entomology, 4, 185-192
(University of California, Department of Entomology, Riverside, CA)

Repeated treatments of the insect growth regulator (IGR) Altolid EC (8) (isopropyl 11-methoxy-1,7,11-trimethyl-2,4-decadienecate) at the rate of 0.1 ppm (0.27 lb/acre) to experimental ponds reduced abundance of several arthropod prey and predator species. Because of the size differential among affected species, the altered community biomass reflected the impact of Altolid more profoundly than abundance. Pupae of the mosquito, *CULEX TAENIORHYNCHUS* (Williston), were devastated by the IGR, representing large potential losses of biomass during the height of the mosquito breeding season. Chironomid larvae were reduced twofold by the treatment, and their importance to the biomass increased with rising spring water temperature. Preliminary laboratory and pond assays determined that Altolid induced mortality in early and late instars of the mayfly, *CALLIBAETIS PACIFICUS* Seeman. During colder winter months mayflies were eliminated from ponds under repeated treatment but populations in check ponds remained low and contribution to total biomass was slight. Rising water temperatures reduced IGR impact on the mayfly population. The apparent negation of Altolid impact on the mayfly population was likely induced by three temperature-related phenomena: observed enhanced recruitment of early instars, acceleration of nymphal development, and increased degradation of the chemical. The ostracod, *CYPRINOTUS* sp., was a major prey component and was not affected by treatment. A major predator, the larval dytiscid beetle, *LACCOPHILUS* sp., was eliminated from the treated ponds. This loss represented 84% of the predator biomass during one period. Odonata naiads comprised the 2nd major group of predators throughout the study. These naiads proved heavily on mosquitoes and ostracods and were not affected by the IGR. (Auth)

<862>
Not given, Environmental Effects of Cooling Systems at Nuclear Power Plants.

1975. CONF-740820; STY/PUB/378; IAEA-SM-187; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974. International Atomic Energy Agency, Vienna, Austria, 829 p. (International Atomic Energy Agency, Vienna, Austria)

Forty-nine papers on the physical and biological effects of cooling systems and thermal discharges from nuclear power plants on the environment were presented. Papers were grouped under the general headings of introduction; heat dissipation; the physical behavior of heated effluents in the atmosphere and various aquatic systems; effects on biota and environmental ecosystems, including synergistic effects; criteria for the establishment of thermal release standards; alternative methods for the management of heated effluents and possible beneficial uses of waste heat; and effects of cooling systems and thermal discharges on siting policies for nuclear power plants. Seventeen papers primarily stressing the effects of heat on aquatic organisms and beneficial uses of waste heat were selected and abstracted separately for the data base. (ST)

<863>
Not given, Environmental Studies at the Savannah River Plant and Immediate Environs. A Bibliography.

1975. TID-3353; 99 p. (Energy Research and Development Administration, Technical Information Center, Oak Ridge, TN)

Energy Research and Development Administration-sponsored environmental research papers pertinent to the Savannah River Plant area are listed. The 702 citations are arranged by category. Citation arrangement within categories is by reports, in report number order, followed by books and journal articles in chronological order. For references previously announced in Nuclear Science Abstracts, the volume and abstract number are given. Two indexes are provided: personal author and a KRIC subject index based on titles of the citation. (ND)

<864>
Bovak, J.T., Temperature-Substrate Interactions in Biological Treatment.

1974. Jour. Water Poll. Control Fed., 46, 1984-1994 (University of Missouri, Department of Civil Engineering, Columbia, MO)

The responses of biological waste treatment systems at varying temperatures and substrate levels were determined, and the maximum rate of substrate degradation (k) and substrate concentration when the rate of degradation is half the maximum (K_{sub}), were obtained. A kinetic model is proposed in which the kinetic constants k and (K_{sub}), vary logarithmically with temperature. These data show that the Arrhenius constant or temperature coefficient is not a single value but is a function of substrate concentration. Theoretical process performance was found to compare well with field and laboratory data. (Auth)

<865>
Ogawa, K., Some Factors Affecting the Survival of Coliform Bacteria in Seawater.

1974. Jour. Oceanogr. Soc. Jap., 30, 54-60 (Tokai University, Faculty of Marine Science and Technology, Shimizu, Japan)

In natural seawater, experimental results did not show that *ESCHERICHIA COLI* was extinct by self-purification or anti-biotics action of seawater, but showed that this organism decreased mainly because of starvation caused by lack of nourishment. Although the decreasing rate of bacterial density was delayed in enriched seawater, addition of nutrient even at the time of bacterial extinction promoted the appearance of a varied form of this bacteria with floc formation. Flocculation of bacterial cells was influenced by quality and quantity of added nutrients. Temperature was shown to have an effect on the floc formation, but appearance of the varied form in flocculated cells of *E. COLI* was not affected by temperature. Flocculated particles of coliform bacteria were adsorbed on suspended particles in seawater and precipitated rapidly. This phenomenon seems to be a cause of the rapid disappearance of coliform bacteria in coastal waters. In bottom deposits the coliform bacteria probably survive longer as physiologically varied forms when suitable nutrients were supplied. (Auth)

<866>

<866>

Ogawa, K.: Distribution of Coliform Bacteria in the Coastal Water.

1973. Jour. Oceanogr. Soc. Jap., 29, 203-208 (Tokai University, Shizuoka, Japan)

In rivers flowing through the city the bacterial density changed with water temperature, whereas in the river running through agriculture districts bacterial density was affected by rainfall. (Auth)

<867>

Oikari, A., and B. Kristoffersson, Plasma Ionic and Osmotic Levels in *MYOXOCEPHALUS QUADRICORNIS* (L.) in Brackish Water during Temperature Acclimation, Particularly to Cold.

1973. Ann. Zool. Fenn. (Fin.), 10, 495-499 (University of Helsinki, Department of Zoology, Division of Physiological Zoology, Arkadiankatu, Helsinki)

Fourhorn sculpin from brackish water (6 ppt S) at 4.5 C were kept at this temperature and acclimated to -0.1 C and 10 C. Blood samples were taken at -0.1 C after 20, 35 and 55 days and at 10 C after 7, 14 and 21 days. The fish were fed ad libitum with living specimens of *NESTIDOTEA EFTONUM*. At -0.1 C plasma osmolality, and sodium, chloride and magnesium concentrations, reached a constant level in five weeks, but inorganic phosphate was constant in three weeks. At 10 C the acclimation process took three weeks, but inorganic phosphate only one week. The thermal acclimation in teleosts and the cold response in marine species, including the fourhorn sculpin living in hypotonic brackish water, are discussed. An organic "antifreeze" substance developing in the cold has been detected even in fourhorn sculpin. (Auth)

<868>

Okino, T., Studies on the Blooming of *MICROCYSTIS AERUGINOSA*.

1973. Japanese Jour. Bot., 29, 381-402 (Shinshu University, Suwa Hydrobiological Station, Nagano Prefecture, Japan)

Water-bloom of *MICROCYSTIS AERUGINOSA* was studied in some eutrophic lakes: Lake Suwa and Lake Kasugaaura and in a small eutrophic pond in Tokyo from 1967 to 1970. The standing crop of phytoplankton population in Lake Suwa represented as chlorophyll content of sampled water changed remarkably with seasons showing three peaks in May, August and October. The dominant species at each peak were as follows: *ASTENONELLA FORMOSA* and *HELOSIRA ITALICA* in May, *MICROCYSTIS AERUGINOSA* in August, and *HELOSIRA GUAULATA* and *CYCLOTELLA* sp. in October. The appearance of *MICROCYSTIS* bloom seems to correlate with such environmental conditions as follows: (1) water temperature above 20 C, (2) formation of thermocline, (3) high pH value of 9 to 11 in the surface layer, and (4) strong solar radiation for a period of time. In the vertical distribution, *MICROCYSTIS* cells tended to concentrate in the surface layer due to buoyancy resulting from gas vacuoles in the colony and gelatinous matter with small specific gravity. The unique distribution concentrating in the surface layer is clearly favorable for effective utilization of the solar radiation in the photosynthesis of the algae. In Lake Suwa, the patterns of daily

variation of photosynthesis were almost similar in spite of the difference in dominant species, i.e., the rate was high in the morning, decreased toward evening and recovered again during the night. In August, when *MICROCYSTIS* occupied the greater part of the algal population in cell number, the maximum rate was five times as high as the minimum. *MICROCYSTIS* colonies tended to concentrate in the surface layer in the daytime and disperse in deeper waters in the night due to daily change of photosynthesis. In many lakes, the standing crop of algal population decreases in summer because of the exhaustion of nutrients at the blooming of diatoms in spring. Therefore, the dense population of *MICROCYSTIS* in eutrophic lakes such as Lake Suwa must be supported by the continuous supply of nutrients by inflow of domestic waste and by a rapid turnover of nutrients. (Auth) (Su)

<869>

Olman, J.E., and K.L. Webb, Metabolism of Iodine 131 in Relation to Strobilation of *AURELIA AURITA* L. (Scyphozoa).

1974. Jour. Exp. Mar. Biol. Ecol. (Beth.), 16, 113-122 (Virginia Institute of Marine Science, Department of Environmental Physiology, Gloucester Point, VA)

The I^{131} isotope of iodine was used to follow the uptake and metabolism of iodine during the process of strobilation in pre-conditioned polyps of *AURELIA AURITA* L. Strobilating polyps accumulated free iodide from the media against a concentration gradient, the segmented portion of the polyps accumulated about three times as much as the basal portion. Almost all of the accumulated iodide appeared in the soluble portion of an acid-ethanol extract of polyp tissue as inorganic iodide. The time course of accumulation of iodine was not affected by previous exposure to either higher temperature or iodide. Experiments designed to elucidate the effects of temperature and iodide on iodide accumulation showed, 1) elevation of the temperature three days prior to iodide administration resulted in no effect on the time course of iodide accumulation at either 20 or 27 C; 2) iodide accumulation at 13 C and 20 C was significantly lower than at 27 C but not different from each other; and 3) administration of I^{131} three days prior to temperature elevation had no effect on the time course of iodide accumulation. All these comparisons were made with respect to the accumulation of iodide by polyps given I^{131} and at 27 C the same time. Inorganic iodide rather than organically bound iodine is thought to be the effective factor in the initiation of strobilation. (ND)

<870>

Olsted, L.L., The Ecology of Largemouth Bass (*MICROPTERUS SALMOIDES*) and Spotted Bass (*MICROPTERUS PUNCTULATUS*) in Lake Fort Smith, Arkansas.

1974. Ph.D. Thesis, University of Arkansas, 144 p. (University of Arkansas, Fayetteville, AR)

The life histories of largemouth bass (*MICROPTERUS SALMOIDES*) and spotted bass (*MICROPTERUS PUNCTULATUS*) from Lake Fort Smith, Arkansas were studied. Largemouth bass were twice as abundant as spotted bass in the 212 hectare water supply reservoir. Age and growth, length-weight relationships, condition factors, mortality rates, food habits, and fecundity were the factors investigated. Both species were actively spawning when surface temperatures reached 15 C. (ND)

<471>

Gpuszyński, R., Selected Temperatures of Whitefish, *COPEGONUS CLOPEAFORMIS* (Mitchilli), in the Vertical Gradient Tank.

1974. Roczn. Nauk Rolniczych (Pol.), 94, 63-72 (Institute Bytactwa Srodsladowego, Zaklad Gospodarki Stawowej, Warszawa, Poland)

Preferred temperature of 4.2 to 7.2 g whitefish fingerlings, *COPEGONUS CLOPEAFORMIS*, in a vertical gradient tank was about 10 C. The result was probably lowered by the fish's tendency to keep near the bottom of the apparatus. The selected temperature of 1.1 to 1.7 g whitefish was 17 C. The position of the thermal gradient within the tank influenced the selected temperature. (Auth)

<472>

Oshima, T., and K. Inahori, Description of *TREPNIUS THERMOPHILUS* (Yoshida and Oshima) Comb. nov., a Nonsporulating Thermophilic Bacterium from a Japanese Thermal Spa.

1974. Inter. Jour. Systematic Bacteriol., 23a, 102-112 (University of Tokyo, Department of Agricultural Chemistry, Tokyo, Japan)

The properties of an extremely thermophilic bacterium isolated from water at a Japanese hot spring and previously named *FLAVOBACTERIUM THERMOPHILUM* are described. The cells are gram-negative, nonsporulating, aerobic rods containing yellow pigment. The optimum temperature for growth is between 65 and 72 C, the maximum being 85 C and the minimum being 47 C. The guanine plus cytosine content of the deoxyribonucleic acid of the thermophile is 69 mol %. This microorganism is sensitive to various antibiotics including those which are known to be rather ineffective against gram-negative bacteria. Spheroplast-like bodies are formed upon treating intact cells with egg-white lysozyme at 60 C. The spheres are osmotically more stable than mesophile protoplasts, and their rupture under hypotonic conditions is not complete unless 0.5M Bril 50 is added to the suspension. Bulk protein extracted from this thermophile is much more stable to heat than mesophile proteins, and only about 10% of the total protein is denatured by heating at 110 C for 5 min. Nevertheless, the amino acid composition of the bulk protein is similar to that of mesophile proteins. As the properties of this organism are similar to those of *TREPNIUS AQUATICUS* (Brock and Freeze) and inasmuch as *FLAVOBACTERIUM* is a poorly defined genus, this thermophilic microorganism is transferred to the genus *TREPNIUS* as *T. THERMOPHILUS* (Yoshida and Oshima) comb. nov. (Auth)

<473>

Otto, C., Growth and Energetics in a Larval Population of *POTAMOPHYLLAI DINGULATUS* (Steph.) (Trichoptera) in a South Swedish Stream.

1974. Jour. Animal Ecol., 43, 399-361 (University of Lund, Department of Animal Ecology, Lund, Sweden)

Larval growth was studied in a south Swedish stream population of *POTAMOPHYLLAI DINGULATUS*. Energetics of individual larvae were studied in the laboratory under stream conditions. Water temperature was measured from October 1971 to October 1972. Weekly means ranged between 0.5 and 17.5 C. Absolute and total

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relative daily energy gain rates decreased during winter but increased during spring. Negative values were obtained about the time of pupation (July - August). Energetic parameters were studied in the laboratory with a before-and-after gravimetric-energetic technique. Consumption (C) and feces (F) were measured directly, while assimilation (A) was calculated according to $C \text{ equals } A \text{ plus } F$. At the temperatures investigated (15, 10, 5 and 1.8 C), consumption as well as assimilation efficiency reached maxima values at 15 C. In terms of assimilation efficiency smaller larvae showed a higher efficiency than larger ones. Maximum respiratory rates were obtained at 15 C. Energy budgets and energy transformation efficiencies were calculated for the life cycle of an average larva. (WD)

<475>

Otto, R.G., and J.O. Rice, Swimming Speeds of Yellow Perch (*PERCA FLAVESCENS*) Following an Abrupt Change in Environmental Temperature.

1974. Jour. Fish. Res. Bd. Can., 31, 1731-1734 (Industrial BIO-TEST Laboratories, Inc., Northbrook, IL)

Groups of yellow perch (*PERCA FLAVESCENS*) were acclimated to constant temperatures of 10 and 20 C for 30 days. Critical swimming speeds using a stamina tunnel were determined prior (4 test days) and following (6 test days) acclimation temperature reversal at 24 hour intervals. Median swimming speeds for the first acclimation temperature tests were 15.5 cm/sec (10 C) and 25.2 (20 C) cm/sec. Median swimming speeds increased to 21.0 cm/sec (10 C) and 33.0 cm/sec (20 C) for the remainder of the training period prior to temperature reversal. Following temperature reversal median swimming speeds for the perch acclimated at 10 C, now at 20 C, increased to 33.5 cm/sec; while the 20 C acclimated perch, now at 10 C, decreased initially to 17.5 cm/sec and then increased to 24.5 cm/sec for the remainder of the tests. Fish subjected to a decrease in temperature required less than 24 hours to regain maximum swimming capability. (WD)

<476>

Otvell, W.S., The Optimum Age, Temperature and Salinity for Stocking Juvenile Stripped Bass, *MORONE SAXATILIS*.

1973. Va. Jour. Sci., 24, 125 (Virginia Institute of Marine Science, Gloucester Point, VA)

Mortality and growth rates of juvenile striped bass, *MORONE SAXATILIS*, were studied in a factorial experimental design. Six age groups were introduced abruptly into nine temperature and salinity combinations. Results indicated considerable hardness of juvenile fish less than two months old. Significant main effects existed for all factors. All first and second order interactions were significant. Tukey's test for mean differences, and graphed results indicated a broad range of acceptable conditions: 18 to 24 C and 8 ppt to 12 ppt. These results suggest an estuarine stocking program could be flexible in site selection and age at release. (Auth)

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<476>

Ottwell, W.S., and J.V. Herringer, Survival and Growth of Juvenile Striped Bass, *MORONE SAXATILIS*, in a Factorial Experiment with Temperature, Salinity and Age.

1975. Trans. Amer. Fish. Soc., 104, 560-565 (Virginia Institute of Marine Science, Gloucester Point, VA)

A in factorial experiment to evaluate the effects of an abrupt transfer of striped bass, *MORONE SAXATILIS*, from a closed system rearing facility into a variety of experimental temperature and salinity combinations demonstrated a considerable hardness of juvenile fish. Striped bass less than two months old had over 80% survival during seven days subsequent to acute introduction from the rearing facility into temperatures of 18 C or 24 C and salinities of 3 ppt or 12 ppt. Relative growth in these treatments was monitored, and the results suggest a degree of flexibility for stocking programs into estuaries. (Auth)

<477>

Ochianikov, V.V., S.I. Gleyzer, and G.Z. Galaktionov, Features of Orientation of the European Eel (*ANGUILLA ANGUILLA* (L.)) at Some Stages of Migration.

1973. Vopr. Ikhtiol., (USSR), 13, 455-463 (Atlantic Research Institute for Sea Fisheries and Oceanography, Leningrad, USSR)

Data are given on features of the migration of juvenile and adult European eels, *ANGUILLA ANGUILLA* (L.). The effect of hydrophysical factors (current, depth, salinity, and water temperature) on the orientation of eels during autumn migrations in the Kurskiy zaliv (Kursches Haff) of the Baltic has been established by the remote observation method. In the presigratory period (May through August) adult eels did not exhibit clear orientation by compass prints. In October, in the period of active migrations, there was an intensification in the navigational ability of the eels manifested in orientation to the north, i.e., to the way out of the Kurskiy zaliv into the Baltic. In the initial period of spawning migrations, eels moved in the direction of minimum positive oxygen and salinity gradients. Adult eels were capable of perceiving a change of 7.6×10^{-3} in salinity and of 1.8×10^{-3} mg/l in oxygen. Wind direction and strength were the meteorological factors which had the most appreciable influence on the orientation of eels. Cloud cover did not have an appreciable influence on the orientation of juvenile eels. The orientation of eels is geomagnetically conditioned in the early stages of ontogenetic development. An investigation of the orientation of glass eels and pigmented eels in the absence of the geomagnetic field compensated by Helmholtz coils revealed disorientation. (Auth) (RD)

<478>

Overstreet, R.H., An Estuarine Low-Temperature Fish-Kill in Mississippi, with Remarks on Restricted Necropsis.

1974. Gulf Research Reports, 4, 326-350 (Gulf Coast Research Laboratory, Ocean Springs, MS)

In January 1973, large numbers of MUGIL CEPHALUS (striped mullet), weighing approximately 250 gm each, died in two freshwater localities in tidewater Bayou of Jackson County, Mississippi. Fish identified as MUGIL CORONA, M. CEPHALUS, MEGALOPS ATLANTICA, DOMINATOR MACULATUS, and PONDOLUS GRABOIS were found dead in other low saline estuarine areas. Fish-kills during cold periods are less commonly encountered in

Mississippi than in Texas or Florida. This particular incident was attributed to conditions of stress for fishes incompletely acclimated to the encountered low temperatures. The most deleterious stress was the low saline water which probably allowed a breakdown in the fishes' ion-osmoregulatory mechanisms. Striped mullet and other euryhaline fishes in salinities greater than 6 ppt survived, as did freshwater centrarchids and ictalurids in areas with dying mullet. Other stresses thought to contribute to the weakening of striped mullet in Paige Bayou during the period of rapidly decreasing temperatures include starvation and high levels of pesticide residues. In examined fish, the alimentary tracts were devoid of food, the gall bladders were distended and leaking bile, the livers contained excess lipid material and were often stained throughout with bile pigments, and the levels of BDT metabolites and endrin residues in the liver were higher than in control fish. Stress caused by low levels of dissolved oxygen, toxic substances in the water, or disease was discounted as a cause of death. (Auth)

<479>

Paasche, E., Growth of the Plankton Diatom *THALASSIOSIRA BORDERSKIOEII* Cleve at Low Silicate Concentrations.

1975. Jour. Exp. Mar. Biol. Ecol. (Meth.), 18, 173-183 (University of Oslo, Department Marine Biology & Limnology, Blindern, Oslo, Norway)

The combined effect of low silicate concentration and temperature on the growth of *THALASSIOSIRA* was investigated by means of batch and semi-continuous cultures. Growth rates were measured in thin cell suspensions (less than greater than half 500 cells/ml) to prevent the silicate concentration in the medium from decreasing by greater 25% during the period of measurement. Half saturation constants of silicate limited growth were calculated according to the Michaelis-Menten equation. At 3 C, the constant was 0.09 ug at Si/l and at 10 C, 0.02 ug-at Si/l. In semi-continuous cultures grown for 1 month at Si concentrations of 0.3-0.4 ug at Si/l, the mean cell division rates were 80-100% of the maximum rates recorded at the respective temperatures. It seems unlikely that decreasing Si concentrations could influence the course of the spring succession of plankton diatom species in arctic or temperate coastal waters. (Auth)

<480>

Packard, T.F., A.H. Devel, and P.D. King, The Effect of Temperature on the Respiratory Electron Transport System in Marine Plankton.

1975. Deep Sea Res., 22, 237-249 (University of Washington, Department of Oceanography, Seattle, WA)

Temperature variations failed to cause systematic changes in the respiratory electron transport activity or the Arrhenius activation energy in the microplankton from the euphotic zone of an area of the eastern Pacific Ocean (between 10 and 45 degrees N latitude) nor were values for Arrhenius activation energy statistically significant for micropelagic, epipelagic zooplankton and bathypelagic zooplankton. (RFC)

<481>
Panagiotopoulos-Karategli, A., I. Tsekos, and S. Karategli, Temperature and Salinity Tolerance of Sea Algae in the Gulf of Thessalonika, Greece.

1974. Bot. Mar., 17, 118-121 (University of Thessalonika, Botany Institute, Thessalonika, Greece)

Red, green and brown surface algae from the Gulf of Thessalonika tolerated temperatures of minus 9 C while some of those in deep water tolerated minus 2 C. Upper limits were 32 to 35 C for surface algae and 28 to 32 C for submerged forms. Air temperature and radiation during the ebb period determined tolerance of surface algae while sea temperatures determined tolerance of the deep water algae. The former were found in salinities of 0.2 to 3.0 ppt and the latter at 0.5 to 1.9 ppt. (RPC)

<482>
Parker, P.A., Empirical Functions Relating Metabolic Processes in Aquatic Systems to Environmental Variables.

1974. Jour. Fish. Res. Bd. Can., 31, 1550-1552 (Washington State University, Departments of Zoology and Computer Science, Pullman, WA)

Two empirical relationships were proposed to describe the metabolic consequences of high and low levels of light intensity, temperature, and nutrients in aquatic systems. Their performance was evaluated for three sets of data taken from the literature. (Auth)

<483>
Parrish, P.W., and R.W. Yerger, Ochlocksee River Fishes: Salinity-Temperature Effects.

1973. Fla. Scientist, 36, 179-186 (Bionomics Marine Laboratory, Pensacola, FL)

In 1968, 39 marine and freshwater fishes were taken over several months under different conditions of salinity and temperature. The degree of influence of these factors depended upon the species and constancy of salinity and temperature. (Auth)

<484>
Partaly, Z.W., Seasonal Changes of Epibiotic Communities on BALANUS IMPROVISUS in Overgrowth Biocenosis.

1974. Zh. Obshch. Biol. (USSR), 35, 854-859 (Institute of Oceanology, Moscow, USSR)

The settling of BALANUS IMPROVISUS on experimental plates in the Taganrog Bay, Azov Sea, USSR, from May through October took place at 11.9 to 23.9 C at salinities from 9.32 to 10.56 ppt. Other fouling species were identified with BALANUS being the most unfavorable, especially in Autumn. (RPC)

<485>
Paterson, W.D., and J.L. Fryer, Effect of Temperature and Antigen Dose on the Antibody Response of Juvenile Coho Salmon (ONCORHYNCHUS KISUTCH) to AEROMONAS SALMONICIDA Endotoxin.

1974. Jour. Fish. Res. Bd. Can., 31, 1743-1749 (Oregon State University, Department of Microbiology, Corvallis, OR)

Specific antibody production in response to an intraperitoneal injection of AEROMONAS SALMONICIDA endotoxin first occurred in juvenile coho salmon (ONCORHYNCHUS KISUTCH) held at 6.7, 12.2, and 17.9 C at 4, 2 and 1 wk, respectively. A. SALMONICIDA endotoxin was antigenic to juvenile coho salmon at all doses between 1 and 5000 ug administered intraperitoneally with and without an alkaline hydroxide carrier. The endotoxin was nontoxic to juvenile coho salmon when 1-5000 ug was injected intraperitoneally and the fish held at temperatures from 6.7 to 17.9 C or when "free endotoxin" was administered by the intramuscular or intraperitoneal route. AEROMONAS SALMONICIDA endotoxin was toxic to mice, however. (Auth)

<486>
Paterson, W.D., and J.L. Fryer, Immune Response of Juvenile Coho Salmon (ONCORHYNCHUS KISUTCH) to AEROMONAS SALMONICIDA Cells Administered Intraperitoneally in Freund's Complete Adjuvant.

1974. Jour. Fish. Res. Bd. Can., 31, 1751-1755 (Oregon State University, Department of Microbiology, Corvallis, OR)

The antibody response of a population of juvenile coho salmon (ONCORHYNCHUS KISUTCH) held at 12 C approached 100% following a single parenteral vaccination with AEROMONAS SALMONICIDA cells emulsified in Freund's complete adjuvant. This response indicates that coho salmon behave as a homogeneous population with respect to immunological competence. Fish as small as 1.2 g produced antibodies as early as four weeks after administration of the vaccine; high levels of antibody persisted for at least one year after injection. The single vaccination provided juvenile coho salmon with protective immunity against furunculosis. (Auth)

<487>
Patton, D.R., A Literature Review of Timber-Harvesting Effects on Stream Temperatures: Research Needs for the Southwest.

1973. U.S.D.A. For. Serv. Res. Note. Rn. 249, 1-4 (Rocky Mountain Forest and Range Experiment Station, Tempe, AZ)

Timber harvesting effects on stream temperature, and water temperature studies on various fish are reviewed. Future areas of research are proposed. Studies cited include how water temperature affects fish by changing their metabolic rate, changing oxygen content of water, influencing hatching and development time, and influencing migration. Timber harvesting creates a more open forest in the water-producing zone which can change water temperature in shallow, low-volume streams. Research is needed on how timber harvesting affects water temperature, in order to produce guidelines to meet Federal Water Pollution Control standards for cold-water fish. (Auth) (RD)

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Penaz, J.S., Reproductive Patterns of Tropical Reef Animals: Three Species of Sea Urchins.

1978. Part of Cameron, R.H. et al. (Eds.), Proceedings of the Second International Symposium on Coral Reefs held on board U.V. Marco Polo (Australia), June 22, 1977. Great Barrier Reef Committee, Brisbane, Australia, (p. 235-240) (University of California, Division of Natural Science, Santa Cruz, CA)

The reproductive patterns of *DIADEMA SETOSUM*, *ECHINOMETRA VATHAZI* and *TRIPNOSTES GRATILLA* of the Indo-West Pacific, and perhaps of their congeneric species in the tropical Atlantic, seemed to be fundamentally different. *DIADEMA SETOSUM* probably had restricted summer breeding in areas farther than approximately 10 to 20 latitude from the equator (N or S), and its reproduction may be limited to periods when sea temps are greater than or approximately 20 C. *ECHINOMETRA VATHAZI* appeared to have a much greater temperature range for reproduction, and may reproduce whenever sea temps are greater than or approximately 20 C, or most places between approximately 30 N and S lat. Reproduction of *T. GRATILLA* did not seem to be related to temperature changes at all, and different populations reproduced at different times, but with a tendency toward semiannual periods. These hypotheses about the breeding patterns of these species of sea urchins are supported by few data, and must be very tentative. (Auth) (ND)

<899>

Penaz, M., Influence of Water Temperature on Incubation and Hatching in *CHONDROSTOMA NASUS* (Linnaeus, 1759).

1978. Zool. Listy., 23, 53-59 (Czechoslovak Academy of Sciences, Institute of Vertebrate Zoology, Brno (Brann) Czechoslovakia)

The duration of incubation of eggs in *CHONDROSTOMA NASUS* was found to be highly dependent on both the mean water temperature during the whole incubation period and on water temperature during hatching. At constant water temperature of 10 C, the incubation lasted 23 days and three hours on the average; at constant water temperature of 15 C, incubation lasted eight days and 8.5 hours. Higher temperatures during hatching accelerated hatching considerably. The degree of development at which the embryos hatch depended on water temperature during incubation. At lower temperatures, more advanced and larger embryos hatched. The optimum temperature regime for artificial propagation was determined to be between 7 and 11 C during incubation, enabling a slow development of more advanced fry, and then gradually increasing the water temperature to 15-16 C to stimulate mass hatching with minimal losses. Possible causes of the disappearance of the species from stream sections whose temperature regime was affected by the erection of river dams are discussed. (Auth) (ND)

<890>

Penaz, M., Embryonic Development of the Barb, *SARBUS SARBUS*, (Linnaeus, 1759).

1978. Zool. Listy., 22, 363-378 (Czechoslovak Academy of Sciences, Institute of Vertebrate Zoology, Brno (Brann) Czechoslovakia)

The embryonic development of the barb, *SARBUS SARBUS*, was studied under laboratory conditions. Nine stages were distinguished for the embryonic period, each were distinguished morphologically and the latest ones ethologically. Hatching took place in the seventh stage when the embryos were still little developed. The mean period of incubation, between insemination and hatching of eleuterobryos, was 198.0 hours at a water temperature of 16 C; 131.7 hours at 18 C; and 91.7 hours at 20.52 C. In contrast to other cyprinid fishes, the eleuterobryonic stage of the barb, with a largely passive way of life on the bottom of the reservoir and with exclusively endogenous nutrition, was very long, lasting 11 to 19 days after hatching, depending upon the water temperature. Apart from detailed descriptions of morphological development of the essential organs, the developmental abnormalities occurring in some cases, and their possible causes were discussed. (ND)

<891>

Penaz, M., Early Development of the Nase Carp, *CHONDROSTOMA NASUS* (Linnaeus, 1759).

1978. Zool. Listy., 23, 275-288 (Czechoslovak Academy of Sciences, Institute of Vertebrate Zoology, Brno (Brann) Czechoslovakia)

Morphological and biological characters are described for *CHONDROSTOMA NASUS*, nase carp, during its early life period under the conditions of the hatchery at Ochoz near Brann. The course and temperature conditions of development were described. The embryonic period was divided into 9 stages with hatching occurring in stages 7 to 9. Six stages were described for the larval period. The juvenile period involved two stages and was characterized by the presence of scales and by the shape of the body. The daily mean temperatures at incubation varied between 6.5 and 13.6 C. The mean duration of incubation at the overall mean temperature of 11.1? C, was 20 days and 23 hours. During the rest of the embryonic period until hatching, the water temperature was 12.2 to 18.5 C. Duration of the developmental stages with respect to water temperatures was discussed. (ND)

<892>

Penaz, M., and M. Prokes, Oxygen Consumption in the Brown Trout, *Salmo Trutta* s. Fario L.

1973. Zool. Listy., 22, 181-188 (Czechoslovak Academy of Sciences, Institute of Vertebrate Zoology, Brno (Brann) Czechoslovakia)

Water temperature and weight were found to affect the absolute and specific O₂ consumption of brown trout, *SALMO TRUTTA*. Trout fry averaging 0.1 g body weight consumed 0.042 mg O₂/hr at 10 C, and 0.083 mg O₂/hr at 20 C. Old individuals weighing 100 g consumed 12.89 mg O₂/hr at 10 C and 28.20 mg O₂/hr at 20 C. (BPC)

<493>

Percy, J.A., Thermal Adaptation in the Boreo-Arctic Echinoid, *STRONGYLOCENTROTUS FOEDERACHIIENSIS* (M.P. Muller, 1776). III. Seasonal Acclimatization and Metabolism of Tissues in Vitro.

1974a. Physiol. Zool., 47, 59-67 (Memorial University of Newfoundland, Marine Sciences Research Laboratory and Department of Biology, Saint John's Newfoundland, Canada)

Respiration rates of several excised tissues of the sea urchin, *STRONGYLOCENTROTUS FOEDERACHIIENSIS* were measured in summer- and winter-acclimatized animals. In the principal tissues examined (the digestive tract and gonads) respiration was significantly higher in winter than in summer over the range of temperatures tested, 5 to 25°C. Acclimatization occurred by an upward translation of the winter rate temperature curve relative to the summer one, corresponding to Prosser's adaptation pattern IIIa. Marked seasonal changes in gonad volume did not contribute significantly to the seasonal changes in total animal respiration. Respiration of all tissues, except gonads, increased regularly with temperature up to 25°C. (ST)

<494>

Percy, J.A., Thermal Adaptation in the Boreo-Arctic Echinoid, *STRONGYLOCENTROTUS FOEDERACHIIENSIS* (M. P. Muller, 1776). IV. Acclimation in the Laboratory.

1974b. Physiol. Zool., 47, 163-171 (Department of the Environment, Fishery and Marine Service, Arctic Biological Station, Ste. Anne de Bellevue, Quebec, Canada)

STRONGYLOCENTROTUS FOEDERACHIIENSIS acclimated for 4 to 6 wk in the laboratory at either summer-like or winter-like temperatures exhibited a compensatory adjustment of respiratory metabolism comparable to that occurring in animals seasonally acclimatized in the natural habitat. This cold-induced augmentation of metabolism was detectable both in intact urchins and in excised tissues. A comparison of the magnitude of the acclimation response exhibited by excised tissues of large and small urchins indicated that acclimation ability was inversely proportional to animal size. (Auth)

<495>

Perez, G., G. Borge, D. Colin, A. Vigal, and P. Rapp, Effects of Temperature on Fish Digestion: Enzyme Activity and Intestinal Absorption.

1974. Rapp. P.-V. Reun., Comm. Intl. Explor. Sci. Mer Mediterr., (Monaco), 22, 59-60 (Institute Michel-Pacha, Laboratory of Marine Physiology, Tamaris-sur-Mer, France)

Optimum temperature for chitinase activity and chitinolytic activity was 40°C in the hagfish (*SCOPAEHA PORCUS* L.) and the conger (*CONGER CONGER* L.). Maximal chitinase activity occurred at pH 3.4 to 5 in the conger and 4 in the hagfish; chitinolytic activity was maximal at pH 3 and 3.5, respectively. Higher temperatures enhanced intestinal absorption of D-acetyl-D-glucosamine in the eel, *ANGUILLA ANGUILLA* L. Up to 30°C, oxygen consumption increased in rainbow trout, *SALMO GAIRDNERI* R. Maximum absorption of glycine and sodium was at 25°C with fixed tissue levels increasing with temperature. (NPC)

<496>

Perez Perez, D., and B.R. Ros, Experimental Cultivation of Post-Larvae of the White Shrimp *PENAEUS SCHMITZI* Barakrood.

1974. Ciencias (Invest. Mar.), Habana, No. 13: 42 p. (University of Havana, Cent. Invest. Mar., Havana, Cuba)

A large difference in growth and development of postlarvae of the white shrimp, *PENAEUS SCHMITZI*, was observed between 20 and 25°C. Mortality was high at 45 ppt salinity, but the effect on growth and mortality at 35 ppt was negative. Short-term tolerance to changes in salinity was lowest at 20°C when tolerances with and without pre-conditioning were determined at 20, 27 and 29°C. (NPC)

<497>

Pertsova, N.N., The Distribution and Life Cycle of *NETHIDIA LONGA* Lohbeck from the White Sea.

1974. Part of Pertsov, N.A. (Ed.). The Biology of the White Sea. Izdatel'stvo Mosk. Gos. Univ., Moscow, USSR, (p. 14-31) 240 p.; V. Belosor. Biol. St. Mosk. Gos. Univ., 4, 14-31 (Mosk. Gos. University, Ref. Zool. Spisokov. Moscow, 655B)

Diurnal vertical migrations in the zooplankton, *NETHIDIA LONGA*, were observed in all seasons, but most intensively in summer when temperatures rose to 13 to 14°C. Variations in age and sex composition of the populations also occurred with seasons. (NPC)

<498>

Peters, B.I., Jr., and G.F. Long, Some Alterations in Hemolymph Proteins of *HEMIGRAPUS VUDUS* Associated with Temperature Acclimation.

1973. Comp. Biochem. Physiol., 46A, 207-211 (Washington State University, Department of Zoology, Pullman, WA)

The purple shore crab, *HEMIGRAPUS VUDUS*, was exposed to environmental temperatures of 10 and 20°C and the time course of changes in hemolymph proteins and clotting time was recorded. Results indicated that this animal exhibits responses to abrupt changes in environmental temperature characteristic of acclimation. Initial shifts of total hemocyanin concentrations of up to 54 per cent of initial value were followed by a return to within two per cent. Total hemolymph proteins and hemolymph clotting time exhibited similar responses, with a correlation between these two variables of -0.95313814. (Auth)

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(499)

Petersen, J.A., H.C. Pyke, and K. Johansen, Eco-Physiological Studies of an Intertidal Crustacean, *POLLICIPES POLYMERUS* (Cirripedia, Lepadomorpha): Aquatic and Aerial Respiration.

1974. Jour. Exp. Biol., 61, 309-320 (Friday Harbor Laboratories, University of Washington, Friday Harbor, WA)

Gas exchange in water and in air of the intertidal cirripod *POLLICIPES POLYMERUS* were studied by combined field and laboratory experiments. Hemolymph gas tensions and pH were correlated with the tidal cycle in the field. Air exposure was accompanied by increasing oxygen and carbon dioxide tensions, and by decreasing hemolymph pH. During resubmersion the respiratory parameters were restored to values typical of the submerged state. There was no accumulation of lactic acid during air exposure. The oxygen uptake of *POLLICIPES* was higher for air-exposed than for submerged animals at each tested temperature (2, 10, 20 and 26-28 C with air exposed animals and 10 and 20 C with submerged animals). Oxygen uptake increased with temperature both for air-exposed and submerged animals. Respiratory rates for the air-exposed animals amounted to 5 times higher uptake at 10 C and three times at 20 C compared to submerged animals. In air exposed animals the oxygen uptake showed a decreasing Q_{10} with increasing temperature between 2 and 27 C. *POLLICIPES* exhibited oxygen conformity under varying ambient oxygen tensions and no oxygen debt was found after exposure to hypoxic water. The peduncle cuticle was permeable to oxygen and cutaneous respiration at this level may contribute significantly to the overall oxygen uptake. *POLLICIPES* was well adapted to respiratory gas exchange in both water and air making it a successful species in the intertidal community. (Auth) (ND)

(500)

Peterson, S.E., and R.A. Schetsky, Temperature Tolerance Studies on Freshwater Fishes.

1975. Part of Proceedings of the Northeast Fish and Wildlife Conference held in New Haven, Connecticut, February 23-26, 1975, 12 p. (Ichthyological Associates, Inc., Drexel, PA)

Following acclimation at 27.2 C channel catfish and bluegill preferred temperatures of 30.5 and 27.2 C respectively; median resistance temperatures (LT50) for each were 25.5 and 19.9 C respectively. The fishes avoided lethal temperatures and median resistance time became unlimited at the avoidance temperature (plus or minus .5 C) for both species. Sublethal upper incipient lethal and total lethal temperatures for the channel catfish and the bluegill were 35, 35.5, 36.6, C and 35, 35.5, 36.1 C respectively. Mortality curves were similar for both species. Channel catfish and bluegill acclimated at 32.2 C, avoided temperatures 2.9 and 1.4 C higher than when acclimated at 26.6 C (plus or minus 0.5 C). Fishes acclimated at 26.6 C (plus or minus 0.5 C) actively avoided temperatures which were lethal to them. Fishes acclimated at 32.2 C were subjected to rapid temperature increases previously lethal when acclimated at 27.2 C. No mortality was observed at the lowest temperature previously lethal to the same species acclimated at 27.2 C. (ND)

(501)

Petrycka, E., The Effect of Temperature on the Number of Bacteria in Water Determined by the Method of Poured Plates.

1974. Pol. Arch Hydrobiol., 21, 69-71 (Silesian Technical University, Sanitary Bioengineering Group, Institute of Environmental Protection, Gliwice, Poland)

River water bacteria were cultivated at 22, 27, 32, and 37 C for periods of 24, 48, 72, and 96 hours and 10 days, on agar media. The most suitable conditions for the development of the greatest number of bacteria in the river water inoculations were: 22 and 27 C during the winter to spring period and 32 C for the other seasons, and 96 hours incubation. Fewer bacteria grew at 37 C, proving that this temperature is useless in investigations of saprophytic microflora in water environment. Seasonal bacterial numbers are discussed. (ND)

(502)

Phillipson, G.E., and B.M.S. Moorhouse, Observations on Ventilatory and Net-Spinning Activities of the Larvae of the Genus *HYDROPSYCHE* Pictet (Trichoptera, Hydroptychidae) under Experimental Conditions.

1974. Freshwater Biol., 4, 525-533 (University of Newcastle upon Tyne, Department of Zoology, Newcastle upon Tyne, England)

Larvae of three species of the genus *HYDROPSYCHE* with distribution patterns indicating they were associated with increasing ranges of flow rate and temperature in the sequence *H. INSTABILIS*, *H. PELLUCIDULA*, *H. AUGUSTIPENNIS* were studied. Experiments on the frequency of ventilatory movements indicated that the larvae were increasingly tolerant to dissolved oxygen concentration, flow rate and temperature in the same species sequence. In each species the frequency of movements and the oxygen concentrations at which asixia occur tended to decrease with increasing flow rate. The oxygen concentrations at which asixia occur are interpreted as the lowest oxygen concentrations at which the species survived under experiment conditions. For all species the frequency of undulations tended to increase with increase in temperature. Experiments on net-spinning indicated a corresponding order of preference for higher temperatures and a general preference for higher flow rates. For each species the percentage of larvae spinning nets decreased with decreasing flow rate and increasing temperature. During experiments on net-spinning the number of larval casualties, ascribed to encounters between individuals, showed marked contrasts between species. The significance of the behaviour of the larvae under experimental conditions is discussed with reference to their distribution in the field. (Auth) (ND)

<501>

Pierce, S.W., The Effects of Thermal Enrichment on the Macroinvertebrate Populations of the Sabash River.

1971. OWR-8-211-190; 72 p. (Babson University, Department of Zoology, Greencastle, IN; Office of Water Research and Technology, Washington, D.C.)

The tricheptera and chironomidae in areas heated by thermal discharges from the Cayuga electric power station on the Sabash River displayed increased development rates with accelerated pupation and emergence. The mayfly STENOPEMA preferred warmer waters and responded with greater sensitivity and speeded development. TRICHOPTERIDAE, BAETIS, and ISOPHYCETA remained unaffected by the thermal range encountered. TRICHOPTERIDAE, however, displayed a strong preference for areas of low current velocities regardless of temperature. Relative densities of macroinvertebrates increased in the warmer areas, while relative dominance values decreased overall. (Auth)

<502>

Pike, J.D., Effects of Temperature and Light Intensity on the Pigmentation and Photosynthesis of CHLOROKINELLA PYRENEIDOSA.

1970. Assoc. Southeast Biol. Bull., 21, 75 (University of Tennessee, Knoxville, TN)

Steady-state cultures of four cell types were grown in environments varying with respect to temperature and light intensity. The four types were: 1) high temperature, high light (summer-type); 2) high temperature, low light; 3) low temperature, high light; and 4) low temperature, low light (winter-type). Pigment measurements were made on each cell type. Polarographic white and colored light photosynthetic saturation curves were run for each cell type. Data showed more chlorophyll a relative to chlorophyll b in summer-type cells. Polarographic data showed greater photosynthetic capacity, as well as greater system I activity (bands greater than 680 mμ) in these same summer-type cells, while system II activity (455 mμ interference filter) was relatively constant for all four cell types. (SDB)

<503>

Pinus, G.W., Some Factors Influencing Early Survival and Abundance of CLUPONELLA in the Sea of Azov.

1970. Part of Blaxter, J.H.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1971. Springer-Verlag, Berlin-Heidelberg (All Union Research Institute for Marine Fisheries and Oceanography, Moscow, USSR)

A significant relationship was found between temperature conditions during peak spawning and the strength of the year class of tilapia, CLUPONELLA DELICATULA, in the Sea of Azov. Peak spawning occurred at 15 to 18 C. In years when the optimum temperature for development (15 to 18 C) lasted about 10 days the abundance of underyearlings was low; when the optimum temperature continued for 18 to 22 days the abundance was high. In the laboratory a temperature-dependent duration of development was observed. Development time decreased from 92 hr at 11.3 C to 21 hr at 23 C. (ST)

<504>

Pitt, T.R., Age Composition and Growth of Yellowtail Flounder (LIMANDA FUSCIGERA) from the Grand Bank.

1970. Jour. Fish. Res. Bd. Can., 31, 1000-1002. (Department of the Environment, Fisheries and Marine Service Biological Station, St. John's, Newfoundland, Canada)

The commercial yellowtail flounder (LIMANDA FUSCIGERA) fishery on the Grand Bank was comprised of fish age 4 to 12 with the main contribution from 6 to 8 year olds. Comparisons of Grand Bank yellowtail with those reported for the Scotian Shelf indicated similar growth curves. Growth curves for males and females indicated slightly different rates of growth between the sexes with females a little larger at comparable age than males, especially beyond age 6. The New England stocks were significantly larger at comparable age probably because of higher water temperatures. (Auth)

<505>

Pitt, T.R., Changes in Abundance and Certain Biological Characteristics of Grand Bank American Plaice, HIPPOGLOSSOIDES PLATESOIDES.

1970. Jour. Fish. Res. Bd. Can., 32, 1303-1308 (Department of the Environment, Fisheries and Marine Service Biological Station, St. John's, Newfoundland, Canada)

Commercial exploitation of American plaice on the Grand Bank increased from the early 1950s reaching a peak of about 92,000 tons in the mid-1960s. Catches have subsequently declined to about 45,000 to 50,000 tons annually. The increased exploitation of plaice was reflected in declines in catch per hour and stock abundance of fully vulnerable age-groups and an increase in the rate of instantaneous fishing mortality. Average size at age increased gradually from the early 1950s to the 1970s apparently because of increased growth rate in the initial 2 or 3 yr of life. Coupled with the increased size at age were significant declines in the age at sexual maturity. Significant correlations were found between stock abundance and asymptotic length, and size at age 5 and 10 and while positive trends could be demonstrated between some of these and mean bottom temperature, the correlations were not significant. (Auth)

<506>

Plumb, J.A., Channel Catfish Virus.

1970. Catfish Farmer World Aquacult. News, 6, 40-44 (Alabama University, Alabama Agricultural Experiment Station, Department of Fisheries and Allied Aquaculture, Auburn, AL)

At 15 C, channel catfish virus caused no mortality or clinical signs of disease. Reduction of water temperatures to 10 to 20 C is suggested for disease prevention. Highest mortality stages of mortality were coincident with fish size of less than 10 g in weight and 10 cm in length during their first summer of life. (BPC)

1970. PG-216 888 (Twinn Laboratory of Fish Nutrition, Corvallis, OR)

(518)

1973). U.S. Thesis, Texas A & M University, 290
p. (Texas A & M University, College Station, TX)

517

1978. *Gidrobiol. Zh. Akad. Nauk, Ukr. (USSR)*,
10, 88-94 (Kiev State University, Kiev, USSR)

45122

1970. *Cisrobia*. 2h. 144d. Sect. 01. (USSR).
10. 64-70 (Not Given)

(513)

1979. Can. Jour. Bot., 52, 2175-2179 (University of Hawaii, Department of Microbiology, Honolulu, HI)

5192

1976. Trans. Amer. Fish. Soc., 105, 711-716
(Colorado State University, Department of Fishery
and Wildlife Biology, Fort Collins, CO)

Salmonid eggs are known to be sensitive to physical shock at certain stages of development. Survivability of the eggs is known when incubating under natural conditions and subjected to the seismic shock of underground nuclear detonations. Salmoes trout eggs were incubated to various stages of development (37.5, 75, 125 or 250 Temperature Units) in isolated rods and subjected to five sequential physical shocks of either 1, 2, 3 or 4 g. Eggs were then allowed to continue incubation to hatch or near hatch. Results indicated no significant difference in survival of eggs subjected to physical shocks of these four magnitudes at the various developmental stages when compared to eggs subjected to no shock. There was no significant difference in egg survival after shocking at 8.2 C or at 11.1 C. (Data)

<515>

Parera, C.T., The Effects of Benzene, Toluene and Ethyl-Benzene on Several Important Members of the Phylarian Community.

1974. Ph.D. Thesis, Lethbridge University, 117 p. (Lethbridge University, Lethbridge, PA)

Acute static bioassays using the mesocyclic aromatic benzene, toluene and ethylbenzene were conducted on the benthic copepod *AMPHIROPS*, and larval and adult grass shrimp *PALAEOMONES PACIFICUS*. The effects of these same aromatics were determined sublethally on the alga *CHLORELLA*. In the test animals, the aromatics displayed an increasing toxic effect for the series benzene, toluene and ethylbenzene whereas in the alga, the series was temperature dependent. The benthic copepod displayed a definite increase in tolerance with an increase in salinity. A reverse response was observed in the larval shrimp which displayed an increased tolerance at the lower test salinity except for ethylbenzene. The adult shrimp response to the aromatics was not so salinity dependent, but showed an increase in tolerance at the lower test temperature. The narcotic effect and the reversibility of narcosis for the adult shrimp indicated an increasing narcotic potency for the series benzene, toluene and ethylbenzene. (Both)

<516>

Potter, J.C., and P.O.R. Sweeney, Lethal Temperatures in Association of Four Species of Lampreys.

1975. Acta Zoologica, 56, 85-91 (University of Bath, England; University of Guelph, Department of Zoology, Guelph, Ontario, Canada)

The resistance time and upper lethal temperature of ammocoetes of four benthic species of lampreys provided with a sand and silt substrate into which they could burrow were studied in the laboratory. Ammocoetes burrowed after transfer from the acclimation to the experimental temperature baths and later came out of the substrate only in lethal temperatures. A relationship was observed between the resistance time and the time taken to emerge, with the resistance time increasing exponentially with decreasing experimental temperature. In *ICHTHYOSTOMA PUMILUM*, landlocked *PTYCHOPTERUS NASUTUS*, *LAMPETUS LAMOTTEI*, and *LAMPETUS PLACERIS* from two different times of the year, the incipient lethal levels over a two week experimental period for larvae acclimated to 15°C were respectively 18.5, 18, 29.5, 28.5 and 20°C. Values for *P. NASUTUS* acclimated to 5 and 25°C were respectively 29.5 and 31°C, whereas in *L. PLACERIS* they were 28 and 29°C in April/May and 27 and 29°C in July/August. Extrapolation of the results for the three acclimation temperatures yielded ultimate incipient lethal levels of 11.4°C in *P. NASUTUS* and 29.2 and 29.4°C for *L. PLACERIS* overwintered in the spring and summer respectively. Results indicated that the antitropical distribution of lampreys may be attributable to the limits of temperature tolerance of this stage in development. (Both) (99)

<517>

Pourriot, Y., Effect of Protein Content, Temperature and Fasting on the Respiration of Mesoplasmodic Rotifers.

1973. Verh. Int. Ver. Limnol., 18, 1829-1833 (Not Given)

The respiration of laboratory cultures of Rotifers (*BRACHIONUS CALYCIFLOREUS* and *BRACHIONUS PHRYGANEUS*) was measured at five temperatures using a microrespiration of the Warburg method. The oxygen consumption of *B. CALYCIFLOREUS* was directly proportional to the protein content. The respiration of the two species increased with temperature. Respiration and log T indicated a linear correlation with a higher Q₁₀ for *B. CALYCIFLOREUS*. When the animals were starved a reduction in oxygen consumption but a similar P-T relation (same Q₁₀) were observed. (Both)

<518>

Poules, P.O., Survival of Australian Anchovy (*ENGRANULUS AUSTRALIS*) Eggs and Larvae in a Boat Trap.

1973. Part of Blaxter, J.R.S., (Ed.), Early Life History of Fish, The Proceedings of an International Symposium held at Banstaff House Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-21, 1973-1981 (Trout University, Trout, Canada)

The Australian anchovy (*ENGRANULUS AUSTRALIS*) spawns in sea bays and estuaries from September to February. Fast egg numbers pass through cooling condensers of Australian steam electric stations. At Valour Point, on Lake Macquarie, survival of late eggs from inlet and discharge canals was 90% and 60%, respectively (November to December), but only 10% when discharge canal temperatures rose above 12°C (January to February). Part of this mortality could be due to turbulence and/or abrasion in the collecting net, since 15% values for anchovy eggs acclimated at 25.5 to 27°C averaged 11.5°C, a temperature rarely reached in condenser pipes. Preliminary estimates for triggerfish, *PSEUDOCYPRUS* *TACHYLEPIS* eggs were somewhat higher, at 37°C. The critical thermal maximum temperature for both species' eggs was between 37 and 40°C. (88)

<519>

Potomina, I.B., Ya.S. Miller, and L.G. Logina, Oxygen Consumption by Thermophilic and Mesophilic Bacteria.

1974. Mikrobiologiya (USSR), 43, 30-31 (Institute Microbiology, Moscow, USSR)

Thermophilic (mesothermophilic and eurythermophilic) bacteria consume 1.5 to 2 times more oxygen, if calculated per 1 mg of the biomass, than thermotolerant and mesophilic strains. This may suggest a disturbance of the correlation between energy and constructive processes in thermophilic microorganisms, that is, a higher degree of coupling between energy and biosynthetic reactions in mesophilic microorganisms. *BACILLUS SUBTILIS*, *S. THERMOPHILUS*, and *PSEUDOMONAS AERUGINOSA* were among the organisms studied. (Both)

(520)

(520)

Prasiewicz, A., The Effect of Heated Waters on Aquatic Biota in Surface Waters.

1970. *Biogeografi* Zool., 23, 377-380 (Institute of Zoology, Copelandki 60dmi, Warsaw, Poland)

The effect of thermal pollution in surface waters is discussed. The widely-used open cooling system in power stations results in an increase of water temperature below the discharge, and causes changes in aquatic ecosystems. These changes are due to the direct or indirect effects of temperature on aquatic biocenoses, and in general they may cause an increase of metabolic rate in ecosystems. A review of the literature has been the basis for analysis of the detrimental and beneficial effects of heat discharges. This problem shows the complexity of biological phenomena and the difficulties involved in attempting an accurate estimation of the effects of thermal pollution. (Ruh)

(521)

Princ, J.S., *SARGASSUM*: Preliminary Culture Experiments with *S. FILIPINENSIS*.

1970. *Jour. Phycol.*, 10, 10 (George Mason University Fairfax, VA)

Culture experiments were conducted to provide preliminary information on factors affecting the growth, reproduction, and survival of the subtidal seaweed, *SARGASSUM FILIPINENSIS*. Growth of spores in minimal culture was rapid in an enriched sea water medium. Length measurements of apices (5 mm terminal portion of in situ plants) grown in a continuous flow culture system at temperatures ranging from 11.5 to 35 C elucidated the optimum, inhibitory, and lethal temperatures for growth. Collateral dry weight measurements generally agreed with growth in length except at 25 C, the temperature which resulted in the maximal growth in length. Growth under different photoperiods and in artificial sea water was maximal at 25 C. Sexual reproduction occurred in none of the initially sterile apices during the culture experiments and are discussed. (Ruh)

(522)

Prinsloo, J.P., and J.A. Van Bode, The Influence of Temperature on the Growth Rate of *BULBOSUS* *TRONICUS* (Fruens) and *LITHUA* *STALENSIS* (Fruens) (Dollice: Baccus tophers).

1973. *Malacologia* (G.B.) (Tug.), 10, 8:40 (Potchefstroom University, Potchefstroom, South Africa)

Laboratory studies were conducted to determine the influence of temperature (27, 25, 21, 18, and 15 C) on the growth rate of *BULBOSUS TRONICUS* and *LITHUA STALENSIS*. *B. TRONICUS* maintained a greater mass than *L. STALENSIS* at 27, 25, and 21 C; but at 18 and 15 C the latter species grew faster than the former. The rate of average mass increase per specimen of *B. TRONICUS* increased with rising temperature and was best at 27 C. At both 27 and 25 C *B. TRONICUS* specimens had died before 0.5 and 5.5 months of age respectively. For *L. STALENSIS* the rate of mass increase improved with decreasing temperature. The average monthly rate of mass increase for *L. STALENSIS* was greatest after 2.5 months of age at 15 C, however the

best average rate of mass increase (0.37 g per specimen per month) was at 18 C between 2.5 and 3.5 months of age. The number of mass groups tended to increase with age in *L. STALENSIS*, but for *B. TRONICUS* the number of mass groups peaked at 0.5 months and decreased toward 6.5 months. Differentiation into mass groups may be correlated with conditions of accelerated growth. The findings for both species invalidate the assumption that different size groups in the same population necessarily represent different generations of the same species, for at 6.5 months the mass per specimen ranged from 90 to 222 mg for *B. TRONICUS* and from 130 to 342 mg for *L. STALENSIS* for specimens of equal age. Ecological life history considerations are discussed for *B. TRONICUS*. (Ruh)

(523)

Prokes, H., Band-stripping and Embryonic Development of *COMBOSUS FILIS* (Cecilia, 1980).

1975. *Zool. Listy*, 20, 185-196 (Czechoslovak Academy of Sciences, Institute of Vertebrate Zoology, Brno) (Brno, Czechoslovakia)

Band-stripping and embryonic development is described for *COMBOSUS FILIS* (Cecilia, 1980), imported to Czechoslovakia in 1970. In band-stripping, males discharged only a small amount of sperm at a time (ave., 0.5 ml). Fertilized eggs were very sticky. The quickest removal of the stickiness (within 4 hours) was obtained by rinsing the eggs with slightly acid water (pH 6.2 to 6.7). Prior to water uptake, two eggs were 1.63 mm in diameter; after water uptake (having spent 60 to 90 min. in water), 2.15 mm. The incubation of eggs at higher mean water temperature (1.63 C) lasted 123 days (200 day degrees); at lower mean water temperature (1.11 C), 185 days (160 day degrees). The described embryonic period lasted 153 days. Of that, the ovular phase (1st to 8th embryonic stages) lasted 19 days at mean water temperature of 2.04 C. The embryonic phase (9th to 16th embryonic stages) lasted from the 20th to the 105th day of development at mean water temperature of 0.96 C; the cleistogametic phase (17th embryonic stage) lasted 7 days at mean water temperature of 12.00 C. At 7 C ovular developmental stages were of shorter duration, but all organisms died before initiation of the embryonic phase. The upper limit of temperature serious of the ovular phase lies below 7 C. The lowest mortality of cleistogametic embryos was ascertained in water with pH 6.1 to 8.0. (Ruh)

(524)

Parise, I.L., and E.I. Bannova, The Rate of Photosynthesis in Phytoplankton in the Discharged Waters of the Koshovo Thermal Electric Power Station.

1973. *OSUL-tr-2787*; *Biol. Vestr. Vot. Inform.* (USSR), 17, 10-22

Testing of cooling water from 8 to 10 C above ambient during the 10 minute passage through the Koshovo, USSR, Electric Power Station had no influence on phytoplankton photosynthetic activity except in July. In a series of experiments investigating the effects of longer exposures to elevated temperatures, it was found that effects depended on the season of the year. In early spring and fall there appeared to be a stimulating effect on photosynthetic activity. In summer, when the temperature of the cooling reservoir was higher than optimal for the majority of algal species, the photosynthetic activity was depressed. (ST)

<525>

Pyon, C.S., Studies on the Spawning Season of *PEVAEUS JAPONICUS* in the Gojo Se Area.

1974. Bull. Fish. Res. Dev. Agency, Fukuoka, Japan, 11, 19-44 (Not Given)

The reproduction cycle of the oriental brown shrimp, *PEVAEUS JAPONICUS*, inhabiting warm waters is described. Landings distribution, occurrence, carapace length and body weight, sex ratio, gonad maturation, gonad histology, and spawning are summarized. Spawning took place two times a year: in June and from August to September, with the middle of August to September being the peak spawning season. (57)

<526>

Jensenberg, J.A., Report on the Culture of Brown Shrimp, *PEVAEUS AZTECUS*, in Ponds Receiving Thermal Effluent from a Power Plant.

1974. U.S. Thesis, Texas A & M University (Texas A & M University, Department of Wildlife and Fisheries Sciences, College Station, TX)

During 1973 brown shrimp, *PEVAEUS AZTECUS*, were cultured in 0.1 ha ponds designed to receive a constant supply of thermal effluent from Houston Lighting and Power Company's Cedar Bayou Electric Power Station near Baytown, Texas. The purpose was to investigate the effect of the water quality of the thermal effluent and to evaluate the potential aquaculture benefit of the effluent. The study determined the long term shrimp survival and growth when subjected to adverse hydrological conditions (high and low water temperatures, low salination, and low oxygen concentrations) as well as predation and competition from foreign organisms in the ponds. Survival was under 0.5 percent, growth less than 0.4 mm per day, and production only 0.51 and 1.59 kg per ha. In a study to determine the effect of stocking density of shrimp growth and survival, survival ranged from 45.1 to 88.8 percent with the highest stocking density producing the lowest survival. Growth rates varied from 0.72 to 1.1 mm per day and were inversely related to stocking density. Food conversion was inversely related to stocking density with rates of 2.96, 3.15, and 3.78. Production ranged from 2.40 to 171.31 kg per ha. Results also revealed a preference by the shrimp for the natural organisms over the artificial ration tested. (Auth) (RM)

<527>

Rachynas, L.A., Feeding of Fishes in the Cooling Ponds of the Lithuanian State Power Plant.

1973. Hydrobiologia (Dau.), 9, 13-18; Cidrobiol. Stud. Zh. Nauk. Ukr. (USSR), 9, 21-27 (Institute of Zoology and Parasitology, Vil'nyus, Lithuanian SSR)

Roach, rudd, and silver bream fed intensively throughout the year in the heated zone of the cooling pond of the Lithuanian Electric Power Plant. In the heated zone bivalve molluscs, macrophytes, algae and some insect larvae were consumed; outside this zone, fadder molluscs and insect larvae became a larger part of the diet. Growth rate, fatness, and fat content of the three species were favorably affected in the heated zone. (57)

<528>

Bakstarr, P., and P. Teguelli, Effect of Temperature on Development of Rice Water Weevil Eggs.

1975. Environ. Entomology, 4, 543-546

Eggs of the rice water weevil, *LISSONOTUS CURTIPALIS*, failed to hatch at a constant temperature of 40 C. Average days to hatch were 9, 6, and 4 at 25, 30, and 35 C, respectively. Little mortality occurred in eggs of various ages held at 25 C but exposed for 1 to 3 hr. to 45 C. Eggs 2 to 3 days old and those in the last stages of development died more readily than eggs halfway developed when exposed to 45 C for 6, 9 or 15 hr. Dependence of age, development rate was about 1 day slower at 45 C. (RHC)

<529>

Bennley, R.P., and E. Bittinger, Types and Distribution of Obligate Thermophilic Bacteria in Man-made and Natural Thermal Gradients.

1975. Appl. Microbiol., 30, 152-155 (University of Nebraska Medical School, Omaha, NB)

The types and distribution of obligate thermophilic bacteria were found to be similar in a thermal gradient resulting from man-made thermal pollution and the thermal gradients of two natural hot springs located in Colorado. (Auth)

<530>

Paninmi, L.S., Histopathology of Thermally Induced Sterility in *AEDES AEGYPTI* (L.) (Diptera: Culicidae) with a Description of Early Embryology.

1975. Ph.D. Thesis, University of Southern Mississippi, 97 p. (University of Southern Mississippi, Hattiesburg, MS)

Sterility was induced in the Tampa strain of *AEDES AEGYPTI* by stressing eggs during the first 24 hours of embryogeny at 43 C. Histopathology of the sterile gonads was studied by taking serial microsections. Sterility was either unilateral or bilateral in females and bilateral in all the males. Sterile gonads were reduced in size. Functional germinal cells were absent. Sections of sterile ovary revealed that the number of ovarioles was substantially reduced, and they showed histological changes. They were reduced in size and possessed a poorly developed follicular epithelium. Only the proximal part of the ovariole had a few small cells with indistinct cell boundaries. The sterile testis had few spermatogonia, which in some cases had differentiated up to the pyroferous stage of spermatids. Mature spermatozoa were absent. Early embryonic development is described. (Auth) (RM)

(511)

(511)

Sanudo, R.F., Effects of Temperature and Salinity on the Oxygen Consumption in Clams.

1973. Jour. Bombay Nat. Hist. Soc. (Ind.), 70, 128-136 (Bombay National Historic Society, Bombay, India)

The G10 and O2 consumption in *NERETINUS* and *NERETINUS* and *NERETINUS* was size dependent in the range 20 to 40 C. The G10 decreased with increasing body weight and increasing temperature. Small specimens appeared to be more sensitive to temperature change than large ones. In *N. OPIMA* oxygen consumption increased with decrease in salinity from 100‰ to 50‰ sea water, and consumption was surface area dependent. In *N. NERETINUS* change from 100‰ to 50‰ sea water had little effect on O2 consumption. (auth)

(512)

Randolph, R.W., The Daily Routine of Channel Catfish, *Ictalurus punctatus*, in Culture Ponds.

1975. Ph.D. Thesis, University of Oklahoma, 67 p. (University of Oklahoma, Norman, OK)

Three distinct behavior patterns were recognized in the daily routine of channel catfish in culture ponds: (1) occupancy of a home area, (2) daily trip to the feeding station, and (3) feeding. When the fish were not in home areas they were going to or from the feeding station by specific routes or swimways. Home areas were relocated from deep to shallow areas or from shallow to deep areas depending on the temperature conditions. In the spring and fall, home areas were in shallow but during summer and winter they were in deeper parts of the pond. Likewise, fish seasonally adjusted their swimways. Foraster swimways were used during spring, but were discontinued for direct swimways when water temperatures reached 18 C. Throughout most of March to October, sorted fish made a daily trip to the feeding station. In the spring, fish did not utilize channel feeders until temperatures were 12 C. Fish stopped downed feeding in the fall at approximately 15 C, following an abrupt decrease in temperature of approximately 11 degrees (C). In the spring, intermittent feeding appeared to be primarily temperature related. At 14 temperatures fish did not feed daily. Fish shifted feeding periods from midday to evening as the feeding season progressed. The shift is explained by the fish becoming acclimated to increasing temperatures and selecting for warmer temperatures. During summer, low oxygen concentration often caused fish to adjust or miss their daily feeding period. Feeding was reduced at oxygen values below 3 mg/l, but small fish occasionally fed at values as low as 2 mg/l since they were acclimated to feeding at low values. Contacts between different sizes of fish at the feeding station established a feeding hierarchy and subordinate fish often waited to feed. Large fish were dominant in feeding and sex did not appear to be a factor in determining feeding status. Length of waiting to feed ranged from 0 to 3 hr for the larger fish and from 0 to 12 hr for the smaller fish. (auth)

(513)

Savitskiy, V., Seasonal Change in the Parasite Fauna of the Pike in Some Lakes with Different Thermal Conditions.

1974. Acta Parasitol. Lith., 12, 61-75 (Institute of Zoology and Parasitology, Vil'nyus, Lithuanian SSR)

Parasitological dissection studies on the pike in lakes Obelija, Slavutas, and Galstas were performed in 1971. Twelve to fifteen specimens from each lake were utilized in the experiments. Fish specimens were one to nine years of age. Thirty-six parasite species were identified. Seasonal changes of parasite invasion (extent and intensity) was more marked for the thermally shallow lake Obelija. Lake Obelija apparently has a quicker and more intense warming period during the spring through summer period, affecting the host-parasite relationship. Seasonal changes of parasitic fauna were less significant for the thermally deeper lakes Slavutas and Galstas. (RM)

(514)

Wood, S.R., C.J. Davis, J.E. Warner, and R.W. Jones, Seasonal Dynamics of the Benthic Aquatic Macrophytes of the Pamlico River Estuary, North Carolina: A Preliminary Report.

1974. Jour. Estuarine Research Soc., 90, 99 (Not given)

A direct relationship was found between water temperature (annually ranging from 5 to 27 C) and the biomass of all major species of the aquatic flora of the Pamlico River Estuary. *SPERMATOPHYTES* dominated during winter low temperatures and high salinity, while *VALISNERIA SPIRALIS* did so in the summer and early fall. Maximum biomass occurred in September and October; minimal in February. The red filamentous alga, *CHLORELLA* appeared in noticeable proportions in the oligo-mesohaline area during early summer. Green algae, *CLADOPHYTES* and *EUTERODERMIS*, reached maximum biomass later in the season. (WPC)

(515)

Beingold, S.C., Temperature Effects on Axonal Conduction in *CALLINECTES SAPIDUS* (Rathbun) and *CALLINECTES BARNES* (L.).

1975. Comp. Biochem. Physiol., 51A, 104-109 (Cornell University, Section of Neurobiology and Behavior, Ithaca, NY)

Temperature-dependent parameters of axonal conduction were investigated in the 5th pereopod of the two ecologically divergent portunid crabs, *CALLINECTES SAPIDUS* and *CALLINECTES BARNES*. The cold block point for axonal conduction in *C. SAPIDUS* is considerably higher than that for *C. BARNES*, while heat block points are not significantly different. G10 for conduction velocity for individual fibers within a species are different; average G10 values between the two species are not statistically different. Cold block preparations show hysteresis of conduction velocity. The results from nerve preparations can be correlated with the response of intact animals to normal environmental temps. (auth)

(536)

Reich, D.J., and D.J. Venzling, Marine and Estuarine Pollution.

1978. Jour. Water Poll. Control Fed., 44, 1437-1451 (California State University, Department of Biology, Long Beach, CA; University of Southern California, Department of Biological Sciences, Los Angeles, CA)

Books and bibliographies as well as literature concerning monitoring, surveys, oil pollution, phytoplankton, sludge beds and dredging, effects of temperature and salinity, diseases, diseases, microorganisms, miscellaneous biological studies, physical and chemical oceanography are reviewed. Population peaks and enclosed species of subtropical, subtidal animals in Florida in the vicinity of heated effluents are given with related temperatures. Results of laboratory and laboratory and field studies on snails, clam larvae, and estuarine crustaceans relative to elevated temperatures as well as to chlorine are reported. Included is research on measurements of the synergistic effects of temperature and salinity on crustaceans and molluscs as well as the effects of salinity alone on shellfish. (BPC)

(537)

Reitmeier, P.F., Thermal Discharges - Problems and Opportunities.

1973. Jour. Environ. Qual. 2, 170-179 (U.S. Atomic Energy Commission, Environmental Sciences Branch, Division of Biology and Medicine, Washington, DC)

This is the opening statement for the symposium on Beneficial Uses for Thermal Discharges held on August 19, 1971 in conjunction with the annual meeting of the American Society of Agronomy in New York City. The papers presented represent an attempt to portray the technology, problems, potentials, and economic practicability of using thermal discharges from power production in agriculture and aquaculture. (BPC)

(538)

Reverez, A.L., Study of the Fishes of Laguna de Toluca, Veracruz, Mexico.

1973, 1975. An. Inst. Biol. Univ. Nac. Auton. Mex. Ser. Cienc. Mar. Limnol., 41, 79-106 (Univ. Nac., Inst. Biol., Auton. Mex., Mexico 81, Mexico)

A mass fish mortality occurred in the Laguna de Toluca, Mexico, in January of 1967 at 10.3 C, the lowest temperature recorded. Highest temperature recorded was 33 C in May of 1966 (BPC)

(539)

Reutter, J.B., and C.E. Berendson, Laboratory Estimates of Fish Response to the Heated Discharge from the Davis-Besse Reactor, Lake Erie, Ohio.

1975. Center for Lake Erie Area Research Clear Technical Report No. 31; 58 p. (Ohio State University, Center for Lake Erie Area Research, Columbus, OH)

Results of testing 1000 delt fish from 35 species and one hybrid for temperature preferences indicated that fish are likely to be attracted to but not killed in significant numbers by a discharge plume in the fall, winter, and spring. This is assessing a plume

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of less than 1.6 km, a maximum temperature change of 11.1 C and a flow rate of 202 cm/sec. In the summer, all fish should be repelled from the center of the plume but some may be slightly attracted or indifferent to the plume periphery. Ictalurus are considered to be relatively tolerant to high temperatures. However, Ictalurus nebulosus preferred to 10.9 C and Morone flavus, 5.5 C in the winter. Sudden temperature changes appeared to be more important than the 11.1 C change. Precluding the possibility of entrainment, maintaining a high discharge velocity should keep fish out of the hottest part of the plume. Alosa pseudoharengus (alewife), Aplocheilichthys (freshwater trout), Perca flavescens (yellow perch), and Micropterus salmoides (white bass) were abundant in the discharge area and relatively intolerant to sudden temperature change. (BPC)

(540)

Reutter, J.B., and C.E. Berendson, Laboratory Estimates of the Seasonal Fish Temperature Preferences on Some Lake Erie Fish.

1976. Proc. 17th Conf. Great Lakes Research, 59-67 (Ohio State University, Center for Lake Erie Area Research, Put-in-Bay, OH)

Temperature preferences of over 2000 Lake Erie fish of 24 species varied by species, season and age although all species preferred temperatures above lake temperature during fall, winter and spring. Summer preferences were equal to or slightly higher than ambient. In the fall, winter and spring, barricades were necessary to prevent all species from swimming into lethal hot water faster than they could acclimate to it. Prior to testing, fish were held at ambient temperatures. (BPC)

(541)

Rey, J., and B. Dupin, Ecology on the Benthic Crustaceans in Lake Port-Bleth (Central Pyrenees): II. Biological Cycles.

1973. Ann. Limnol., 9, 259-271 (Universite' Paul-Sabatier, Laboratoire d'Hydrobiologie, Toulouse Cedex, France)

The biological cycles of several populations of Cladocera and Copepoda of a high mountain lake, Lake Port-Bleth, were followed from June to November 1971, a period when the lake was free of ice. In most cases, the life cycle of the species (growth, reproduction) was extended over the summer period, the lake being frozen for the rest of the year. Most species were monocyclic. The cycle of the Cladocera started with the hatching of resting eggs when the ice melted, and then followed a period of asexual parthenogenetic reproduction in August and September. A general phase of quiescence marked the end of the cycle. The Copepoda were already reproducing when the ice melted; the removal of populations occurred in summer. The species adapted to the extreme conditions of the environment by exhibiting special morphological and physiological characteristics: epipia of Cladocera, encystment and a dormant phase of Copepoda. (auth)

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Dev, J., and P. Dupin, Ecology of Benthic Crustacea in Lake Port-Siolk (Central Pyrenees) I. Distribution.

1971. Ann. Zool., 4, 121-134 (Université Paul-Sabatier, Laboratoire d'Écologie, Toulouse Cedex, France)

Population of benthic Cladocera, Copepoda and Isopoda were studied in a high mountain lake, Lake Port-Siolk, during the ice-free period. Several dominant species formed most of crustacean biomass. Two communities were recognized, and corresponded to the littoral zone (1 to 7 m) and the littoral-profundal zone (7 to 10 m). The nature of the substrate, the temperature and the oxygen content were examined in relation to the distribution of species. The thermal conditions seemed to play a basic role in the distribution and development of the populations. (Auth)

(544)

Reynolds, J.S., Interrelations of Photosynthetic Behavior and Zooplankton Population in a Natural Population of a Blue-Green Alga.

1974. Freshwater Biol., 4, 123-134 (Beres Laboratory, Freshwater Biological Association, Preston Northway Hall, Sharncliffe, England)

The photosynthetic activity of *ANABAZA CYPRINUS* showed a strong correlation with temperature in prepared suspensions exposed to the natural light field of Cross Lake, a shallow, eutrophic lake noted for its surface blooms of blue-green algae. The effect of increasing temperature was to suppress the population in the light-gradient. (BPC)

(545)

Reynolds, J.S., E.J. Riddlebrooks, D.B. Porcella, and S.J. Greeney, Effects of Temperature on Growth Constants of *SELWATERIA CAPRICORNUTUM*.

1974. Jour. Water Poll. Control Fed., 47, 2423-2434 (Utah State University, Division of Civil and Environmental Engineering, Logan, UT)

The alga, *SELWATERIA CAPRICORNUTUM* grew in batch and semi-continuous flow cultures at 15°C and 27°C, but not at 30°C. Determination of the various specific growth rates and the half-saturation constants in an ammonia-nitrogen-limited environment over a temperature range of 20 to 33°C were determined. The luxury uptake function was applied to an ammonia-nitrogen-limited environment. Nutrient utilization constants were determined at 20 to 33°C. (BPC)

(546)

Reynolds, J.S., E.J. Riddlebrooks, and D.B. Porcella, A Continuous Flow Kinetic Model to Predict the Effects of Temperature on the Toxicity of Oil Refinery Water to Algae; Temperature-Toxicity Model for Oil Refinery Waste.

1973; 1974. Part of Proceedings of the 20th Industrial Waste Conference held in Lafayette, Indiana, May 1-3, 1973; Jour. Environ. Eng. Div., Proc. Amer. Soc. Civil Eng., 100, 557-576 (Utah State University, Division of Civil and Environmental Engineering, Logan, UT)

Equations were developed utilizing continuous flow stirred tank reactor kinetics and enzyme inhibition kinetics to describe the effects

of temperature on toxicity to microorganisms. These equations were tested by semi-continuous and continuous flow experiments with phenol and the algae, *SELWATERIA CAPRICORNUTUM*. Comparison of competitive inhibition constants for *S. CAPRICORNUTUM* exposed to phenol at 20, 24 and 29°C indicated that phenol toxicity increased with an increase in temperature according to the Arrhenius function. (Auth) (BPC)

(547)

Reynolds, J.S., Control of Thermal Discharges to the Great Lakes.

1974. AICHE Symp. Ser., 70, No. 114, 250-265 (Chemical Engineering Co., Jackson, MI)

An evaluation of water temperatures, intake extrusion, entrainment effects, effects on benthic organisms, effects of the thermal plume on fish, the problem of attached algae and the effects of chlorination using the Palisades Nuclear Plant on Lake Michigan as an example led the author to redefine current philosophy regarding thermal effluent control. (BPC)

(548)

Reynolds, J.S., and D.A. Thomas, Responses of Young Gulf Grunion, *LEPIDOSTEUS SEPIOLA*, to Gradients of Temperature, Light, Turbulence and Oxygen.

1974. Copeia, 3, 747-754 (Pennsylvania State University, Department of Biology, Hiltner-Berre, PA)

Young Gulf of California grunion, between 25 and 160 days posthatching, exhibited a steady temperature preference of 32°C. Prior to 3 weeks of age, they showed no clear temperature preference. At all ages from hatching through at least 150 days, the fish were strongly photo-positive, selecting the brightest available light intensity (3200 lux). They also preferred a moderate level of turbulence, and tended to avoid oxygen concentrations below 5 ppm, as well as unusually high dissolved oxygen concentrations. These laboratory responses are consistent with the known distribution of juvenile Gulf of California grunion in the warm, shallow inshore waters of the Gulf, and may provide a mechanism by which they seek, and remain in, a favorable environment. (Auth)

(549)

Reynolds, J., Diatoms and Dinoflagellates as Large de Walvis Bay (South-West Africa).

1973. Bull. de l'I.P.A.W., 15, 273-284 (Not Given)

Diatoms and dinoflagellates were collected from four stations in Walvis Bay, South-West Africa from June 1965 to April 1966. The hydrology of the area is characterized by the presence of the cold Benguela current and by strong winter seasonal upwellings. The climate is comparable to the Mediterranean area in the North Hemisphere. Fifty eight diatom species and 32 dinoflagellate species were identified. Populations had a clear temperature affinity, with diatoms most prevalent. Diatoms were chiefly: *CACTOCHELOS*; *THALASSIOSIRA*; *HYPERCHAETA*; *SHILOSOLENIA*; and *ASTEROIDEA*. During the same period, the prevailing species were generally different for the stations. The diversity study showed phytoplankton activity to be very high all year. (BD)

(543)
 Richards, B.A., "Migratory Behavior and Growth of Juvenile Anadromous Alewives, *Alosa pseudoharengus*, in a Rhode Island Drainage."

1974. Trans. Amer. Fish. Soc., 103, 483-497
 (University of Rhode Island, Graduate School of Oceanography, Kingston, RI)

The activity of juvenile alewives (*Alosa pseudoharengus*) migrating seaward from Narragansett Reservoir, North Kingstown, Rhode Island, did so on less than 10 per cent of the total days of their period of residence in freshwater during 1974, 1975, and 1976. Extensive migration occurred following increases in pond outflow, abrupt water temperature declines, and/or precipitation. Daily patterns of movement were diurnal, with greatest movement occurring in mid-afternoon. Groups of fish migrating downstream during periods of extensive migration were random portions of the pond population. Growth rates varied in different parts of the drainage system. A model of the behavioral basis for seaward migration of juvenile alewives from ponds and lakes is presented. (Auth)

(544)
 Richter, B.A., and A.J. Liberson, An Evaluation of the Impact of the Morgantown SES on Macrobenthic Populations.

1975. Morgantown Qualifying Program Report Series 90. NT-75-1; 45 p. (Marine Biologists, Environmental Technology Center, Baltimore, MD)

Studies were conducted to determine the effect of entrainment through the Potomac Electric Power Company's Morgantown Steam Electric Station on populations of fish larvae, amphipods and opossum shrimp. The following conclusions were drawn: (1) Densities of fish larvae declined significantly as a result of mechanical and thermal damage sustained upon passage through the plant cooling system. Few larvae of commercially important fish species were found or can be expected to occur in the Morgantown (94-1) area, and those larval species present are ubiquitous scavengers. Thus, there appears to be very low probability that the cooling system of the Morgantown plant will seriously affect the abundance of any fish species in the Chesapeake Bay. (2) The studies suggested that amphipod and opossum shrimp populations are not seriously affected as a result of the mechanical and thermal stress of entrainment. Thus, there appears to be little likelihood that plant cooling system efforts will be felt at higher trophic levels as a result of the propagation of biomass declines in these forage species through the food chain. (3) Increased mortality of fish larvae was noted during chlorination, but similar increases in amphipod and opossum shrimp mortality were not observed. (4) The presence of a curtain wall at the intake had no consistent influence on densities of macrobenthos entrained. (ST)

(545)
 Wiley, J.D., The Distribution and Mortality of Sole Eggs (*SOLEA SOLA* (L.)) in Inshore Areas.

1974. Part of Blaxter, J.N.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1971. Springer-Verlag, Berlin-Heidelberg (Fisheries Laboratory, Lowestoft, England)

The distribution of sole eggs and larvae off the English east coast was surveyed in 1969

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 and 1973. Proportions of egg stages were not significantly different between different regions. Stage duration was measured in the laboratory at temperatures from 4 to 26 C. Sole eggs failed to gastrulate at temperatures higher than 16 C; however, eggs taken through gastrulation at lower temperatures, developed and hatched normally up to 20 C and at 4 C. The temperature range for successful incubation was 7 to 15 during early gastrulation. The temperature limits for successful feeding by hatched larvae were 12 to 19 C. The abundance of each egg stage in sea samples was divided by the laboratory stage duration to give an estimate of the numbers produced per day. These estimates were plotted against the midpoints of the developmental stages, and the slopes of the fitted regression lines indicated an egg mortality of 95.65% during 1969 in the River Blackwater and 99.95% on the English east coast in 1973. Spawning on the east coast in 1973 was restricted to the regions south of Flenborough Head and was more concentrated in the Humber/Don and Thames regions. (ST)

(547)
 Ringler, R. W., and J. D. Sali, Effects of Logging on Water Temperature and Dissolved Oxygen in Spawning Ribs.

1975. Trans. Amer. Fish. Soc., 104, 111-121
 (Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR)

A serious reduction in survival of emergent coho salmon was caused from the raising of in-stream water temperatures by clearcut logging in spawning beds to as much as 10 C during embryonic development. Some direct mortality may have occurred from periods of 20 C while some alevins were still in the gravel. There was earlier fry emergence in the stream with a mean water temperature of 7.9 C. Two other streams averaged 6.3 C. Lowest dissolved oxygen levels generally occurred well after the critical hatching period. A decrease in the residual population of cutthroat trout after logging may have been related to these changes. (BPC)

(548)
 Rippinapple, R.J., and E.P. Redgins, Population Growth of a Copepod *GLADIOPHEUS INPAHIFES* Thompson.

1974. Australian Jour. Mar. Freshwater Res., 25, 251-260 (Western Australia Institute Technology, Department of Biology, South Bentley, Western Australia, Australia)

The intrinsic rate of increase of an animal population can be calculated from data on longevity, sex ratio, maturation rate and fecundity and can be expressed as r . A population growth equation is given in the article. Lab and field data are used to calculate the value of r per day for *GLADIOPHEUS INPAHIFES*. The r values obtained were 0.146 per day at 15 C and 0.293 per day at 25 C. This high population growth potential is interpreted as an adaptation to the estuarine habitat. (Auth)

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Robertson, A., C.W. Gehrs, B.F. Hardin, and G.W. Went, Culture and Ecology of *DIAPYCNUS CLAVIPES* and *CYCLOPS VERNALIS*.

1974. EPA-660/3-74-006 (University of Oklahoma, Department of Zoology, Norman, OK)

Studies were undertaken to develop a method of maintaining healthy, self-propagating, laboratory cultures of the freshwater calanoid copepod, *DIAPYCNUS CLAVIPES*. Recommendations are given as to the conditions of container size, type of culture medium, light conditions, temperature conditions, food type and quantity, frequency of replacement medium, and amount of disturbance suggested for culturing. Temperature was shown to affect the longevity of the adult females as well as the size, carrying time, and probable total lifetime production of clutches. The results of this study indicated that certain of the reproductive attributes of the females are affected by the temperature of early life as well as the acclimation temperature. Results from a study on the dynamics of a field population of *D. CLAVIPES* are included. The durations of the various life history stages were estimated from laboratory and field data. Life tables were constructed for the spring generation of this population as well as all generations in a reproductive year combined. The stages of greatest relative mortality were identified. The report also presents recommendations for culturing the cyclopoid copepod, *CYCLOPS VERNALIS*, and the results of studies concerning the effects of temperature on certain reproductive attributes of this species. Temperature was shown to affect longevity of the adult female, egg carrying duration, clutch size, and egg development rate. (Auth)

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Rodgers, J.H., Jr., and C. R. Dillion, Theriol Effects on Primary Productivity of Lentic Phytoplankton, Periphyton and Benthic Macrophytes.

1974. Assoc. Southeast Biol. Bull., 21, 78 (Clemson University, Clemson, SC)

Rates of C^{14} uptake by lentic phytoplankton, periphyton and benthic macrophytes were greater in the limited area affected by heated effluents from a nuclear power plant than in either a control area or cooling water inlet area of a large man-made impoundment. (NPC)

<556>

Romberg, G.P., S.A. Spigarelli, W. Praprechal, and T.H. Thomas, Migratory Behavior of Fish Tagged at a Nuclear Power Plant Discharge into Lake Michigan.

1974. Proc. 17th Conf. Great Lakes Res., 65-77 (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, IL)

With the proliferation of nuclear power plants on Lake Michigan, such concern has been expressed over the effects of plume "residence" and abnormal temperature exposures on the physiology and migratory behavior of important fish species. A mark and recapture study was conducted at the Point Beach Nuclear Plant to describe the migratory behavior of fish at this thermal discharge. A total of 1741 fish (seven species) were captured, tagged and released during 1972 and 1973. As of August 1, 1974 144 of the tagged fish have been recaptured, primarily by sport fishermen. Eighty-four percent of the recaptures by fishermen occurred at locations other than Point Beach, and the number of recapture generally decreased with distance. Rainbow trout

tended to be the most migratory, but individuals of each species showed extensive movement. For all species, the majority of fish caught by fishermen had migrated away from Point Beach. The predominant direction of movement was north. Only brook trout and chinook salmon had more recaptures from southerly locations. Experimental temperature-sensitive fish tags indicated that the majority of fish recaptured at Point Beach spent less than 10% of their time at discharge temperature. Brown trout exhibited a stronger attraction to discharge waters than did rainbow trout or chinook salmon. High percentages of recapture for most species suggest negligible mortalities due to plume "residence" or the tagging procedure and imply that Lake Michigan sport fishermen are annually harvesting a substantial proportion of the fish stocks. (Auth) (ND)

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Rose, C.D., A.M. Harris, and B. Wilson, Extensive Culture of Penaeid Shrimp in Louisiana Salt-Marsh Impoundments.

1975. Trans. Amer. Fish. Soc., 104, 296-307 (Chesapeake Biological Laboratory, Natural Resources Institute, Center for Environmental and Estuarine Research, University of Maryland, Solomons, MD; Nicholls State University, Department of Biological Sciences, Thibodaux, LA)

Wild and hatchery-produced shrimp were stocked in two impoundments off Bayou Jean Lacroix in 1968 and 1969. Maximum annual harvest was 181.2 kg/hectare of wild shrimp averaging 119 mm in total length (73 count per kg, heads on) from an impoundment in which attempts were made to remove predators and competitors. Harvest in an impoundment in which attempts were made to remove predators and competitors. Harvest in an impoundment in which predators and competitors were not removed was 43.2, 79.1 and 161.9 kg/hectare of wild shrimp, blue crabs, and large fishes, respectively. Lack of predator control resulted in about a four-fold decrease in survival of marked white shrimp (*PENAEUS SETIFERUS*). Daily growth rates of juvenile and subadult brown shrimp (*P. AZTECUS*) ranged from 1.3 to 1.9 mm and 0.27 to 0.5 mm, respectively, during the investigation. Brown shrimp remaining in an impoundment for the entire 200-day annual growing season attained 164 mm. Subadult white and pink (*P. DUOROSTRUM*) shrimp grew at rates of 0.83 and 0.18 mm/day, respectively. A marking-recapture study indicated that 70% of subadult brown shrimp were captured during 5 nights of harvesting at an impoundment weir in June, while only 53% of subadult white shrimp were recovered during 22 nights in November. Peak egress of subadult and adult brown shrimp during spring and summer occurred during full and new moons. An apparently causal relationship between decreasing water temperature and white shrimp egress was observed. White shrimp did not survive impoundment life during the winter of 1968-1969. (Auth)

<558>

Rosen, H.H., The Relationship Between the Activity of Splenic Enzymes and the Immune Response in the Goldfish, *CARRASCIUS AURATUS*.

1974. Ph.D. Thesis, New York University (New York University, New York, NY)

Antibodies were produced and removed from circulation more quickly at the higher of two temperatures at which goldfish were kept. Red blood cells were much more effective than human saliva in stimulating this production. (NPC)

<559>

Rosachupko, B.P., Changes in Color Value, Transparency and Oxidizability in the Zone Affected by the Heated Waters of the Krasnaya Thermal Electric Power Station.

1973. ORNL-tr-2749; Biol. Vnutr. Sod. Inform. Syull. (USSR), 18, 60-64 (Not Given)

The inflow into the Ivankovo Reservoir of the heated waters of the Krasnaya Thermal Electric Power Station, (USSR), caused increased temperature, and contributed to an increased activity in the development of a sequence of chemical and biological processes, including an increase in petroleum products, in assimilation of CO₂, in quantity of bacteria, and in biomass of phytoplankton. Results from studies on the influence of the heated water on the color value, transparency, and oxidizability of the water in the Ivankovo Reservoir at different seasons are reported. (NB)

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Pothlisberg, P.C., Larval Ecology of PANDALUS JORDANI Bathban.

1975. Ph.D. Thesis, Oregon State University, 131 p. (Oregon State University, Corvallis, OR)

The distribution and abundance of larval PANDALUS JORDANI were characterized for the Oregon area for the first time by an intensive plankton survey. Seasonal wind regimes and surface currents were shown to affect larval distribution. Growth rates of larval shrimp were observed to be slower in 1971 than in 1972. This corresponded with the generally lower temperatures in the early larval season of 1971. Larval survival, as estimated in the plankton survey, was lower in 1971 than in 1972. Stratified plankton tows and the use of an epibenthic sampler demonstrated that P. JORDANI larvae occupied the entire water column. There was an age gradient with depth, with older larvae found deeper. Vertical migratory habits were demonstrated in the last larval and first juvenile instars. Late larvae were not recruited to the bottom until after the molt to the first juvenile instar. Response surface techniques were used to determine the combined effects of temperature and salinity on survival of larval P. JORDANI reared in the laboratory. In early larvae, the optimal temperature range was 9 to 11 C. This was observed over the entire range of salinities (26-34 ppt) tested. In older larvae the temperature optimum increased to 11 to 12 C, and low salinities (approximately 26 ppt) reduced survival. Increased temperatures had a direct effect on larval growth rate. Molting frequency was increased and internolt period shortened at higher temperatures. An inverse relationship between temperature and

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maximum larval size was not observed. Larvae reared at 8, 11 and 14 C all attained similar sizes which were larger than those reared at 5 and 17 C. Larval growth increments were measured in laboratory reared and field sample larvae. There was no apparent relationship between temperature or stage of development and the growth increment in laboratory reared animals. Growth increment measured in field larvae decreased with increasing stage of development. Extrapolations from commercial shrimp landing data were used to assess long term trends in larval survival from 1960-1973 in order to compare these levels with the levels of larval survival observed in this study. This analysis, and knowledge gained in the laboratory rearing experiments, indicates that the colder temperatures or other conditions that accompany strong upwelling enhance larval survival, while the elevated temperatures that characterize weak upwelling have an adverse effect on larval survival. (Auth) (NB)

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Poux, C., The Variations in the Metabolism/Temperature Curve of Gammarus PULEX (L.) and GAMMARUS FOSSARUM Koch (Amphipoda) Under the Influence of Various Ecological Factors.

1975. Crustaceana, 29, 33-48 (Universite Claude-Bernard-Lyon 1, Department of Biol. Anim. Ecol., Villeurbanne, France)

The M/T curves of GAMMARUS PULEX and GAMMARUS FOSSARUM demonstrate the existence of specific physiological differences between these 2 species. The respiratory metabolism of GAMMARUS PULEX was largely influenced by certain factors studied, such as temperature stream velocity and substrate. This species seemed to be adapted to variable biotopes, especially at temperatures greater than 15 C. At these temperatures it disposes of greater energetic reserves than did GAMMARUS FOSSARUM. The respiratory metabolism of GAMMARUS FOSSARUM showed a certain stability. It was not influenced by stream velocity and was only slightly influenced by temperature and substrate. This species seems to be adapted to specialized biotopes with running water and low temperatures, in which it has a competitive advantage over G. PULEX. These physiological characters appeared to be correlated with the ecological and geographical distribution of both species. (Auth)

<562>

Mowe-Rova, D.T., Reaction Times of Certain Freshwater Fishes to a Rotenone-Containing Piscicide.

Not given. Jour. S. African Wildlife Management Assoc., 3, 16-18 (Natal Parks Board, Pietermaritzburg, Natal, South Africa)

Reaction times for eight freshwater fishes to 1 ppm Barbacoo (0.068 ppm rotenone) was established in the laboratory at 21 C. In field tests for 10 fish species, different reaction times were noted in certain species at different temperatures, particularly largemouth bass at 13 C and 18 C and bluegill at 14 and 26 C. Reaction time was much shorter at the higher temperatures. In general, small fish lost equilibrium sooner than large fish of the same species. (RFC)

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Powe, V.L., R.B.W. Hynes, and A.V. Tyler, Reproductive Timing by the Polychaetes *CLYNEHELLA TORQUATA* and *FRAXILLELLA PRATERMISSA* in Passamaquoddy Bay, New Brunswick.

1975. Can. Jour. Zool., 53, 293-296 (University of Waterloo, Waterloo, Ontario, Canada; Fisheries Research Board of Canada, St. Andrews, New Brunswick, Canada)

Two species of polychaete, *CLYNEHELLA TORQUATA* and *FRAXILLELLA PRATERMISSA*, are able to maintain sufficient numerical stability to be a regular food item of fish in Passamaquoddy Bay, New Brunswick. Each species is living near an extreme of its distribution in Passamaquoddy Bay. This has necessitated adaptations in habitat and in reproductive biology. *CLYNEHELLA* spawn at the same temperature (12-14 C) as do populations to the south but later in the summer. *FRAXILLELLA*, an Arctic species, spawns during winter. A seasonal drop in sea and sea temperature may be a necessary condition or final stimulus to ripening and spawning for the Arctic species. (Auth) (ND)

<564>

Powell, D.H., J.J. Cech, Jr., and D.W. Bridges, Respiratory Metabolic Responses of the Winter Flounder (*PSEUDOPLEURONectes AMERICANUS*) to Environmental Stress.

1975. Part of Cech, J.J., Jr., et al. (Eds.), Respiration of Marine Organisms, Proceedings of the Marine Section of the First Maine Biomedical Science Symposium held in Augusta, Maine, March 18-19, 1975. Research Institute of the Gulf of Maine (TRIGOM), South Portland, Maine, (p. 163-170), 211 p. (Research Institute of the Gulf of Maine (TRIGOM), South Portland, ME)

Oxygen consumption rates of a group of winter flounder held at seasonal mean temperatures of 5, 10, 15, and 18 C (unstressed fish) and a group exposed to a two hour 5 C temperature increase over the mean seasonal temperature (stressed fish) were compared. Significant increases in oxygen uptake were associated with the stressed groups when compared to unstressed fish at the same temperature. This was especially true at the higher temperature regimes. The 23 C stressed group appeared to experience physiological difficulties. Results of these experiments will be used to examine 5 C temperature increases in the Maine coastal environment. (ST)

<565>

Rucker, R. W., and P.W. Kangas, Effect of Nitrogen Supersaturated Water on Coho and Chinook Salmon.

1978. Progressive Fish Culturist, 36, 152-156 (U.S. Fish and Wildlife Service, Western Fish Disease Laboratory, Seattle, WA)

Eggs of coho salmon (*Oncorhynchus kisutch*) and chinook salmon (*O. tshawytscha*) were not harmed by air or W2 supersaturated waters up to 128% nor were fry harmed by rearing for about one week at up to 128% W2 + Argon. Gas bubble disease occurred with increasing time, however, with its severity related to degree of supersaturation. In one case 115% W2 + Ar with 95% O2 caused no problem for at least a month. When gas bubbles were produced mortality was usually caused by rupture of the vitelline membrane due to gas pressure. (RWC)

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Ruddy, G.B., S.Y. Feng, and G.S. Campbell, The Effect of Prolonged Exposure to Elevated Temperatures on the Biochemical Constituents, Gonadal Development and Shell Deposition of the American Oyster, *CRASSOSTREA VIRGINICA*.

1975. Comp. Biochem. Physiol., 51B, 157-164 (University of Connecticut, Marine Research Laboratory, New Britain, CT)

The oyster, *CRASSOSTREA VIRGINICA*, in heated effluent averaged 56% higher in protein concentration, 109% higher in carbohydrate concentration and 22% higher in condition index than control oysters during the winter and spring months. The warm temps in the discharge canal during this period (18 to 19 C) permitted the oysters to feed during the very large spring phytoplankton bloom, while the control oysters in the ambient temp (2-7 C) remained relatively inactive. During the summer months, the control oysters attained levels of protein, carbohydrate and condition index that were similar to those of the warm-water grown oysters. The development of the gonads of the oysters in the heated effluent occurred 4 months earlier than in the controls, but spawning took place only 1 month earlier. The warm-water grown oysters produced thicker shells than the control oysters. (Auth)

<567>

Ryals, G.L., and B.R. Ingram, Laboratory and Responses of Nidge Larvae to Daylength and Temperature (Diptera: Chironomidae).

1973. Amer. Zoologist, 13, 1341 (Clemson University, Clemson, SC)

Preliminary investigations of the seasonal ecology of several species of chironomids as revealed by laboratory experiments using different combinations of daylength and temperature have been completed. The species of midges investigated were the following: *CHIRONOMUS HIPPIUS*, *GOELDICHIRONOMUS NIGROPRINUS*, *ABLABESNIA PELEZENSIS*, *ABLABESNIA* sp., *ENDOCHEIRONOMUS* sp., *TRIBELOS* sp., *DICROTENDIPES* sp., and *GLYTOTENDIPES* sp. Upon eclosion, larvae were subjected to 11- and 18-hour photoperiods at six different temperatures (5, 10, 15, 20, 25, and 30 C). Response times (days from eclosion to pupation) of the larvae differed significantly among the species and the different experimental regimes. Differences in response to the two daylengths were found for some species, while they were absent in others. The differential responses to the contrasting photoperiods were also influenced markedly by the temperature as were developmental rates in species not exhibiting a photoperiodic response. The results of the laboratory experiments will be related to aquatic systems subjected to thermal stress and the timing of life cycle events in response to environmental signals. (Auth) (ND)

<568>

Ryerson, W.R., Ecological Effects of Thermal Pollution.

1973. NTIS-PK-155; 99 p. (National Technical Information Service, Springfield, VA)

The bibliography contains 98 selected abstracts of research reports retrieved utilizing the NTIS on-line bibliographic search system NTISearch. The abstracts include studies on mixing and dispersion of thermally enriched waters and waste heat utilization as well as ecological studies of thermal effects on aquatic organisms. (Auth) (ST)

<569>

Byland, J.S., J.H. Nichols, and A.M. Sykes, Effect of Temperature on the Embryonic Development of the Plaice, *PLEUROCTES PLATESSA* L. (Teleostei).

1975. Jour. Exp. Mar. Biol. Ecol. (Beth.), 18, 121-137 (MAPP, Fishery Laboratory, Lowestoft, Suffolk, England)

In normal years, eggs and prolarvae of *PLEUROCTES PLATESSA* in the southern North Sea develop within the temperature range 6.0-9.5 C, although the water may at times be some degrees colder or warmer than this. The effect of temperature (t) (C) on the embryonic development time (D) (days) has been investigated within the tolerated range 2.4-10.5 C. Various models to express the observed curvilinear relationship between t and D have been considered. At investigated temperatures in the range 4.1-10.5 C the smallest eggs in a batch from a single source hatched first. Within the tolerated range, hatching prolarvae were substantially smaller at 10.5 C than at the other temperatures. During the period of prolarval yolk utilization, growth is slower at the high temperatures, so that median temperatures of 6.5-9.0 C are most efficient in terms of the relationship between growth in length and yolk utilization. Toward the end of the yolk-sac phase, the rate of yolk utilization declines unless a suitable external food source (Artemia nauplii) is provided. (Auth) (ND)

<570>

Saila, S.B. (Ed.), Fisheries and Energy Production: A Symposium.

1975. Lexington Books, D.C. Heath and Company, Lexington, Massachusetts, 237 p. (Not Given)

The symposium includes 19 papers covering the subject of mechanical and thermal effects of entrainment of fish and fish larvae through power plant cooling systems. Studies include impact simulations and laboratory studies of mechanical stresses, environmental monitoring, laboratory and field performance and avoidance temperatures as related to established standards, bypass and electrical barrier systems, site studies and an overview of entrainment. Three of the papers were abstracted for inclusion in the data base. (NPC)

<571>

Saito, S., Growth Rate of a Green Alga, *GONION MULTICOCCUM* (Volvocaceae).

1978. Bull. Jap. Soc. Phycol., 22, 6-9 (Hokkaido University, Institute of Algae Research, Faculty of Science, Hokkaido, Japan)

Under a continuous light, the maximum growth constant was for the alga, *GONION MULTICOCCUM* was 7.3 doublings/day at 36 C, one of the most rapid rates reported for algae in liquid culture. (NPC)

<572>

Saksena, V.P., Effects of Temperature and Light on Aerial Breathing of the Longnose Gar, *LEPISOSTEUS OSSEUS*.

1976. Ohio Jour. Sci., 75, 58-62 (Huskingen College, Department of Biology, New Concord, OH)

The effects of temperature and light on the rate of aerial breathing of *LEPISOSTEUS OSSEUS* were studied under laboratory conditions. The aerial breathing rates were recorded at various temperatures ranging from

3.3 to 35.5 C. In general, the aerial breathing rate increased the temperature increased. The Q₁₀-Q₁₀ (temp coefficient) values for the temp range of 8.8 to 32.2 C varied between 0.04 to 1.05. At temperatures below 12.2 C the longnose gar had a higher aerial breathing rate during the day but at temperatures above 12.2 C they breathed more during the night. A natural diurnal rhythm of aerial breathing was not evident in the longnose gar. In two complementary experiments at 22.2 C the rate of aerial breathing was higher during darkness than during equal periods of light regardless of whether the darkness occurred in natural day or night. The difference in aerial breathing rates in day and night (or light and darkness) may be related to activity since all experimental fish were more active during periods of higher breathing. (Auth) (ND)

<573>

Salanki, J., P. Lazacovics, and L. Viripi, The Effect of Temperature Variations on the Rhythmic and Periodic Activity of the Fresh Water Mussel (*ANODONTA CYGNETA* L.).

1976. Annal. Biol. Tihany, 81, 69-79 (Hungarian Academy of Sciences, Biological Research Institute, Tihany, Hungary)

A rapid increase of 10 C caused an initial pronounced increase in frequency of the rhythmic activity of the adductor muscles of the mussel (*ANODONTA CYGNETA* L.) which dropped to a control level. Similar effects were caused by a slow, 15 C rise over 48 hr and by a rapid decrease of 10 C (but to a lesser degree). A slow temperature decrease caused a decrease in the frequency of rhythm with the active period becoming dominant for more than 2 weeks. Low concentrations of KCl and CdCl₂ (themselves ineffective) caused an enhancement of the effects of a temperature increase with no adaptation and no recovery within 24 hr. A rapid 10 C rise shortened active periods and increased the frequency of alternate active and rest periods. This effect was also enhanced by KCl and CdCl₂. Temperature sensitivity of the aerobic mechanism, the peripheral receptors, and the central regulatory mechanism may be responsible for the observed effects. (NPC)

<574>

Sano, S., Some Problems on the Artificial Propagation of Pacific Salmon.

1973. Part of Notoda, S. (Ed.), Propagation of Marine Resources of the Pacific Ocean, First Japan-USSR Joint Symposium on Aquaculture of the Pacific Ocean Tokyo and Shizuoka, Japan, December, 1972 Tohoku University, Tokyo (Assoc. Technol. Devel. Fish. Resour. Hokkaido, Sapporo, Japan)

The peak appearance of fry schools of the Pacific salmon occurred on the coast when sea temperatures were about 10 C. The fry almost disappeared from the coast with a rise to 15 C, migrating to offshore areas. Seasonal change in sea temperature on the coast varied with localities and year and with the period of optimum temperature for fry being shorter on the southern coast than on the northern. Shorter optimum periods for release of fry means fewer fry may be propagated. (NPC)

<575>

<575>

Sarokon, J.A., Feeding Frequency, Evacuation, Absorption, Growth and Energy Balance in Rainbow Trout, *SALMO GAIRDNERI*.

1975. Ph.D. Thesis, University of Colorado, 71 p. (University of Colorado, Boulder, CO)

This study was designed to investigate the effect of feeding frequency on evacuation, absorption, growth and energy balance of young-of-the-year rainbow trout, *SALMO GAIRDNERI*, fed a pelleted diet or caddis fly larvae, *LYMPHOSILUS* sp. Rate of evacuation was measured as the difference between amount of food intake and food remaining in the stomach in terms of dry weight. At a water temperature of 15 C, percent evacuation at 24 hours for fish consuming one, two or three meals of pellets averaged 74.1% with no significant difference between groups. Fish consuming two, four, six or eight meals of pellets at a water temperature of 11 C, evacuated an average of 67.1% in 24 hours and showed no difference between groups. Fish consuming double rations of pellets on alternate days had evacuation rates about 70% faster than fish consuming single rations daily. Fish consuming caddis larvae at frequencies of two meals/day, eight meals/day and two meals on alternate days evacuated significantly more when fed on alternate days. (Auth) (ND)

<576>

Savage, W.B., Responses of Selected Bivalve Molluscs to Temperature and Dissolved Oxygen.

1975. Ph.D. Thesis, University of Rhode Island, 140 p. (University of Rhode Island, Kingston, RI)

An optimum temperature was observed for rebarroving of the clams, *MYTILUS*, *SPISULA SOLIDISSIMA*, and *PIRAN MORRHUANA* which declined with increasing temperature. This optimum heat level occurred about 4 to 10 degrees below the level of heat coma. Thermal optima and upper limits activity were species specific, as were rebarroving rates. *MYTILUS* acclimated to summer temperatures was able to continue rebarroving as rapidly with less than 1 ml O₂/l seawater as with more than 5 mg/l. No thermal optima were observed in *M. MYTILUS* and *S. SOLIDISSIMA*. Heart beat increased exponentially with temperature to the point that *M. MYTILUS* reacted to the heat by closing the valves. Siphon extension became increasingly more prevalent as O₂ declined and temperatures rose. Specific differences in temperature and dissolved oxygen responses were found to be related to habitat and geographic distribution. (NPC)

<577>

Savage, P.D., Industrialization and the Biology of Southampton Water.

1975. Proceedings of the Conference on Pollution Criteria for Estuaries held at the University of Southampton, July, 1973. Pentech Press Ltd., London, (p. 8.1-8.18) (Central Electricity Generating Board, Marine Biological Laboratory, Fawley, Southampton, England)

Changes in abundance and composition of zooplankton in Southampton Water occurred

possibly as a result of increased water temperatures brought about by Barchwood Power Station. The clam, *MYTILUS MYTILUS*, has multiplied in response to these conditions. Various studies by the CEC Marine Biology Laboratory at Fawley, Southampton University and a number of local laboratories on the effects of industrialization including temperature conditions are reviewed. (NPC)

<578>

Saechyn, W.W., The Biology of Two Related Species of Coenagrionid (Odonata: Zygoptera) in Western Canada.

1975. Can. Entomol., 107, 119-128 (Saskatchewan Research Council, Saskatoon, Saskatchewan, Canada; University of Saskatchewan, Department of Biology, Saskatoon, Saskatchewan, Canada)

At water temperatures of 2 C (during the first 2 weeks of October), larval development of the dragonflies, *COENAGRION ASCULATUM* and *C. RESOLUTION* ceased. Larvae overwintering frozen in ice 15 to 20 cm below the pond surface survived lower than normal temperatures of -5 to -6 C. Highly synchronous emergence (essentially complete within 10 days) began in May only when daily mean water temperatures exceeded 12 C and mean maximum air temperatures reached 20 to 21 C. (NPC)

<579>

Schaumann, K., Experimental Studies on the Effects of Various Salinity and Temperature Combinations on the Growth of Higher Fungi from Marine and Brackish Waters.

1974. Veroeff. Inst. Meeresforsch. Bremerh., (Suppl. 5), 443-474 (Institute Meeresforsch., Bremerhaven, German Federal Republic)

The fungus, *CHAETOMIUM RHIZOPOLOUS*, was almost unaffected by temperature variations, but was affected by salinity. All other fungi studied showed distinct temperature optima, normally at about 25 C, which were influenced by salinity at least in some species. A shift of salinity optima depending on temperature was also observed. Discrepancies between in vitro and in situ studies indicated an influence of additional factors on the natural distribution of higher fungi in marine and brackish waters. (NPC)

<580>

Schlichter, D., The Influence of Physical and Chemical Factors on the Uptake by Actinians of Amino Acids Dissolved in Sea Water.

1974. Marine Biol. (W. Ger.), 25, 279-290 (University of Köln, Zoology Institute, Köln, German Federal Republic)

Changes in abiotic environmental factors did not adversely influence the capacity of *ACTINIA SULCATA* (Coelenterata, Anthozoa) to take up dissolved amino acids from sea water; e.g., resorption occurred also under anaerobic conditions. The influence of temperature on amino acid uptake (Q₁₀ = 2) indicated that the translocation of the organic molecules through membranes of the ectoderm depends on energy. (Auth) (NPC)

<581>
Schlichting, R.E., Jr., Survival of Some
Fresh-Water Algae Under Extreme Environmental
Conditions.

1978. Trans. Amer. Micro. Soc., 93, 610-613
(Microcontrol Company, Fort Sanilac, MI; University
of Oklahoma Biological Station, Kingston, OK)

Survival of some fresh-water algae under
extreme environmental conditions is reviewed.
The adaptability of some fresh-water algae
has allowed their survival under stress of
fluctuating temperature, light quality and
intensity, pressure, salinity, pH, soil,
water, and air chemistry, and moisture.
Algae are found in aerial, aquatic, and
terrestrial habitats; and their polymorphic
tendencies, reflected in their morphological
and cytological variations, may have aided in
survival through geological time. (Auth) (PD)

<582>

Schneider, P.J., C.D. Becker, D.R. Picheas,
T.O. Thatcher, E.C. Wolf, and E.L. Hunt, Aquatic
Physiology of Thermal and Chemical Discharges.

1975. COMP-740820; STI/POB/378; IAEA-SM-187/15;
Part of Proceedings of a Symposium on the
Environmental Effects of Cooling Systems at
Nuclear Power Plants held in Oslo, Norway, August
26-30, 1974, (p. 547-561) (Battelle Memorial
Institute, Pacific Northwest Laboratories,
Richland, WA)

Descriptions and results of investigations of
the ecological effects of reactor effluents
are given. Five major project areas being
investigated at Pacific Northwest
Laboratories are discussed in the paper: (1)
The effects of fatigue on thermal tolerance
in fish, (2) the behavioral response of fish
influenced by thermal plumes and the effect
of thermal experience on fish sensory
physiology, (3) the effects of heat and gas
super-saturation on fish, (4) the effects of
cold shock on fish, and (5) the effects of
heat and pollutant chemicals on fish. (ST)

<583>

Schone, H.K., Experimental Investigation on the
Ecology of the Marine Diatom *THALASSIOSIRA*
BOTULA. II. The Influence of Salinity.

1978. Marine Biol. (N. Ger.), 27, 287-298
(Botanisches Institut der Rheinisch-Westfälischen
Technischen Hochschule, Abteilung für Systematik und
Geobotanik, Bielefeld, Germany) (PD)

At 12 and 17 C, the marine diatom,
THALASSIOSIRA BOTULA, grew at salinities from
12 to 19 ppt. At 4 C, it did not grow below
16 ppt. Generation time was not influenced
by salinity within the tolerance range if
adapted cultures were grown under optimal
illumination (1000 lux, light-dark cycle of
10:10 h; 12 C) or temperature (17 C; 2000
lux, 10:10 h). With increasing illumination
or decreasing temperature, the other factors
remaining constant, maximum growth rates
occurred at 20 to 32 ppt. (NFC)

<584>

Schoff, T.J., Survey of Genetic Differentiation
in a Coastal Zone Invertebrate: The Ectoprost
SCHIZOPORELLA ERBATA.

1978. Biol. Bull., 146, 70-87 (University of
Chicago, Department of the Geophysical Sciences,
and Committee on Evolutionary Biology, Chicago,
IL; Marine Biological Laboratory, Woods Hole, MA)

Gene frequencies for two polymorphic loci
which make the enzymes leucine aminopeptidase
and glutamate oxalate transaminase
in the mollusc, *SCHIZOPORELLA ERBATA* (S.
SHICORNIS is most literature), changed in a
regular manner which correlated with Cape Cod
water temperatures in 1972 and 1973 during
the warmest seasons. (NFC)

<585>

Schubel, J.R., Some Comments on the Thermal
Effects of Power Plants on Fish Eggs and Larvae.

1975. Part of Shila, S.B. (Ed.), Fisheries and
Energy Production: A Symposium. D.C. Heath and
Company, Lexington, Massachusetts, (p. 31-50), 237
p. (State University of New York at Stony Brook,
Marine Sciences Research Center, Stony Brook,
Long Island, NY)

Studies concerning some characteristics of
steam electric stations, typical time-excess
temperature histories, thermal effects of
entrainment on eggs and larvae and results of
both field and laboratory studies are
discussed. The author stresses the need for
additional data particularly from laboratory
studies. Data for eggs and larvae are
summarized. (NFC)

<586>

Scott, D.R., N. Bazarkievich, and P. Leenas,
Respiration and Ventilation of the Polychaetes
NEPHEIS VIRENS and *GLYCERA DIBRANCHIATA*.

1975. Part of Cech, J.J., Jr., et al. (Eds.),
Respiration of Marine Organisms, Proceedings of
the Marine Section of the First Maine Biomedical
Science Symposium held in Augusta, Maine, March
18-15, 1975. Research Institute of the Gulf of
Maine (TRIGOM), South Portland, Maine, (p.
85-101), 211 p. (University of Maine, Department
of Oceanography, Bangor, ME)

The respiratory rates of *NEPHEIS VIRENS* and
GLYCERA DIBRANCHIATA were investigated at
acclimation temperatures of 2 and 27 C. Data
for *N. VIRENS* showed a temperature dependence
of metabolism at both temperatures of
acclimation. Q_{10} s approaching 1.0 were
apparent even over small (5 C) temperature
ranges except in the interval 25 to 30 C for
the 2 C acclimated group. *N. VIRENS* also
showed a compensatory modification of the
metabolic rate with regard to its pattern of
temperature acclimation. The acclimation
patterns shown by the bloodworms *G.*
DIBRANCHIATA was non-compensatory. These
animals acclimated to 27 C showed higher
metabolic rates than the group acclimated to
2 C when tested at similar temperatures.
Daily cycles of respiration and ventilation
were also investigated. (ST)

<587>

<587>

Seeger, J.L., The Effects of Lethal Heating on Plasma Potassium Levels, Hematocrit and Cardiac Activity in the Alewife (*Alosa pseudoharengus*) Compared with Three Other Teleosts.

1973. Proc. 14th Conf. Great Lakes Res., 16, 154-162 (University of Wisconsin, Department of Zoology, Milwaukee, WI)

Plasma and muscle potassium, muscle water, hematocrit and electrocardiograms of alewives, common shiners, golden shiners and white suckers were measured as these fishes were subjected to lethal heat death. Lethal heating had no significant effect on muscle potassium or muscle water, but significantly elevated the hematocrit. Hypertalemia was induced by the heating, but caused no ventricular fibrillation or cardiac arrest. The heart always continued to beat after respiratory stoppage and the cause of death appeared to be respiratory-related. The heart rate increased with temperature until a plateau was reached and subsequently fell off. It was concluded that cardiac failure is not induced by naturally occurring levels of hypertalemia expected to be found in Lake Michigan alewives. The elevation in hematocrit may have been caused by hemoconcentration of the blood. The elevation of plasma potassium appeared to be primarily a result of hemolysis. Erythrocyte fragility studies in alewives and other fishes are discussed as they relate to the hemolysis found in this study. (Auth)

<588>

Seiler, W., J. Lambert, and G.J. Al-Therib, Acetyl-coenzyme A: 3,4-Diaminobutane N-acetyltransferase: Activity in Rat Brain During Development, in Experimental Brain Tumours and in Brains of Fish of Different Metabolic Activity.

1975. Jour. Neurochem., 28, 797-800 (Max-Planck-Institut für Hirnforschung, Arbeitsgruppe Neurochemie, Frankfurt/B.G.F.R.)

With increase in adaptation temperatures from 5 to 23 C, the activity of putrescine acetylase increase linearly (about 0.1 nmol/mg protein/h/degree C in trout brains (*Salmo trutta*)) while concentration of putrescine decreased by about 0.3 nmol/mg protein/degree C; i.e. by 2.4 nmol/brain/degree C. (RPC)

<589>

Semenko, L.I., Some Aspects of the Population Dynamics and Natural Reproduction of the Yank Bay Population of the Navaga (*Eleginus gracilis* (Tilesius)) of the Sea of Okhotsk.

1973. Jour. Ichthyol., 13, 974-982 (Azov Fisheries Research Institute, Rostov on Don, USSR)

Consideration is given to the dependence of the yield of year-classes of the navaga (*Eleginus gracilis* (Tilesius)) on water temperature regime in the spawning grounds, the plankton biomass, and the quality and abundance of the parental stock. It is established that strong year-classes regularly appear in warm years, weak year-classes in cold years and average year-classes in intermediate years. The age composition of the spawners and the availability of food to the young, which we assume indirectly from the plankton biomass, have a great influence on the yield of year-classes. (Auth)

<590>

Sosul, K.E.O., and K.V.B. Lagerpetz, The Role of Cholinergic Receptors in the Thermal Resistance and Thermal Resistance Acclimation of the Ciliary Activity in the *ABODONTA* Gills.

1979. Comp. Gen. Pharmacol., 5, 169-179 (University of Tampere, Institute Biomedical Sciences, Tampere, Finland)

Acetylcholine (ACh), added into the 39 incubation medium in concentrations up to 2 x 10⁻³ g per ml, prolonged the thermal resistance of ciliary activity in the isolated gills of the freshwater mussel, *ABODONTA CYGNETA CELLIENSIS*, acclimated for 1 day to cold or warm temperature in tap water or in cholinomimetic or anticholinergic solution. Atropine and eserine added into the acclimation medium reduced the higher thermal resistance of the war acclimated controls, but had no effect on the cold-acclimated gills to the level of the cold-acclimated gills in the water incubation at 39 C. Tetramethylammonium (TMA) added into the acclimation medium reduced the thermal resistance measured in the 39 C water incubation of the isolated gills acclimated either to cold or warm conditions. Equimolar doses of ACh, choline and TMA in the incubation medium at 39 C enhanced in equal degree the thermal resistance of ciliary activity in the cold-acclimated as well as in the warm-acclimated gills. It is suggested that the thermal resistance of ciliary activity in the *ABODONTA* gills is regulated by cholinergic mechanisms. The functional basis of the thermal resistance acclimation may be the ACh receptor molecule synthesis dependent on the external temperature. (Auth)

<591>

Serfling, S.A., and R.P. Ford, Ecological Studies of the Pueruli Larval Stage of the California Spiny Lobster, *PANULIUS INTERRUPTUS*.

1976. Fish. Bull., 73, 360-377 (San Diego State University, Center for Marine Studies, San Diego, CA)

The appearance of pueruli of the California spiny lobster, *PANULIUS INTERRUPTUS*, from May through September was found to be unrelated to temperature or lunar cycles. (RPC)

<592>

Serna, S.L., and K. Strawn, Age and Growth of Bluegill, *LEPOMIS MACROCHIRUS*, in Two Heated Texas Reservoirs.

1975. Trans. Amer. Fish. Soc., 104, 506-512 (Texas A&M University, Department of Wildlife and Fisheries Sciences, College Station, TX)

The method of ageing bluegills (*LEPOMIS MACROCHIRUS*) by their scales was validated for two Texas reservoirs. Annular formation occurred from January through July (peak February-April) in Lake Bastrop and from January to June (peak in March and April) in Lake Nasworthy. Female bluegills grew faster than males in both lakes. Little or no growth occurred from October-November through February. Growth of bluegills in Lakes Bastrop and Nasworthy was above average for the first two years when compared to the growth of bluegills in other lakes reported in the literature. The length-weight regression equations for bluegills from Lake Bastrop and Lake Nasworthy are given. (Auth)

<593>

Sharitz, R.P., Responses of Two Species of Cattail to Thermal Effluents.

1974. Assoc. Southeast Biol. Bull., 21, 82-83
(Savannah River Ecology Laboratory, Aiken, SC)

Thermal effluents from the Savannah River Plant near Aiken, South Carolina flowing into Par Pond have caused alterations in growth, reproduction and possibly in competitive interaction between the cattails, *TYPHA LATIFOLIA* and *T. DOMINGENSIS*. The latter was dominant at normal water temperatures but disappeared in heated areas where *T. LATIFOLIA* grew. (RPC)

<594>

Sharitz, R.P., J.E. Irwin, and E.J. Christy, Vegetation of Swamps Receiving Reactor Effluents.

1974. Oikos, 25, 7-13 (University of Georgia, Savannah River Ecology Laboratory, Aiken, SC; University of North Carolina, Department of Botany, Chapel Hill, NC)

High water temperatures, increased flooding, and silting associated with the discharge of reactor effluents into streams feeding the swamp near the Savannah River Nuclear Power Plant in South Carolina have destroyed the forest canopy. Tree species 40% in unstressed areas 10% of the total number of species in stressed areas. Diversity of the herbaceous flora remained high during thermal loading and during post-thermal recovery. Successional recovery of the swamp was slow after stress removal. (RPC)

<595>

Shoeder A., and B. Moss, Effects of Light and Temperature on Germination and Growth of *ASCOPHYLLUM NODOSUM* (L.) Le Jol.

1975. Estuarine Coastal Marine Sci., 3, 125-132 (University of Newcastle upon Tyne, Department of Plant Biology, Newcastle upon Tyne, England)

Germination of zygotes of *ASCOPHYLLUM NODOSUM* was obtained between 8 and 23 C, with the maximum percentage occurring at 10 C at all light intensities and in total darkness. The zygotes and young embryos remain viable in total darkness up to 90 days and if returned to light they appear to grow and to develop normally. Increased temperature up to 20 C and increased light intensity up to approximately 10 000 lux increased thallus growth. Light intensity greater than 1480 lux inhibited rhizoid growth. Doubling the daylength from 8 to 16 hours increased the growth of both rhizoids and thalli. Both light and temperature affected the morphological development of the germlings. These results are related to the geographical distribution and to the zonation of this sp on the shore. (Auth)

<596>

Shoeder, A., and P. Evans, Feeding and Gut Structure of *PANATHEMISTO GAUDICHAUDI* (Guerin) (Amphipoda, Hyperiidea).

1975. Jour. Mar. Biol. Assn. U.K., 55, 641-656 (Dove Marine Laboratory, Cattercott, North Shields, Tyne and Wear, England)

Food requirements of the amphipod, *PANATHEMISTO GAUDICHAUDI*, depended on temperature; the small summer specimens at 13.5 C fed at about 15 times the rate of larger winter specimens at 5.9 C. In summer, however, only about 45% fed as compared with 95% in winter. The species were more abundant during the coldest time of the year (February through April). (RPC)

<597>

Sherstneva, T.A., and A.A. Shabalina, Some Aspects of Carbohydrate-Lipid Metabolism in Rainbow Trout (*SALMO IRIDEUS* (Gibb.)) Following Lengthy Starvation.

1973. Jour. Ichthyol., 13, 576-582 (State Research Institute for Lake and River Fisheries, Leningrad, USSR)

Information is given concerning alteration in the concentration of sugar and nonesterified fatty acid (NEFA) in blood serum and of glycogen in the tissues of the rainbow trout (*SALMO IRIDEUS*) following prolonged starvation in different seasons. It is shown that glycemia level does not alter in the course of starvation, but that NEFA level is reduced. Glycogen concentration in the liver and in the white and red muscles is reduced following starvation. It is noted that the most significant reductions in the concentration of NEFA and of glycogen in the tissues occur at high temperatures. (Auth)

<598>

Shifer, C.C., J.J. Riddlebrooks, D.B. Porcella, and W.P. Sigler, Effects of Temperature on the Toxicity of Oil Refinery Waste, Sodium Chlorate, and Treated Sewage to Fathead Minnows.

1974. OWR-8-070-074; 84 p. (Utah Water Research Laboratory, Logan, UT)

A literature review and experiments were conducted to determine the effects of temperature on the toxicity of three materials to fish (fathead minnows, *PIMEPHALES PHOXELAS*). These three toxicants (oil refinery waste, sodium chlorate, and treated sewage) were studied at different temperatures using standard static bioassay techniques. The treated sewage was generated by a compact zero discharge treatment system which will disinfect, remove suspended solids, and remove oxygen demanding materials by physical and chemical means. Phenol was found to exert 40 percent of the total toxic action exerted at the toxic limit (TL50) concentration for the oil refinery waste assuming that the toxicities of all substances in the oil refinery waste were additive. Sodium chlorate and sodium chloride were found to exert less than 35 percent of the total toxic action exerted at the toxic limit (TL50) concentration for the treated sewage, assuming that the toxicities of all substances in the treated sewage were additive. (Auth)

<599>

<599>
Shimura, I., Studies on the Cultivation of an Edible Brown Alga, *CLADOSPORA OKAMURAE* -III Development of Zoospore from Plurilocular Sporangia.

1974. Bull. Jap. Soc. Sci. Fish., 40, 1213-1222 (Kagoshima Prefect. Fish. Exp. Sta., Kagoshima, Japan)

Erect germlings failed to grow from discoid germlings of the brown alga *CLADOSPORA OKAMURAE*, when discoid germlings were cultured at a higher temperature (25 C or more) or lower illuminance (2.5 klx or less), showing only repeated generations of discoid development of zoospores from their plurilocular sporangia. Water temperatures of 20 to 25 C, nearly 30 ppt salinity and 1 to 2.5 klx were suitable for attachment of zoospores from plurilocular sporangia. Temperatures from 25 to 30 C were adequate for germling growth up to 1 mm high but 15 to 20 C, 15 to 25 ppt salinity and 5 to 10 klx were optimum for growth as they became erect. (NPC)

<600>

Shimura, I., *POSPHYRA TANIGASHIENSIS*, a New Species of Rhodophyceae from Tanegashima Island in Southern Japan.

1974. Bull. Jap. Soc. Sci. Fish., 40, 735-749 (Kagoshima Prefectural Fisheries Experimental Station, Kagoshima, Japan)

Growth rate of a new species of red alga, *POSPHYRA TANIGASHIENSIS*, was optimum at 23 C in laboratory experiments. This temperature is 3 to 4 C higher than optimum growth temperatures for some other species of cultivated *POSPHYRA*. (NPC)

<601>

Shyam Sundari, K., and R.K. Ramanaatha, Effect of Temperature on Embryonic and Post-Embryonic Stages of *COROPHION TRIAENONTII* Stebbing (Crustacea, Amphipoda).

1974. Biotera (Ind.), 43, 187-194 (Andhra University, Department of Zoology, Waltair, India)

Individual stages, complete development and molting in *COROPHION TRIAENONTII*, an important feeding amphipod, were found to be temperature dependent. (NPC)

<602>

Sizell, B.D., Turnover of Cytochrome C in Skeletal Muscle of Green Sunfish (*LEPOMIS CYANELLUS*) During Thermal Acclimation.

1975. Ph.D. Thesis, University of Illinois, 108 p. (University of Illinois at Urbana-Champaign, Urbana, IL)

Cytochrome c content of green sunfish (*LEPOMIS CYANELLUS*) skeletal muscle increases with decreasing temperature of acclimation. Content of cytochrome c was 1.51, 1.17 and 0.98 nanomoles per gram wet weight from muscle of animals acclimated to 5 C, 15 C, and 25 C respectively. The roles of synthesis and degradation of cytochrome c in the maintenance of steady-state concentrations, and during thermal acclimation were investigated by measurement of loss of specific radioactivity from cytochrome c and from total mitochondrial heme protein, and by analysis of the rate of concentration change of cytochrome c during thermal acclimation. The radioisotope used was C-14-aminolevulinic acid, a nonreutilizable heme precursor. At a steady-state acclimation temperature of 25 C, the half-life of cytochrome c was found to be 7.1 days based on radioactivity measurements, and 5.6 days based on concentration change measurements. Statistical analysis showed no significant difference in half-lives obtained by the two methods. Total mitochondrial heme protein half-life was determined to be 5.7 days on the basis of radioactivity data, under the same conditions. No significant difference was found between the rate of turnover of the heme protein pool from mitochondria and either measurement for cytochrome c at 25 C. At an acclimation temperature of 5 C, skeletal muscle cytochrome c had a half-life of 13.7 days based upon concentration change measurements. At low temperature, radioactive label was retained in acid-soluble form by fish for many days, precluding measurement of half-life by this technique. Transfer of fish from 25 C, to 5 C resulted in a rapid decrease of approximately 40% in synthetic rate of skeletal muscle cytochrome c, and concomitant decrease in the degradation rate constant for this molecule of approximately 60%. The disproportionality in temperature-sensitivities of these two processes leads to an approximately 50% increase in the concentration of cytochrome c over an acclimatory time span. In transfer from 5 C to 25 C, the converse rapid readjustments in synthetic and degradative parameters occur, resulting in the observed decrease in cytochrome c content. It is suggested that a disproportionate effect of temperature on synthesis and degradation may account for changes in content of components of the mitochondrial respiratory chain, and may share a common basis with other systems showing quantitative change during thermal acclimation. The energy requirements during thermal acclimation to colder temperatures would be satisfied by the above mechanisms. (Auth)

<603>

Siefert, R.E., R.P. Carlson, and L.J. Gerson, Effects of Reduced Oxygen Concentrations on the Early Life Stages of Mountain Whitefish, Smallmouth Bass, and White Bass.

1974. Progressive Fish Culturist, 36, 186-190 (U.S. Environmental Protection Agency, National Water Quality Laboratory, Duluth, MN)

Survival of mountain whitefish, *PROSOPION WILLIAMSONI*, was similar at 100% (control) and 50% saturation of dissolved oxygen (DO) at 4 C, moderately reduced at 35% and markedly reduced at 25% and below with no hatching at 12.5% saturation. As DO was lowered, development was progressively inhibited. At 7 C, survival at 100% and 50% saturation was similar to that at 4 C with a 7 to 11-day delay in completion of hatching and a 5.1 mm reduction in average growth at 50% DO and 7 C. The few fish hatching at 25% died within 24 hr. Survival of smallmouth bass, *MICTOPHTERUS DOLOMIEUXI*, at 20 C was nearly 20% reduced at 50% DO but rate of development was similar to controls hatching was accelerated and average length reduced. Successful hatching occurred at 25% DO but survival was 0 by the day 5. Hatching failed at 12.5%. A 26% reduction in survival at 50% DO and 25 C occurred compared to 50% DO and 20 C. At 25 C, development was generally more advanced. One-hundred percent mortality occurred at 25% DO before first feeding. Only after 7 days did white bass, *MORONE CHRYSOPTERUS*, show a marked reduction in survival at 16 C and 20%. Hatching and size were unaffected by different DO's. Hatching occurred 1 day earlier at 19 C than at 16 C; survival was similar; development was accelerated at 10 C and 19 C all larvae died before reaching a horizontal swimming stage. At 35% and 19 C after 8 days, larvae fed or searched for food but a high mortality was observed 2 days later. Survival was best at 35%, decreasing with increasing DO. (RPC)

<604>

Siefert, R.E., and W.A. Spoor, Effects of Reduced Oxygen on Embryos and Larvae of the White Sucker, Coho Salmon, Brook Trout, and Walleye.

1974. Part of Blaxter, J.N.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1973. Springer-Verlag, Berlin-Heidelberg (U.S. Environmental Protection Agency, National Water Quality Laboratory, Duluth, MN)

The effects of continuous reduced dissolved oxygen concentrations on the development and survival of the white sucker, *CATOSTOMUS COMMERSONI*; coho salmon, *Oncorhynchus kisutch*; brook trout, *Salvelinus fontinalis*; and walleye, *Stizostedion vitreum*, were determined at the optimum temperature for each species. Walleye were also tested at a temperature above optimum. Thirty-five percent saturation produced a sharp decrease in survival of walleye at their optimum temperature of 17 C. At all oxygen concentrations, 20 C was near the lethal temperature for early stage larvae. (ST)

<605>

Siler, J.R., and J.P. Clogston, Largemouth Bass Under Conditions of Extreme Thermal Stress.

1975. Part of Stroud, R.H. and Clepper, R. (Eds.), Black Bass Biology and Management. Sport Fishing Institute, Washington, DC (p. 333-341) (Duke Power Environmental Laboratory, Huntersville, NC; Cooperative Fishery Research Unit, U.S. Fish and Wildlife Service, University of Georgia, Athens, GA)

When temperatures in Pond C, a cooling reservoir for the Savannah River Power Plant near Aiken, South Carolina, neared 30 C, largemouth bass, *MICTOPHTERUS SALMOIDES*, as well as other species moved into a few small refuge areas. During part of the summer, they were forced to live in warm water less than 1 m deep at 30 to 34 C, with adults caught in areas of up to 35 C. Immature bass were collected in waters from 36 to 39 C. Mortalities occurred occasionally when fish were trapped in areas where temperatures rose rapidly. During January and February when water temperatures were lowest, average gonad development for both sexes reached its peak. Spawning seemed to be generally unsuccessful. Growth ceased in summer presumably because of high water temperature, crowding and a reduced food supply. Although seasonal cycles of relative condition of bass were pronounced (low in September to January, and high in April to July) their general condition throughout the year was good and closely comparable with that in two unheated reservoirs in South Carolina. (RPC)

<606>

Silverthorn, S.U., Hormonal Involvement in Thermal Acclimation in the Fiddler Crab *UCA PUGILATOR* (Decapoda). I. Effect of Eyestalk Extracts on Whole Animal Respiration.

1975. Comp. Biochem. Physiol., 50A, 281-283 (University of South Carolina, Belle W. Baruch Institute for Marine Biology and Coastal Research, Columbia, SC)

Eyestalk extracts prepared from crabs, *UCA PUGILATOR*, acclimated at 15 C significantly increased respiration in crabs acclimated at 25 C. The reverse occurred when cold-acclimated crabs were injected with extracts from warm-acclimated. Two distinct hormones were demonstrated. (RPC)

<607>

Simmons, R.A., and A.W. Knight, Respiratory Response of *NEONYSIS INTERMEDIA* (Crustacea: Mysidacea) to Changes in Salinity, Temperature and Season.

1974. Comp. Biochem. Physiol., 50A, 181-193 (University of California at Davis, Department of Water Science and Engineering, Davis, CA)

Respiratory response to temperature in the mysid shrimp, *NEONYSIS INTERMEDIA*, was found to be weight dependent; the larger the mysid, the greater the respiration change with temperature increase from 6 to 21 C at 3 degree intervals. Seasonal temperature acclimation was apparent only at 6 C. Respiration generally decreased as salinity increased with smaller mysids experiencing greater changes. (RPC)

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Simon, K.A., The Effect of Thermal Shock on Asteroid Larvae.

1973. Amer. Zoologist, 13, 1289-1290 (University of the Pacific, Pacific Marine Station, Dillion Beach, CA)

Larvae of the starfish, *PATISIA MINATA*, were subjected to thermal shock ranging from 5 to 25 C above ambient temperature. The larvae remained at the elevated temperature for either five or 10 minutes and were then cooled to the initial temperature over a period of five to 30 minutes. With an increase of 25 C all the larvae were dead after the initial five minutes of exposure. In 20 C increase experiments all of the larvae had died by the end of the cooling phase. Larvae subjected to a shock of 15 C for a period of 5 minutes showed no initial mortality, nor was there any evidence of higher than normal mortality at later times. Those larvae maintained for 10 minutes at 15 C above ambient exhibited some initial mortality; this represented only a small percent of the population. The number of larvae continued to decline for several days until approximately 50% of the original number remained. In these latter two cases there was no evidence of abnormal growth or development of the surviving larvae. (Auth) (ST)

<609>

Sissonvine, M.P., Variability in Recruitment and Equilibrium Catch of the Southern New England Yellowtail.

1974. Jour. Cons. Int. Explor. Mer., 36, 15-26 (University of Rhode Island, Graduate School of Oceanography, Kingston, RI)

A decline of the Southern New England yellowtail flounder fishery in three fishing grounds, defined as the Southern New England, Georges Bank and Cape Cod during the late 1940's resulted from a general atmospheric warming trend in the region as determined by correlations of regressions. (RFC)

<610>

Sizemore, R.R., and L.H. Stevenson, Environmental Factors Associated with Proteolytic Activity of Estuarine Bacteria.

1974. Life Science, 15, 1825-1832 (University of Maryland, Department of Microbiology, College Park, MD)

Maximum activity of protein hydrolysis by salt marsh bacteria was observed at pH 8 and 18 C. Availability of O₂ appeared to be one of the important factors controlling extracellular protease production. (RFC)

<611>

Slankis, A.Ya., and A.O. Lazda, The Effect of Temperature on the Motility and Survival of Larval *HYBHELINIA SUPHRESCOLA*.

1974. Izv. TINRO, 88, 79-87 (TINRO Vladivostok, USSR)

Experiments with larval tapeworm *HYBHELINIA SUPHRESCOLA* collected from Alaska pollock and greenling were carried out to study their motility under different temperatures before and after acclimation, to determine their duration of life under lethal negative and positive temperatures and to study their

behavior under temperature gradient conditions. Motility was temperature-dependent. The rate of contractions increased with an increase in temperature from 0 to 30 to 33 C and decreased with a further increase. The larvae acclimated to 20 C were more resistant to high temperature than those acclimated to 0 to 5 C. There was no marked temperature limit of survival; the exposure to sublethal temperatures decreased the duration of life. The larvae collected from the body cavity and those from the nucleus showed similar response to temperature effects. The larvae possessed no thermotactic ability. (Auth)

<612>

Sneyda, T.D.J., and B. Mitchell-Jones, Dark Survival of Autotrophic, Planktonic Marine Diatoms.

1974. Marine Biol. (W. Ger.), 25, 19-202 (University of Rhode Island, Graduate School of Oceanography, Kingston, RI)

Dark survival of the diatom, *SERLIOTHEA COSTATUM*, was found to be inversely related to temperature. It survived at least 24 weeks at 2 C and 1 to 4 weeks at 20 C. The author reviewed the literature on effects of temperature and light on dark survival, and of darkness on the chemical composition and photosynthesis following reillumination of photomixotrophic microalgae. (RFC)

<613>

Szigielsti, A.S., Hormone-Induced Spawings of the Summer Flounder and Rearing of the Larvae in the Laboratory.

1975. (National Marine Fisheries Service, Northeast Fisheries Center, Narragansett Laboratory, Narragansett, RI)

Percentage survival of laboratory-spawned of summer flounder (*PARALICHTHYS DENTATUS*) larvae reared at 15 C was greater than at 18 C. Black-sided (rather than clear) aquaria and the presence of a *CHLORELLA*-like algae also improved survival. The parent fish had been incited to ovulate by injections of carp pituitary. (RFC)

<614>

Smith, G.C., and E.S. Harvey, Metabolism, Thermal Preference, and Critical Thermal Maxima of the Mosquito Fish, *GAMBUSIA AFFINIS*.

1974. Assoc. Southeast Biol. Bull., 21, 85 (Purman University, Greenville, SC; Savannah River Ecology Laboratory, Aiken, SC)

Critical thermal maxima of acclimated and unacclimated mosquitofish *GAMBUSIA AFFINIS* from three sites on the Savannah River Plant in Aiken, SC were determined; pond C fish had been exposed 50 C for 10 or more years; fish from a shallow temporary pond had experienced widely fluctuating temperatures and Carolina Bay fish had experienced average seasonal temperatures. Mosquitofish acclimated to high temperatures had lower thermal preferences than those acclimated to low temperatures. Acclimation temperature had more effect on the critical thermal maxima than did exposure to high temperatures over a period of several years. (RFC)

<615>

Smith, J.W., Distribution of Seaward-Migrating Chinook Salmon and Steelhead Trout in the Snake River above Lower Monumental Dam.

1978. Marine Fish. Rev., 36, 42-45 (National Marine Fisheries Service, Northwest Fisheries Center, Seattle, WA)

No significant correlation was found between temperature and horizontal or vertical distribution of juvenile salmon, SALMO GATSDNERI, and steelhead trout, ONCORHYNCHUS Tshawytscha, perhaps due to the lack of substantial variations in the prevailing river conditions. Chinook salmon displayed a tendency to migrate nearer the surface of the river than did steelhead trout and would be, therefore, more subject to losses from supersaturation of dissolved gases. (RPC)

<616>

Smith, L.L., Jr., and W.M. Koenst, Temperature Effects on Eggs and Fry of Perch and Pike.

1975. EPA-660/3-75-017: 91 p. (University of Minnesota, Department of Entomology, Fisheries, and Wildlife, St. Paul, MN)

Temperature effects on the early life history stages of the walleye (STIZOSTEDION VITREUM VITREUM (Mitchell)) and sauger (STIZOSTEDION CANADENSE (Smith)) were examined. Walleye eggs and fry were exposed to six temperatures (6 to 21 C) for effects on fertilization, incubation, and fry survival. Patern sauger were held and eggs were fertilized at four temperatures (9 to 18 C). Both species were incubated at 6 to 21 C. Sauger fry survival was also tested at 6 to 21 C. Optimum fertilization temperatures were 6 to 12 C for walleye and 9 to 15 C for sauger. Optimum incubation temperatures were 12 to 15 C for both walleye and sauger. A sharp drop or rise in temperature had no great effect on walleye fry and juvenile survival except when the upper lethal or lower lethal temperature was approached. Optimum temperature for juvenile walleye and sauger growth was 22 C. Upper lethal temperatures for walleye juveniles were determined for acclimation temperatures at 2 C intervals between 8 and 26 C. The upper lethal temperature of walleye juveniles was 27.0 to 31.6 C, depending on acclimation. The lower lethal temperature for juvenile walleyes acclimated to 24 C is slightly lower than 8 C. The upper lethal temperature of sauger acclimated to 10 to 26 C was 26.5 to 30.8 C. There was little temperature difference (1 to 2 C) between 100% survival and no survival. (Auth)

<617>

Smith, W.R., B.J. Meyers, J.B. Gentry, J.E. Gibbons, F.G. Howell, W.M. Lewis, W.J. O'Farrell, and W.R. Sharitz, Annual Report of Ecological Research at the Savannah River Ecology Laboratory.

1978. University of Georgia - Savannah River Ecology Laboratory Annual Report: 78 p. (Savannah River Ecology Laboratory, Aiken, SC; University of Georgia, Institute of Ecology, Athens, GA)

Studies of land use, cycling processes and thermal ecology comprise the three main sections of this report. The latter describes research related to the thermal effluents from the Savannah River Power plant showing increases in abundance of turtle

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parasites, enhancement of growth rate in juvenile bass (MICROPTERUS SALMOIDES) low condition factor of adult bass from thermally heated areas, seasonal periodicities in bass parasite population densities, changes in cattail dominance patterns in affected areas, effects on larval toad development, alterations in floristic composition, revegetation patterns after removal of thermal loading, increases in standing crop of Spanish moss, effects on seasonal distribution of the alligator, development of water masses, adaptation of dragonfly nymphs, impact on species diversity, and the naturally high thermal tolerance of mosquitofish, GAMBUSIA AFFINIS. (RPC)

<618>

Soel, W., and C. Heip, The Culturing of Some Parapneustoid Copepods from Brackish Water.

1978. Biol. Jaarb. Dodonaea (Belg.), 42, 159-169 (Rijksuniversiteit Gent, Laboratorium voor Morphologie en Systematiek der Dieren, Gent, Belgium)

A culture method for three copepods from a brackish water pond in northern Belgium was established. Survival of TACHIDIUS DISCIPES was between 75 and 81% at 5, 10 and 17 C. At 20 and 25 C survival varied between 55 and 60%. Survival of PARONYCHOCAMPUS NAUUS was highest at 10 C. The relative duration of the naupliar stages of T. DISCIPES was prolonged with increasing temperature from 5 to 25 C. (ST)

<619>

Sayle, W.J., The Effect of Temperature on the Development Time of the Eggs of Three Freshwater Cyclopoid Copepods from the English Lake District.

1978. Crustaceana, 27, 278-288 (Freshwater Biological Association, Ambleside, England)

In the laboratory at temperatures below 9.5 C (the early May breeding period field temperature for both CYCLOPS STRENUUS ABYSSORUM and MESOCYCLOPS LEUCANTII), the eggs of C. STRENUUS ABYSSORUM developed faster than those of M. LEUCANTII. Above 9.5 C, the reverse occurred. Since the copepods become increasingly carnivorous at each molt, development temperature would affect the relative numbers of each species surviving. The benthic species, ACANTHOCYCLOPS VIBIDIS developed even faster, hatching at 5.5 C and above. (RPC)

<620>

Soliski, A., The Influence of Discharged Heated Waters from the Power Station at Szawina on Microflora of Vistula River.

1978. Pol. Arch. Hydrobiol., 21, 75-82 (Meteorology and Water Economics Research Institute, Warszawa, Wrocław, Poland)

Heated discharges from the power station at Szawina influenced the bacterial and fungal populations of the river adversely only at temperatures above 30 C. Temperatures during the 6 months of study varied from 11 to 29.5 C. (RPC)

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Soltz, D.L., Variation in Life History and Social Organization of Some Populations of Nevada Pupfish, *CYPRINODON NEVADENSIS*.

1975. Ph.D. Thesis, University of California, 160 p. (University of California, Los Angeles, CA)

Three breeding systems were described for Nevada pupfish, *CYPRINODON NEVADENSIS*, depending on ecological conditions: aggregative spawning in flowing, variable temperature habitats; breeding territoriality in large to moderate size, constant temperature springs; and a dominance hierarchy in small, constant and variable temperature springs. An apparent lack of correlation between most pupfish life history features and the constancy and temperatures of their environments may result from the effects of genetically invariant, temperature dependent metabolic processes on growth (BPC)

<622>

Sorensen, E.N.B., Thermal Effects on the Biological Significance of Arsenic in Green Sunfish, *LEPOMIS CYANEUS*.

1975. Ph.D. Thesis, University of Texas at Austin, 286 p. (University of Texas, Austin, TX)

The pattern of heavy metal concentration in organs of both living and dead *LEPOMIS CYANEUS* was measured in Section I as a function of exposure time at 10, 20 and 30 C and 0, 30 and 50 ppm arsenic as sodium arsenate. The temperature quotient Q10 for the rate of arsenic uptake and the lethal time before 50% mortalities LT(50) occurred were calculated. Arsenic concentration in liver, gut, and muscle tissue was determined in living and dead specimens by neutron activation analysis. The occurrence of individual specimen variability in arsenic uptake data did not override general trends of increasing uptake with exposure time, temperature, and arsenic concentration. Data on the arsenic retention of fish in 10 C and 0, 30 and 50 ppm treatments indicated that the majority of arsenic in organs is not retained after 7 days. Correlation of uptake with various specimen and tissue parameters proved inconclusive. The mean Q10 value for arsenic uptake in liver was 4.5. Since the typical Q10 range for the genus *LEPOMIS* is 1.6 to 3.0 (O'Hara, 1968), the high mean Q10 for *L. CYANEUS* seems to suggest that temperature acts synergistically with arsenic uptake. The LT(50) values, a measure of survival, were calculated by straight line graphic interpolation after linear regression analysis of data on percent survival versus time of death. All regressions were highly significant. As temperature increased from 10 to 20 to 30 C at 50 ppm arsenic, percent survival decreased such that LT(50) values were reduced from 678 to 210 to 128 hours, respectively. For an arsenic concentration of 30 ppm and temperatures of 20 and 30 C, LT(50) values are 527 and 209 hours, respectively. Since the results of Section I showed that arsenic was accumulated in organs--especially the liver--of *LEPOMIS CYANEUS* and that external variations exacerbate this accumulation, an intracellular study was made in Section II to follow the appearance and rate of change of hepatocyte alterations. Hepatocyte alteration was measured as arsenic concentration (i.e., 30 and 50 ppm) and exposure time (i.e., 1, 2, and 3 weeks)

varied at 20 C. As concentration and exposure time increased, the appearance and increase in aberrant mitochondria and electron dense particles were observed. Lysosomes and smooth endoplasmic reticulum increased in number, while the number of myelin figures decreased. Hepatocyte alterations and arsenic uptake did not appear to be correlated to specimen condition. (Auth)

<623>

Southward, A.J., Long Term Changes in Abundance of Eggs of the Cornish Pilchard (*SARDINA PILCHARDUS* Walbaum) off Plymouth.

1978. Jour. Mar. Biol. Assn. U.K., 58, 641-649 (The Laboratory, Marine Biological Association, Citadel Hill, Plymouth, England)

A review of 70 years of weekly observations of seasonal changes in abundance of Cornish pilchard, *SARDINA PILCHARDUS*, eggs off Plymouth, England revealed that falling sea temperatures were responsible for a decline in summer spawning since 1961 although a detailed correlation could not be made. A significant correlation was found between numbers of Autumn-spawned eggs which have become more abundant since 1962 and sea temperatures during the 18 months prior to spawning. (BPC)

<624>

Spectorova, L.V., T.N. Aronovich, S.I. Deroshev, and V.P. Popova, Artificial Rearing of the Black Sea Turbot Larvae (*SCOPHTHALMUS MAXIMOVICUS*).

1978. Aquaculture, 8, 329-340 (All Union Research Institute of Marine Fisheries and Oceanography, Moscow, USSR)

Incubation period for eggs from black sea turbot, *SCOPHTHALMUS MAXIMOVICUS*, of spawners from both natural conditions and from those reared artificially was about 8 days at 16 C and longer at lower temperatures. The rate of yolk sac absorption was temperature-dependent and highest at 19 C. (BPC)

<625>

Sperling, J.A., Algal Ecology of Southern Icelandic Hot Springs in Winter.

1975. Ecology, 56, 183-190 (Queens College, Department of Biology, Flushing, NY)

A survey of algal habitats of southern Icelandic hot springs (Hengill-Olfas district) was made between Dec. 15, 1969, and Jan. 20, 1969. C-14 primary productivity was measured in experiments designed to compare the role of direct solar radiation on algal habitats of different aspect and inclination. Residual populations of *HAUSTORIUM* *LAURUS* were found up to 55 C in quiet waters. Healthy mats of *PROCHLORIS* *COCCINEA*, *LYNGBYA* *HEUSTENSIIANA* and *HAUSTORIUM* occurred locally in south flowing effluents (41 - 51 C) in moderate to fast flow. The aerial blue-green algal community bordering the hot springs appeared unchanged from that of the summer. The cryptic persistence of *HAUSTORIUM* on submerged rock from habitats (55 - 60 C) having a swept bare appearance was demonstrated in the lab. This finding obviates the suggestion that nonthermal over-wintering niches might serve as seedling sources for the large-scale resumption of growth in the spring. Eight of the 18 PVC substrates left for 15 days in thermal effluents showed signs of colonization, which indicated that the 28-hr compensation point for this period had been exceeded. (Auth) (ND)

<624>

Spigarelli, S.A., Behavioral Responses of Lake Michigan Fishes to a Nuclear Power Plant Discharge.

1975. COMF-7a3820; STI/POB/378; IAEA-SB-197/18; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 879-888) (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, IL)

Since 1970, the USABC has sponsored thermal effects research at Argonne National Laboratory. This program has developed into a detailed study of the behavior of Lake Michigan fishes in relation to waste-heat discharges from large power plants. Echo location techniques indicate that some fish densities are similar in plume and reference areas, except during the spawning seasons of alewife (*Alosa pseudoharengus*) and smelt (*Osmerus mordax*) when plume densities exceed reference area densities. Power plant shutdowns in July and September resulted in little change in fish density or distribution. Mark and recapture studies indicate that Lake Michigan salmonids are extremely migratory and generally do not reside in a thermal plume for long periods. Temperature-sensitive fish tags and measurements of fish-body temperatures indicate that salmonids which frequent the outfall area do not acclimate to maximum discharge temperatures. Sport fishing in thermal outfalls in Lake Michigan is quite popular and often provides unexcelled fishing for salmonids. Species composition of the catch and fishing success are partially dependent upon season and water temperature. (auth)

<627>

Stadelmann, P., J.E. Moore, and E. Pickett, Primary Production in Relation to Temperature Structure, Biomass Concentration, and Light Conditions at an Inshore and Offshore Station in Lake Ontario.

1974. Jour. Fish. Res. Bd. Can., 31, 1215-1232 (Canada Center for Inland Waters, Department of the Environment, Fisheries and Marine Service, Burlington, Ontario, Canada)

A lag in increase in biomass and photosynthesis rate of the primary producers at an offshore station in Lake Ontario in early summer was attributed to deep vertical mixing, itself a result of a springtime thermal bar which kept algae below the euphotic zone for a disproportionate length of time. Algal populations were shown to behave differently at different depths during the stratified period. (RFC)

<628>

Stanley, D.W., Production Ecology of Epipellic Algae in Alaskan Tundra Ponds.

1974. Ph.D. Thesis, North Carolina State University, 155 p. (North Carolina State University, Raleigh, NC)

Epipellic benthic algae in several tundra ponds and in a lake near Point Barrow, Alaska, showed a higher temperature optimum (more than 20 C) for photosynthesis than did the phytoplankton (14 C) but the epipellic Q₁₀ (2.5 to 12.5 C) for photosynthesis was only 2.2, compared to 3.0 for the planktonic

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algae. Thus the epipellic algae seemed to be adapted to the sediment environment where temperatures were higher (up to 4 C on sunny days) than in the water. The planktonic algae, in contrast, appeared to consist of species with photosynthesized more efficiently at the lower temperatures of the pond water. Photosynthetic half-saturation light intensity was found to be temperature dependent, increasing as much as 3-fold in the epipellic algae over a 10 degree range. Light inhibition was common at low temperatures in the plankton algae but never in the epipellic. Model simulations strongly suggested that much of the year-to-year variation in total epipellic production in these ponds as a result of temperature and light variations alone. (RFC)

<629>

Stanley, J.G., Mucus and Freshwater Osmoregulation in Inadrosous Fishes and Relationships to Mortalities in the Alewife.

1973. MOA-73122701; 18 p. (University of Wisconsin, Department of Zoology, Milwaukee, WI)

The alewife (*Alosa pseudoharengus*) tolerated 10 C changes in temperature and had an acute upper lethal temperature well above those normally encountered in the Great Lakes. Thermal condition per se was unlikely to cause the mass mortality often seen in this species. Low plasma sodium levels were found associated with the moribund state and with fungal infections. Numbers of epidermal mucous cells did not generally correlate with changes in electrolyte levels. However, laboratory-held fish had high plasma sodium levels and increased numbers of epidermal mucous cells. A hypothesis is proposed that moderate stress causes hypersecretion of adrenal corticoids which produce high plasma sodium levels, whereas severe shocks result in exhaustion and loss of electrolyte. Exposure of alewives to cold or warm temperatures and to lethal heat resulted in only minor changes in electrolyte levels and numbers of mucous cells. The lack of effects on mucous cells suggest that further studies in this area might not be warranted. (auth)

<630>

Stanley, S.O., and C.W. Brown, Influence of Temperature and Salinity on the Amino-Acid Pools of Some Marine Pseudomonads.

1974. Part of Colwell, R.F. and Horita, R.Y. (Eds.), Effect of the Ocean Environment on Microbial Activities, Proceedings of the Second United States-Japan Conference on Marine Microbiology held in Baltimore, Maryland, August 25-30, 1972. University Park Press, Baltimore, Maryland, (p. 92-103). (Donstaffage Marine Research Laboratory, Scotland)

Although salinity most affected the pool size and pool composition of amino acids in the pseudomonad bacteria, a decrease in temperature resulted in an increase in concentrations of most of the components of the amino acid pool. (ST)

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Staples, D.S., and J.C. Fry, Factors Which Influence the Enumeration of *Bdellovibrio bacteriovorus* in Sewage and River Water.

1973. Jour. Appl. Bact., 36, 1-11 (University of Wales Institute of Science and Technology, Department of Applied Biology, Cathays Park, Cardiff, Wales)

A loeble layer plating technique was used for counting *Bdellovibrio bacteriovorus* in river water and sewage samples. The optimum conditions for enumeration were provided by dilute media with 0.6% of agar as the top layer, incubated for 6 days at 30 C with *Achromobacter* sp. as the host. Maximal *Bdellovibrio* numbers were obtained in five days at 37 C, 6 - 8 days at 30 C, and 14 - 15 days at 15 and 20 C. The lower incubation temperatures resulted in few plaques. At 37 many protozoal plaques developed. Pretreatment of samples affected counts: centrifugation and membrane filtration reduced the *Bdellovibrio* count, homogenization increased it. (ND)

<632>

Stauffer, J.R., The Influence of Temperature on the Distribution, Community Structure and Condition of Fish of the New River, Glen Lyn, Virginia.

1975. Ph.D. Thesis, Virginia Polytechnic Institute and State University, 249 p. (Virginia Polytechnic Institute and State University, Blacksburg, VA)

Although the condition factor of most tested fish species was significantly lowered, the overall effects of heated effluents from the Glen Lyn Virginia, Appalachians Power Company's fossil fuel plant were judged to be minimal. Fish displayed three types of response to the heated waters: avoidance, preference and no response. Catfish from heated areas had different stomach materials than those from non-heated areas. It was determined that residence time cannot be estimated by a comparison of internal body temperature with water temperatures. Laboratory preference and avoidance data for the most important species were generated. (RPC)

<633>

Stauffer, J.R., D.S. Cherry, K.L. Dickson, and J. Cairns, Jr., Laboratory and Field Temperature Preference and Avoidance Data of Fish Related to the Establishment of Standards.

1975. Part of Salla, S.B. (Ed.), Fisheries and Energy Production: A Symposium. D.C. Heath and Company, Lexington, Massachusetts, (p. 119-139), 237 p. (Virginia Polytechnic Institute and State University, Biology Department, Blacksburg, VA)

Though thermal discharges from the Glen Lyn Power Plant were about 7.7 C above ambient stream temperatures, no appreciable harm should come to fish species designated as "important" according to 1973 EPA standards. Distribution of the spotted shiner (*Notropis spilopterus*) appeared to be unaffected by temperature, being equally abundant in the field at 20.5, 35 and 26.5 C while the stoneroller (*Campostoma anomalus*) definitely preferred temperatures cooler than 23.8 C. The northern hog sucker (*Hypentelium*

nigricans) increased in abundance as temperatures rose from 19.4 to 26.1 C. Its ultimate calculated preference was 27.0 C. Ninety percent of the channel catfish (*Ictalurus punctatus*) captured were in waters of more than 34.3 C. Calculated preference was 33.7 C. Calculated final temperature preference for spotted bass (*Micropterus punctulatus*) and smallmouth bass (*Micropterus dolomieu*) was 30 C. No response was shown in the lab by the fantail darter (*Etheostoma falsetharum*) but field data indicated a preference for 23.8 C or more. From close agreement between field observations and laboratory data, extrapolations may be drawn when only one set of data is available. The setting of an upper stream temperature standard of 27.2 C would not be scientifically justified under present conditions at the Glen Lyn Plant. (RPC)

<634>

Stauffer, J.R., K.L. Dickson, A.G. Heath, G.W. Lane, and J. Cairns, Jr., Body Temperature Change of Bluegill Sunfish Subjected to Thermal Shock.

1975. Progressive Fish Culturist, 37, 90-92 (Virginia Polytechnic Institute and State University, Department of Biology and Center for Environmental Studies, Blacksburg, VA)

When bluegill sunfish, *Lepomis macrochirus*, from acclimation temperatures of 5.5, 8.3, 11.1 or 13.3 C were exposed to conditions simulating those in the New River (VA.) where heated effluents are discharged by the Glen Lyn Power Plant, a lack of significant correlation between size, weight, and condition factor and time for internal temperatures to reach an equilibrium with the environmental temperature was found. More time was required for equilibrium at temperatures below the acclimation temperature than at temperatures above the acclimation temperature. A difference in time to reach equilibrium between live and dead fish suggested that blood flow rate via activity may be a factor in determining heat exchange. It was concluded that the practice of basing residency time of the fish in the plume on the relationship of its internal temperature with the ambient and discharge temperatures may be inaccurate. (RPC)

<635>

Stewart, W.W.A., The Rate of Larval Development of *Aedes implicatus* Vockeroth in Field and Laboratory.

1974. Mosquito News, 34, 283-285 (Agriculture Canada, Research Station, Research Branch, University Campus, Saskatoon, Saskatchewan, Canada)

Laboratory developmental periods for the mosquito, *Aedes implicatus*, at 20.6 C were 2, 1.5, 1.4, 3 and 2.1 days for 1st, 2nd, 3rd and 4th instar larvae and pupae. The heat units required for larval development in the laboratory were almost identical to those measured at 1/2 inch in the pond; i.e., 80, 60, 56, and 120 degree-days above 8.4 C for 1st, 2nd, 3rd, and 4th instars in that order. The application of heat units in the practical aspect of control is discussed. (RPC)

<636>

Spillwell, J.H., M.C. Matthews, and D.L. Bell, The Effect of "Once Through" Power Plant Cooling of Freshwater Mussels.

1974. Bull. Amer. Malacol. Union, Inc., 40, 73 (Sattelle Memorial Institute, Columbus Laboratories, Columbus, OH)

Growth rates were determined for the dominant species of freshwater mussels collected in the vicinity of three fossil fuel electric power plants located on the Muskingum River in Ohio. The species composition and diversity of the naiad population in the area of one of the plants were compared with data collected 10 years previously. Curves derived from shells collected upstream and downstream of the thermal outfalls of these plants were compared. No significant differences in growth rates could be attributed to the increased temperatures found downstream of the plants. (Auth)

<637>

Stirewalt, R.L., and R.S. Harvey, Some Effects of a Slight Elevation in Temperature on the Diversity of Macroinvertebrates in Artificial Pools.

1974. Assoc. Southeast Biol. Bull., 27, 87 (Augusta College, Augusta, GA; Savannah River Ecology Laboratory, Aiken, SC)

The greatest fluctuations in the total number of organisms and the number of species during the summer of 1973 were observed in a pool maintained at about 5°C above creek water temperature as compared to diversity in two other pools approximating the temperature of nearby Upper Three Runs Creek, Georgia. (RPC)

<638>

Stokes, G.W., The Distribution and Abundance of Penaeid Shrimp in the Lower Laguna Madre of Texas, with a Description of the Live Bait Shrimp Fishery.

1974. Texas Parks and Wildlife Department Technical Series No. 15; 32 p. (Texas Parks and Wildlife Department)

Brown shrimp, *PENAEUS AZTECUS*, were most abundant in the lower Laguna Madre of Texas when the average water temperature was 20 to 26.6°C. At over 26.8°C, largescale emigration occurred during the spring. White shrimp were most abundant from 24.2 to 28.7°C except during the winter of 1972 when they were relatively abundant in trawl areas at 20.0°C and 22.3°C; maximum immigration occurred at above 24.4°C. Pink shrimp were most abundant at 18.8 to 25.5°C. No distribution or abundance relationships were observed with regard to dissolved oxygen. (RPC)

<639>

Stolte, L.W., Introduction of Coho Salmon into the Coastal Waters of New Hampshire.

1974. Progressive Fish Culturist, 36, 29-32 (New Hampshire Fish and Game Department, Concord, NH)

Water temperatures in the Lamprey and Exeter Rivers were found to vary from 0 to 25°C and to consistently approach 21°C during the summer when 3 broods of coho salmon, *Oncorhynchus kisutch*, were introduced in 1969, 1970, and 1971. The author concluded that the coho sport fishery program will be primarily hatchery-dependent due to the high summer temperatures coupled with a lack of suitable spawning habitat in New Hampshire coastal streams. (RPC)

<640>

Strekal, T.A., and W.P. McDuffett, Factors Affecting Germination, Growth, and Distribution of the Freshwater Sponge, *SPONGILLA FRAGILIS* Leidy (Porifera).

1974. Biol. Bull., 146, 267-278 (Bucknell University, Department of Biology, Lewisburg, PA)

There was an apparent threshold between 6 and 8°C for germination of the freshwater sponge, *SPONGILLA FRAGILIS*, under dark laboratory conditions; no germination occurred after 30 days at 6°C. Germination time decreased with temperature increases up to 20°C. Results at 16 and 20°C were similar. Field germination temps. averages were 7.5 to 10.5°C and formation of overwintering gemmules began after 5 months of temperatures below 16°C followed within 2 weeks by a drop to 7 or 8°C. (RPC)

<641>

Stromberg, P.C., and J.L. Crites, Population Biology of *CANALLANUS OXYCEPHALUS* Ward and Nagath, 1916 (Nematoda: Canallanidae) in White Bass in Western Lake Erie.

1975. Jour. Parasitology, 61, 123-132 (Ohio State University, Center for Lake Erie Area Research and Department of Zoology, Columbus, OH)

Seasonal cycles in population structure, site selection, intensity of infection, maturation, and reproduction of the nematode, *CANALLANUS OXYCEPHALUS*, infecting white bass, *MORONE CHRYSOPS*, in western Lake Erie was probably related to temperature but may also have involved host hormone cycles. (RPC)

<642>

Suau, P., Contribution to the Knowledge of the Spawning Grounds of Anchovy.

1974. Result. Exped. Cient. Buque Oceanogr. "Comandante de Saavedra" (Paseo Nacional, Inst. Invest. Pesq., s/n Barcelona, Spain)

The anchovy, *ENCYCLIS ENCYCLICOLUS*, was found to occur in two spawning grounds of the Spanish Mediterranean coincident with surface water temperatures varying from 19.5 to 23.7°C. (RPC)

<643>

Suberkropp, K., and H.J. Klug, The Effect of Temperature on the Flora of Decomposing Leaves in a Freshwater Stream.

1974. Abs. Ann. Meet. Amer. Soc. Microbiol., 74, 31 (Michigan State University, W. K. Kellogg Biological Station, Hickory Corners, MI)

When the mean weekly temperature of a stream exceeded 18°C in summer, species associations of aquatic hyphomycetes on oak and hickory leaves changed from being dominated by *ALATOSPORA ACUMINATA* to domination by *LOMULOSPORA CURVULA*. The reverse occurred when temperatures went below 18°C in the fall. The latter species never became dominant on leaves placed in areas never reaching 18°C. Laboratory studies indicated a close correlation between the temperature growth response and environmental temperatures observed for each species. (RPC)

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Sukhanova, V.V., Mathematical Model of the Seasonal Dynamics of Weight Gain of Juvenile Sockeye Salmon *OMCOBNYSCHUS NERKA* (Walb.).

1974. Vopr., Ikhtiol., (USSR) 18, 575-580 (Institute Evolutionary Physiology and Biochemistry, Leningrad, USSR)

The dynamics of weight gain within the annual cycle for sockeye salmon, *OMCOBNYSCHUS NERKA*, are described by a mathematical model of the fish under the effect of seasonal temperature and food variations. The hysteresis phenomenon in the relation between the specific growth rate and environmental temperature is explained by the fact that the growth rate is affected by temperature and by food. Temperature limits and optimum are reported (RPC)

<645>

Sylvester, J.R., Critical Thermal Maxima of Three Species of Hawaiian Estuarine Fish: A Comparative Study.

1975. Jour. Fish Biol., 7, 257-262 (Oceanic Institute, Waimanalo, HI)

In relation to acclimation temperature, the Hawaiian estuarine fish *MUGIL CEPHALUS* and *CHELOS ENGELI* had similar critical thermal maxima with *KUHLIA SANDVICENSIS* having a critical thermal maxima (CTM) about one degree C below that of the other two species. *MUGIL CEPHALUS* and *C. ENGELI* showed an increasing CTM toward midday which decreased thereafter. The CTM of *K. SANDVICENSIS* increased throughout the day. Critical thermal maxima of the three species at acclimation temperatures of 20 and 29 C were: *KUHLIA SANDVICENSIS*, 36.7 and 40.3 C; *CHELOS ENGELI*, 38.4 and 40.9 C; and *MUGIL CEPHALUS*, 38.5 and 41.3 C, respectively. (RPC)

<646>

Sylvester, J.R., Biological Considerations on the Use of Thermal Effluents for Finfish Aquaculture.

1975. Aquaculture, 6, 1-10 (Oceanic Institute, Waimanalo, HI)

The author reviews research indicating that thermal effluents can be used as a source of warm water which may be utilized to control and maintain a fish-farm system within optimum thermal limits. The primary effect of the bio: temperatures on cultured organisms will be through increased activity and metabolism. The principal finfish attracted to thermal effluent areas are warmwater species which could provide suitable culture animals. At present, few fish species are cultured in thermal effluents under controlled condition. (Auth) (RPC)

<647>

Sylvester, J.R., Factors influencing the Efficacy of MS-222 to Striped Mullet (*MUGIL CEPHALUS*).

1975. Aquaculture, 6, 163-169 (Oceanic Institute, Waimanalo, HI)

Temperature, pH, and oxygen concentrations all significantly affected induction to total loss of equilibrium in freshwater-adapted striped mullet, *MUGIL CEPHALUS*, at a concentration of 80 ppm MS-222. Anesthetic toxicity was less for saltwater-acclimated fish than for freshwater-acclimated fish. A decrease occurred in induction times at acclimation temperatures other than 25 C, suggesting that anesthetic action may be intensified in fish acclimated to conditions other than those near their physiological optima. (RPC)

<648>

Sylvester, J.R., and C.E. Nash, Thermal Tolerance of Eggs and Larvae of Hawaiian Striped Mullet, *MUGIL CEPHALUS* L.

1975. Trans. Amer. Fish. Soc., 104, 144-147 (Oceanic Institute, Waimanalo, HI)

Relationships between temperature and mortality of eggs and survival of the larvae for the striped mullet, *MUGIL CEPHALUS* L., are described. Eggs were incubated at temperatures between 1.0 and 40.5 C. Mortalities were least (4.2%) within the range 22.7-23.3 C. Hatching time was inversely related to temperature. At optimum temperature (22.7-23.2 C) the length of the incubation period was 40-49 hours. The equation: $Y = 3.6674 \sinus 1.5240 \text{ times } X$ describes the relation between incubation time and temperature over the range of 11-30 C. Larvae were exposed to temperatures between 2.7 and 32.9 C. Survival up to 12 days was greatest (19.9%) at a mean temperature of 24.9 C (range 24.5-25.3 C). (Auth) (SD)

<649>

Tandon, R.S., and B.D. Joshi, Seasonal Variations in Blood Glucose and Serum Calcium Levels of Freshwater Fishes: I. *CLARIAS BATHYACHUS*.

1974. Z. Tierphysiol. Tierernahr. Futtermittelkd., 33, 108-112 (Lucknow University, Department of Zoology, Lucknow, India)

Changes in blood glucose levels in the fish *CLARIAS BATHYACHUS* from a low mean of 60.8 plus or minus 14.6 mg/100 ml in October to a high of 72.8 plus or minus 8.9 mg/100 ml in January were in general correlated with thermal variations and spawning period. A change in serum Ca from a low of 11.2 plus or minus 3.4 mg/100 ml in February to a high of 16.0 plus or minus 6.8 mg/100 ml in June/July was influenced more by sexual maturity than by temperature changes. (RPC)

<650>

Tat'yantin, Yu.V., The Effect of Preliminary Adaptation Temperature on the Distribution of Young Cod *GADUS MORHUA MORHUA* L. and Pollock *POLLACHIUS VIRENS* (L.) Within the Temperature Gradient.

1974. Vopr. Ikhtiol., (USSR), 14, 869-874 (Murmansk. Morsh. Biol. Inst., Dal'nje Zelentsy, USSR)

In a temperature gradient young cod, *GADUS MORHUA MORHUA* and pollock, *POLLACHIUS VIRENS*, selected colder areas in summer when the adaptation temperature was decreased and warmer areas in winter when adaptation temperatures were increased. Adaptation was more rapid at high than at low temperatures. (RPC)

<651>

Taufik, M.P.S., and K.P. Awadallah, The Biology of the Water Scorpion *BAWATRA VICINA* Signoret (Heteroptera, Nepidae).

1975. Dtsch. Entomol. Jour., 22, 229-240 (Cairo University, Plant Prot. Dept., Fac. Agric., Giza, Egypt)

BAWATRA VICINA is a nepid predator inhabiting shallow water preferably well vegetated. Its rearing in laboratory during a year of investigation (1973) revealed 3 successive generations. Most adults of the last generation became sexually quiescent from about the end of October till mid April. Various stages of this insect are described and their durations were estimated in association with its 3 generations. The respective life-cycles lasted for 69.0, 58.25 and 57.75 days at 26.0, 27.7 and 28.1 C, while the total developmental periods were attained in 52.33, 40.53 and 45.6 days at 25.2, 27.8 and 25.6 C, respectively. Biological processes: mating, oviposition and feeding, are described. (Auth) (RD)

<652>

Taylor, J.B., Planktonic Prosobranch Veligers of Kaneohe Bay.

1975. Ph.D. Thesis, University of Hawaii, 605 p. (University of Hawaii, Honolulu, HI)

As a result of weekly samplings of the surface waters of the Kaneohe Bay (Oahu, Hawaii) plankton during a two and one-half year period, more than two hundred species of planktonic prosobranch veligers have been described, their temporal and spatial distribution in the plankton established, the growth patterns of their juveniles examined and the capacity of veligers of *CROCIBULUS SPINOSUS* to withstand heat and detergent stress quantified. It was found that diversity of species increases from the inner bay to the outer reef areas; abundance decreases from the southeastern to the northwestern region. Ecological factors which may restrict species of veligers to definite areas are discussed. *CROCIBULUS SPINOSUS*, a calyptraeid, is the species of prosobranch veliger most abundant in Kaneohe Bay throughout the year; the ability of these veligers to withstand heat and detergent stress was quantified in separate experiments. In veligers of *C. SPINOSUS*, temperatures ranging from 30 C to 36.5 C produced highly significant increases in death rates in the experimental groups as

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compared with the control groups at 27 C (ambient temperature during collection). At 30 C, these differences in per cent mortality become significant after 67 hours, at 33 C after 53 hours, at 35 C after 35 hours and at temperatures above 36.5 C within eight hours. Transferral of *C. SPINOSUS* larvae to temperatures only a few degrees higher than that of ambient sea water appeared to be one factor which stimulates metamorphosis in the veliger. These post-metamorphic juveniles are more likely to survive at continuously high temperatures than are the veliger stages. Veligers that were able to metamorphose quickly upon exposure to linear alkyl sulfonates were more likely to survive than those remaining as veligers. Successful rearing techniques and problems encountered in rearing juvenile gastropods of differing life styles are described and discussed. Variations in diet, temperature and other factors alter rates of growth, but generally the following species require the following periods from metamorphosis to reproductive maturity with a temperature range of 25 to 28 C: *STYLIPERMA GONIOMACHIA*, 16 days; *EPITOMIUM ULU*, 21 days; *LITIOPA HELLABOSTOMA*, 23 days; *CEBITIUM ATROBACINATUM*, 5 weeks; *SHARADIA BRYANAE*, 10 weeks; *WATICA QUALTIERIANA*, 12 weeks; *CROCIBULUS SPINOSUS*, 3 to 4 weeks for development of the male gonad, 12 to 15 weeks for the female apparatus to become functional. Discontinuous growth occurred in some carnivorous juveniles. (Auth) (RD)

<653>

Taylor, J.D., and H.J. Payater, Effect of Temperature on the Bacterial Component of Lake Water Maintained under Continuous Culture Conditions.

1974. Abs. Ann. Meet. Amer. Soc. Microbiol., 74, 31 (Clemson University, Clemson, SC)

Mean cell count of bacteria from a non-polluted lake (Lake Keowee, S.C.) was maximal (approx. 3.5×10^6 (±5)/ml) at 24 C. At 2 C, 55% were capable of degrading protein, the percentage decreasing with increasing temperatures to a minimum of 17% at 24 C. At 2 C, 20% were capable of utilizing starch; this fell to 5% at 24 C. The lipid degrading population was minimal at 2 C and 24 C and maximal (15%) at 24 C. (RPC)

<654>

Taylor, R.E., Adaptation of Gage Fish to Highly Alkaline Desert Lakes.

1974. GUNT-1-042-229, 7 p. (University of Nevada, Center for Water Resources Research, Reno, NV)

None of various species of rainbow trout survived transplanting from fresh water to the saline water of Pyramid Lake, Nevada when water temperatures differed. The trout survived with no temperature differential at time of transplant. Under these conditions, all temperatures between 7.2 and 17.7 C were successful. The trout tolerated dissolved solids of 5,000 ppm, alkalinity of 1,340 ppm, sulfate of 245 ppm and a pH of 9.0. (RPC)

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Templeton, W.L., W.J. Schneider, and C.I. Gibson, Effects of Thermal and Chemical Discharges from Nuclear Power Plants.

1974. BNWL-SA-5206; CORP-741137-1; 33 p. Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Data from laboratory studies using blood lactic acid and glucose to monitor the fatigue level physically fatigued in rainbow trout, SALMO GARDNERI, showing their response to elevated water temperatures is detailed. Loss of equilibrium and death were used as the ultimate measure of response. In rainbow trout, sunfish, and crayfish acclimated to temperatures ranging from 15 to 13 C followed by declines of 1 to 10 °/hr, loss of equilibrium and coma were used as indications of cold shock. Investigations on the response of fish populations to thermal discharges in the field and the effects of the supersaturation of natural waters with atmospheric gases on the induction of bubble gas disease and survival of 10 species of fish are reported. Studies combining the effects of residual chlorine content from 0.082 to 0.079 ppm and temperatures ranging from 10 to 20 C on the survival of rainbow trout, brook trout (SALVELINUS FONTINALIS) and crayfish (PACIPASTACUS LEWISICULUS), the principal food of trout, showed differences in resistance between species. (RFC)

<656>

Thorhaug, A., Ecological Study of the Effects of Nuclear Power Plants on Benthic Macroplant Microcosms in Subtropical and Tropical Estuaries.

1975. ONO-a333-2; 10 p. (Miami University, Coral Gables, FL)

Research projects involving the thermal ecology, growth, reproduction, and transplantation, of *THALASSIA* sp. of Card Sound and Turkey Point, Florida are detailed as well as the red and green macroalgal ecology and plant succession in a previously damaged Turkey Point *THALASSIA* community. (RFC)

<657>

Thorhaug, A., S.D. Back, R. Nixon, H.A. Rosenler, I.W. Brook, and R. Jonsdottir, Thermal Effluent Discharges from a Power Plant into Card Sound, Florida: Observations Before, During and After.

(University of Miami, School of Medicine, Department of Microbiology, Miami, FL; University of Miami, Rosenstiel School of Marine and Atmospheric Science, Department of Biology and Living Resources, Miami, FL; Tropical Biotechnology Development Company, Miami, FL)

A three-year study before, during and after power plant effluents entered Card Sound, Florida, showed that damage to benthic communities occurred only in a two to three ha area adjacent to the canal mouth. The *THALASSIA* and green macroalgae disappeared but regrew after removal of sediments. At the canal mouth, temperatures ranged 1 to 3 C above ambient and reached more than 18 C only for short time periods. Bottom waters averaged 1 to 2 C above ambient. After an initial depression in species richness, no significant damage occurred in the animal

populations. The presence of red algae (predominantly *LAGUNCULARIA* sp.) was the dominant variable affecting animal indicator abundance, followed by salinity. Greater diversity of trawled animals, increased growth and diversity of sponge populations and increase in total animal catch indicated some beneficial effect. Abundance of *BOLITA* sp., *MITELLA* sp., *VERMICULARIA* sp., and *PAGURUS* sp. was closely correlated with vegetation and temperature while *BOBOLIA* sp., *PELUSIA* sp., and *NECIPARUS* sp. correlated best with salinity. (RFC)

<658>

Thorhaug, A., D. Seger, and H.A. Rosenler, Impact of a Power Plant on a Subtropical Estuarine Environment.

1973. Marine Poll. Bull., 4, 166-169 (University of Miami, School of Medicine, Miami, FL)

The impact of the discharge of cooling water from power stations into Biscayne Bay, a shallow subtropical bay near Miami, has been studied over four years. The discharge has resulted in persistent temperatures of up to 5 C above ambient, and considerable changes in mineral concentrations. The vegetation (mainly turtle grass *THALASSIA* and oel grass *ECOSTERIA*) has declined, and has been replaced with blue-green algae. However, in winter, *THALASSIA* rebounded, and the plus 2 C isotherm was overall more productive than control stations. Sampling with an otter trawl has shown similar exclusion of fish, echinoderms, coelenterates, and porifera. Laboratory tests on lethal temperatures corroborated field data on both plants and animals. (Auth)

<659>

Thorp, J.E., and D.E. Ross, Effects of Salinity and Cyclic Temperature on Survival of Two Sympatric Species of Grass Shrimp (*PALAEMONETES*), and Their Relationship to Natural Distributions.

1975. Jour. Exp. Mar. Biol. Ecol. (Beth.), 10, 19-24 (North Carolina State University, Raleigh, NC; National Marine Fisheries Service, Atlantic Estuarine Fisheries Center, Beaufort, NC)

Survival and respiration of *PALAEMONETES* *PAGIO* and *P. VULGARIS* from the Newport River estuary were measured after exposure to cyclic and constant winter temperatures, to rapid decreases in temperature, and to various temperature-salinity combinations. Both species were subjected to nine temperature-salinity combinations including temperature regimes of cycle 7 to 13 C, constant 7 and 10 C, and salinities of 5, 20, and 35 ppt. Based on the lab and field results, the differences in physiological tolerance to winter temperatures and salinities were analyzed in relation to habitat partitioning by these sympatric species. Survival after continuous exposure to cyclic temperature regimes at medium to high salinities was similar to that observed for comparable constant temperatures; however, at low salinities mortality was significantly lower under the cyclic regime than under either constant regime. This suggests that cyclic temperatures may be detrimental in combination with some other stress. A rapid, transient decrease in temperature from either 7 or 10 C to 2 C had no measurable effect on survival or rate of O₂ consumption at any temperature-salinity acclimation. Neither salinity (except in areas intermittently subjected to salinities less than 3 ppt) nor winter temperatures appear to affect habitat partitioning in grass shrimp. (Auth)

(443)

Shilova, T.B., and Ye.P. Brogorov, Growth of the Oligochaete *Streblospio benedicti* in the Trinity Bay (Pomur' Bay, Sea of Japan).

1974. *Phycologia*, 12, 45-52 (Inst. Biol. Serp'v' 48 S.S.S.R., Vladivostok, 7518).

A study was made of the size-age structure of the population, of the linear growth and seasonal variations in *Streblospio benedicti*. The linear growth was found to be seasonal and to occur mainly in spring and in autumn, at temperatures ranging from 8 to 16 C. The relationship between the shell length and the 'total wet weight' of the animals was observed to vary with age. The average life span of the mollusc was calculated to be 11 years. (Both)

(444)

Stevenson, A.W., and C.W. Boyce, Digestion and Gut Evacuation by Channel Catfish Given Pelleted Foods.

1976. *Trans. Kansas Acad. Sci.*, 74, 254-264 (Kansas State University, Division of Biology and Department of Grain Science and Industry, Kansas Agricultural Experiment Station, Manhattan, KS).

Rates of digestion and gut evacuation were determined for channel catfish (*Ictalurus punctatus*) given pelleted foods. Age group I and older fish were permitted to feed or were force-fed and contents of the gut recovered at various time intervals after feeding. Water temperature varied from 26 to 29.8 C. After the pellets disintegrated, the finely ground ingredients may be moved rather rapidly through the digestive tract. Water temperature above 25 C enhanced digestion and food passage. (Both)

(445)

Tirun, J., P.H. Goldstein, R.S. Allen, J.B. Gantle, R.V. O'Neill, P.B. Waller, Jr., R.H. Shogart, and R.T. Booth, A Production Model for *Streblospio benedicti*.

1975. *Ecology*, 56, 1129-1139 (University of Wisconsin, Madison, WI; Oak Ridge National Laboratory, Oak Ridge, TN).

The mathematical model BEEI was derived to study the productivity of the submerged macrophyte *Streblospio benedicti* in the littoral of Lake Biwa, Madison, Wisconsin. The model coordinates four biomass compartments with selected physiological processes evaluated for a stratified water-saturated water column. Light and temperature are the primary environmental forcing functions. The model considers growth rate/depth distribution of biomass, total biomass/water-saturated, the depth profile of photosynthesis and macrophyte contributions to dissolved and particulate organic matter pools in the water column. The model output was tested against field data for seasonal patterns of standing crop, depth distribution of biomass and depth profile of photosynthesis for a rooting depth of 150 cm. BEEI has permitted the simulation of macrophyte growth response to changes in environmental conditions and has outlined areas of needed research. (Both)

(446)

Tanaka, C., Effect of Constant Temperatures on the Developmental Rates of Immature Stages of *Streblospio benedicti* L. (Trichoptera, Phryganeidae).

1971. *Pol. Pismo Entomol.*, 41, 799-809 (Zool. Inst. Entomol., Inst. Zool., Univ. Lodz, 71, 90000 Lodz, Poland).

The vital activities of caddis larvae and pupae *Streblospio benedicti* and their tolerance and adaptation to temperature conditions which deviated from normal in their natural environment were investigated. To determine the lowest temperature in which breeding is possible the biological zero of early and late instar larvae, and the thresholds of activity and sensitivity to mechanical stimuli in rapid and slow reduction of temperature, were studied. On rapid reduction of temperature the threshold of activity of early instar was 4 C and of late instar larvae 4 C. The threshold of mechanical sensitivity was 2 and 3, the biological zero - 1.5, 2 and 2.5 C. By slow reduction, the mentioned parameters show some differences: thresholds of activity 2 and 4 C thresholds of mechanical sensitivity 1.5 and 2 C, biological zero 1.5 and 2 C. The lowest temperature at which breeding could take place was 4 C for starved larvae and 6 and 12 C for the fed larvae. Lower constant temperatures slowed developmental rates of larvae and pupae, but in the limits of biological time. At various temperatures the individual characters of survival, which composed a range in each series of specimens, were ascertained. Such a range of characters makes a selection zone in a population which can respond to the different changes of temperature in its natural environment by the development of adaptive processes. The reactions of pupae were related to the emergence of the imago which occurred at temperatures above 16.5; at 6 C the pupae completed development after two mo, at 12 C they took one mo. At low temperatures, the pupae can survive for a period of three mo at two mo; these specimens have the greatest capacity for adaptation and tolerance. (Both)

(447)

Toner, B.C., Food Preference and Feeding of the Bay Scallop, *Argopecten irradians* Lamarck (1819).

1976. Ph.D. Thesis, Northeastern University, 100 p. (Northeastern University, Boston, MA).

After 7 days at 24 C 67% of bay scallop larvae survived and averaged 100 μ in length. After 7 days at 21 C, 70% of the animals survived and averaged 121 μ in length. Diets of various combinations of three species of phytoplankton were compared as to growth effects. (SPC)

<664>

<665>

Tsui, P.T., and W.L. Peters, Embryonic Development, Early Instar Morphology, and Behavior of *TOSTOPUS INCEPTUS* (Phlebotomidae: Polvitaridae).

1974. Fla. Entomol., 57, 349-356 (Environ. Science & Engineering Inc., Environmental Sciences Division, University Station, Gainesville, FL)

The chorion of the egg of *TOSTOPUS INCEPTUS* was studied with the scanning electron microscope. Embryonic development at various temps was observed externally. Anatrepsis was blocked at 11.65 plus or minus C. Eggs kept at 19.85 plus or minus C and 23.0 plus or minus C hatched after 33 and 41 days respectively. Mandibular tusks were present in the fully developed embryos. The morphology of the 1st and 2nd larval instars is given; the cleaning and burrowing behavior of early larval instars are described. Early larval instars have a decided preference for burrowing in and substrate over sand. (Auth)

<664>

Yasukida, S., and T. Jaioku, Effects of Prenatal and Postnatal Temperatures on Secondary Sex Differentiation, Mortality, and Vertebral Column Abnormality of Cuppies, *POECILIA RETICULATA*, Reared at High Temperatures.

1974. Environ. Control in Biol., 12, 93-100 (Osaka City University, Faculty of Science, Osaka, Japan)

To evaluate the adaptive effects of prenatal temperatures, cuppies borne by 23 degrees C- and 28 degrees C-acclimated parents were reared at 23 degrees, 28 degrees, 30 degrees, or 32 degrees C, and secondary sex differentiation, mortality, and vertebral column abnormality were observed. Both mortality and the occurrence of vertebral column abnormality increased at the postnatal temperature increased. The rate of secondary sex differentiation was highest at postnatal temperature and decreased in the order 32, 28, 23 C. In fish borne by 23 degrees C-acclimated parents, mortality at 30 degrees and 32 degrees C and vertebral column abnormality at 30 degrees C were higher and the rate of secondary sex differentiation was always higher in comparison with fish borne by 28 degrees C-acclimated parents. Thus, the prenatal temperature is considered to adaptively affect the tolerance of fish to high postnatal temperatures. (Auth)

<667>

Yasukida, S., and U. Ohnaka, Effects of Temperature Acclimation on the Isozyme Patterns of Liver Lactate Dehydrogenase in the Goldfish, *CARASSIUS AURATUS* (L.).

1974. Annot. Zool. Japon., 47, 206-214 (Osaka City University, Faculty of Science, Osaka, Japan)

Liver lactate dehydrogenase of goldfish (*CARASSIUS AURATUS*) acclimated to 8 or 10 C consisted of five isozymes while 20 C-acclimated fish had only three. After prolonged acclimation at 20 C, however, the missing isozymes reappeared and did so faster when well-acclimated, probably due to reactivation. (BPC)

<550>

W.C., R.S. Spaulding, and W.W. Goette, Effect of Temperature on Survival and Growth of Infectious Pancreatic Necrosis Virus.

1975. Infection and Immunity, 11, 1409-1412 (Utah State University, Department of Biology, Logan, UT; Utah Division of Wildlife Resources, Fisheries Experiment Station, Logan, UT)

When grown in rainbow trout gonad (RTG-2) cells, infectious pancreatic necrosis virus was stable for 10 days at 4 C in stream and well water, after which the virus had a half-life of 7.5 days. At 15 C, the virus was stable for 5 days, and then had a half-life between 5 and 6 days. Viral antigen in infected cells developed more slowly at 4 C than at 20 C. Infected cells released infectious viral particles at temperatures as low as 4 C. Nutrition had a greater effect on the production of infectious virus at 4 C than at 20 C. (Auth)

<659>

Osley, L.R., J.L. Fryer, and R.S. Pilcher, Relation of Water Temperature to Ceratomyxosis in Rainbow Trout (*SALMO GAYDNERI*) and Coho Salmon (*Oncorhynchus kisutch*).

1975. Jour. Fish. Res. Bd. Can., 32, 1545-1551 (Oregon State University, Department of Microbiology, Corvallis, OR)

Juvenile rainbow trout (*SALMO GAYDNERI*) were exposed to infection with *CERATOMYXA SASTA*, transferred in groups of 25 to aquaria, and tempered to various temperature levels increasing from 3.9 to 21.3 C by 2.8 degree C increments. During a 237-day observation period mortality in the experimental groups averaged about 80%, and was independent of water temperature between 6.3 and 21.3 C. No deaths occurred at 3.9 C. The geometric-mean time from exposure to death, however, was definitely a function of temperature, increasing from 14 days at 21.3 C to 155 days at 6.7 C. A similar experiment with juvenile coho salmon (*Oncorhynchus kisutch*) gave quite different results. In this species, percent mortality due to *C. SASTA* increased progressively from 2% at 9.4 C to 22% at 15.0 C and 84% at 20.5 C. No deaths occurred at 3.9 or 6.7 C during the 201-day experimental period. As with the rainbow trout, the geometric-mean time from exposure to death was temperature dependent, increasing from 12.5 days at 21.3 C to 146 days at 9.4 C. The data indicate that ceratomyxosis in coho can be suppressed by water temperatures of 6.7 C or below. (Auth)

<670>
 Usakov, B.P., and E.A. Bogayeva, The Environmental Temperature and Physiological Polymorphism of Populations - I. The Effect of Heat Acclimation on Variability and Survival of a Population at Elevated Temperature.

1975. Jour. Thermal Biol., 1, 1-4 (Academy of Sciences, Laboratory of Comparative Cytology, Institute of Cytology, Leningrad, USSR)

A study was made of changes in the organismal heat resistance of the sea worm *CERATOLOMA CONVOLUTA* at elevated temperature under experimental and natural conditions. The increase in a population's survival during heat adaptation occurred mainly at the expense of initially low resistant individuals. An adaptive increase in survival was accompanied by a narrowing in the individual variability in the heat resistance levels of animals. The resistance adaptations counteracted selection caused by elevated temperature and, consequently, should be regarded as adaptations stabilizing the population. (Auth)

<671>
 Williams Court, G., and R. Contre, Influence of Heat from the Gentilly Nuclear Power Station on Water Temperature and Gastropods.

1975. COMP-740020; STI/PUB/370; IAEA-SM-187/51; Part of Proceedings of a Symposium on the Environmental Effects of Cooling Systems at Nuclear Power Plants held in Oslo, Norway, August 26-30, 1974, (p. 449-460) (Universite du Quebec a Trois-Rivieres, Trois-Rivieres, Quebec, Canada)

The paper deals with the effects of an increase in water temperature caused by the operation of the Gentilly Nuclear Power Station on the physical characteristics of the environment and on some species of mollusc. The results showed that when the reactor is operating at 800 MW the increase in the temperature in the discharge cone is 3.5 C; it is almost 10 C when the reactor is operating at maximum power. In the latter case, mortality among the molluscs increases to the point where they disappear completely. (Auth)

<672>
 Vasantha, N., Effect of Temperature on the Chromatophores and Chromatophorotropins in the Freshwater Prawn, *CARIDINA VERNI*.

1973. Broteria (Ind.), 47, 149-159 (Marathwada University, Department of Zoology, Aurangabad, India)

When eye-stalk extracts were injected into prawns on white and black backgrounds after adaptation for 2 hr at 15, 27 or 37 C, red pigment concentrated at high temperatures and dispersed at low while the white pigment did the opposite. Red pigment dispersing hormone was more active at low temperatures at all concentrations of eye extract while red pigment concentrating hormone and white pigment dispersing hormone were more active at room temperatures at all concentrations. White pigment concentrating hormone was not detected at any temperature. (BPC)

<673>
 Veldhuijzen, J.F., Glucose-Tolerance in the Pond Snail *LYMNAEA STAGNALIS* as Affected by Temperature and Starvation.

1975. Neth. Jour. Zool., 25, 206-218 (Free University, Department of Biology, Amsterdam, Netherlands)

Glucose-tolerance experiments were performed with specimens of the pond snail *LYMNAEA STAGNALIS*, acclimatized at various temperatures from 8 to 25 C, and with snails, acclimatized at 19 C, which were starved during 14 days. Injected glucose (150 mg per snail) did not alter the amount of carbohydrates present in the high molecular and in the low molecular (except glucose) fractions of the haemolymph. The injection procedure caused a slight hyperglycemia. The rate of glucose removal was temperature dependent, the half-times varying from 50 min at 8 C to 11 min at 25 C. However, there is a considerable difference in the half-times of the injected glucose of snails acclimatized at 8 or 19 C (very low reproductive activity and growth) and 19 or 25 C (active reproduction and growth). Since this difference it was suggested that reproductive activity and, to a lesser extent, growth are important processes in the removal of glucose from the haemolymph. This is corroborated by the observation that starved snails show larger half-time values than fed snails, when both groups are kept at 19 C. Under these circumstances, half of the injected amount of glucose removed from the haemolymph was used for processes related to reproduction and growth. It was suggested that an increasing glucose concentration in the haemolymph stimulates the release of hormones, involved in the control of reproduction and growth. (Auth)

<674>
 Velisirov, B., Growth and Age Determination in the Sea Fan *EUPHICELLA CAVOLINII*.

1975. Oecologia (Ger.), 19, 259-272 (University of Cape Town, Department of Zoology, Cape Town, South Africa)

Between February and April, gorgonians of the sea fan, *EUPHICELLA CAVOLINII*, grew significantly faster than during the rest of the year. A correlation of the period of maximum growth with minimum temperature and maximum water movement was observed. Reduced growth during the summer was probably due to high light intensities. Colony age was estimated by a theoretical model which approximated an empirical growth curve. (BPC)

(674)
(674)

Venkataramiah, S.S.P., and C.S. Madan, Temperature Characteristics of Oxygen Consumption of the Freshwater Crab, *BASTYLLIPUS CURTIS* M. Sillie Edwards and Their Relation to Stress.

1970. *Memorie Zool. Ital.* (N.S.), 9, 19-20 (Vishwanath Bahadurayya, Department of Zoology, Banded, India)

Oxygen consumption of the crab, *BASTYLLIPUS CURTIS* M. Sillie Edwards was studied at various temperatures as a function of the stresses produced by sudden and gradual temperature changes. Oxygen consumption increased with temperature for both stresses. The effect followed a similar pattern for both; however, the temperature characteristics were different under the two conditions suggesting their dependence on the type of stress. The percent variation was maximum at lower temperatures and minimum at higher temperatures. The variation was sudden and steep on sudden stress, but gradual and less steep on gradual stress. Q₁₀ values were higher at lower temperatures and lower at higher temperatures for both considerations but in general they were more in gradual stress, especially at extreme temperatures (7 to 20°C and 30 to 37°C). The U values were higher for lower temperatures and lower for higher temperatures and the critical temperature was 19°C in both cases. However, they were higher for gradual stress than for sudden stress. The possible significance of these variations in temperature characteristics are discussed. Gradual variations in temperature are preferable to sudden variations during studies on temperature effects and thermal acclimatization. (SB)

(676)

Venkataramiah, A., G.J. Lakshmi, and C. Genter, The Effects of Salinity, Temperature, and Feeding Levels on the Food Conversion, Growth, and Survival Rates of the Shrimp *PENAEUS MONDULUS*.

1972. Part of the Proceedings of Marine Technology Society: Food-Dregs from the Sea, 29-32 (Gulf Coast Research Laboratory, Ocean Springs, MS)

The effects of salinity, temperature and feeding levels on the food conversion, growth, and survival rates of the shrimp *PENAEUS MONDULUS* were studied under laboratory conditions. Growth and food conversion ratios were highest at 26°C, except at unlimited food levels at 31°C. Growth and food conversion was poor at 21°C. Growth rates were better for lower salinity concentrations (25‰ and 50‰ seawater) at 26 and 21°C, and at 25‰ seawater at 31°C. The highest rate of food consumption was at 31°C. With increased feeding rates there was a steady growth in all media at 31°C. Maximum growth rates (at 26°C) in 25 and 50‰ S.W. were obtained with food levels of 40%. In 100‰ seawater maximal growth was obtained with the 30% food level. Survival was best at ambient temperatures (26°C) and in (25 and 50‰ seawater) lower salinities, and was more successful at withstanding the wider salinity and feeding levels. (SB)

(677)

Vernberg, W.B., P.J. de Coursey, and J. O'Hara, Multiple Environmental Factor Effects on Physiology and Behavior of the Fiddler Crab, *UCA PUGILATOR*.

1970. Part of Vernberg and Vernberg, (Eds.), Pollution and Physiology of Marine Organisms, ISBN 01278250, Academic Press, NY, (p. 101-125) (University of South Carolina, Belle W. Baruch Institute for Marine Biology and Coastal Research, Columbia, SC)

The toxicity of cadmium and mercury to the fiddler crab, *UCA PUGILATOR*, was reviewed. The effect of both metals depended on age, sex, thermal history and environmental conditions. Larvae were more sensitive to mercury than adult stages and adult males were more sensitive than females. Mercury was most toxic at low temperatures and low salinity. Warm-acclimated animals were less tolerant at low temperatures than cold-acclimated ones. Tissue distribution of mercury was dependent on environmental regime, but total body burden was not. Cadmium was most toxic at high temperatures and low salinity. Adult crabs were less sensitive than larvae, but there were no differences between males and females. The tissue distribution and total body burden of cadmium was dependent upon environmental conditions. (Auth) (ST)

(678)

Vogele, L.E., Reproduction of Spotted Bass, *MEGALOPTERUS PUNCTULATUS*, Bull Shoals Reservoir, Arkansas.

1975. Technical Papers 008. U.S. Fish and Wildlife Service, United States Department of the Interior, Washington, DC (Bureau of Sport Fisheries and Wildlife, South Central Reservoir Investigations, Fayetteville, AR)

Spotted bass, *MEGALOPTERUS PUNCTULATUS*, were studied in Bull Shoals Reservoir during 1966-71 to determine some of the environmental requirements for successful spawning and to estimate the reproductive potential of the species. Underwater observations were conducted weekly during the spawning seasons in habitats along a steep bluff and in shallow coves. During two seasons in which water levels were low, nest density was greatest along the bluff; during two high-water seasons, however, the bluff area was not used for spawning. Spawning seasons began as early as April 10 and as late as April 27 in different years, and extended into late May or early June. Nests with fresh eggs were found at water temperatures of 12.8 to 22.8°C. Eggs hatched in about 5 days at 18.8 to 15.6°C; larvae remained in nests for about 8 days at temperatures of 15.6 to 17.2°C. Nest depth was directly correlated with water transparency along the bluff but not in coves. Males defended nests during incubation and larval development, and guarded schools of fry as long as 8 weeks. Mean number of eggs in 21 nests was 5,016 and mean number of larvae in 15 nests was 1,476. Three males are known to have renested after their initial nests were unsuccessful. Fecundity of 27 females ranged from 3,249 to 10,506; it was directly correlated with total length, body weight, and age of fish. Resorption of residual ova began soon after spawning, and regeneration of ova was in progress by October. (Auth)

(679)
Vynogradova, T.A., Distribution and Ecology of
Rare and Interesting Species of Blue-Green Algae.

1978. Ukr. Zet. Zh., 11, 733-739 (Institute
Hydrobiology, Kharkov Ser. Kiev, USSR)

An extensive growth of several rare species
of halophilic blue-green algae, *SPHAEROCYSTIS*
OVATISPORA Porti var. *CASPICA* Usakov,
ANABAEA SPHAERICOCYSTOIDES Porti and
ANABAEOPSIS PACIFICUS (Volosin.) V. Siller
of tropical origin was observed in the
reservoir-cooler of the Zeev thermal
electrostation (the Dombas, USSR) due to
increased temperatures. (BPC)

(680)
Dahl, G.W., Heat Tolerance in Strains of Brook
Trout (*SALVELINUS FONTINALIS*).

1978. Ph.D. Thesis, Pennsylvania State
University, 97 p. (Pennsylvania State University,
University Park, PA)

Brook trout (*SALVELINUS FONTINALIS*), brown
trout (*Salmo trutta*), and rainbow trout
(*Salmo gairdneri*) fingerlings were placed in
water were enough to be lethal and the times
to lethality were measured. Rainbow trout
were found to be least heat tolerant and
brown trout were most tolerant. Brook trout
fell between brown and rainbow and had a
16-hour TL_{50} of 25.5 C and a 69-hour TL_{50} of
25.5 C. Fingerlings of 16 brook trout
strains and 12 hybrids between these strains
were tested in water at 27.5 C after
acclimation for 24 hours at 21 C to determine
if these trout were genetically different in
regard to heat tolerance. Results were
highly repeatable in trial after trial. The
most tolerant strains were West Virginia,
Fabred 9, Bellefonte, and Fabred 8. The
least tolerant strains were Fabred 0 and 12.
The least tolerant strains were
significantly different from the most
tolerant strains when times to lethality were
compared. Nearly all individuals of the
least tolerant strain were dead before any of
the most tolerant strain succumbed. Times to
lethality for F1 hybrids fell in an
intermediate position between their parents
except in one instance where the hybrid
showed a slight mean gain in tolerance over
either parent. F2 generation fish did not
have the same mean time to lethality as their
F1 counterparts but were less resistant to
warm water; in general, variability of the F2
was less, not greater, than that of the F1's.
Times to lethality varied somewhat less for
fabred strains than for open-bred strains
even though none of these strains had been
previously selected for heat tolerance. It
seems likely that some heat tolerant strains
could be developed through a selective
breeding program. No clear relationship
between fish length and susceptibility to
heat death could be determined among
fingerlings but yearlings were more
susceptible than fingerlings. Among
yearlings there were no differences between
the sexes. (Auth)

(681)
Painstein, M.B., V.G. Dovyathin, and I.V.
Nitropolskaya. Photosynthetic Phytoplankton
Activity in the Ivankovskoye Reservoir in the
Zone of Heated Water from the Konakovskaya State
Regional Electric Power Station Influence.

1973. Gidrobiol. Zh. Akad. Nauk. Ukr. (USSR), 9,
22-29 (Institute of Inner Water Biology, Borok,
USSR)

In the spring and autumn, algae, which passed
through the condensers of Konakovskaya State

Regional Electric Power Station, showed no
decrease in their photosynthetic activity. A
slight decrease in activity was observed in
some summer periods. The acclimation of the
plankton phytoplankton to the heightened water
temperature was evident in a flow through the
drain channel and Konakovskoye Bay. This
flow provided the optimal photosynthetic
temperature rise toward the end of the bay.
(BB)

(682)
Sakabayashi, R., and S. Hgasa, Characteristics of
Symbacteria Associated with Some Freshwater Fish
Diseases in Japan.

1978. Bull. Jap. Soc. Sci. Fish., 40, 751-757
(University of Tokyo, Department of Fisheries,
Tokyo, Japan)

Morphological, cultural and biochemical
characteristics of 12 cultures of
symbacteria isolated mainly from eels with
"branchionophthalic" and cypriids with elcer
disease were studied. These organisms were
gram-negative, slender rods which exhibited
gliding motility on agar medium. All
cultures were able to grow at 5, 10, 20 and
27 C, and tolerated a sodium chloride
concentration of 1% for growth. They were
uniform in their biochemical properties,
though diverse in the production of
cytochrome oxidase and in the reduction of
nitrate. Some distinguishing features of the
organisms were as follows: degradation of
starch, casein and chitin; utilization of
glucose, galactose and citrate; decomposition
of tyrosine; nonproduction of hydrogen
sulfide; negative reaction to Congo red.
They are physiologically similar to the
symbacteria isolated from the American
hatchery-raised salmonids with gill disease,
tail rot or other symbacterial infections.
The histopathological features of
experimentally infected eels resembled those
of salmonids with 'hemorrhagic type of gill
disease' described by Good and Yasutake.
(Auth)

(683)
Walker, J.D., and R.B. Colwell, Factors Affecting
Enumeration and Isolation of Actinoncytes from
Chesapeake Bay and Southeastern Atlantic Ocean
Sediments.

1975. Marine Biol. (U. Ger.), 30, 193-201
(University of Maryland, Department of
Microbiology, College Park, MD)

Parameters influencing the occurrence and
recovery of actinoncytes in an estuary,
Chesapeake Bay, and in the Southeastern
Atlantic Ocean, including: media, freezing
and thawing of samples, salt concentration,
incubation temperature and time, season,
nutrients and geographical location were
studied. The effects of incubation
temperature, incubation time and salt
concentration on actinoncyte populations
isolated from Chesapeake Bay during January
1974 were examined. No actinoncytes were
isolated from plates held at 5 C for 6 weeks.
The number of actinoncytes isolated from
the Chesapeake Bay stations were
approximately the same for media containing
0, 1, and 3% NaCl and incubated at 15 and 25
C. The percent of actinoncytes comprising
the total microbial population after
incubation at 15 and 25 C was consistently
higher when NaCl was omitted from the media.
Greater numbers of actinoncytes were
isolated using incubation temperatures of
25 C for estuarine stations and 15 C for
deep-ocean stations. (BD)

<684>

<684>

Gillis, R.L., Thermal Tolerance of *MYTILUS EDULIS* of Eastern Australia.

1975. Marine Biol. (U. Ger.), 39, 183-192
(University of New South Wales, School of Zoology, Kensington, Australia)

The ultimate upper incipient lethal temperature of the mussel, *MYTILUS EDULIS*, was found to be 38.2°C, with statistically significant changes in thermal resistance parameters with size, temperature and salinity. A correlation was found between latitude and both incapacitation spanning temperatures in the laboratory. (RFC)

<685>

Hurd, D.W., and T.D. Brock, Temperature and Nutrient Limitation of Oil Biodegradation in Lake Mendota, Wisconsin.

1978. Abstr. Ann. Meet. Amer. Soc. Microbiol., 78, 64 (University of Wisconsin, Madison, WI)

Optimal temperature for biodegradation of mineral oil and C¹⁴ labeled 1-hexadecane in hydrocarbon-supplemented surface water samples was between 20 and 30°C indicating seasonal (early spring and late fall) limitations. In summer at optimal temperatures, oxidation rates were limited by a decrease in soluble nitrogen and phosphorus. When either of these were added in excess, rate of oil oxidation depended on amount of other nutrient available. For only one month a year, oil degradation rate by microorganisms in Lake Mendota surface waters is maximal due to simultaneous optimum temperature and nutrient concentrations. (RFC)

<686>

Hurd, J.V., A Temperature-stressed Stream Ecosystem below a Hypolimnetic Release Mountain Reservoir.

1978. Arch. Hydrobiol. (Ger.), 78, 267-275
(Colorado State University, Department of Zoology and Entomology, Fort Collins, CO)

Average deviations from the mean annual water temperature at four sites at varying distances up to 8.5 km from a hypolimnetic release mountain reservoir were 2.2, 2.5, 2.6, and 3.2°C with increasing distance. Low diversity and large standing crop of macroinvertebrates immediately below the dam may have been the result of the discharge of cold, nutrient-rich water from the reservoir causing stream temperatures to be higher than normal in winter and lower in summer, with less diurnal and seasonal fluctuation and a seasonally displaced maximum. All of these effects decreased downstream. (RFC)

<687>

Harden, R.L., and R.J. Lorio, Movements of Largemouth Bass (*MICROPTERUS SALMOIDES*) in Impounded Waters as Determined by Underwater Telemetry.

1975. Trans. Amer. Fish. Soc., 104, 694-702
(Mississippi State University, State College, MS)

Sixteen sonic-tagged largemouth bass (*MICROPTERUS SALMOIDES*) were released from March 4 1972 to April 18, 1973 to determine water management practices and environmental factors that may affect fish movement, home range of largemouth bass, and behavior patterns associated with activity within home area. Tags had an average life of 13.8 days. They were implanted in the body cavity and seemed to have no effect on the movements of the bass. A total of 570 hours of tracking showed water temperature to be the only parameter that related to increases or decreases in movement. Diurnal movement was prevalent in the spring and fall. Nocturnal movement increased as water temperature approached summer highs. Fish were most active in March and September and least active in December and January. Home ranges differed with seasonal water temperature changes but never exceeded 100 m. Behavior patterns associated with activity within home range consisted of movements from deep to shallow water. (Auth)

<688>

Hear, P.C., Incubation in British Decapod Crustacea, and the Effects of Temperature on the Rate and Success of Embryonic Development.

1978. Jour. Mar. Biol. Assn. U.K., 58, 745-762
(Chinese University of Hong Kong, Marine Science Laboratory, Shatin, Hong Kong, China)

Eggs of four different species of crustacea underwent a form of diapause which could not be shortened significantly by raising the water temperature. For 12 species with continuous development, times from spawning to hatching of eggs were described as functions of temperature by Delehradek's temperature equation. A rapid rise of as little as 3°C could disrupt spawning sequence and incubation of successive egg batches and reduce fecundity by more than 90%. Small eggs survived higher temperatures than larger, more yolk eggs and at 3°C and below, the tolerance limits were probably determined by excessive slowing down of development. Larval viability was reduced when the entire period of egg development occurred outside the normal range of 3 to 16°C, especially among species with large eggs incubated at higher than normal temperatures. (RFC)

<689>

Heiss, G., Finding and Description of Larvae of *MICRONESISTIUS AUSTRALIS* in Patagonic Waters of Argentina (Pisces, Gadidae).

1978. Physis, 33, 537-542 (Instituto Marino Biología, Mar del Plata, Argentina)

Larvae of *MICRONESISTIUS AUSTRALIS* were found from 5.2 to 6.5°C and from 33.39 to 33.83 ppt salinity. Reproduction was found to occur beyond the slope in the Argentine Patagonic region at more than 150 m and in the spring months from September to October. The species is morphologically similar to *M. PORRASSOU* from the N. Atlantic. (RFC)

<690>

Stell, R.W.B., and J.B. Hatches, The Effects of Temperature on the Activity of Lake Sediment Bacteria.

1974. Part of Proceedings of the Annual Meeting of the American Society of Microbiologists (University of Washington, College of Fisheries, Seattle, WA)

Glucose mineralization rates of lake sediment bacteria were found to be directly related to temperature when compared on the basis of glucose turnover times and Q_{10} values. These rates were measured seasonally at in situ temperatures in four lakes representing differing ecological environments in the Puget Sound area of the State of Washington. In all these lakes, the rate was highest in summer when temperatures reach seasonal levels, decreased in fall, and attained minimum values in winter. However when glucose mineralization rates at corresponding in situ temperatures were compared, sediments from the two lakes at higher altitude exhibited higher rates than the lower lakes. When littoral zone sediment samples collected in mid-winter were analyzed at varying temperatures, there was a close correlation with data from samples collected seasonally and analyzed at the in situ temperatures. However, when a similar comparison was made for summer samples, the correlation was not as great. The optimal temperature for glucose mineralization occurred at 20 to 25 degrees C for sediments from this area at all times of the year. For sediment obtained at depths from 30 to 60 meters, where environmental temperatures do not normally exceed 9 degrees C, a similar optimal temperature range was found. (Aeth)

<691>

Hells, L., and B. House, Life History of the Spottail Shiner (*NOTROPIS HUDSONIUS*) in Southeastern Lake Michigan, the Kalamazoo River, and Western Lake Erie.

1974. United States Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife Research Report 78, Washington, DC (Great Lakes Fishery Laboratory, Ann Arbor, MI)

Life history information on the spottail shiner (*NOTROPIS HUDSONIUS*) in southeastern Lake Michigan, the Kalamazoo River, and western Lake Erie are presented. Data includes age, age groups, mortality, growth, weight, maturation, and spawning. With respect to depth and temperature distribution, the study showed that fish in deeper water tended to be longer and older. Bottom water temperatures of Lake Michigan at 3 and 7 fathoms were 19.5 and 13.1 C, respectively, suggesting that the differences in shiner distribution may be related to temperature. (ND)

<692>

Weston, K., Cultivation of the American Crayfish *PACIFASTACUS LEWISICULUS*.

1973. Part of Abrahamsson, S. (Ed.), Freshwater Crayfish, Papers from the First International Symposium on Freshwater Crayfish held in Austria, 1972. Studentlitteratur, Lund, Sweden (Ser. Fish. Investigation, Helsinki, Finland)

Optimum temperature for growth and survival of the crayfish *PACIFASTACUS LEWISICULUS* was about 13 to 16 C when tested at temperatures from 10 to 21 C. (BPC)

<693>

White, D.S., The Biology of *HYSTERA BELABOPS* (Neffenae), the Spotted Sucker.

1974. Ph.D. Thesis, University of Louisville, 201 p. (University of Louisville, Louisville, KY)

Aspects of the biology of *HYSTERA BELABOPS*, the spotted sucker, were studied in Goose Creek, Kentucky, and compared with specimens from other central Kentucky streams, with museum specimens from throughout the range, and with data and specimens from Lakesucha and Spavinaw, Oklahoma. Variations were found in the breeding tubercle patterns and in spawning habits. In the northern portions of the range, *HYSTERA BELABOPS* reproduced every second year as compared to each year in the southern habitats. Spawning began when the temperatures were greater than 12 C. Growth and condition were much greater for lake specimens when compared with stream specimens. *HYSTERA BELABOPS* had distinct dawn-dusk feeding periods with the major foods being zooplankton and detritus. The habitat of *HYSTERA BELABOPS* is one of small streams, oxbows, ponds, and lakes with an accumulation of debris and detritus. The spawning habitat requires deep, swift riffles over sand and gravel. Lack of suitable habitats create the boundaries of the range. The abundance and range are decreasing with siltation and channelization from urbanization and agriculture. Southern impoundments provide particularly good habitats, and the abundance of *HYSTERA BELABOPS* is increasing there. (Aeth)

<694>

White, J.W., W.S. Woolcott, and W.L. Kirk, A Comparative Study of Fish Communities in the Vicinity of a Thermal Discharge in the James River, Virginia (*Osteichthyes*).

1974. Assoc. Southeast Biol. Bull., 21, 89 (Virginia Institute for Scientific Research and University of Richmond, Richmond, VA)

Average abundance for the year was higher for fish species collected on the unheated side of the James River where ambient temperatures ranged from 2 to 26 C than from the north side having a range of 9 to 39 C receiving a thermal discharge from a power station. Significant differences in seasonal patterns were found between communities in the thermal discharge and those on the opposite side for number of species, and the Shannon Wiener and evenness indices. (BPC)

<695>

Whiting, H., T. Leslie, and L.L. St. Clair, The Non-Diatom Algae of Utah Lake.

1974. Proc. Utah Acad. Sci. Arts Lett., 51, 73-78 (Brigham Young University, Provo, UT)

In Utah Lake, 103 different taxa of non-diatom algae were identified, 95 of which were planktonic and showed a definite succession through the summer. Diatoms were inhibited from late July to mid-August by ecological factors, including warmer water temperatures, which left *CYANOBACTERIA* and several *CYANOPHYTES* as the dominant algae. The overwhelming dominance of a relatively few species is evidence of the stresses (high silt loads, warm temperatures, and high nutrient levels) on the Utah Lake flora. Little evidence was found that the stresses were man-made. (BPC)

<696>

<696>

Whitworth, W.R., Effects of Simultaneous Variations of Dissolved Oxygen, Salinity, and a Pollutant on the Growth of White Catfish.

1978. ONR A-036-COBB; 5 p. (Connecticut University, Institute of Water Resources, Storrs, CT)

Reduced growth rates and lower weights were exhibited by white catfish (*ICHTALURUS CATENS*) exposed to the highest of two diurnally fluctuating temperature and oxygen regimes and the highest of three fluctuating, aluminum and sodium chloride levels. (BPC)

<697>

Hiesagepe, L.R., Thermal Resistance and Acclimation Rate in Young White and Brown Shrimp, *PENAEUS SETIPERUS* Linn. and *PENAEUS AZTECUS* Ives.

1978. Ph.D. Thesis, Texas A & M University, 313 p. (Texas A & M University, College Station, TX)

The temperature that caused 50% mortality at 10,000 min for postlarvae of the shrimp, *PENAEUS AZTECUS*, acclimated at 28 C was between 35 and 36 C and between 36 and 37 C for *PENAEUS AZTECUS* and *PENAEUS SETIPERUS* postlarvae acclimated at 29 and 30 C. Twenty-four hr LC50's were 36.3, 37.5, and 38.3 C for *PENAEUS AZTECUS* postlarvae acclimated at 28, 29, and 30 C, respectively, and 38.3, and 38.9 C for *PENAEUS SETIPERUS* postlarvae acclimated at 29 and 30 C, respectively. Postlarval *PENAEUS AZTECUS* were more resistant at most lethal temperatures than were 30 hr *PENAEUS AZTECUS*. Postlarval and 30 hr *PENAEUS SETIPERUS* had similar resistance times, which were greater than those of 50 hr *PENAEUS SETIPERUS*. Acclimation times to 5 and 9 C increases and a 5 C decrease in temperature were studied. *PENAEUS AZTECUS* postlarvae, which enter the bays in spring when temperatures are mild, had less thermal resistance and a slower rate of acclimation to a temperature increase than did *PENAEUS SETIPERUS* postlarvae which enter in the summer. Separate groups of postlarvae were acclimated to six combinations of two temperatures (29 and 30 C) and three acclimation salinities (25, 35, and 45 ppt), and tested for thermal resistance at each combination. Thermal resistance was greatest at a test salinity of 25 ppt, but acclimation to a higher or lower salinity gave maximum protection against heat death at that salinity and at all salinities closer to 25 ppt. (Auth) (ST)

<698>

Williams, I.V., Investigation of the Prespawning Mortality of Sockeye in Horsefly River and McKinley Creek in 1969.

1973. Prog. Rept. Int'l. Pac. Salmon Fish. Comm., 27, 1-32 (International Pacific Salmon Fishery Commission, New Westminster, British Columbia, Canada)

Since a 1969 prespawning loss of 88.7% in Horsefly River and 64.8% in McKinley Creek occurred in sockeye salmon from CPDWSOCOCOCUS COLUMBIENSIS injections in spite of temperatures of 16.4 C or less sustained naturally in the former and artificially in the latter, it was concluded that other factors such as temperature in the lower Fraser River during the upriver migration, timing of the run, infections, and degree of maturation were involved. (BPC)

<699>

Williams, R., and P.J.B. Hart, Vertical and Seasonal Variability of Fish Eggs and Larvae at Ocean Weather Station India.

1978. Part of Blaxter, J.H.S. (Ed.), The Early Life History of Fish, Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association at Oban, Scotland, May 17-23, 1978. Springer-Verlag, Berlin-Heidelberg (Institute for Marine Environmental Research, Oceanographic Laboratory, Edinburgh, Scotland)

The vertical and seasonal distribution of *NAUROLICUS NEULLERI* eggs and total fish larvae are given for 1971 and 1972 from the International Ocean Weather Station India. *NAUROLICUS* eggs occurred between 100 and 500 m and their distribution was correlated with the 9 C isotherm in both years, the eggs remaining in water between 8.8 and 10 C. Maximum densities of five eggs/m³ occurred at 150 m in May, at 200 m in June 1972 and at 180 m in June-July 1971. The seasonal distribution of the larvae is discussed in relation to predators and food availability. (ST)

<700>

Williams, S.P., Rearing Conditions and Their Effects on Growth, Food Conversion, and Survival of English Sole (*PAROPHREYS VETULUS* Girard).

1975. Ph.D. Thesis, Oregon State University, 102 p. (Oregon State University, Corvallis, OR)

In culture studies, fastest growth of juvenile English sole, *PAROPHREYS VETULUS*, occurred at the lowest temperature (9.5 C) and highest ration. Growth declined with decreasing ration and increasing temperature. At 21 C, juveniles lost weight regardless of ration. For fish fed Oregon Moist Pellet the maintenance ration was determined to be 3.1% at 9.5 C, increasing to 4.7% at 18 C. Highest food conversion occurred at the lowest temperature and the 8% ration. Food conversion declined with increasing temperature and at rations greater than 8%. At an 8% ration and 12, 15, and 18 C, growth rate of fish about 16 to 19 months old was about the same as for those 4 to 7 months old. At 1.3 ppt salinity the time to 50% mortality at 9.5 C (86 hr) was twice that at 16.5 C (23 hr) for O-group sole. At 1.6 ppt and 16.5 C, time to 50% mortality was 1.5 times greater than with O-group fish (26 hr) compared with I-group fish (15 hr). (BPC)

<701>

Wilson, J.W., and R. Smed, Reproduction in *MYTILUS EDULIS* L. (Mollusca: Bivalvia) in Carlingford Lough, Northern Ireland.

1978. Ir. Fish. Invest. Ser. B., 15, 1-30 (Queen's University, Belfast, Northern Ireland, United Kingdom)

The reproductive cycles of several *MYTILUS* populations in Carlingford Lough were investigated between November 1968 and May 1971. The annual cycle varied slightly from population to population though spawning began simultaneously at all stations in the spring months when sea temperature was rising between 7.5 and 12 C. (ND)

<702>

Witman, R., Preliminary Thermal Studies on Young PARULIDUS ARGUS.

1973. Fla. Scientist, 36, 154-159 (Marine Research Laboratory, Florida Department of Natural Resources, St. Petersburg, FL)

Preliminary survival and growth studies suggested that the spiny lobster, PARULIDUS ARGUS, has a relatively narrow range of desirable temperatures. Early postlarval lobsters die in a few days at 10.0 C, in less than 49 hours at 15.0 C, and in less than 24 hours at 17.0 C. Initial survival was good and an average growth rate of 125 percent for two months was recorded at 32.0 C; however, very few survived that long. Growth rates at the lowest survival temperature, 15.6 C, were as low as two percent, while similarly sized lobsters at 26.7 C increased their average carapace length by 29 percent during the same 2 month time period. Smaller lobsters at 15.6 C increased their average carapace length by 17 percent, while similarly sized specimens at ambient (averaging 26.7 C) temperatures increased 55 percent over the 2 month period. Low temperatures in deep waters of the Florida current would appear to be a deterrent to migrations of "marching" lobsters between Florida and the Bahama Islands. (MC)

<703>

Wolf, E.G., M.J. Schneider, R.W. Schwarzwiler, and T.O. Thatcher, Toxicity Tests on the Combined Effects of Chlorine and Temperature on Rainbow (SALMO GAIRDNERI) and Brook (SILVELINUS FONTINALIS) Trout.

1975. BNWL-SA-5349; 20 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Combined biological effects of thermal stress and chlorine on trout were demonstrated utilizing 36 hr TL 50 flow through toxicity tests. The data illustrated that the combined interaction became evident only after rainbow trout acclimated at 5, 10, 15 and 20 C were tested simultaneously at specific test temperatures. It was also determined that the rainbow trout must experience thermal stress greater than 10 C before a combined effect was noted. Fish size, especially for brook trout, influenced sensitivity more than the combined interaction of chlorine and thermal shock. Brook trout larger than 89 mm were significantly less vulnerable to chlorine-temperature toxicity than the smaller fish. Concepts also discussed are the compatibility of findings concerning latent mortality, the primary site of chlorine toxicity, and the reliability of short term, high dose tests that have recently been reported in the literature. (Auth)

<702>

<706>

Wolfert, D.R., G.D.W. Busch, and C.T. Peter, Predation by Fish on Walleye Eggs on a Spawning Reef in Western Lake Erie, 1969-71.

1975. Ohio Jour. Sci., 75, 118-125 (U.S. Fish and Wildlife Service, Sandusky Biological Station, Sandusky, OH; Ohio Department of Natural Resources, Division of Wildlife, Sandusky, OH)

Fish predation of walleye (STIZOSTEDION VITREUM) eggs by yellow perch appeared to be significant only when the rate of water warming slowed or stopped, creating an extended overlap in the walleye-yellow perch reproductive period in Lake Erie. Four species of fish contained walleye eggs: yellow perch (PERCA FLAVESCENTES), spottail shiner (NOTROPIS HUDSONIUS), stonecat (NOTURUS FLAVUS) and white sucker (CATOSTOMUS COMMERSONI). (RPC)

<705>

Wood, R.J., and P.O. Johnson, Sprat Larvae to the North of Scotland.

1974. Ann. Biol., Cons. Pers. Int. Explor. Ser., Copenh., 29, 147-149 (NIPF, Fishery Laboratory, Lowestoft, Suffolk, England)

Surface water temperatures were 11.5 to 12 C over the main area of sprat larvae and 11 to 12 C near the bottom. Salinity was about 35.2 ppt. Larvae were smaller and such higher in numbers in 1972 than in 1971. (RPC)

<706>

Woolcott, W.S., W.L. Kirk, and E.G. Petrakis, The Effects of a Thermal Discharge on Algae Populations of a Piedmont Section of the James River, Virginia.

1974. Assoc. Southeast Biol. Bull., 21, 91-92 (Virginia Institute for Scientific Research and University of Richmond, Richmond, VA)

Blue-green algae were found to be most abundant in waters warmed by effluents from a power station in a Piedmont section of the James River throughout the year, at times forming mats over natural substrates. Abundance of attached forms of diatoms, green, and yellow-green algae was reduced at stations in the heated water as compared with unheated stations. (RPC)

<707>

Wootton, R., and J.W. Smith, Observational and Experimental Studies on the Acquisition of ANISARIS Sp. Larvae (Nematode: Ascarididae) by Trout in Fresh Water.

1975. Intl. Jour. Parasitol., 5, 373-378 (Marine Laboratory, Victoria Road, Torry, Aberdeen, Scotland)

Within 24 hr. fewer larvae of ANISARIS sp. successfully penetrated the gut wall of brown trout at 4 C than at 15 plus or minus 1 C. Brown trout were more easily infected than rainbow trout. Trout in Wanningfield Reservoir, Essex, England apparently acquired the parasite as juveniles by being fed untreated marine fish containing live larvae. (RPC)

<708>

<709>

Yanaguchi, N., Effect of Elevated Temperature on the Metabolic Activity of the Coral Reef Asteroid *ACANTHASTER PLanci* (L.).

1978. Pacific Sci., 28, 139-146 (University of Guam, Marine Laboratory, Agaña, Guam)

Rate of oxygen uptake increased in *ACANTHASTER PLanci* with increase of temperature from 25 to 31 C. At 33 C (slightly above laboratory ambient water temperature), the rate decreased and the feeding and resting cycles became abnormal. The incipient thermal death point was estimated to be near 33 C. (NPC)

<709>

Yanaguchi, N., Growth and Reproductive Cycles of the Marine Posing Ascidians *CIONA INTESTINALIS*, *STYELA PLICATA*, *SCYRILLOIDES VIOLACEUS*, and *LEPTOCLINUM WITSUKURII* at Aburatsubo-Boroiso Inlet (Central Japan).

1975. Marine Biol. (U. Ger.), 29, 253-259 (University of Guam, Marine Laboratory, Agaña, Guam)

Doubling time of colony growth of the two simple ascidians, *CIONA INTESTINALIS* and *STYELA PLICATA*, decreased approximately two fold with a 10 C increase in environmental temperature. Doubling time in two compound ascidians, *LEPTOCLINUM WITSUKURII* decreased approximately threefold with a 10 C increase in temperature. *CIONA INTESTINALIS* grew to sexual maturity in one month in summer and in two months in winter; *S. PLICATA*, in two months in summer and in nearly 5 months in winter. (NPC)

<710>

Yee, W.C., Thermal Aquaculture: Potential and Problems.

1978. Part of Gallagher, R.J. (Ed.), Proceedings of a Symposium on Energy Production and Thermal Effects held in Oak Brook, Illinois, September 10-11, 1973. Limnetics, Inc., Milwaukee, Wisconsin (Tennessee Valley Authority, Division of Planning and Assessment, Chattanooga, TN)

Projects utilizing power plant waste heat in aquaculture are reviewed. These include the culturing of oysters, shrimp, catfish, flatfish, yellowtail and other species using thermal effluents. The author has also completed a feasibility study of a conceptual design and the market potential for a shrimp culture facility. Market estimates and technological problems with respect to design, chemical pollutants and fish wastes are discussed. (ST)

<711>

Young, J.O., The Occurrence of Diapause in the Egg Stage of the Life-cycle of *PHAEOCORA TYPHLOPS* (Vejdovsky) (Turbellaria: Neorhabdocoela).

1978. Jour. Animal Ecol., 43, 719-731 (University of Liverpool, Department of Zoology, Liverpool, England)

The active phase in the life-cycle of *PHAEOCORA TYPHLOPS* in Little Crosby Pond, near Liverpool, England extends from May to September; the rest of the year is spent in the egg or cocoon stage. Numerous laboratory experiments indicated that low temperature (5 C and lower) is the only environmental feature which stimulates egg development and the cumulative periods of this are adequate, at 3.5 C the exposure period required is 4 wk or more, though a minority of cocoons require only 2 to 3 wk. Temperatures of 9 C and over are necessary for hatching of cocoons after the necessary low temperature stimulus. Hatching rates increased with increasing temperatures and averaged 30 to 31 days at 9 C and 18 to 19 days at 22 C. Experimental results describing the influence of temperature on egg development and hatching of cocoons agree well with the timing of the appearance of young animals in the field (May). Experiments showed that neither the low DO content of the substratum nor the drying up of the pond affects the viability of the cocoons; however, exposure to -10 C and complete desiccation, situations which never arise in the study pond, cause mortality of the developing worms within the cocoons. The data suggest that the resting state is not initiated by an environmental stimulus but is inherent; it is concluded that the eggs have an obligate diapause. (Auth)

<712>

Young, J.S., Menhaden and Power Plants--A Growing Concern.

1978. Marine Fish. Rev., 36, 19-23; NRP Paper 1094 (National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Sandy Hook Laboratory, Highlands, NJ)

The life history of menhaden, *BREVOORTIA TYRANNUS*, and menhaden kills associated with power plants are reviewed. Menhaden kills associated with power plants have been attributed to six causes: heat shock, cold shock, impingement on intake screens, gas embolisms, biocides, and entrainment. Fishkills associated with each of these causes are cited. Some solutions to the problems are proposed. (ST)

<713>

Young, J.S., and C.I. Gibson, Effect of Thermal Effluent on Migrating Menhaden.

1973. Marine Poll. Bull., 4, 94-96 (National Marine Fisheries Service, Ecosystems Investigations, Sandy Hook Laboratory, Highlands, NJ)

During August and September of 1971, fishkills of menhaden were observed in Long Island Sound. The fishkills occurred when migrating juveniles swam from cool water underlying the heated effluent from the Long Island Lighting Company's Electric Generating Station into the heated surface water. The shocked fish sank to the bottom and died. Water temperature at this time of year measured 22 to 23 C. The temperature of the discharge immediately adjacent to the power plant was 37 to 38 C. (ST)

<714>
Young, L., and J.W. Anderson, Influence of Salinity and Temperature on the Oxygen Consumption of *NEANTHES ARENACEODONTATA* Moore.

1974. Amer. Zoologist, 14, 1260 (Texas A & M University, College Station, TX)

Steady state levels of O₂ consumption for a laboratory population of *NEANTHES ARENACEODONTATA* (Beish strain) were studied at combinations of 15 and 25 C and 12, 22 and 32 ppt salinity. This population had been inbred for over 100 generations. Respiration rates were determined by Gilson respirometry with a 170 cycles/min shaking rate. Correlation coefficients of curves for O₂ consumption and dry weight ranged from -0.60 to -0.85. Size ranges of worms (0.18 to 20 mg dry wt) from different treatments were similar, but O₂ consumption levels were significantly different. All data were corrected to a 5 mg dry weight worm. Salinity had no effect, but temperature was highly significant at the P=0.01 level. An interaction was found. The size coefficient (beta=0.51) was insensitive to the treatments. (Q) 10 values indicate thermal compensation at 22 ppt, but not at 12 and 32 ppt. It is apparent that the combination of 25C-32 ppt represents normal conditions for this laboratory cultured population. Therefore decreases in salinity and temperature resulted in depressed O₂ consumption rates. (Auth)

<715>
Zinck, R.E., and R.P. Addison, The Effect of Temperature on the Rate of Conversion of p,p'-DDT to p,p'-DDE in Brook Trout (*SALVELINUS FONTINALIS*).

1975. Can. Jour. Biochem., 53, 636-639 (Bedford Institute of Oceanography, Marine Biology Laboratory, Dartmouth, Nova Scotia, Canada)

Rate of production of p,p'-DDE metabolized by brook trout (*SALVELINUS FONTINALIS*) from injected C-14 labeled p,p'-DDT, varied with temperature. After 16 weeks, about 9, 13 and 19% of the original p,p'-DDT in fish maintained at 2, 10 and 18 C, respectively, was converted. No other metabolite was detected. (RPC)

<716>
Zolotareva, N.S., A.P. Masatov, and N.V. Sanin, Effects of Thermal Effluents on Biocoenoses of Water Bodies.

1973. Vodye Resursy, (USSR), 1, 66-75 (Not Given)

Literature on the effects of thermal effluents from power plants was reviewed and the effects of effluents on biochemical processes, bacterial and phytoplankton growth processes and self-purification, oxygen demand, aquatic life, plankton and benthos production, fauna interactions, temperature thresholds, and life cycles and reproduction were considered. It was concluded that heat increases stimulated development of aquatic biota in the absence of other forms of pollution and suppressed development in polluted water. Temperatures above optimal suppressed biological processes, impoverished ecosystems, and in extreme cases, caused mortality. The need for strict controls is emphasized. (ST)

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