LIMNOLOGICAL SURVEY OF SACONY CREEK BASIN, BERKS COUNTY, PENNSYLVANIA

U.S. GEOLOGICAL SURVEY

Water Resources Investigations 76-84

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CONTENTS

	Page
Factors for converting English units to International System of units (SI)	iv
Abstract	1
Introduction	2
Purpose and scope	2
Description of study area	2
Streamflow	2
Geology	4
Climatology	4
Data collection	4
Physio-chemical	4
Biological	4
Fecal coliform bacteria	4
Benthic macroinvertebrates	5
Fishes	5
Results	6
Physio-chemical	6
Biological	10
Fecal coliform bacteria	10
Benthic macroinvertebrates	10
Fishes	10
Age composition of trout populations	20
Estimates of trout populations	24
Summary and conclusions	27
Selected references	28

ILLUSTRATIONS

Figure 1.	Map showing study area and sampling stations	3
2.	Diel fluctuation in dissolved oxygen and temperature	8
3.	Graph showing species diversity and standing crop of fishes	21
4.	Graph showing comparative length-age of Sacony Creek and Benner Springs hatchery brown trout	25

TABLES

Page

Table 1. Median or mean concentrations of chemical and bacteriological constituents in Sacony Creek basin, July 1974 to May 1975 ---------- 7
2. Results of anticipated maximum and minimum dissolved oxygen study in Sacony Creek ---------- 9
3. Population composition of benthic macro-invertebrates in Sacony Creek, September 24-27, 1974 ---------- 12
4. Diversity (d) and redundancy (r) of Sacony Creek benthos, September 24-27, 1974 ---------- 16
5. Numbers and standing crop of fish inhabiting selected reaches of Sacony Creek basin ---------- 18
6. Length-age frequency of Sacony Creek brook trout ---------- 22
7. Length-age frequency of Sacony Creek brown trout ---------- 23
8. Population estimate of trout in selected reaches of Sacony Creek ---------- 26
9. Water-quality determinations in Sacony Creek basin ---------- 30

FACTORS FOR CONVERTING ENGLISH UNITS TO INTERNATIONAL SYSTEM OF UNITS (SI)

Multiply English units	*By*	*To obtain SI units*
inches (in)	25.4	millimetres (mm)
feet (ft)	.3048	metres (m)
yards (yd)	.9144	metres (m)
miles (mi)	1.609	kilometres (km)
acres	4047	square metres (m^2)
	.4047	square hectometres (hm^2)
	.004047	square kilometres (km^2)
square miles (mi^2)	2.590	square kilometres (km^2)
cubic feet per second (ft^3/s)	.02832	cubic metres per second (m^3/s)
pounds (lb)	.454	kilograms (kg)
pounds per acre (lb/acre)	1.1208	kilograms per square hectometre (kg/hm^2)

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By James L. Barker and Kenneth P. Kulp

ABSTRACT

Samples of water, fish, and benthic macroinvertebrates collected at 10 sampling stations over a 10-month period indicate that Sacony Creek and its major tributaries contain water of good to excellent quality. The waters were found to be free of excessive quantities of dissolved nutrients, oxidizable matter, and fecal coliform bacteria.

Fish inhabitants include a sizable wild trout population in the upper Sacony basin and a diverse warm-water population, dominated by white suckers (Catostomus commersoni), in the lower basin. A population of 590 trout or 119 pounds per acre (133 kilograms per square hectometre) was estimated for good habitat in the upper basin. A maximum standing crop of 558.7 pounds per acre (626 kilograms per square hectometre) was measured at one of the more productive reaches.

Benthic macroinvertebrate collections tended to support the water chemistry and fish population studies. Diversity (d) and redundancy (r) ranged from 2.44 to 3.46 and 0.14 to 0.38, respectively. Such diversity and redundancy values indicate a healthy environment at all stations.

INTRODUCTION

Purpose and Scope

A limnological survey of Sacony Creek basin was conducted to establish a base of physical, chemical, and biological data pertaining to the general health of the stream. A secondary objective of the survey was to delineate that part of the creek supporting a resident trout population.

This investigation included the study of the aquatic ecosystem at 10 preselected stations within 7 reaches of Sacony Creek. Determined were the general water chemistry, fecal coliform bacteria, the population and biomass of fishes, and diversity of benthic macroinvertebrates.

The study area included Sacony Creek and its major tributaries from its headwaters to the Greenwich Bridge north of Kutztown, a distance of about 7.5 mi (12.07 km).

The fishes and macroinvertebrates were collected for this investigation between September 24, 1974, and October 2, 1974, except for fishes at Sacony Creek tributary near Bowers (Station 4) which were collected on May 14, 1975. Water chemistry and bacteria analyses were conducted bimonthly from July 1974 to May 1975.

Description of the Study Area

Sacony Creek has its headwaters in the South Mountain and Reading Prong regions of southeastern Berks County. The Sacony flows north and west for approximately 13 mi (20.9 km) before joining Maiden Creek at Virginville. The study area map (fig. 1) shows the Sacony Creek watershed above Greenwich Bridge, the farthest downstream sampling site. The drainage area of the Sacony is 55.3 mi^2 (143 km^2).

Streamflow

The average flow of Sacony Creek at its mouth is about 100 ft^3/s (2.8 m^3/s), based on the flow of the Schuylkill River at Berne. The minimum discharge measured was 1.33 ft^3/s (0.04 m^3/s) on September 3, 1963. While no flood discharges have been measured, a maximum of about 4,000 ft^3/s (113 m^3/s) was probable during the June 1972 tropical storm "Agnes." Serious flooding in the borough of Kutztown resulted from a discharge of that magnitude.

Streamflow conditions during the survey were near normal for the period. A discharge of 12.8 ft^3/s (0.36 m^3/s) was measured at the Greenwich Bridge (Station 10) on September 24, 1974.

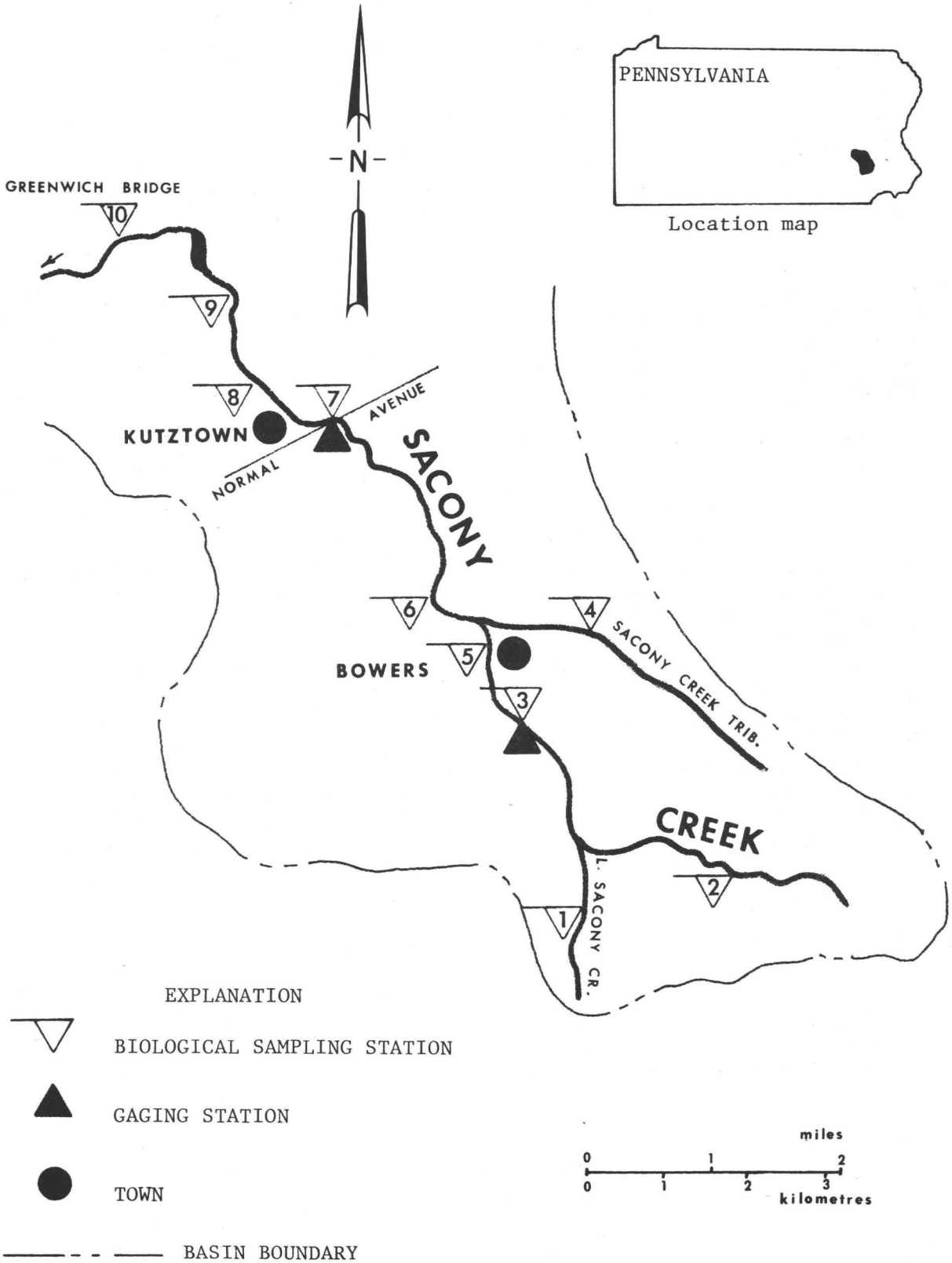

Figure 1.--Sacony Creek study area and sampling locations.

Geology

The Sacony basin upstream from Bowers is underlain by granitic gneiss and other igneous and metamorphosed rocks. The bedrock of the 5-mi (8 km) reach downstream of Bowers is limestone and dolomite of Cambrian and Ordovician age. North and west of Kutztown the bedrock is shale and siltstone of the Martinsburg Formation of Ordovician age.

Climatology

The climate of the study area is generally characteristic of continental areas despite the proximity of the Atlantic Ocean. Prevailing air flows are westerly. The annual average temperature is 51°F (10.6°C) and the average precipitation is 44 in (111.8 mm) per year; about half (20 in or 50.8 mm) occurs as runoff.

DATA COLLECTION

Physio-chemical

Physio-chemical studies at the 10 selected sampling stations were conducted to coincide with the biological studies so that interpretations of the aquatic ecosystem may be correlated. Field analyses consisted of the determinations of discharge, temperature, specific conductance, dissolved oxygen, and pH. Laboratory analyses consisted of the determinations of carbonate, bicarbonate, nitrogen species, ortho and total phosphorus, sulfate, chloride, biochemical oxygen demand (BOD), and chemical oxygen demand (COD). Pesticide analyses for aldrin, DDD, DDE, DDT, dieldrin, endrin, heptachlor, lindane, chlordane, heptachlor epoxide, toxaphene, plus PCB and PCN were run on raw water samples. Analytical work was conducted according to procedures recommended by the American Public Health Association and others (1971) or the U.S. Geological Survey (Brown and others, 1970).

Biological

Fecal coliform bacteria

Bimonthly water samples for fecal coliform bacteria were collected in conjunction with the physio-chemical studies. Concentrations of coliform bacteria were determined by the membrane filtration method as described by Slack and others (1973).

Benthic macroinvertebrates

Macroinvertebrates collections were made at each of the 10 stations with a dip net of 0.210 mm mesh size. All available habitats were thoroughly sampled at each station until no new organisms were found. Each station was sampled with the same diligence to insure a valid comparison.

Specimens were preserved with 70 percent ethyl alcohol in the field and were later sorted, counted, and identified in the laboratory. The macroinvertebrates were identified to the family level of classification unless there were more than one genera of that family in the sample, in which case they were identified further to make that distinction evident in the result.

Following sorting, identification, and counting, the diversity index and redundancy values were computed using the method described by Wilhm and Dorris (1968).

The diversity index, (d), is a number zero or greater which expresses the degree of diversity in the population. The maximum value of (d) depends upon the total number of individuals counted and can be any positive number (Wilhm, 1970). A polluted aquatic environment usually yields a (d) value of less than 1, and a clean aquatic environment usually has a (d) value of from 3 to 4 (Wilhm and Dorris, 1968). Redundancy (r), which is an expression of the dominance of one or more species, can also be calculated. Redundancy is inversely proportional to the number of species; therefore, a low (r) value is indicative of clean water and a high value of polluted water.

Fishes

All fish collections were accomplished with a 110 volt AC power supply designed to supply AC 60-cycle voltage from 0 to 700 volts or half-wave 60-cycle pulses from 0 to 300 volts DC at 300 watts as described by Sharpe and Burkhard (1969). The voltage from the power supply was regulated to maintain a pulsed direct current output of 1.0 to 1.25 amperes that was sufficient to induce electrotaxis and subnarcosis over the range of conductivity of the water sampled.

A reach of 200 to 300 yds (182 to 273 m) of stream was electrofished at each station to determine population and biomass. The area sampled was selected to be representative of the reach being investigated. An effort was made to select a riffle-pool combination at each of the 10 sampling stations. A block net was used to enclose the upstream end of the sample area to prevent movement of fish to or from the area where no natural or man-made barrier existed.

Each area was electrofished three times. Trout population estimates were based upon the removal method proposed by Zippin (1956). All fishes collected were sorted to species, counted, and weighed. In the case of trout, scale samples were removed for determination of age and to distinguish wild from hatchery fish. Lengths were also determined for each trout. Except for game fish, representative specimens of the fishes at each station was preserved in 10 percent formaldehyde and identified in the laboratory. All game fish were retained in a live cage until processing and returned to the stream.

The efficiency of electrofishing is dependent upon the size of the stream, turbidity, electrical conductivity, bottom type, stream velocity, species of fish, and experience and alertness of the sampling personnel. As indicated by Schuck (1945), direct current electrofishing has been shown to be more efficient in sampling large fish, but also is capable of sampling up to 30 percent of the fish as small as 2 in (50 mm) in length.

RESULTS

Physio-chemical

In general, surface water in Sacony Creek basin is of high quality with little evidence of degradation due to cultural pollution. The water is a calcium-bicarbonate type that is slightly alkaline with median pH values between 7.4 and 8.3 at all stations. Table 1 summarizes the median or mean concentrations of the chemical and bacterial parameters measured. Dissolved oxygen values were adequate for all forms of aquatic life and were near or slightly below saturation at all sites.

On October 1, a 24-hour dissolved-oxygen study was performed on Sacony Creek. Dissolved oxygen and temperature were measured at Normal Avenue (Station 7) every 2 hours to define the diel oxygen and temperature curves. The results of the diel study are presented in figure 2 and table 2. The curves reflect the oxygen and temperature patterns resulting from diel insolation and photo-synthesis processes. Samples were also collected at all other stations between the hours of 0500 and 0630, and again between 1500 and 1700 hours to define the anticipated maximum and minimum concentrations at each station.

Water quality is progressively altered downstream from the headwaters by the runoff and infiltration of agricultural and domestic wastes and the natural solution of minerals. From the headwaters to Sacony Creek above Kutztown (Station 6), the dissolved solids are fairly low(55 to 60 mg/1). At Normal Avenue at Kutztown (Station 7) and downstream the carbonate rock and pollution increase the dissolved solids to more than 400 mg/1 (milligrams per litre) during periods of low flow. Chloride, sulfate, phosphorus, and nitrogen (table 1) show substantial increases in concentration reaching a peak just downstream from the Kutztown sewage treatment plant (Station 9). There is no evidence that the increased nutrient and organic load stresses the assimilative capacity of the stream.

A major increase in the bicarbonate content and discharge at Normal Avenue (Station 7) indicates the intrusion of significant quantities of ground water from a limestone source. The quality of this ground water and its source(s) was not determined.

Water samples collected for analyses of the common chlorinated hydrocarbon pesticides during the September 1974, January 1975, and May 1975 samplings indicated no significant background levels of pesticides The findings concur with those of Truhlar and Reed (1975, p. 23) for other Pennsylvania streams where they found that "***base-flow samples contain little or no pesticide residues regardless of the residues present in basin soils."

Table 1.--Median or mean concentrations of chemical and bacteriological constituents in Sacony Creek basin.

[Results in milligrams per litre, except as noted] 1/

Station No.	Station name	Laboratory analyses											Field determinations			
		Carbonate (CO_3)	Bicarbonate (HCO_3)	Nitrate-nitrogen (NO_3-N)	Ammonia (NH_4-N)	Organic nitrogen	Total Kjedahl nitrogen (TKN)	Orthophosphorus	Total phosphorus	Sulfate (SO_4)	Chloride (Cl)	Biochemical oxygen demand (BOD)	Chemical oxygen demand (COD)	Specific conductance (micromhos at 25°C)	Dissolved oxygen	pH	Fecal coliform 2/ (number per 100 ml)
1	Little Sacony Creek near Bowers	0	22	1.4	.02	.36	.41	.01	.01	10	7.0	0.9	5.0	110	10.8	7.5	58
2	Sacony Creek at Sally Ann Furnace, near Bowers	0	24	1.3	.03	.42	.44	.01	.01	12	3.0	.8	6.0	100	11.2	7.5	55
3	Sacony Creek above Bowers	0	27	1.0	.04	.29	.33	.01	.01	15	5.0	.6	6.7	120	11.2	7.6	160
4	Sacony Creek tributary near Bowers	0	30	.56	.03	.31	.32	.01	.02	19	3.0	.6	8.0	120	11.0	7.5	290
5	Sacony Creek below Bowers	0	27	.93	.02	.38	.39	.01	.01	14	4.8	1.2	8.0	110	10.6	8.3	300
6	Sacony Creek above Kutztown	0	28	.99	.05	.43	.52	.01	.01	14	4.6	1.0	8.0	120	10.5	8.1	1,100
7	Sacony Creek at Normal Avenue, at Kutztown	0	128	3.7	.02	.59	.60	.02	.02	26	8.5	1.8	8.0	340	10.2	7.4	1,300
8	Sacony Creek at Kutztown	0	149	3.8	.05	.56	.59	.02	.02	26	9.0	1.4	7.0	360	11.0	7.8	1,000
9	Sacony Creek below Kutztown	0	156	4.1	.50	.93	1.4	.22	.25	33	20	2.6	9.0	395	11.4	7.8	2,300
10	Sacony Creek at Greenwich Bridge, near Kutztown	0	149	4.1	.17	.79	1.07	.15	.17	27	19	1.2	11.0	370	9.6	7.5	1,400

1/ See Table 9 for range in values.
2/ Geometric mean.

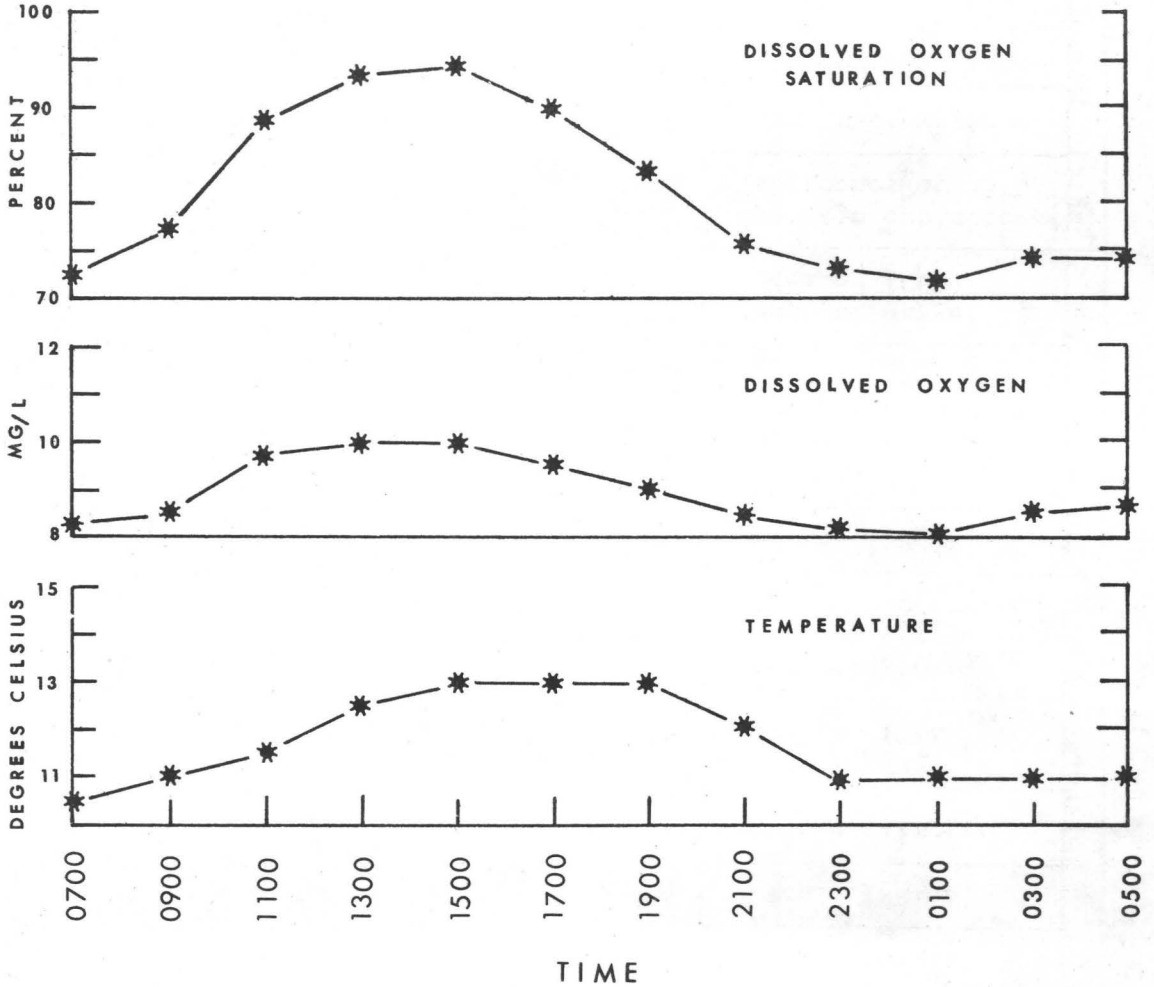

Figure 2.--Diel fluctuation in dissolved oxygen and temperature in Sacony Creek (Station 2) on October 1-2, 1974.

Table 2.--Results of maximum and minimum dissolved-oxygen study in Sacony Creek.

Station No.	Station name	Time	Dissolved oxygen		Water temperature (°C)
			mg/l	Percent saturation	
1	Little Sacony Creek near Bowers--------	0610	9.8	87	10.5
		1610	9.9	89	11.0
2	Sacony Creek at Sally Ann Furnace, near Bowers----------	0605	9.7	85	10.0
		1520	9.8	90	12.0
3	Sacony Creek above Bowers----------	0600	9.7	85	10.0
		1510	9.8	92	13.0
4	Sacony Creek tributary near Bowers--------	0550	9.8	86	10.0
		1620	9.8	92	13.0
5	Sacony Creek below Bowers----------	0545	9.7	85	10.0
		1625	9.9	93	13.0
6	Sacony Creek above Kutztown----------	0540	7.6	67	10.5
		1630	10.0	95	13.5
7	Sacony Creek at Normal Avenue, at Kutztown	0530	8.2	73	10.5
		1700	9.9	93	13.0
8	Sacony Creek at Kutztown----------	0525	8.6	77	11.0
		1645	9.6	91	13.5
9	Sacony Creek below Kutztown----------	0520	8.6	77	11.0
		1650	9.6	91	13.5
10	Sacony Creek at Greenwich Bridge, near Kutztown------	0515	7.2	66	12.0
		1700	9.1	86	13.5

Biological

Fecal coliform bacteria

Fecal coliform bacteria concentrations increased progressively from the headwaters toward the downstream sampling station. As with the various chemical constituents, the concentrations of bacteria are affected by the runoff and infiltration of natural, agricultural, and domestic pollutants. Table 1 shows the geometric mean concentrations of fecal coliform bacteria reaching a peak just downstream of the Kutztown sewage treatment plant.

Benthic macroinvertebrates

The results of the macroinvertebrate study support other findings that the waters of Sacony Creek are, in general, clean and capable of supporting a biologically healthy population of organisms. The macroinvertebrates identified and their numbers are listed in table 3.

Diversity (d), listed in table 4, ranged from a low of 2.44 at Station 1 to a high of 3.46 at Station 7, while redundancy values (r) ranged from 0.14 at Station 4 to 0.38 at Station 1. The diversity (d) and redundancy (r) values tend to support other biological and chemical data that indicate the waters to be of good quality. Variability in (d) and (r) between stations may, in part, be explained by inadequate sampling. As pointed out by Wilhm (1970), five samples are sometimes required in order to obtain a consistent value.

The physical characteristics of Sacony Creek change from the upper to the lower reaches. The upper stations are characterized by swift, shallow, turbulent waters, with many riffles and few pools. Bottom materials are boulders, sand and gravel with practically no aquatic vegetation. The lower stations have slower, deeper water with a combination of riffle and pool areas. Bottom materials here are a mixture of cobbles, gravel, sand, and mud with abundant rotted aquatic vegetation. The available habitat at the lower stations is more favorable for a diverse population.

The relatively low (d) value and high (r) value of Station 1 is probably due to the limited habitat necessary to support a large number of species. All chemical investigations verify that the water quality at Station 1 is equal to or superior to that at the other stations samples.

Fishes

The results of the fish population data are summarized in table 5. A total of 8,291 individual specimens, representing 29 species and weighing 820 lbs (372 kg), were collected at the 10 stations sampled in the Sacony Creek basin. The number of species ranged from 4 at Little Sacony Creek (Station 1) to 20 at Greenwich Bridge (Station 10).

Table 3.--Population composition of benthic macroinvertebrates in Sacony Creek, September 24-27, 1974.

Common name	Phylum	Class	Order
Segmented Worms	Annelida		
Leeches		Hirudinea	Rhynchobdellida
Joint Footed Animals	Arthropoda		
Aquatic Arthropods		Crustacea	
Scuds, Sideswimmers			Amphipoda
Aquatic Sowbugs			Isopoda
Crayfish			Decapoda
Insects		Insecta	
Mayflies			Ephemeroptera
Dragonflies, Damselflies			Odonata
True Bugs			Hemoptera
Back Swimmers			
Dobsonflies, Hellgrammites, Fishflies, Alderflies			Megaloptera
Caddis Flies			Trichoptera

Table 3.--Population composition of benthic macroinvertebrates in Sacony Creek, September 24-27, 1974.

Family	Genus	(Stations) Number of individuals 1	2	3	4	5	6	7	8	9	10
Glossiphoniidae								2	5	1	1
Gammaridae	Gammarus							12	38	9	1
Asellidae	Asellus						1	11	8	10	5
Astacidae		2	3	2	3	1		1	1		
Heptageniidae	Stenonema	39	53	29	9	43	34	7	7	23	34
	Iron		9	19		6					
Baetidae	Ameletus	39	142	91	2	22	19	12	12	2	7
	Tricorythodes			4	1	3	1	3	39	36	1
	Ephemerella	11	75	11							5
	Habrophlebia		3	1		3	3	3	3	3	3
Ephemeridae	Potamanthus	3	3	1	3						
Coenagrioridae				3		1	7				6
Gomphidae			3	2	2	3			13	11	
Agrianidae					1				3		
Notonectidae					3			9	3		
Corydalidae	Corydalus										1
	Chauliodes		1								
Sialidae	Sialis			2				1			
Hydropsychidae	Hydropsyche	188	149	99	16	124	127	11	36	90	52
Philopotamidae	Chimarra	71	28	34		4	2	2			2
Hydroptilidae											3
Limnephilidae					1	4					
Rhyacophilidae	Agapetus		3	2		5					
	Rhyacophila	4	7	11							

Table 3.--Population composition of benthic macroinvertebrates in Sacony Creek, September 24-27, 1974--continued.

Common name	Phylum	Class	Order
Aquatic Caterpillars			Lepidoptera
Beetles			Coleoptera
Water Pennies			
Predaceous Diving Beetles			
Water Scavenger Beetles			
Flies			Diptera
Black Flies			
Midges			
Crane Flies			
Horse Flies			
Snipe Flies			
Moth Flies			
Soldier Flies			
Shore Flies			
Stoneflies			Plecoptera
Mollusks	Mollusca		
Snails, Limpets		Gastropoda	Pulmonata
Clams, Mussels		Pelecypoda	

Table 3.--Population composition of benthic macroinvertebrates in Sacony Creek, September 24-27, 1974--continued.

Family	Genus	(Stations) Number of individuals									
		1	2	3	4	5	6	7	8	9	10
Pyralididae	Elophila						1				
Unidentified								8			
Psephenidae		1	1	7		13	8			1	7
Elmidae		14	35	2	4	13	47	4	13	12	15
Dytiscidae								1	1		
Dryopidae		2	2			1	1				
Hydrophilidae							2				
Unidentified									1		
Simuliidae		24	12	6			4	1	3	3	
Tendipedidae		11	37	71		16	45	39	81	64	52
Tipulidae		2	15	1	1		6			3	2
Tabanidae				4	1			2	5	1	1
Rhagionidae			7	9		5	1			1	3
Psychodidae			1								
Stratiomyiidae					1						
Ephydridae									1		
Pteronarcidae	Pteronorcys		8	3							
Peltoperlidae	Peltoperla	11	32	1	1						
Perlidae	Acroneuria		33	15		12	3				
Ancylidae	Ferrissia					1	2				1
Physidae	Physa				1	1		2	8	7	
Planorbidae	Heliosoma									1	
Sphaeriidae				1				2	5	1	
Total number of types		14	23	25	15	19	18	19	20	18	19
Total number of ind.		385	659	428	47	278	311	130	283	276	199

Table 4.--Diversity (d) and redundancy (r) of Sacony Creek benthos, September 24-27, 1974.

Station no.	Station name	Diversity (d)	Redundancy (r)
1	Little Sacony Creek near Bowers-----	2.44	0.38
2	Sacony Creek at Sally Ann Furnance, near Bowers----------	3.44	.26
3	Sacony Creek above Bowers----------	3.35	.29
4	Sacony Creek tributary near Bowers--	3.13	.14
5	Sacony Creek below Bowers----------	2.86	.37
6	Sacony Creek above Kutztown---------	2.73	.37
7	Sacony Creek at Normal Avenue, at Kutztown----------	3.46	.24
8	Sacony Creek at Kutztown----------	3.33	.23
9	Sacony Creek below Kutztown---------	2.92	.32
10	Sacony Creek at Greenwich Bridge, near Kutztown----------	3.03	.32
Average		3.07	.29

Table 5.--Number and standing crop per acre of fish inhabiting selected reaches of Sacony Creek basin.

[Number per acre with corresponding pounds per acre in parentheses]

Common name	Scientific name	1	2	3
Brook trout	Salvelinus fontinalis	83(13.5)	92(7.9)	4(1.6)
Brown trout	Salmo trutta	41(5.6)	425(97.9)	26(6.7)
Rainbow trout	Salmo gairdneri	----------	----------	----------
White sucker	Catostomus commersoni	----------	125(33.3)	341(63.6)
Blacknose dace	Rhinichthys atratulus	891(4.8)	408(2.0)	605(2.4)
Longnose dace	Rhinichthys cataractae	----------	8(tr)	4(tr)
Northern creek chub	Semotilus atromaculatus	58(2.7)	8(0.5)	177(2.8)
Cutlips minnow	Exoglossum maxillingua	----------	----------	4(tr)
Common shiner	Notropis cornutus	----------	----------	50(1.1)
Common sunfish 1/	Lepomis sp.	----------	----------	50(1.0)
Johnny darter	Etheostoma nigrum	----------	----------	14(tr)
Yellow perch	Perca flavescens	----------	----------	4(0.2)
Satinfin shiner	Notropis analostanus	----------	----------	50(0.4)
Bluntnose minnow	Pimephales notatus	----------	----------	8(0.1)
Spottail minnow	Notropis hudsonius	----------	----------	14(0.2)
Eastern madtom	Schilbeodes insignis	----------	----------	----------
Largemouth bass	Micropterus salmoides	----------	----------	----------
E. banded killifish	Fundulus diaphanus	----------	----------	----------
E. creek chubsucker	Erinyzon oblongus	----------	----------	----------
Golden shiner	Notemigonus crysoleucas	----------	----------	----------
Redfin pickerel	Esox americanus	----------	----------	----------
Brown bullhead	Ictalurus nebulosus	----------	----------	----------
Rock bass	Ambloplites rupestris	----------	----------	----------
Carp	Cyprinus carpio	----------	----------	----------
N swallowtail shiner	Notropis procne	----------	----------	----------
Fallfish	Semotilus corporalis	----------	----------	----------
Smallmouth bass	Micropterus dolomieui	----------	----------	----------
Black crappie	Pomoxis nigromaculatus	----------	----------	----------
American eel	Anguilla rostrata	----------	----------	----------
Number of species		4	6	15
Total trout		124(19.1)	517(105.8)	30(8.3)
Total non-trout		949(7.5)	549(35.8)	1321(71.8)
Grand total		1073(26.6)	1066(141.6)	1351(80.1)

1/ Includes Lepomis auritus, L. gibbosus, and hybreds.

Table 5.--Number and standing crop per acre of fish inhabiting selected reaches of Sacony Creek basin.

[Number per acre with corresponding pounds per acre in parentheses]

Stream station number						
4	5	6	7	8	9	10
---	---	---	14(2.1)	2(0.3)	1(tr)	---
---	---	---	14(2.8)	---	---	---
---	4(2.2)	---	---	---	---	---
1400(51.4)	881(76.9)	2019(154.8)	2135(525.7)	1698(291.8)	1085(352.2)	850(56.0)
1500(0.5)	481(2.2)	2571(17.5)	14(0.1)	56(0.2)	131(0.8)	317(2.2)
---	4(tr)	5(tr)	---	2(tr)	4(tr)	397(4.0)
650(4.4)	231(1.0)	152(4.0)	3(0.5)	---	26(1.8)	130(2.6)
---	12(0.2)	14(0.3)	3(0.1)	---	13(0.5)	587(6.8)
267(1.0)	85(0.3)	180(3.3)	49(1.8)	11(0.3)	7(0.2)	103(2.6)
---	219(5.2)	171(5.1)	132(5.1)	50(1.8)	72(2.6)	130(4.0)
200(0.8)	31(0.2)	52(0.3)	305(1.5)	308(1.5)	112(1.5)	113(0.5)
---	---	---	---	---	---	---
---	669(3.5)	614(3.1)	41(0.3)	29(0.2)	10(0.1)	47(0.5)
17(tr)	519(2.4)	486(3.1)	57(0.4)	21(0.1)	44(0.2)	---
---	204(2.9)	29(0.4)	134(0.8)	59(0.6)	---	103(1.9)
---	27(0.4)	129(2.7)	5(0.2)	---	---	77(2.5)
---	4(0.1)	---	5(0.1)	15(0.4)	18(0.7)	7(0.2)
---	4(tr)	200(1.6)	---	---	---	---
---	---	---	105(9.5)	65(1.1)	19(1.8)	---
---	---	---	138(2.2)	42(1.6)	141(3.6)	---
---	---	---	273(4.9)	79(1.4)	10(0.8)	---
---	---	---	3(0.6)	---	---	17(3.8)
---	---	---	---	---	12(1.5)	40(4.0)
---	---	---	---	9(6.6)	16(3.3)	10(7.0)
---	---	---	---	---	69(0.2)	793(3.7)
---	---	---	---	---	---	70(3.7)
---	---	---	---	---	---	13(0.2)
---	---	---	---	---	---	3(0.3)
---	---	---	---	1(tr)	---	---
6	16	14	19	17	19	20
0	4(2.2)	0	28(4.9)	2(0.3)	1(tr)	0
4034(58.1)	3371(95.3)	6622(196.2)	3352(553.8)	2446(307.6)	1789(372.0)	3807(106.5)
4034(58.1)	3375(97.5)	6622(196.2)	3380(558.7)	2448(307.9)	1790(372.0)	3807(106.5)

Three species of fish found at most stations were the white sucker (Catostomus commersoni), blacknose dace (Rhinichthys atratulus), and northern creek chub (Semotilus atromaculatus). The headwater stations (1 and 2) contained the fewest species but the largest trout populations. A few species such as the American eel (Anguilla rostrata), smallmouth bass (Micropterus dolomieui), fallfish (Semotilus corporalis), rainbow trout (Salmo gairdneri), and black crappie (Pomoxis nigromaculatus) were found in small numbers and at few sites. In general, a greater diversity of species was found lower in the watershed. This is due to a greater diversity of habitat and warmer water.

The standing crop of fishes based upon actual collections ranged from a minimum of 26.6 lbs/acre (12.1 kg/hm^2) at Little Sacony Creek (Station 1) to 558.7 lbs/acre (253.4 kg/hm^2) at Normal Avenue (Station 7). The bulk of the standing crop from Sacony Creek above Bowers to Greenwich Bridge (Stations 3 to 10) is due to the large population of white suckers. In fact, the white sucker composed from 53 to 95 percent of the weight at Stations 3 through 10. Species diversity and standing crop are summarized in figure 3.

Trout inhabited seven of the 10 sampling stations. brook trout (Salvelinus fontinalis) were found at six stations, brown trout (Salmo trutta) at four, and rainbow trout (Salmo gairdneri) at one. Trout dominated the standing crop in the headwaters (Stations 1 and 2) and were a significant segment of the standing crop downstream to Bowers (Station 3). Downstream from Bowers, trout become an incidental species and do not successfully compete for dominance with several species of minnows and the white sucker.

No trout were revealed at Stations 4, 6, and 10. The lack of suitable habitat is believed the reason for trout not being in the sample at Station 6, as several brook trout were observed about half a mile downstream of the sample area. Stations 4 and 10 contained suitable habitat for trout, so their absence in the sample must be attributed to other causes. It was observed that Stations 4 and 10 contained very few adult fish and lower biomass than expected, suggesting periodic environmental stress.

Age Composition of Trout Populations.--The population of brook and brown trout were separated into age groups according to the number of annuli or year marks as shown in tables 6 and 7. Brook trout older than age-group I were rare and none were found older than age-group II. Brown trout were found up to age-group IV, with only 8 percent older than age-group II. These data correspond closely with that of McFadden and Cooper (1961) for other Pennsylvania streams.

Hatchery fish were distinguished from wild fish primarily by the growth patterns of the scales. Wild fish characteristically have a slower rate of growth, particularly during the first year. They also have a lower incidence of scale regeneration and their gross external appearance is usually unlike a hatchery fish.

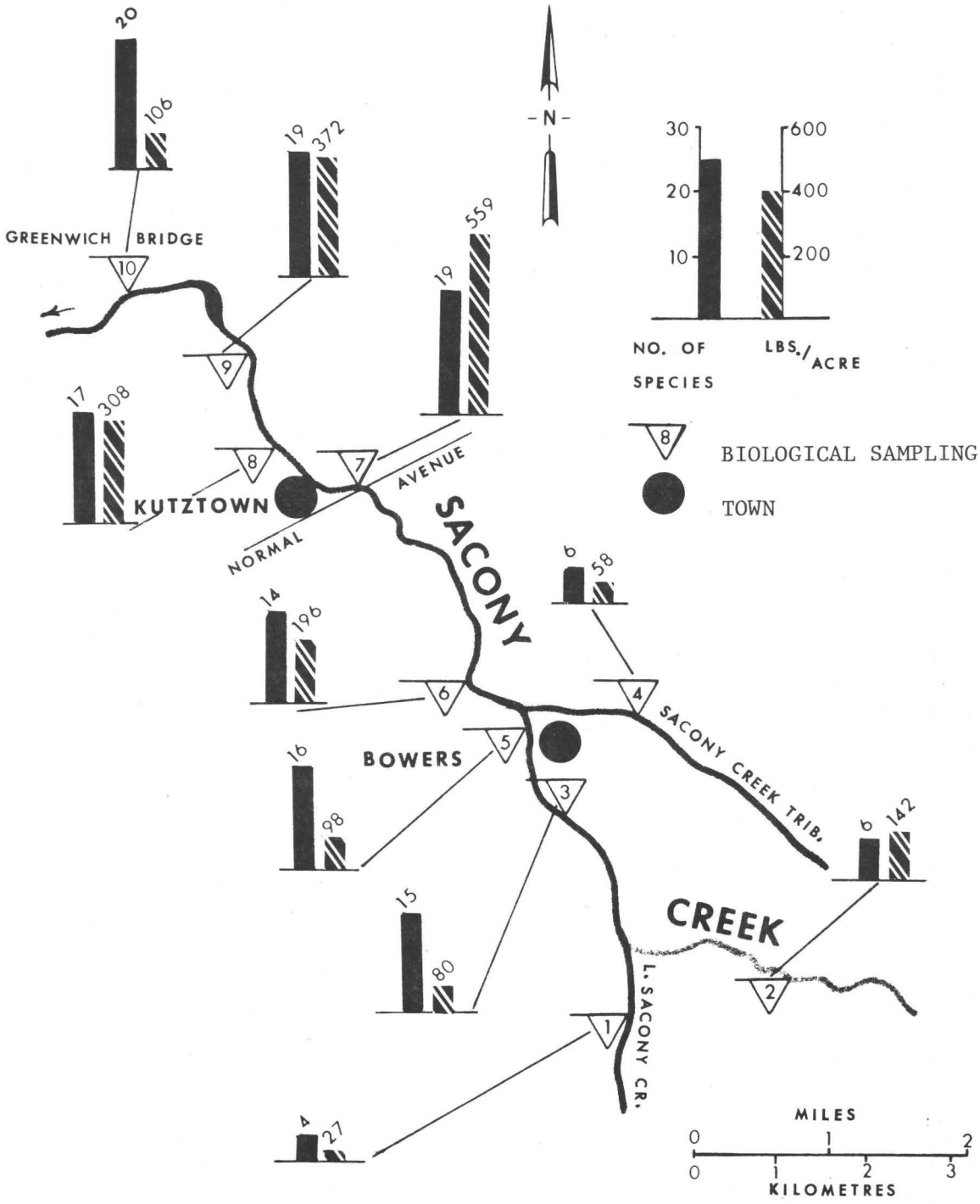

Figure 3.--Species diversity and standing crop of fishes in Sacony Creek basin.

Table 6.--Length-age frequency of Sacony Creek brook trout.

Length, millimetres	Number of Annuli					H 1/
	0	I	II	III	IV	
70- 89	5					
90-109	8					
110-129	3					
130-149		1				
150-169		1				
170-189						1
190-209		2				1
210-229		2				
230-249						1
250-269			1			2
270-289			1			
290-309						1
Total	16	6	2			6

1/ Fish of hatchery origin.

Table 7.--Length-age frequency of Sacony Creek brown trout.

Length, millimetres	Number of Annuli					
	0	I	II	III	IV	H[1/]
70- 89	4					
90-109	10					
110-129	3					
130-149						
150-169		2				
170-189		20				
190-209		3				
210-229		2	4			2
230-249			4			3
250-269			2			1
270-289						
290-309				2		1
310-329				1		
330-349				1		
350-359						1
370-389						
390-409						
410-429						
430-449					1	

1/ Fish of hatchery origin.

Growth of brown trout in Sacony Creek is compared to the growth rate of fish reared in the Pennsylvania hatchery system (fig. 4). It takes the wild fish in Sacony Creek nearly 48 months of growth to attain the size of a 19-month old hatchery fish. The growth rate of wild brown trout in Sacony Creek agrees favorably with that in other trout streams in Pennsylvania (McFadden and Cooper, 1961).

Both the brook trout and brown trout populations in Sacony Creek are essentially of wild origin. Although the stream is stocked with hatchery brook, brown and rainbow trout, hatchery fish composed only 20 percent of the brook trout and 12 percent of the brown trout population. The single rainbow trout found at Station 5 was of hatchery origin.

The number of wild trout in the population decreases rapidly downstream of Stations 1 and 2. Only four wild brook trout and five wild brown trout were found outside of Stations 1 and 2, indicating little migration to the lower reaches.

Estimates of Trout Populations.--The trout populations were projected by the graphical method for determining maximum likelihood estimates of population size based upon removal data as described by Zippin (1956). The estimates presented in table 8 are based upon removal data for three runs over each sample area.

Station 2 was the only location where the numbers of trout escaping capture on the second run remained high. The high probability of capture after three runs is indicated by the small difference between the captured and estimated populations at all stations.

Considering the relative low fertility of the headwaters, the estimated 590 trout or 119 lbs/acre (133 kg/hm^2) at Station 2 is quite high and represents 77 percent of the standing crop. By comparison, McFadden and Cooper (1961) reported an average of 479 trout or 74 lbs acre (82.9 kg/hm^2) for six Pennsylvania streams with wild trout populations. The high standing crop of trout at Station 2 is due to good habitat and minimal exploitation by anglers.

Efficiency of the electrofishing effort was not evaluated. However, an estimate of the proportion of the trout population sampled can be derived from table 8. As previously mentioned, only at Station 2 was a high percentage of the estimated trout population remaining after the second run. The extremely rocky streambed and poor visibility due to high velocity and turbulance are the primary reasons for the poor recovery at Station 2. In general, it is believed a high percentage of the larger fish and thus an equally high percentage of the biomass was collected at all stations.

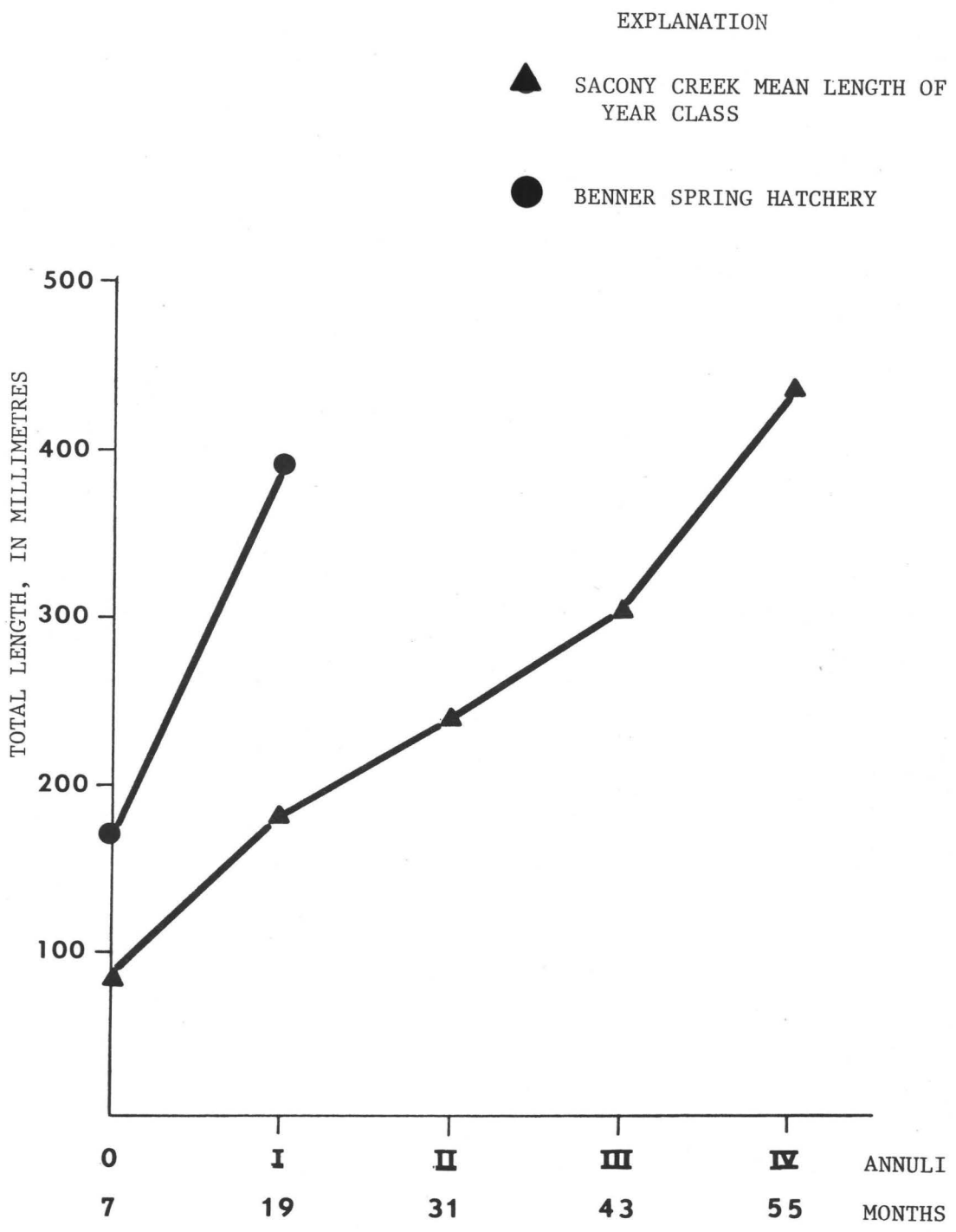

Figure 4.--Comparative length and age of brown trout in Sacony Creek and Benner Springs Hatchery.

Table 8.--Population estimate of trout in selected reaches of Sacony Creek.

[Graphical method of Zippin, 1956]

Station number	Station name	Species	Run (number per acre) 1	2	3	Total	Population estimate
1	Little Sacony Creek near Bowers	brown	41	0	0	41	41
		brook	83	0	0	83	83
2	Sacony Creek at Sally Ann Furnace, near Bowers	brown	275	92	58	425	462
		brook	50	17	25	92	128
3	Sacony Creek above Bowers	brown	13	13	0	26	28
		brook	4	0	0	4	4
7	Sacony Creek at Normal Avenue, at Kutztown	brown	11	3	0	14	14
		brook	11	0	3	14	14
8	Sacony Creek at Kutztown	brown	0	0	0	0	0
		brook	2	0	0	2	2
9	Sacony Creek below Kutztown	brown	0	0	0	0	0
		brook	1	0	0	1	1

SUMMARY AND CONCLUSIONS

Water quality and the general health of the Sacony Creek basin was found to be good to excellent. Chemical quality indicates little degradation from cultural pollution. There is, however, a progressive increase in dissolved nutrients, oxidizable matter, and fecal coliform bacteria as the stream flows through rich farmland. Dissolved and particulate matter reach a peak in concentration immediately downstream of the Kutztown sewage treatment plant. At no point, however, is the assimilative capacity of the stream exceeded. No chlorinated hydrocarbon pesticides were found in water samples collected in September 1974, January 1975, and May 1975.

Benthic macroinvertebrate investigations concur with other findings that the waters of Sacony Creek in general, support a healthy biota. The total number of kinds of organisms at each station ranged from 14 to 25. Clean water forms dominated the population at all stations, with mayflies, caddis flies, and midges the most numerous. Diversity (d) and redundancy (r) indices averaged 3.07 and 0.29 and ranged from 2.44 to 3.46 and 0.14 to 0.38, respectively. Such values support the healthy nature of the stream.

The Sacony Creek basin was found to contain a healthy fish population with 29 species represented. The number of species at any station ranged from 4 to 20, with the headwater stations containing the fewest species. Standing crop of fishes ranged from 27 to 559 lb/acre (626 kg/hm^2) with the bulk of the weight in trout in the headwaters and in white suckers in the lower reaches.

Trout were found to be inhabiting 7 of the 10 sampling stations but were a dominant or significant segment of the population only at the upper three stations. Those stations lacking a significant trout population contained an excess of competitive species (white sucker), lacked suitable habitat, or both. It is significant that only four wild brook trout and five wild brown trout were found downstream of Stations 1 and 2, indicating little migration to the lower reaches.

The trout population is essentially of wild origin with only 20 percent of the brook trout and 12 percent of the brown trout of hatchery origin, despite annual stocking by the Pennsylvania Fish Commission. The wild trout were found to be a short-lived fish with no brook trout and only 8 percent of the brown trout found older than age-group II (31 months). The growth rate of wild trout agrees favorably with other streams in Pennsylvania of similar chemical composition.

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Table 9.--Water-quality determinations in Sacony Creek basin.

[Results in milligrams per litre except as noted]

Date	Time	Laboratory analyses								
		Carbonate (CO_3)	Bicarbonate (HCO_3)	Nitrate-nitrogen (N)	Ammonia nitrogen (N)	Organic nitrogen (N)	Total Kjedhal nitrogen (N)	Orthophosphorus (P)	Total phosphorus (P)	Sulfate (SO_4)
Little Sacony Creek near Bowers, Pa. (Station 1)										
7-31-74	1435	0	31	1.4	0	0	0	0	0	10
9-27-74	0930	0	29	2.1	.06	.45	.57	.02	.03	9.7
11-14-74	1200	0	24	1.4	.08	.35	.43	.01	.01	27
1-22-75	1400	0	17	1.6	.02	.36	.38	.01	.02	8.6
3-12-75	1320	0	14	1.3	.02	.39	.41	.01	.01	14
5-14-75	1100	--	--	---	----	----	----	----	----	----
5-21-75	1100	0	22	1.2	0	0	0	0	0	12
Sacony Creek at Sally Ann Furnance, near Bowers, Pa. (Station 2)										
7-31-74	1315	0	30	1.3	----	----	----	----	----	11
9-26-74	1500	0	32	1.3	.03	.50	.53	.01	.01	11
11-14-74	1230	0	26	1.1	.03	.06	.09	.0	.01	25
1-22-75	1330	0	19	1.5	.04	.52	.56	.01	.01	14
3-12-75	1400	0	17	1.3	.02	.42	.44	.01	.01	12
5-14-75	0945	--	--	---	----	----	----	----	----	----
5-21-75	1330	0	24	.99	.01	.17	.18	.0	.02	12

Table 9.--Water-quality determinations in Sacony Creek basin.

[Results in milligrams per litre except as noted]

Chloride (Cl)	Biochemical oxygen demand (BOD)	Chemical oxygen demand (COD)	Fecal coliform (No. per 100 ml)	Field determinations: Water temperature (°C)	Discharge (ft^3/s)	Specific conductance (micromhos per cm at 25°C)	Dissolved oxygen: Milligrams per litre	Dissolved oxygen: Percent saturation	pH
Little Sacony Creek near Bowers, Pa. (Station 1)									
7.5	0.8	10	630	20.0	0.55	135	8.2	88	7.6
7.4	1.0	6.2	750	12.0	.92	125	10.0	92	7.2
6.5	1.8	3	18	8.5	1.10	110	10.8	92	7.5
12	1.6	0	1	2.5	2.38	160	13.4	97	6.9
7.0	.9	15	33	3.5	7.14	110	13.7	102	7.5
----	---	----	61	14.0	4.38	105	11.0	97	7.9
7.0	.6	5.0	130	16.5	3.04	105	9.6	97	7.3
Sacony Creek at Sally Ann Furnace, near Bowers, Pa. (Station 2)									
2.5	0.2	29	310	19.0	2.60	120	8.4	90	7.7
3.6	1.4	5.4	110	13.5	1.59	120	10.2	97	7.5
4.0	1.0	9.0	88	8.0	4.24	120	11.2	94	7.4
3.0	1.0	3.0	4	1.5	6.82	100	14.2	100	6.8
4.0	.8	7.0	18	4.0	25.4	100	13.8	103	7.5
----	---	----	---	14.5	3.94	100	11.2	108	7.8
3.0	.7	6.0	160	17.0	7.81	100	9.4	97	7.5

Table 9.--Water-quality determinations in Sacony Creek basin--continued.

[Results in milligrams per litre except as noted]

Date	Time	Laboratory analyses								
		Carbonate (CO_3)	Bicarbonate (HCO_3)	Nitrate-nitrogen (N)	Ammonia nitrogen (N)	Organic nitrogen (N)	Total Kjedhal nitrogen (N)	Orthophosphorus (P)	Total phosphorus (P)	Sulfate (SO_4)
Sacony Creek above Bowers, Pa. (Station 3)										
7-31-74	1130	0	32	1.2	----	----	----	----	----	11
9-26-74	1000	0	34	1.0	.04	.48	.52	.02	.03	12
11-14-74	0950	0	30	.99	.04	.29	.33	.0	.01	18
1-22-75	1045	0	20	1.5	.04	.76	.80	.01	.01	18
3-12-75	1200	0	19	1.3	.01	.29	.30	.01	.01	15
5-14-75	0830	--	--	---	----	----	----	----	----	----
5-21-75	1100	0	27	.98	.01	.03	.04	.01	.02	14
Sacony Creek tributary near Bowers, Pa. (Station 4)										
7-31-74	1025	0	41	0.54	----	----	----	----	----	15
9-26-74	0820	0	39	.56	.01	.31	.32	.02	.03	15
11-14-74	1040	0	36	.61	.05	.22	.27	.01	.01	22
1-22-75	1000	0	26	.93	.04	.47	.51	.01	.02	22
3-12-75	1000	0	26	.90	.03	.43	.46	.01	.01	19
5-14-75	1400	--	--	---	----	----	----	----	----	----
5-21-75	1245	0	30	.56	.01	.16	.17	.01	.02	19

Table 9.--Water-quality determinations in Sacony Creek basin--continued.

[Results in milligrams per litre except as noted]

Chloride (Cl)	Biochemical oxygen demand (BOD)	Chemical oxygen demand (COD)	Fecal coliform (No. per 100 ml)	Field determinations: Water temperature (°C)	Discharge (ft^3/s)	Specific conductance (micromhos per cm at 25°C)	Dissolved oxygen: Milligrams per litre	Dissolved oxygen: Percent saturation	pH
Sacony Creek above Bowers, Pa. (Station 3)									
4.0	0.2	8.0	460	20.0	2.95	140	8.2	90	7.5
4.2	1.0	6.7	530	12.0	3.89	120	10.6	97	7.6
6.0	.4	9.0	100	7.5	5.37	120	11.6	96	7.7
5.5	.8	4.0	3	.0	12.9	110	14.2	98	6.8
5.0	.6	5.0	170	4.5	15.9	110	13.5	103	7.6
----	---	----	320	13.5	18.1	100	11.2	106	7.9
5.0	1.4	9	700	17.0	11.4	120	10.0	102	7.2
Sacony Creek tributary near Bowers, Pa. (Station 4)									
2.0	0.8	10	2,600	23.0	0.58	155	7.9	91	7.4
3.0	.8	4.6	3,000	12.5	.42	125	9.8	90	6.6
3.0	.6	8	42	8.0	.47	130	11.2	93	7.5
3.0	1.0	6.0	3	.0	1.26	120	14.0	95	6.7
4.0	.6	8.0	280	4.0	2.05	120	13.6	110	7.8
----	---	----	530	18.5	4.19	110	11.0	155	7.9
2.0	.6	12	1,200	18.0	2.48	120	8.0	83	7.7

Table 9.--Water-quality determinations in Sacony Creek basin--continued.

[Results in milligrams per litre except as noted]

Date	Time	Laboratory analyses								
		Carbonate (CO_3)	Bicarbonate (HCO_3)	Nitrate-nitrogen (N)	Ammonia nitrogen (N)	Organic nitrogen (N)	Total Kjedhal nitrogen (N)	Orthophosphorus (P)	Total phosphorus (P)	Sulfate (SO_4)
Sacony Creek below Bowers, Pa. (Station 5)										
7-30-74	1845	0.0	31	0.77	----	----	----	----	----	12
9-25-74	1500	1.0	31	.97	.02	.48	.50	.01	.02	12
11-13-74	1540	.0	27	.81	.07	.32	.38	.0	.01	18
1-22-75	0830	.0	21	1.6	.05	.52	.57	.01	.01	17
3-12-75	0845	.0	22	1.6	.01	.38	.39	.01	.01	14
5-13-75	1545	--	--	---	----	----	----	----	----	----
5-21-75	1500	0	0	.93	.01	.20	.21	.01	.01	0
Sacony Creek above Kutztown, Pa. (Station 6)										
7-30-74	1935	0	32	0.66	----	----	----	----	----	13
9-25-74	1315	.8	33	.99	.06	.70	.76	.02	.02	11
11-13-74	1450	0	28	.81	.10	.42	.52	.01	.01	19
1-21-75	1430	0	22	1.5	.05	.47	.52	.01	.01	20
3-11-75	1540	0	22	1.8	.01	.43	.44	.01	.01	14
5-13-75	1445	--	--	---	----	----	----	----	----	----
5-22-75	1130	0	28	.93	.01	.30	.31	.01	.02	15

Table 9.--Water-quality determinations in Sacony Creek basin--continued.

[Results in milligrams per litre except as noted]

Chloride (Cl)	Biochemical oxygen demand (BOD)	Chemical oxygen demand (COD)	Fecal coliform (No. per 100 ml)	Field determinations: Water temperature (°C)	Discharge (ft^3/s)	Specific conductance (micromhos per cm at 25°C)	Dissolved oxygen: Milligrams per litre	Dissolved oxygen: Percent saturation	pH
Sacony Creek below Bowers, Pa. (Station 5)									
4.0	1.2	14	2,100	24.0	2.92	160	7.4	86	7.4
4.8	1.2	4.6	2,500	15.5	3.38	110	10.6	105	8.5
5.5	1.6	15	900	8.5	7.73	120	10.7	90	7.5
5.5	1.4	7.2	8	.0	12.6	100	14.2	97	6.7
5.0	.6	8.0	120	3.5	12.8	110	13.4	100	7.7
----	----	----	410	19.5	14.1	105	10.0	108	8.4
4.5	1.0	12	120	19.5	11.8	95	9.6	103	8.3
Sacony Creek above Kutztown, Pa. (Station 6)									
3.5	2.2	18	12,000	24.0	3.97	130	6.8	78	7.7
4.6	1.6	2.9	9,600	16.5	3.72	130	11.9	120	8.4
6.5	1.6	19	1,300	9.0	9.31	130	10.5	90	7.6
6.0	1.0	8.0	1	4.5	17.1	120	14.2	108	7.4
5.0	.4	7.0	120	6.5	13.7	120	13.4	107	8.1
----	---	----	700	20.5	16.1	120	10.2	111	8.6
4.0	1.0	10	2,500	21.0	12.3	115	10.0	110	8.4

Table 9.--Water-quality determinations in Sacony Creek basin--continued.

[Results in milligrams per litre except as noted]

Date	Time	Laboratory analyses								
		Carbonate (CO_3)	Bicarbonate (HCO_3)	Nitrate-nitrogen (N)	Ammonia nitrogen (N)	Organic nitrogen (N)	Total Kjedhal nitrogen (N)	Orthophosphorus (P)	Total phosphorus (P)	Sulfate (SO_4)
Sacony Creek at Normal Avenue, at Kutztown, Pa. (Station 7)										
7-30-74	0930	0	84	2.7	----	----	----	----	----	19
9-25-74	1100	0	167	5.0	.02	.46	.48	.03	.04	27
11-13-74	1345	0	76	1.8	.14	.86	1.0	.01	.02	25
1-21-75	1340	0	128	4.2	.05	.99	1.04	.03	.03	30
3-11-75	1445	3.0	145	5.0	.01	.59	.60	.02	.02	28
5-13-75	1345	--	--	---	----	----	----	----	----	----
5-22-75	1020	0	138	9.7	.01	.04	.05	.01	.02	26
Sacony Creek at Kutztown, Pa. (Station 8)										
7-30-74	1200	0	95	2.5	----	----	----	----	----	20
9-25-74	0800	0	187	4.5	.03	.56	.59	.02	.02	28
11-13-74	1315	0	84	1.6	.11	.75	.86	.02	.02	26
1-21-75	1245	0	169	4.3	.05	.80	.85	.02	.03	37
3-11-75	1330	3.0	151	.50	.06	.42	.48	.02	.02	29
5-13-75	1300	--	--	---	----	----	----	----	----	----
5-22-75	0920	0	149	3.8	.01	.12	.13	.02	.03	25

Table 9 --Water-quality determinations in Sacony Creekbasin--continued.

[Results in milligrams per litre except as noted]

Chloride (Cl)	Biochemical oxygen demand (BOD)	Chemical oxygen demand (COD)	Fecal coliform (No. per 100 ml)	Field determinations: Water temperature (°C)	Discharge (ft^3/s)	Specific conductance (micromhos per cm at 25°C)	Dissolved oxygen: Milligrams per litre	Dissolved oxygen: Percent saturation	pH
Sacony Creek at Normal Avenue, at Kutztown, Pa. (Station 7)									
6.0	2.2	21	19,000	19.0	15.8	255	6.9	73	7.3
30	1.8	4.2	16,000	12.0	8.11	475	10.2	93	7.4
9.0	2.2	22	4,000	9.0	14.2	250	10.0	85	7.4
9.5	2.4	7.0	75	4.0	24.8	370	12.6	95	7.3
8.5	.1	10.0	69	8.0	34.5	390	13.4	111	7.9
----	---	----	600	17.5	33.3	320	11.8	120	8.0
8.0	.6	8.0	1,600	16.0	23.6	340	9.8	97	7.7
Sacony Creek at Kutztown, Pa. (Station 8)									
7.0	2.8	16	7,600	22.0	13.8	270	8.5	95	7.8
60	1.6	8.3	4,500	10.5	10.3	520	11.0	97	7.4
9.0	2.4	19	9,000	9.5	17.3	260	10.4	90	7.4
12	1.4	7.0	67	3.0	22.6	480	13.7	100	7.3
10	.2	7.0	46	8.5	35.3	410	13.8	116	8.1
----	---	----	640	16.5	36.3	340	12.2	123	8.2
9.0	.6	6.0	1,800	15.5	25.3	360	10.4	103	7.9

Table 9.--Water-quality determinations in Sacony Creek basin--continued.

[Results in milligrams per litre except as noted]

Date	Time	Laboratory analyses								
		Carbonate (CO_3)	Bicarbonate (HCO_3)	Nitrate-nitrogen (N)	Ammonia nitrogen (N)	Organic nitrogen (N)	Total Kjedhal nitrogen (N)	Orthophosphorus (P)	Total phosphorus (P)	Sulfate (SO_4)
Sacony Creek below Kutztown, Pa. (Station 9)										
7-30-74	1330	0.0	106	3.2	----	----	----	----	----	24
9-24-74	1600	.0	194	5.0	1.04	1.28	2.32	.47	.54	38
11-13-74	1140	.0	96	2.3	.50	.93	1.4	.27	.31	34
1-21-75	1120	.0	170	4.9	.29	.77	1.06	.13	.15	49
3-11-75	1145	1.0	164	5.2	.59	1.1	1.69	.22	.23	33
5-13-75	1150	--	--	---	----	----	----	----	----	----
5-22-75	0845	.0	156	4.1	.01	.27	.28	.22	.25	28
Sacony Creek at Greenwich Bridge, near Kutztown, Pa. (Station 10)										
7-30-74	1450	0.0	114	2.9	----	----	----	----	----	25
9-24-74	1200	.0	194	5.0	.28	.79	1.07	.92	.94	35
11-13-74	1040	.0	85	1.9	.17	.94	1.11	.17	.19	27
1-21-75	1000	.0	149	4.1	.07	1.15	1.2	.13	.15	41
3-11-75	1035	4.0	154	5.0	.32	.59	.91	.15	.15	33
5-13-75	1045	--	--	---	----	----	----	----	----	----
5-22-75	0800	.0	150	3.7	.01	.39	.40	.12	.17	24

Table 9.--Water-quality determinations in Sacony Creek basin--continued.

[Results in milligrams per litre except as noted]

Chloride (Cl)	Biochemical oxygen demand (BOD)	Chemical oxygen demand (COD)	Fecal coliform (No. per 100 ml)	Field determinations: Water temperature (°C)	Discharge (ft^3/s)	Specific conductance (micromhos per cm at 25°C)	Dissolved oxygen: Milligrams per litre	Dissolved oxygen: Percent saturation	pH
Sacony Creek below Kutztown, Pa. (Station 9)									
20	3.4	20	6,200	24.0	14.9	340	8.8	103	7.8
48	4.8	13	11,000	14.5	12.2	680	13.2	127	8.0
21	3.6	19.0	6,300	9.0	23.3	340	10.0	85	7.3
20	2.6	7.0	1,400	1.5	23.6	520	13.8	98	7.3
22	.2	6.0	100	7.0	38.2	490	13.5	110	8.0
----	---	----	2,300	15.5	46.1	380	11.4	113	7.8
18	1.2	9.0	2,400	15.5	29.9	395	9.6	95	7.8
Sacony Creek at Greenwich Bridge, near Kutztown, Pa. (Station 10)									
19	2.6	21	3,200	24.0	17.0	350	7.4	87	7.8
27	2.1	11.0	4,700	11.0	12.8	530	9.3	83	7.5
14	1.2	14	2,500	9.0	28.9	280	9.6	82	7.3
27	1.8	6.0	1,300	.5	24.1	480	13.8	95	7.4
24	.7	5.0	280	6.5	41.0	490	12.4	100	7.6
----	---	----	1,100	15.0	44.0	350	11.0	107	7.8
14	1.2	12	700	16.0	27.5	370	8.4	84	7.5