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GENERAL SUMMARY OF PROGRESS

1972-1973

Plutonium Concentration along Fresh Water Food Chains
of the Great Lakes, U. S. A.

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In this report we summarize the following:

- a) Sample collections made in Lake Ontario during the summer of 1972.
- b) Analyses completed, since writing the 1971-72 Progress Report, on the samples collected in 1971.
- c) Analyses completed on the 1972 samples.
- d) Some preliminary attempts to compare and contrast the analytical data from the two years of sampling.

SAMPLING

The 1972 sampling program is set out in Table 1, and the sample locations are shown in Figure 1. We are greatly indebted to Mr. G. C. LeTendre, Cape Vincent Fisheries Station, New York Department of Environmental Conservation, for his outstanding assistance to us in obtaining the samples of fish and of fresh-water clams, and to Mr. Alfred Larsen, Great Lakes Fishery Laboratory, U. S. Dept. of the Interior, for making available to us time on the R/V ADVANCE II for the collecting of water, sediment and plankton samples. Mr. Allan G. Gordon, WHOI, finally collected these latter samples.

In Table 1 we have shown by asterisks which of the biological samples have been analyzed or are now being analyzed.

ANALYSES

A. Water Samples: In Table 2 are summarized the radiochemical data collected on the 1971 water samples --data that were incomplete at the time of our Progress Report last year --; in Table 3 are summarized, in the same pattern, the analyses so far completed on the 1972 water samples. Most Sr-90 values are from only single extractions of the Y-90 daughter; the concentration levels are, however, high enough so that quite narrow confidence limits apply, and we do not believe that second milkings would improve the data enough to justify the work involved.

B. Sediment Samples: In Tables 4, 5, 6 and 7 are summarized the radiochemical data for, respectively, cores 71-2, 71-3, 71-4, and 71-5; in Tables 8A, 8B and 9 are summarized similar data for cores 72-1, 72-4 and 72-5, the only members of the 1972 series so far analyzed. In the hope that the data will be more conveniently presented and examined we have changed from the "dpm per gram" used last year, to give all the values in "disintegrations per minute per kilogram". No Sr-90 values are yet available from the 1972 sediments.

It should be pointed out, in connection with the Cs-137 values, that our calculation procedure evidently has for some time over-estimated the "blank" for this nuclide; the effect of this is seen in the over-abundance of negative values in the profiles of Cs-137 in sediments.

Examples of this are:

Core 72-1 (Table 8A): of 32 values less than 15 dpm per kg, 19 are negative.

Core 71-2 (Table 4): of 9 values less than 15 dpm per kg, 6 are negative.

Core 71-4 (Table 6): of 22 values less than 15 dpm per kg, 19 are negative.

It is not entirely clear to us how this information may best be used to improve our calculations; certainly it may be taken, qualitatively, as indicating

that confidence may be placed in the reality of most of the low positive values for Cs-137 in Tables 4 through 9.

C. Biological Material: In Table 10 are summarized all the available radiochemical data for the biological material collected in 1972. The uncertainties attached to most of the Pu-239 values are very large, and should be explained. Counting periods were mostly in the range 1000-1500 minutes, during which many samples of small size, modest chemical yield and low Pu content yielded only 1 to 3 counts in the Pu-239 channels. Comparison with the counter "blank" in these channels (1 count in 2500 to 3500 minutes) convinces us that most of the collected counts were from Pu-239 in the samples. The uncertainties are the result of applying normal statistics to the very small populations of counts actually measured.

All the radiochemical data of Table 10 are presented as dpm per kilogram wet; in the case of the five plankton samples the wet weight was not measured directly, but the dry weights were converted by using a wet:dry ratio of 10, as seems not unreasonable from our own and various published data.

For convenience of cross reference, the samples are arranged in Table 10 in the same order as in Table 1; empty spaces indicate analyses still uncomplicated -- other reasons for missing data are specifically shown. No Sr-90 data are yet available for these samples.

DISCUSSION

A. Quality of Data: Unfortunately no good intercomparison samples exist for radionuclide analyses on fresh-water samples. In general, however, the procedures that we have followed in this program are the same as those we follow in our salt-water program, from which we have a good deal of quality control data. These may be summarized as being from four sources:

1. Quality control intercomparison water samples analyzed by ourselves, and by commercial radiochemical laboratories. These cover, unfortunately, only Sr-90 and Cs-137: Table 11 summarizes some of these data, as presented in a report, now in preparation, of the ratios of Cs-137 to Sr-90 in ocean waters. Our conclusion, from these and other intercomparison data, was that there is no systematic discrepancy between WHOI and either of two radiochemical contractors.
2. Recently the International Atomic Energy Agency, in Monaco, distributed intercomparison samples of sea water, rather heavily contaminated with radioactive waste. As reported by Fukai et al (1973, in press) the WHOI values, versus the "preferred values", were as follows:

SW-I-1 Sr-90 , preferred 5.0 ± 0.1 pCi/kg; WHOI 4.85 ± 0.35 pCi/kg

Cs-137, preferred 14.4 ± 0.3 pCi/kg; WHOI 13.8 ± 0.2 pCi/kg

SW-I-2 Sr-90 , preferred 55.2 ± 1.4 pCi/kg; WHOI 52.9 ± 3 pCi/kg

Cs-137, preferred 201 ± 4 pCi/kg; WHOI 192 ± 10 pCi/kg

Plutonium intercomparison data on these same water samples are being reported separately by Murray (1973, in press); our present understanding of this situation is as follows:

SW-I-1 Pu-239, preferred value 0.084 ± 0.006 pCi/kg; WHOI 0.074 ± 0.005 pCi/kg

Pu-238, preferred value 0.010 ± 0.002 pCi/kg; WHOI $0.011 \pm .003$ pCi/kg

SW-I-2 Pu-239, preferred value 0.230 ± 0.024 pCi/kg; WHOI 0.259 ± 0.005 pCi/kg

Pu-238, preferred value 0.036 ± 0.004 pCi/kg; WHOI 0.050 ± 0.003 pCi/kg

3. Presently the International Atomic Energy Agency is conducting an inter-comparison exercise on a sample of seaweed (Fucus vesiculosus) rather heavily contaminated with radioactive waste. A preliminary report of these data has been presented by Fukai and Ballestra (1973, in press) and shows the following:

Sr-90 , preferred value 9.8 ± 0.1 pCi/g; WHOI value 10.1 ± 0.3 pCi/g

Cs-137, preferred value 74.9 ± 0.9 pCi/g; WHOI value 78.0 ± 0.3 pCi/g

On this sample, data for Pu-239 have been sent us by Murray (personal communication), and show the following:

Pu-239, mean of 10 "better" laboratories: 27.2 ± 2 pCi/g

Pu-239, WHOI value 30.0 ± 0.2 pCi/g

Pu-238, mean of 10 "better" laboratories: 3.7 ± 0.3 pCi/g

Pu-238, WHOI value 4.2 ± 0.3 pCi/g

4. Blank samples of "seawater" derive from an oil well brine (Devonian Age) that is free from any artificial radioactivity; from seawater from the wells at the Coney Island Aquarium, that are free from either Cs-137 or Pu-239; or from "reagent blanks", consisting of, usually, 20 liters of distilled water processed with the same reagent quantities as would be used for a seawater sample. Data from a number of blanks of these sorts are summarized in Table 12.

It is our belief that these quality control analyses confirm that, at least in respect to analyses for Sr-90, Cs-137 or Pu-239 we are doing about as well as can be, and that considerable confidence may be placed on the analytical data in Tables 2-10.

B. Water Samples: As shown in Table 2, we have completed analysis of Cs-137 and Sr-90 on all the 1971 water samples. We believe these data may be summarized as follows:

1. There is no evidence for any pattern of variation of Sr-90, either vertically or horizontally; it does not seem to vary in relation to either of the other nuclides measured. Mean Sr-90, from the 12 samples, is 287 ± 10 and the three values differing from the mean by more than 1 sigma appear a reasonable fraction, considering that the uncertainty of the individual values was estimated only from the departure of the counting data from the Y-90 decay curve.
2. We believe that the shallow samples (surface or 18 m) are significantly higher in Cs-137 and lower in Pu-239 than are the samples from 30 m or deeper. The data do not show evidence of any very strong gradient with depth, being more consistent, we believe, with the presence of two fairly well-mixed water bodies, one above 30 m or so, the other deeper.

Comparison of the 1971 data with those from 1972, in Table 3, does show some trends:

3. Sr-90 appears again to show no pattern of variation, but the 1972 mean, 274 ± 6 , we believe is significantly down from 1971. We believe there would be a good deal of value in establishing the slope of the rate of decrease, annually, of Sr-90 in Lake Ontario, especially in relation to the mean rainwater concentrations at nearby stations.
4. The 1972 samples show no evidence of the high near-surface Cs-137 that was striking in 1971; in fact there is some tendency for Cs-137 to be highest in the water deeper than 45 m: mean 9.6 ± 0.6 , 50 m and deeper, versus 8.6 ± 1 , 40 m and shallower. It is not impossible that this difference from 1971 is related more to the horizontal circulation of the

lake: the 1971 samples were relatively closer to the south shore and the strong west to east shallow current. We hope to clarify this point with the 1973 samples.

5. The same vertical trend in the Pu-239 concentrations was seen in both years: higher mean Pu-239 in the deeper water body. The data are consistent, however, with an increase from 1971 to 1972 in the Pu-239 of shallow water in the lake, and with a decrease in the same time span in the deeper water. The same question of horizontal distributions applies here as did for the Cs-137 data above, and we will have to hope for clarification from further samples.

C. Sediment Cores:

Comparison of the profiles of radioactivity in the seven cores so far analyzed presents a very confusing picture. Of the four 1971 cores (Tables 4, 5, 6, 7) only one, core 71-5, presents the type of profile one would expect for fallout in an undisturbed area of "normal", though rapid, sedimentation; there should be, in such a situation, a maximum in the curve of fallout versus depth-in-core near, but below, the sediment surface (reflecting the 1963-64 maximum in delivery rate), and one or more lesser peaks in the curve, at greater depths, reflecting high delivery rates in 1958 and earlier. Sediment cores showing patterns like this have been reported consistently by Schreiber and others, from the Ligurian coast of Italy, and recently by Pennington et al (1973) from five lakes in the English Lake District. Interestingly enough, several of the problem features of our core 71-5 are also presented by the curves shown in Pennington et al, although these were not remarked by the authors.

Briefly, we may summarize core 71-5 as presenting the following problems, some of which we noted last year in connection with core 71-3:

- a) The depth of occurrence of Pu-239 and Cs-137 is much too great to be explained by undisturbed sedimentation at rates estimated for Lake Ontario (range of 10 cm per 100 years).
- b) While the depth of burial of the upper Cs-137 peak at 4-5 cm is not wholly unreasonable, the separation between this peak and the next deeper one, at 14-15 cm, is much too great: perhaps 5 years for a 10-cm interval here, versus 4-cm for about 8 years more recently.
- c) The vertical distribution of Pu-239 appears quite different from that of Cs-137, probably indicating differential movement of Pu relative to Cs. The variations of the ratio Pu-239 to Cs-137 strongly show this. On the other hand the variations of the ratio Pu-238 to Pu-239 appear inconsistent with redistribution of Pu through the sediment column: note especially the low ratio at the 4-5 cm peak versus the high ratios in the two neigh-

boring sections, and the high ratio at the very bottom of the core. Explaining such data is quite impossible in relation to the SNAP burnup as the primary source of Pu-238:239 ratios higher than about 0.04 in the northern hemisphere.

- d) The sizes of the two peaks in Pu-239 concentration do not correspond well with the patterns of annual fallout delivery in this latitude band. As calculated by Noshkin and Bowen (1973) the peak deliveries of Pu-239 were in 1959 (about 8% of the total delivered up to 1970) and in 1963 (about 19%); if we were to compare the two sets of 3-year high deliveries, 1956-1958 accounted for 18% of the 1970 total deposit, whereas 1962-1964 accounted for 44.5%. By contrast, the upper peak of core 71-5 (0-8 cm) contains 48.3% of the Pu-239 in the upper 25 cm of the core, while the lower peak (11-25 cm) contains 49% of the total.

The other 1971 cores present alternative pictures: as noted last year, core 71-3 shows a very deeply buried peak about 16-20 cm down (probably a double peak), and evidence of an increase in Pu-239 beginning again about 37 cm down; core 71-2 shows peak concentrations at the surface, falling off very rapidly with depth, but a hint of increase, again, at 13-14 cm, the bottom of the core; core 71-4 is quite similar to this, in its top section, but concentrations fall even more rapidly with depth, and there is no second peak, even though the core penetrated to 32 cm.

As we suggested last year, we are inclined to believe that the vertical patterns of cores like 71-3 are explainable by transfer of deeply scoured, low-concentration sediments, like those of most of core 71-4, to overlie "normal" sediment deposits. Patterns like those of 71-2 and 71-4, one would like to explain by transfer of scoured, very high concentration

sediments; the problem in this arises from the fact that we have only once seen a sediment in Lake Ontario of high enough concentration to give, after resuspension and (presumably) some mixing, concentrations of Pu-239 in the range 40-60 dpm per kg or of Cs-137 in the range 2000-3000 dpm per kg. Supply of such concentrations, by resuspension of surface sediments, would appear to require an impossibly complex set of special circumstances, and by resuspension of subsurface sediments would require extremely high concentration source materials (in the range of that shown by core 72-4!), and very special resuspension circumstances as well.

Of the 1972 cores, core 72-1 bears a good deal of resemblance to core 71-4 with its top centimeter lost; this is interesting, since both are from the east end of the Rochester Basin (as defined by Thomas, Kemp and Lewis, 1972, J. Sediment. Petrol.). Derivation of core 72-1 from core 71-4 modified by erosion is, however, unattractive because the latter is so much the shallower (76 m for 71-4 versus 140 m for 72-1). The very high wet-to-dry weight ratio of the top centimeter of core 72-1 also argues against this having been taken in a region of rapid erosion.

Cores 72-4 and 72-5 are clearly of the same family as core 71-2: with very high concentrations at the sediment surface, decreasing rapidly with depth in the upper 5-6 cm, and with, in core 72-5, a well defined deep maximum (probably double peaked) at 20-30 cm. The deep maximum of core 72-5 is not so sharp as that suggested for core 71-2, and is a little deeper. Both cores, 72-4 and 72-5, are from the Niagara Basin, which is concluded, by Thomas et al, to have the lowest average sedimentation rate of the three basins of Lake Ontario. The concentrations of both Pu-239 and Cs-137 are extraordinarily high -- by far the highest we have seen -- and that of core 72-4 (remembering

that the top layer analyzed was 2-cm thick) showed exactly twice the Pu-239 concentration seen in core 72-5. These data appear to us to be consistent with our suggestion, in last year's Progress Report, that there is a significant supply of Pu-239, Cs-137 from the Niagara River; it seems necessary to argue that the river-borne nuclides have such large vertical velocities that they mostly deposit in the Niagara Basin, and that they sediment out so rapidly that horizontal homogeneity is not reached even within the basin. There is no clear reflection of this phenomenon in the profiles of water concentrations (Table 3), as one would expect from the high vertical velocities that have to be assumed.

The great depth of penetration of fallout nuclides shown by core 72-5 (distinct maxima of concentration at 24-48 cm for Cs-137 and at 24-27 cm for Pu-239) clearly cannot be reconciled with the sedimentation rates reported by Thomas et al (1972), as confirmed by finding the horizon for ragweed pollen (140-150 years) at 15-16 cm. Evidently Pu-239 and Cs-137 have moved downward into the sediment at rates faster than one would have estimated for diffusion, or to depths greater than one would have estimated for biological mixing; an alternative explanation is that our procedure of freezing the large diameter cores, and then sawing them into sections, causes significant translocation down the core. We do not believe that this explanation is consistent with such vertical distributions as that of core 71-3 or 71-5; we believe, also, that our practice of trimming away the outer few millimeters of each slice would prevent inclusion of significant translocated material in the samples analyzed. It is, however, our intention to test this possibility further by analyzing some unfrozen cores from Lake Ontario, if any can be obtained that are sufficiently plastic to allow them to be sampled as soon as retrieved. We are also engaged in testing this possibility on near-shore marine cores.

Fallout Pu-239 delivery to Lake Ontario should have ranged about 2-2.1 mc per km² (Noshkin and Bowen, 1972), an estimate based on soil data plus HASL precipitation figures. Caesium 137 should have ranged about 110 mc/km². Integration of such complex, and ill-understood, curves as those of our sediment cores might seem profitless; it is, however, worth noting that even the cores richest in Pu 239 (72-4 and 72-5) represent only 1/4 or less of this estimated delivery. Core 71-5, with some extrapolations, can be integrated to represent, in the upper 25 cm, 1.07 mc Pu-239/km², about 1/2 the estimated delivery; core 72-5, in comparison, represents only 0.40 mc/km² in the upper 27 cm, which contain only 19.6 mc Cs-137/km². Some of the 1971 cores appear richer in Cs-137: core 71-4 represents 30.5 mc/km², and core 71-5 about 25 mc/km². In general, however, the cores richest in fallout contain only modest fractions of the estimated deliveries; if we argue that significant amounts of their content have been translocated from the sites of such low-fallout cores as 72-1, then we must conclude that close to 90% of the fallout delivered to the Lake has already left its basin -- or, even less palatably, has penetrated so deeply into the sediment as to be below our coring penetration.

D. Biological Materials: The extensive series of analyses of fish collected in 1972 offer quite a contrast to the few results from 1971 samples reported last year.

Reference to figure 1 will show that the five 1972 plankton samples reasonably well represent the whole lake. We are able to offer no explanation why the results should fall into such clear subclasses: three high, at about 0.16 dpm Pu-239 per kg wet, and two low, at about 0.02; nothing we now know about the circulation of Lake Ontario would support a prediction of about an order of magnitude difference between plankton at stations 72-2 and 72-4 and those at 72-1, -3 and -5. In fact, our prediction would have been, based on the sediment data, that 72-4 would be highest of all.

The concentration factor for Pu-239 in the 1971 plankton sample (compared to the mean Pu-239 in 1971 lake water) was just under 10^3 . For the three high Pu-239 plankton samples of 1972, the indicated concentration factor is just over 200, and for the two low samples, 50 or less. We are inclined to take this difference as confirming the suggestion made last year that the high Pu-239 in the plankton collected close to shore near the R. Ginna reactor site was actually related to the operations of the reactor. We will wish to examine this question in more detail in 1973-74.

The alewives collected in 1972, from four rather widely separated points about the lake, all agree in showing very little accumulation of Pu-239 -- concentration factors of less than 100 compared to the 1972 average for water samples 20 m, or shallower, in depth. These data, also, appear to us to confirm reactor operation as a cause for the very high Pu-239, 238 and for the Cs-134 of the 1971 alewife sample. Interestingly enough (making about a factor of five allowance for comparison of the 1972 values on a wet basis, with those of 1971, on dry weight) the 1972 alewives have more Cs-137 than did the 1971

sample; evidently the small amounts of flesh and skin remaining in the 1971 fish (collected dead) had little holding power for Cs-137.

Of the other fish samples so far analyzed from 1972, very few show evidence of any considerable concentration of Pu-239. We have called attention, earlier, to the number of Pu-239 values with very large uncertainties we will mostly, in this discussion, ignore the uncertainties of the values to be discussed.

Whole-fish samples that show evidence of occasionally reaching Pu-239 concentration factors in excess of 300 are: smelt, slimy sculpin, and black crappie. In the cases of fish that were dissected before analysis, bones, liver, or guts show the highest concentrations, the meat -- the edible portion -- being usually much lower in Pu-239. The only really high level of Pu-239 observed was in the combined guts and liver of the gizzard shad; it is interesting that in this fish the meat showed a higher concentration than did the bones -- the only case yet seen.

Although the data are far from complete, it seems likely that one can generalize that bottom-feeding fish like the gizzard shad, redhorse sucker, carp, bullhead, or fresh-water drum have higher Pu-239 concentrations than do such fairly high-level predators as yellow perch or largemouth bass. To refine this generalization will require a good deal of literature searching for information on the feeding habits of the fish analyzed; this search will be complicated by the evident probability that such information can be extrapolated only with great caution from the more usual river, stream or pond habitats of these species, to Lake Ontario. We will also need to collect a good deal more analytical data, to improve our statistics -- and on larger samples in most cases, as well.

The unionid clams, the only benthic invertebrate collected that gave

enough sample for analysis, show rather high Pu-239 in the meats and much more in the shells. The latter observation is not surprising, but we require more data to confirm whether Pu-239 is actually incorporated in the shells of these creatures, or whether the observation represents another case of radionuclide accumulation by the periphyton covering the mollusc shell. An effort will be made, this year, to obtain samples of muskrats from an area where fresh water clams form an important part of their diet, to ascertain the biological availability of the plutonium in the clam's flesh.

In general, we do not believe our data are consistent with there being any very striking "food-chain magnification" of plutonium in these fresh water ecosystems. It is far from unlikely, however, that plutonium concentrated on silt particles is remobilized by the digestive processes of filter feeders or bottom feeders, and that there may be rather large differences among species in respect to the efficiency of this. It also seems to us important to examine in more detail, and on much larger samples, the levels of plutonium and cesium in the roe of these Lake Ontario fish; our data cannot, so far, exclude the possibility that in some species quite considerable concentrations of Pu-239 or of Cs-137 are accumulated in the roe -- a question of real radiobiological importance.

TABLE 1

LAKE ONTARIO SAMPLES COLLECTED DURING 1972

A. From RV ADVANCE II:

STATION 72-1: Position 43°40'12" N; 76°43'48"W (ADVANCE II Sta. 84)

DATE 9-11-72; TIME 2350; WATER DEPTH 140m; THERMOCLINE 18 m.

60 L. WATER SAMPLES @ Surface, 20 m, 40 m, 120 m.

Plankton Tow ½ m. #6 Mesh for 20 min.

21-cm Diameter Gravity Core @ 140 m: grey mud, barrel full.

STATION 72-2: Position 43°45'00" N; 77°42'00" W (ADVANCE II Sta. 53)

DATE 9-12-72; TIME 0500; WATER DEPTH 90 m; THERMOCLINE 15 m.

60 L. WATER SAMPLES @ Surface, 20 m, 40 m, 80 m.

Plankton Tow ½ m. #6 Mesh for 15 min.

21-cm Diameter Gravity Core @ 90 m: clay 8-10" in barrel.

STATION 72-3: Position 43°38'24" N; 78°30'00" W (ADVANCE II Sta. 33)

DATE 9-12-72; TIME 0912; WATER DEPTH 140 m; THERMOCLINE 12 m.

60 L. WATER SAMPLES @ Surface, 15 m, 80 m, 130 m.

Plankton Tow ½ m. #6 Mesh for 15 min.

21-cm Diameter Gravity Core @ 140 m: mud up to 8" of top of core barrel.

STATION 72-4: Position 43°24'00"N; 79°00'36" W (ADVANCE II Sta. 15)

DATE 9-13-72; TIME 1415; WATER DEPTH 90 m; THERMOCLINE 8 m.

60 L. WATER SAMPLES @ Surface, 12 m, 50 m, 80 m.

Plankton Tow ½ m. #6 Mesh for 15 min.

21-cm Diameter Gravity Core @ 90 m: full up grey mud.

STATION 72-5: Position 43°21'36"N; 79°28'48"W (ADVANCE II Sta. 5)

DATE 9-13-72; TIME 1930; WATER DEPTH 104 m; THERMOCLINE 13 m.

60 L. WATER SAMPLES @ Surface, 15 m, 50 m, 95 m.

Plankton Tow ½ m. #6 Mesh for 15 min.

21-cm Diameter Gravity Core @ 104 m: full to top of barrel.

B. Other Biological Samples:

DESCRIPTION	DATE CAUGHT	LOCATION	WATER DEPTH
* Alewives	5-4-72	Port Credit	20 fm
"	5-11-72	Mexico Bay	40 fm
* "	5-6-72	Olcott	20 fm
* "	5-11-72	Mexico Bay	20 fm
* "	5-14-72	Prince Edward Point	20 fm
"	7-28-72	Mexico Bay	15 fm
* Smelt	5-11-72	Mexico Bay	10 fm
* "	5-14-72	Prince Edward Point	20 fm
* "	7-22-72	Olcott	20 fm
* "	7-24-72	Rochester	20 fm
Slimy Sculpin	7-22-72	Olcott	20 fm
" "	7-24-72	Rochester	20 fm
* " "	7-28-72	Mexico Bay	40 fm
* Unionid Clams	8- -72	Cape Vincent	--

TABLE 1 Continued

<u>DESCRIPTION</u>	<u>DATE CAUGHT</u>	<u>LOCATION</u>	<u>WATER DEPTH</u>
White Sucker	Not Recorded	East End of Ontario	<5 fm
Redhorse Sucker	" "	"	"
* Carpsucker	" "	"	"
* Bluegill	" "	"	"
* Smallmouth Bass	" "	"	"
* Largemouth Bass	" "	"	"
Rock Bass	" "	"	"
White Bass	" "	"	"
Freshwater Drum	" "	"	"
* Black Crappie	" "	"	"
* American Eel	" "	"	"
* White Perch	" "	"	"
Yellow Perch	" "	"	"
* Longnose Gar	" "	"	"
* Brown Bullhead	" "	"	"
Northern Pike	" "	"	"
Smelt	" "	"	"
Alewives	" "	"	"
Pumpkin Seed	" "	"	"
* Yellow Perch	Oct. 72	Extreme East End of Ontario	<5 fm
White Perch	"	"	"
* Carp	"	"	"
* Fresh Water Drum	"	"	"
* Gizzard Shad	"	"	"
* Northern Pike	"	"	"
White Sucker	"	"	"
* Redhorse Sucker	"	"	"
Smallmouth Bass	"	"	"
Rock Bass	"	"	"
American Eel	"	"	"
* Coho Salmon	"	"	"
* Chinook Salmon	"	Not Recorded	Not Recorded

TABLE 2

RADIOCHEMICAL ANALYSES OF 1971 LAKE ONTARIO WATER SAMPLES

RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER 100 KG

STATION		71-1	71-3	71-5	71-6
POSITION		43°18'N;77°12'W	43°28'N;77°00'W	43°31'N;76°57'W	43°24'N;77°28'W
DATE - 71		8-17	8-17	8-18	8-18
WATER DEPTH - m		8	173	215	201
SAMPLE DEPTHS - m					
0	Pu ²³⁹	0.14 ± 0.02	0.11 ± 0.03	0.08 ± 0.02	0.20 ± 0.06
	Cs ¹³⁷	18.1 ± 11.3	12.7 ± 1.2	15.3 ± 0.5	14.0 ± 12.4
	Sr ⁹⁰	287 ± 15	299 ± 3	266 ± 3	288 ± 3
18	Pu ²³⁹			0.07 ± 0.04	
	Cs ¹³⁷			10.5 ± 1.1	
	Sr ⁹⁰			296 ± 7	
31	Pu ²³⁹		0.14 ± 0.14		
	Cs ¹³⁷		6.2 ± 3.5		
	Sr ⁹⁰		291 ± 4		
49	Pu ²³⁹				0.26 ± 0.03
	Cs ¹³⁷				6.5 ± 5.2
	Sr ⁹⁰				289 ± 11
76	Pu ²³⁹			0.13 ± 0.13	
	Cs ¹³⁷			8.0 ± 1.2	
	Sr ⁹⁰			297 ± 7	
92	Pu ²³⁹		0.23 ± 0.05		
	Cs ¹³⁷		8.4 ± 3.7		
	Sr ⁹⁰		267 ± 2		
153	Pu ²³⁹		0.13 ± 0.08		
	Cs ¹³⁷		8.8 ± 2.3		
	Sr ⁹⁰		295 ± 7		
183	Pu ²³⁹				0.29 ± 0.06
	Cs ¹³⁷				8.8 ± 19.6
	Sr ⁹⁰				283 ± 2
214	Pu ²³⁹			0.23 ± 0.05	
	Cs ¹³⁷			8.4 ± 2.2	
	Sr ⁹⁰			291 ± 7	

TABLE 3

RADIOCHEMICAL ANALYSES OF 1972 LAKE ONTARIO WATER SAMPLES
RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER 100KG

STATION	72-1	72-2	72-3	72-4	72-5
POSITION	43°40'12"N; 76°43'48"W	43°45'00"N; 77°42'00"W	43°38'24"N; 78°30'00"W	43°24'00"N; 79°00'36"W	43°21'30"N; 79°28'48"W
DATE - 72	9-11	9-12	9-12	9-13	9-13
WATER DEPTH - m	140	90	140	90	104
SAMPLE DEPTHS (m)					
Pu239	0.08 ± 0.02	0.13 ± 0.03	----	0.07 ± 0.03	0.07 ± 0.04
0 Cs137	8.4 ± 0.6	8.0 ± 0.6	7.3 ± 0.7	9.5 ± 0.7	7.9 ± 0.6
Sr90	274 ± 2	283 ± 3	268 ± 2	278 ± 6	273 ± 3
12- Pu239			----	0.09 ± 0.02	0.06 ± 0.03
15 Cs137			7.8 ± 0.8	9.5 ± 0.8	9.7 ± 0.5
Sr90			278 ± 3	267 ± 1	271 ± 2
Pu239	0.04 ± 0.02	----			
20 Cs137	8.4 ± 0.6	9.8 ± 0.6			
Sr90	275 ± 5	260 ± 5			
Pu239	----	0.10 ± 0.03			
40 Cs137	7.5 ± 0.6	9.1 ± 0.5			
Sr90	267 ± 2	267 ± 6			
Pu239				0.15 ± 0.03	0.04 ± 0.02
50 Cs137				10.0 ± 0.7	10.0 ± 0.5
Sr90				276 ± 2	276 ± 1
Pu239		0.14 ± 0.01	----	0.22 ± 0.05	
80 Cs137		10.4 ± 0.6	9.1 ± 0.7	9.9 ± 0.8	
Sr90		271 ± 3	272 ± 4	271 ± 1	
Pu239					0.12 ± 0.03
95 Cs137					11.1 ± 0.5
Sr90					294 ± 1
Pu239	0.14 ± 0.01		----		
120- Cs137	6.7 ± 0.7		9.2 ± 0.7		
130 Sr90	277 ± 2		277 ± 3		

TABLE 4

RADIOCHEMICAL ANALYSES OF 1971 LAKE ONTARIO SEDIMENT CORE -- STATION 71-2

RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER KG DRY SEDIMENT

Core Collection Date : 8/17/71
 Location : 43°17'N, 77°28'W
 Water Depth : 36 m
 Core Cross-sectional Area: 28.3 cm²

Depth in Sediment (cm)	Wet/dry Weight	Dry Weight Section (kg)	Pu ²³⁹	Cs ¹³⁷	Sr ⁹⁰	Pu ²³⁸ /Pu ²³⁹
0- 1	1.36	0.036	43.0±3.0	2198±17	---	0.09±0.02
1- 2	1.33	0.045	3.0±1.0	140±11	88± 3	b.d.
2- 3	1.29	0.050	1.3±0.6	89± 9	---	b.d.
3- 4	1.34	0.046	1.2±0.4	55± 9	---	b.d.
4- 5	1.36	0.041	0.7±0.5	18±12	---	b.d.
5- 6	1.36	0.043	<0.5	4±11	4±10	b.d.
6- 7	1.33	0.042	<0.5	-14± 8	---	b.d.
7- 8	1.39	0.045	<0.5	- 8± 8	71±29	b.d.
8- 9	1.41	0.039	<0.7	-12±13	---	b.d.
9-10	1.44	0.042	1.3±0.9	8±28	---	b.d.
10-11	1.46	0.041	0.6±0.4	-22±14	---	b.d.
11-12	1.49	0.038	---	-18±15	---	---
12-13	1.52	0.054	---	-16± 7	---	---
13-14	2.06	0.057	7.5±1.3	434± 7	---	0.09±0.05

b.d. = below detection limits.

TABLE 5

RADIOCHEMICAL ANALYSES OF 1971 LAKE ONTARIO SEDIMENT CORE -- STATION 71-3

RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER KG DRY SEDIMENT

Core Collection Date : 8/17/71
 Location : 43°28'N, 76°57'W
 Water Depth : 173 m
 Core Cross-sectional Area: 260 cm²

Depth in Sediment (cm)	Wet/Dry Weight	Dry Weight Section (Kg)	Pu ²³⁹	*Cs ¹³⁷	Sr ⁹⁰	Pu ²³⁸ /Pu ²³⁹
0- 1	5.95	0.058	3.0±1.0	170± 90	73± 1	1.4 ±0.6
1- 2	4.78	0.068	0.9	150± 80	38± 1	b.d.
2- 3	3.62	0.045	1.0	140	30± 1	1.3
3- 4	3.88	0.050	0.5	300	17± 1	b.d.
4- 5	4.37	0.057	0.8±0.6	90	---	b.d.
5- 6	3.96	0.081	---	110	51± 2	---
6- 7	3.91	0.078	---	100	---	---
7- 8	3.80	0.087	1.0	110	58±12	b.d.
8- 9	3.45	0.098	---	210± 80	---	---
9-10	3.24	0.109	1.4±0.4	150± 80	69± 2	0.03
10-11	3.10	0.105	4.5±1.5	130±100	---	---
11-12	3.07	0.128	5.9±1.2	300± 50	52± 1	0.05±0.03
12-13	2.98	0.130	9.3±1.7	610± 110	---	0.02
13-14	2.88	0.120	8.8±1.4	370± 90	14± 2	0.03
14-15	2.72	0.140	8.8±1.9	560±130	---	0.06
15-16	2.91	0.135	16.4±2.4	680±210	28± 1	0.03±0.02
16-17	2.94	0.146	37.4±2.9	2020±610	---	0.03±0.01
17-18	2.88	0.139	17.0±1.9	870±180	16± 1	0.04±0.02
18-20	2.88	0.243	45.0±2.7	---	---	0.04
20-22	2.61	0.297	12.3±1.9	---	2± 2	0.05
22-24	2.60	0.279	3.6±1.5	---	---	0.03±0.02
24-26	2.50	0.272	3.6±1.5	---	7± 2	0.03±0.03
26-28	2.55	0.302	0.7±0.2	50± 5	---	b.d.
28-30	2.46	0.315	1.5±0.6	83± 5	17± 1	b.d.
30-35	2.29	0.830	0.7±0.3	---	---	b.d.
35-40	2.55	1.137	6.0±2.0	300± 6	13± 1	b.d.

Cs-137 values from 0-18 cm obtained in d.p.m./Kg by multiplying corresponding values in d.p.m./g in 1971-72 Progress Report by 1000.

TABLE 6

RADIOCHEMICAL ANALYSES OF 1971 LAKE ONTARIO SEDIMENT CORE -- STATION 71-4
RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER KG DRY SEDIMENT

Collection Date : 8/17/71
 Location : 43°27'N, 76°35'W
 Water Depth : 76 m
 Core Cross-Sectional Area: 28.3 cm²

Depth in Sediment (cm)	Wet/Dry Weight	Dry Weight Section (Kg)	<u>Pu²³⁹</u>	<u>Cs¹³⁷</u>	<u>Pu²³⁸/Pu²³⁹</u>
0- 1	1.54	0.024	59.6 ± 7.8	2979 ± 14	0.05 ± 0.03
1- 2	1.32	0.034		88 ± 12	
2- 3	1.34	0.032		8 ± 15	
3- 4	1.42	0.036		-27 ± 14	
4- 5	1.45	0.031		-38 ± 13	
5- 6	1.44	0.036	0 ± 0.08	54 ± 18	
6- 7	1.46	0.026		51 ± 18	
7- 8	1.50	0.030		36 ± 15	
8- 9	1.42	0.031		33 ± 19	
9-10	1.39	0.033		62 ± 12	
10-11	1.40	0.030		-27 ± 12	
11-12	1.44	0.032		3 ± 14	
12-13	1.50	0.026		-15 ± 14	
13-14	1.54	0.028		4 ± 14	
14-15	1.52	0.021		-16 ± 14	
15-16	1.52	0.031		26 ± 15	
16-17	1.50	0.026		-14 ± 15	
17-18	1.46	0.028		-31 ± 16	
18-19	1.48	0.025		-23 ± 17	
19-20	1.54	0.026		---	
20-21	1.52	0.029		75 ± 19	
21-22	1.47	0.030		-7 ± 19	
22-23	1.43	0.030		-28 ± 16	
23-24	1.12	0.033		-21 ± 14	
24-25	1.41	0.027		-28 ± 17	
25-26	1.47	0.030		-33 ± 20	
26-27	1.42	0.026		-28 ± 19	
27-28	1.15	0.034		-21 ± 16	
28-29	1.46	0.026		-24 ± 20	
29-30	1.44	0.034		-31 ± 19	
30-31	1.39	0.031		-18 ± 20	
31-32	1.43	0.023		-31 ± 26	

TABLE 7

RADIOCHEMICAL ANALYSES OF 1971 LAKE ONTARIO SEDIMENT CORE -- STATION 71-5

RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER KG DRY SEDIMENT

Core Collection Date: 8/18/71

Location: 43°30'N; 76°57'W

Water depth: 215 m

Core cross-sectional area: 260 cm²

Depth in Sediment (cm)	Wet/dry Weight	Dry Weight Section (kg)	Pu ²³⁹	Cs ¹³⁷	Sr ⁹⁰	Pu ²³⁸ /Pu ²³⁹
0-1	6.18	0.141	27.6 ± 1.4	1033 ± 8	53 ± 2	0.03 ± 0.01
1-3	7.11	0.157	40.9 ± 3.7	945 ± 7	127 ± 1	0.03 ± 0.01
3-4	5.20	0.094	48.2 ± 2.2	1402 ± 10	----	0.06 ± 0.01
4-5	4.53	0.090	49.8 ± 5.6	2377 ± 43	126 ± 1	<0.03
5-6	3.31	0.126	37.8 ± 2.3	994 ± 9	----	0.05 ± 0.01
6-7	3.58	0.091	28.2 ± 2.3	490 ± 30	37 ± 5	<0.06
7-8	3.57	0.164	20.4 ± 1.9	640 ± 20	----	<0.03
8-9	3.83	0.109	9.0 ± 1.2	268 ± 10	36 ± 2	<0.05
9-10	3.90	0.126	4.6 ± 0.6	139 ± 5	----	<0.02
10-11	3.84	0.127	5.1 ± 1.0	148 ± 12	43 ± 1	<0.04
11-12	3.50	0.121	9.8 ± 1.1	275 ± 6	----	<0.05
12-13	3.45	0.144	10.6 ± 1.2	339 ± 8	24 ± 4	<0.04
13-14	3.36	0.101	12.4 ± 1.2	545 ± 7	----	<0.02
14-15	3.76	0.124	26.8 ± 2.3	1114 ± 7	30 ± 15	0.04 ± 0.02
15-16	3.67	0.129	14.9 ± 3.2	820 ± 10	----	
<hr/>						
18-20	3.43	0.226	36.6 ± 4.0	1350 ± 19	----	
20-22	4.58	0.170	16.2 ± 1.3	517 ± 5	----	0.03 ± 0.01
22-24	4.61	0.159	21.5 ± 1.6	764 ± 5	----	0.03 ± 0.01
24-26	4.32	0.196	----	704 ± 6	----	
26-28	4.30	0.185	----	560 ± 4	----	
28-30	4.48	0.155	----	693 ± 4	----	
30-35	3.15	0.580	----	509 ± 4	----	
35-40	2.84	0.670	8.2 ± 1.1	364 ± 5	----	0.06 ± 0.03

TABLE 8A

RADIOCHEMICAL ANALYSES OF 1972 LAKE ONTARIO SEDIMENT CORE - STATION 72-1

RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER KG DRY SEDIMENT

CORE COLLECTION DATE: 9/11/72
 LOCATION: 43°40'12"N; 76°43'48"W
 WATER DEPTH: 140 m
 CORE CROSS-SECTIONAL AREA: 285 cm²

Depth in Sediment(cm)	Wet/dry Weight	Dry Weight Section(kg)	Pu ²³⁹	Cs ¹³⁷
0-1	11.63	0.008	<0.5	27 ± 35
1-2	4.24	0.042	<0.5	35 ± 18
2-3	3.38	0.114	<0.5	-1 ± 7
3-4	2.95	0.078	<0.5	2 ± 9
4-5	2.91	0.159	<0.5	-4 ± 6
5-6	2.81	0.135	<0.5	-10 ± 6
6-7	2.77	0.165	<0.5	-7 ± 5
7-8	2.81	0.227	<0.5	-4 ± 6
8-9	2.71	0.136	<0.5	-3 ± 6
9-10	2.69	0.118	<0.5	-5 ± 5
10-11	3.00	0.148	<0.5	13 ± 4
11-12	2.83	0.109	0.7 ± 0.3	-5 ± 4
12-13	2.90	0.143	<0.5	-8 ± 5
13-14	2.68	0.104	<0.5	-11 ± 4
14-16	2.82	0.241	<0.5	-7 ± 4
16-18	3.05	0.259	0.5 ± 0.3	-7 ± 7
18-19	2.73	0.169	<0.5	-6 ± 6
19-20	2.87	0.149	<0.5	-5 ± 9
20-21	2.84	0.145	....	4 ± 5
21-22	2.83	0.128	....	0 ± 6
22-23	2.77	0.129	....	0 ± 5
23-24	2.77	0.141	....	1 ± 12
24-25	2.94	0.126	....	7 ± 5
25-26	3.22	0.130	<0.5	-3 ± 6
26-27	2.95	0.143	....	2 ± 5
27-28	2.85	0.141	<0.5	2 ± 7
28-29	2.78	0.147	....	0 ± 7
29-30	2.81	0.149	<0.5	-2 ± 9
30-31	2.88	0.161	....	53 ± 7
31-32	2.88	0.166	<0.5	13 ± 12
32-33	2.82	0.149	....	14 ± 6
33-34	2.83	0.141	<0.5	3 ± 7
....				
37-38	2.77	0.143	....	-1 ± 6
....				
42-43	2.75	0.155	....	-4 ± 7
....				
47-48	2.68	0.142	....	2 ± 5
51-64	2.01	2.322	....	11 ± 6

TABLE 8B

RADIOCHEMICAL ANALYSES OF LAKE ONTARIO SEDIMENT CORE -- STATION 72-4

RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER KG DRY SEDIMENT

Core Collection Date: 9/13/72
Location: 43°24'00"N, 79°00'36"W
Water Depth: 90 m
Core Cross-Sectional Area: 285 cm²

<u>Depth in Sediment (cm)</u>	<u>Wet/Dry Weight</u>	<u>Dry Weight Section (Kg)</u>	<u>Pu²³⁹</u>	<u>Cs¹³⁷</u>	<u>Pu²³⁸/Pu²³⁹</u>
0-2	9.02	0.046	459.5 ± 18.5	13548 ± 31	0.033 ± 0.007
2-3	4.84	0.037	193.5 ± 20.3	6614 ± 27	0.077 ± 0.030
3-4	4.10	0.041	108.6 ± 8.1	3497 ± 19	0.028 ± 0.013
4-5	3.42	0.067	40.0 ± 3.7	1201 ± 10	0.026 ± 0.015

TABLE 9

RADIOCHEMICAL ANALYSES OF 1972 LAKE ONTARIO SEDIMENT CORE - STATION 72-5

RADIONUCLIDES IN DISINTEGRATIONS PER MINUTE PER KG DRY SEDIMENT

CORE COLLECTION DATE: 9/13/72
 LOCATION: 43°21'36"N; 79°28'48"W
 WATER DEPTH: 104 m
 CORE CROSS-SECTIONAL AREA: 285 cm²

Depth in Sediment(cm)	Wet/dry Weight	Dry Weight Section(kg)	Pu ²³⁹	Cs ¹³⁷	Pu ²³⁸ /Pu ²³⁹
0-1	8.93	0.030	294.8 ± 6.2	10593 ± 41	0.026 ± 0.003
1-2	4.58	0.040	166.1 ± 7.2	7554 ± 22	0.025 ± 0.007
2-3	3.87	0.077	45.9 ± 2.7	3277 ± 12	0.035 ± 0.010
3-4	3.16	0.104	10.3 ± 1.3	712 ± 6	0.033 ± 0.024
4-5	2.84	0.106	3.7 ± 0.8	126 ± 10	
5-6	2.56	0.097	0.4 ± 0.3	30 ± 4	
6-7	2.46	0.129	1.6 ± 0.6	62 ± 7	
7-8	2.72	0.138	1.3 ± 0.4	34 ± 5	
8-9	2.50	0.140	0.3 ± 0.2	16 ± 9	
9-10	2.73	0.128	0.2 ± 0.2	32 ± 7	
10-11	2.78	0.136	1.0 ± 0.4	74 ± 6	
11-12	2.69	0.160	0.2 ± 0.2	111 ± 40	
12-13	2.81	0.140	1.8 ± 0.5	99 ± 9	
13-14	2.76	0.157	0.5 ± 0.3	-----	
14-15	2.77	0.137	.....	32 ± 7	
15-16	2.80	0.128	.....	48 ± 7	
16-17	2.76	0.142	.....	93 ± 6	
17-18	2.90	0.169	1.0 ± 0.4	104 ± 5	
18-19	2.84	0.140	.....	112 ± 12	
19-20	2.70	0.142	0.8 ± 0.4	42 ± 6	
20-21	2.86	0.138	2.4 ± 0.6	71 ± 9	
21-22	2.91	0.158	2.5 ± 0.7	133 ± 12	
22-23	2.88	0.130	3.1 ± 0.5	79 ± 5	
23-24	2.88	0.164	1.3 ± 0.5	94 ± 5	
24-25	2.87	0.141	4.1 ± 0.6	241 ± 7	
25-26	2.89	0.162	4.0 ± 0.6	187 ± 16	
26-27	2.76	0.126	4.7 ± 0.8	193 ± 6	
27-28	2.88	0.180	.....	219 ± 8	
.....					
29-30	2.84	0.161	1.3 ± 0.5	.....	
.....					
37-38	2.78	0.148	1.3 ± 0.4	68 ± 15	
.....					
45-46	2.66	0.143	1.0 ± 0.4	27 ± 11	
.....					
51-61	1.48	2.240	2.4 ± 0.7	43 ± 7	

TABLE 10

RADIOCHEMICAL DATA ON 1972 BIOLOGICAL MATERIAL

(See Table 1 for other information on samples)

<u>Sample</u>	<u>Identification</u>	<u>Wet Wgt (kg)</u>	<u>Dry Wgt (kg)</u>	<u>-dpm per kg wet - Pu-239</u>	<u>Cs-137</u>
Plankton	72-1	---	0.013	0.18 ± 0.09	22 ± 4
"	72-2	---	0.0154	0.03 ± 0.03	15 ± 2
"	72-3	---	0.0116	0.14 ± 0.08	5 ± 3
"	72-4	---	0.0127	0 ± 0.04	7 ± 2
"	72-5	---	0.0112	0.16 ± 0.08	10 ± 2
Alewives	Port Credit	1.079	0.284	0 ± 0.02	149 ± 1
"	Mexico Bay (composite)	2.554	0.627	0.03 ± 0.02	67 ± 1
"	Olcott	1.850	0.516	0.06 ± 0.06	141 ± 1
"	Prince Edward Point	1.363	0.328	0.04 ± 0.02	110 ± 1
Smelt	Mexico Bay	1.323	0.309	0.28 ± 0.28	298 ± 1
"	Prince Edward Point	1.353	0.298		179 ± 1
"	Olcott	1.091	0.240	0.02 ± 0.02	86 ± 1
"	Rochester	1.261	0.277	Lost	Lost
Slimy Sculpin	Mexico Bay	0.981	0.245	0.20 ± 0.14	2 ± 1
Unionid Clams	Cape Vincent				
Soft Parts		0.803	0.092	0.80 ± 0.17	30 ± 1
Shells		1.658	1.548	1.48 ± 0.49	8 ± 1
Carp sucker	East End				
Meat					
Bones		0.3079	0.1105		202 ± 1
Liver		0.0225	0.0047		38 ± 10
Guts					
Bluegill	East End	0.5043	0.2194	0.04 ± 0.03	326 ± 1
Smallmouth Bass	" "				
Backbone		0.087	0.034		536 ± 4
Gills		0.085	0.023		383 ± 4
Liver		0.028	0.007		530 ± 8
Guts		0.105	0.024		545 ± 4
Roe		0.162	0.059	0. ± 0.28	240 ± 2

TABLE 10 (Continued - 2)

<u>Sample</u>	<u>Identification</u>	<u>Wet Wgt (kg)</u>	<u>Dry Wgt (kg)</u>	<u>- dpm per kg wet - Pu-239</u>	<u>Cs-137</u>
Largemouth Bass	East End				
Meat		0.585	0.140	0.06 ± 0.03	468 ± 1
Bones		0.080	0.024	0.12 ± 0.06	499 ± 4
Liver		0.010	0.008	0 ± 0.50	500 ± 300
Guts		0.044	0.008	0 ± 0.32	395 ± 15
Black Crappie	East End	0.465	0.163	0.23 ± 0.23	41 ± 9
American Eel					
Whole, fronthalf	" "	0.968	0.361		257 ± 1
Liver		0.018	0.005		832 ± 18
Guts		0.105	0.041		280 ± 3
Cord		0.145	0.072	0 ± 0.06	505 ± 3
White Perch	East End				
Bones		0.074	0.031	0 ± 0.18	Lost
Gills		0.052	0.014	0 ± 0.13	343 ± 5
Liver		0.026	0.006	0 ± 0.48	1224 ± 8
Guts		0.068	0.023	0.12 ± 0.12	307 ± 3
Roe		0.110	0.032	0 ± 2.0	479 ± 3
Longnose Gar	East End	0.942	0.352	0.09 ± 0.09	271 ± 1
Brown Bullhead	" "				
Meat		0.681	0.143	0 ± 0.03	23 ± 1
Bones		0.228	0.057	0.08 ± 0.08	457 ± 2
Liver		0.033	0.006	0 ± 0.79	277 ± 7
Guts		0.118	0.022	0 ± 0.34	310 ± 4
Yellow Perch	Extreme East				
Meat		1.168	0.301	0.02 ± 0.01	111 ± 2
Bones		0.279	0.068	0.02 ± 0.02	816 ± 2
Liver		0.019	0.005	0 ± 0.68	395 ± 20
Guts		0.178	0.052	0.06 ± 0.04	274 ± 4
Carp	Extreme East				
Meat					
Bones		0.3415	0.0801	0.02 ± 0.02	243 ± 1
Guts & Liver		0.2425	0.0803	0.26 ± 0.09	164 ± 2
Roe		0.5128	0.1626		109 ± 2

TABLE 10 (Continued - 3)

<u>Sample</u>	<u>Identification</u>	<u>Wet Wgt (kg)</u>	<u>Dry Wgt (kg)</u>	<u>- dpm per kg wet -</u>	
				<u>Pu-239</u>	<u>Cs-137</u>
Fresh-Water Drum	Extreme East				
Meat		1.316	0.386	0.02 ± 0.01	321 ± 1
Bones		0.214	0.074	0.04 ± 0.04	336 ± 11
Liver		0.033	0.008	0.26 ± 0.18	285 ± 95
Guts		0.144	0.053	0.06 ± 0.06	317 ± 2
Gizzard Shad	Extreme East				
Meat		1.307	0.132	0.12 ± 0.04	189 ± 1
Bones		0.284	0.070	0.02 ± 0.02	70 ± 3
Guts & Liver		0.157	0.085	5.7 ± 0.6	240 ± 3
Northern Pike	Extreme East				
Meat		2.050	0.475		156 ± 1
Bones		0.229	0.084		297 ± 2
Liver		0.045	0.014	0.58 ± 0.58	336 ± 6
Guts		0.150	0.050		230 ± 4
Roe		0.091	0.017		897 ± 6
Redhorse Sucker	Extreme East				
Meat		1.309	0.336	0.10 ± 0.04	120 ± 1
Bones		0.164	0.051	0.18 ± 0.18	132 ± 2
Guts & Liver		0.196	0.079	0.07 ± 0.07	1110 ± 12
Roe		0.200	0.060		275 ± 2
Coho Salmon	Extreme East				
Meat		1.4469	0.3203		292 ± 1
Bones		0.2026	0.0553		273 ± 2
Liver		0.0329	0.0097	0.14 ± 0.14	769 ± 8
Guts					
Roe		0.4434	0.1842		22 ± 1
Chinook Salmon	Not Recorded				
Meat					
Bones		0.1008	0.0806		338 ± 2
Liver		0.0439	0.0107		259 ± 5
Guts		0.4602	0.096	0 ± 0.02	333 ± 1

TABLE 11

QUALITY CONTROL DATA

 ^{137}Cs and ^{90}Sr Analyses of Replicate Samples from Woods Hole Harbor

Description	Analyst	- dpm per 100 Liters -		$^{137}\text{Cs}/^{90}\text{Sr}$ Ratio
		^{137}Cs	^{90}Sr	
November 1969	TPA	51.9 ± 1.1 (6)	43.1 ± 1 (6)	1.20
November 1969	WHOI	48.6 ± 1 (8)	49.3 ± 1 (8)	0.99
September 1971	TW	49.0 ± 1.1 (7)	45.9 ± 1.6 (7)	1.07
September 1971	WHOI	48.4 ± 1 (2)	43.1 ± 0.6 (2)	1.22
July 1972	WHOI	39.4 ± 0.3 (3)	37.6 ± 0.8 (3)	1.05
	TPA	38 ± 1 (1)	3.7 ± 1 (1)	1.03
November 1972	TW	38.6 ± 2 (10)	38.7 ± 2 (10)	1.0
	WHOI	37.6 ± 2 (2)	38 ± 2 (2)	0.99

TABLE 12
ANALYSES OF BLANK SAMPLES

Description	Analyst	dpm per Sample	
		¹³⁷ Cs	⁹⁰ Sr
Own Reagent Blanks:	WH 5002	-0.1 ± 0.2	
	5003	-0.2 ± 0.1	
	641	0 ± 0.2	0 ± 0.4
	618	-0.2 ± 0.2	0.5 ± 0.1
	596	1.8 ± 0.2	2.3 ± 0.2
	571	-0.4 ± 0.3	0.3 ± 0.3
	549	0.5 ± 0.2	0.4 ± 0.1
	514	-0.5 ± 0.2	0.2 ± 0.4
	494	-0.4 ± 0.2	-0.2 ± 0.1
	471	-0.71 ± 0.24	-0.4 ± 1.1
	462	-0.1 ± 0.2	Lost
	455	0.0 ± 0.3	Lost
	443	+0.2 ± 0.3	Lost
	431	-0.2 ± 0.3	Lost
	419	-0.1 ± 0.2	0.5 ± 0.1
	407	-0.2 ± 0.3	0.5 ± 0.3
	398	0.1 ± 0.3	1.6 ± 0.5
	387	0.1 ± 0.4	Lost
	367	-0.3 ± 0.3	1.2 ± 0.6
	355	0.2 ± 0.3	0.2 ± 0.1
	339	-0.1 ± 0.3	0.3 ± 0.3
	326	0.0 ± 0.4	0.3 ± 0.2
	299	0.2 ± 0.2	0.1 ± 0.3
	Mean	-0.02	0.52
	TW M51		0.2 ± 0.1
	N51	0.3 ± 0.2	0.7 ± 0.5
	N52	0.2 ± 0.2	0.7 ± 0.4
	N53	0.4 ± 0.2	0 ± 0.9
	Mean	0.3 ± 0.2	0.4 ± 0.3
	TPA-Mean Data*	0 ± 0.3 (5)	0 ± 0.4 (5)

* Individual data not available.

TABLE 12 (Continued)

Description	Analyst ¹	dpm per 100 L.	
		¹³⁷ Cs	⁹⁰ Sr
Oil-well Brine	TPA 1813	<1.0	<0.3
	TPA 1836	<0.3	<0.4
	WH 680	14.2 ± 0.7	
	WH 603	0.3 ± 0.5	0.7 ± 0.2
	WH 604		-0.7 ± 0.7
	WH 408	-0.1 ± 0.3	3.4 ± 0.4
	WH 409	0.2 ± 0.4	2.6 ± 0.8
	WH 323	0.2 ± 0.4	0.2 ± 0.1
	WH 324	0.4 ± 0.4	0.6 ± 0.1
	WH 325	0.1 ± 0.4	0.3 ± 0.1
	Mean	0.70	0.84
Coney Island Well Water	TPA 1814	<0.4	
	TPA 724	<0.4	
	TW 1914	0.8 ± 0.5	
	WH 631	0.32 ± 0.34	
	WH 524	-0.2 ± 0.4	
	WH 525	-1.0 ± 0.7	
	WH 351	0.2 ± 0.2	
	WH 352	0.3 ± 0.3	
	WH	0.3 ± 0.3	
	TPA FY72Q	<0.4	
	TW FY72Q	0.5 ± 0.7	
	Mean	0.1 ± 0.4	

Figure 1:

Chart of Lake Ontario, North America, showing locations of samples
collected in 1971 and 1972 for study of plutonium distributions