Mercury in Fish from Rivers and Lakes in Southwestern Northwest Territories

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B.J. Grey[1†], S.M. Harbicht[2‡] and G.R. Stephens[1]

[1] Department of Indian Affairs and Northern Development, Yellowknife
[2] Department of Fisheries and Oceans, Yellowknife

[†]Now at the Department of Indian Affairs and Northern Development, Ottawa
[‡] Now at the Department of the Environment, Yellowknife

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EXECUTIVE SUMMARY

This report presents and interprets data on mercury contamination in fish from the Slave and Hay Rivers in southwestern Northwest Territories. Fish were also sampled from a study control site, Leland Lake, in the Slave River basin. The original purpose of this study was to assess water quality in the Slave River including mercury levels. Since it is difficult to accurately measure mercury in the water column, fish were selected as the measurement medium. Mercury data from fish tissues were provided to Health Canada (formerly Health and Welfare Canada) for health evaluations related to dietary consumption.

Walleye, pike and lake whitefish were sampled over three years (1988 to 1990). These three species were selected because of their importance to local residents for subsistence fishing. Total mercury concentrations were determined in the samples, with methylmercury concentrations determined in a random subset. Based on this subset, approximately 90% of the total mercury concentration was methylmercury.

The relationship between mercury concentration and fish age showed differences between locations and species. Correlations indicated significant relationships between mercury concentrations and age in walleye and whitefish from Leland Lake and in pike from the Hay River.

Mercury concentrations in walleye and pike were similar at all three sites. This trend was also observed for mercury concentrations in whitefish, however levels were substantially lower. This difference among species is attributed to differences in trophic level among the study species. At the Slave River, walleye and pike had the same average mercury concentration (0.34 ppm) with substantially lower concentrations found in whitefish (0.08 ppm). In the Hay River, the highest average mercury concentrations were found in pike (0.32 ppm) followed by walleye

(0.22 ppm) and whitefish (0.07 ppm) respectively. The Leland Lake walleye contained higher average concentrations (0.46 ppm) than pike (0.34 ppm) and whitefish (0.11 ppm).

Overall, mercury concentrations in pike varied the least between sites, ranging on average from 0.32 - 0.34 ppm. This would indicate that fish from the Slave and Hay Rivers are not being affected by upstream sources.

Slave River, Hay River and Leland Lake fish contained lower mercury concentrations compared to the same species at other sites (commercial fisheries database) in the southwestern Northwest Territories. The regional pattern for mercury contamination did not appear to indicate the presence of anthropogenic point sources of mercury. In fact, the highest mercury concentrations were observed in fish from remote lakes and may therefore reflect geological sources or atmospheric deposition. This confirms other findings of mercury in fish from waters in the Peace and Athabasca basins, and elsewhere in Alberta. Although a few individual fish at the study sites did contain mercury concentrations at or above the Canadian guideline for human consumption, average mercury concentrations for each species were below the guideline.

SOMMAIRE

Le rapport qui suit présente et interprète des données sur la contamination du poisson par le mercure provenant des rivières Slave et Hay, dans le sud-ouest des Territoires du Nord-Ouest. On a également échantillonné des poissons du lac Leland dans le bassin de la rivière Slave, site témoin de l'étude. Le but initial de l'étude était d'évaluer la qualité de l'eau de la rivière Slave, incluant le taux de mercure. Comme il est difficile de mesurer avec précision quelle quantité de cette substance se trouve dans une colonne d'eau, on a choisi d'utiliser des poissons pour déterminer ce taux. Les données sur le mercure provenant des tissus de poissons ont été fournies à Santé Canada (anciennement Santé et Bien-être social Canada) pour que ce ministère vérifie si ces espèces de poissons peuvent être consommées sans danger.

Pendant trois ans (de 1988 à 1990), des échantillons de doré, de brochet et de grand corégone ont été prélevés. Ces trois espèces ont été sélectionnées en raison de leur importance pour la subsistance des résidants de la région qui les pêchent. On a dosé le mercure total des échantillons et le méthylmercure à partir d'un sous-ensemble choisi au hasard. Ceci a permis d'établir qu'environ 90 p. 100 du mercure total était présent sous forme de méthylmercure.

Le rapport entre la concentration de mercure et l'âge du poisson permettait d'observer des différences selon les lieux et les espèces. Pour le doré, le grand corégone du lac Leland de même que pour le brochet de la rivière Hay, des corrélations indiquaient l'existence d'une relation significative entre l'âge du poisson et les concentrations de mercure présent dans ses tissus.

Les concentrations de mercure chez le doré et le brochet étaient semblables aux trois sites; on observait la même tendance pour les concentrations de mercure chez le grand corégone, avec toutefois des niveaux beaucoup plus faibles. On attribue cette différence entre les espèces à des différences de niveau trophique chez celles étudiées. Aux sites de la rivière Slave, on observait

la même concentration moyenne de mercure chez le doré et le brochet (0,34 ppm), alors que des concentrations beaucoup plus faibles étaient notées chez le grand corégone (0,08 ppm). Dans la rivière Hay, on observait les concentrations moyennes de mercure les plus élevées respectivement chez le brochet (0,32 ppm), le doré (0,22 ppm) et le grand corégone (0,07 ppm). Le doré du lac Leland contenait des concentrations moyennes de mercure plus élevées (0,46 ppm) que celles du brochet (0,34 ppm) et du grand corégone (0,11 ppm).

Dans l'ensemble, les concentrations de mercure chez le brochet étaient celles qui présentaient le moins de variations selon les sites, étant comprises en moyenne entre 0,32 et 0,34 ppm. Ceci indiquerait que les poissons des rivières Slave et Hay ne sont pas touchés par un contaminant provenant de l'amont.

Les poissons de la rivière Slave, de la rivière Hay et du lac Leland contenaient des concentrations de mercure inférieures à celles des mêmes espèces observées à d'autres sites (base de données des pêches commerciales) du sud-ouest des Territoires du Nord-Ouest. Le profil régional de la contamination par le mercure ne semblait pas indiquer la présence de sources ponctuelles de mercure d'origine anthropique. En fait, les concentrations de mercure les plus élevées étaient observées chez les poissons des lacs éloignés, ce qui peut donc refléter l'effet de sources géologiques ou de dépôts atmosphériques. Cette constatation vient étayer d'autres observations sur le mercure mesuré chez les poissons des bassins des rivières Peace et Athabasca, et d'ailleurs en Alberta. Bien qu'on ait remarqué, chez un petit nombre de spécimens provenant des sites de notre étude, des concentrations de mercure atteignant ou dépassant les limites établies pour la consommation humaine dans les lignes directrices canadiennes, les concentrations moyennes de mercure pour chaque espèce étaient inférieures aux valeurs des lignes directrices.

TABLE OF CONTENTS

PART II HEALTH EVALUATION

LIST OF FIGURES

LIST OF TABLES

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PART I
THE STUDY

1.0 INTRODUCTION

The contamination of water bodies with mercury has been a problem for a long time. Much of the mercury is from natural sources. Mercury deposits occur in all types of rocks (for example, igneous, sedimentary and metamorphic) and can be released from metalliferous sectors of these rocks. In addition, mercury is present in, and can be deposited from, the atmosphere where it exists as metallic vapours and volatilized organic mercury compounds (several examples are referenced in Lindqvist, 1991). Some anthropogenic point sources of mercury contamination still exist, such as wastes from smelting operations, discarded equipment containing mercury, combustion of fossil fuels and a number of pesticides. Anthropogenic sources in some localities are more ecologically significant than natural sources. A detailed description of the sources and transport mechanisms of mercury can be found in the National Research Council of Canada report, *Effects of Mercury in the Canadian Environment* (NRCC, 1979).

The natural levels of mercury in surface waters vary regionally, with western Canada generally having higher values than the central and Pacific regions (CCREM, 1987). Sediment mercury concentrations also vary, with organic sediments containing higher concentrations than inorganic sediments. Mercury in water and sediment exists mainly in the inorganic form with the sediment usually acting as a sink for mercury entering a drainage basin. As a result, mercury can be liberated from sediment via methylation and potentially pollute long after anthropogenic inputs have ceased.

The purpose of this report is to present the mercury data from a variety of fish collected from 1988 to 1990 from the Slave and Hay Rivers in the southern part of the Mackenzie Basin, in the Northwest Territories (NWT). The rationale for the study has changed over the years. The original study was initiated as a result of discussions and negotiations held by the technical committee of the Alberta-NWT Transboundary Water Management Agreement. In response to the need to establish the existing levels of contaminants in the Slave River, members of the technical committee agreed to measure a wide range of contaminants in the aquatic ecosystem. Fish were chosen to measure mercury because it accumulates over time in biotic tissues, and thus can be measured even when undetected in water or sediment. The Department of Indian Affairs and Northern Development (DIAND) then developed a program to measure the levels of mercury in fish from the Slave River. The program was similar to a number of studies on mercury in fish done in Alberta (Alberta Environment Centre, 1983, 1984; and Moore et al., 1986). This meant that a comparative database existed against which to evaluate the state of NWT (Slave River) fish, with respect to upstream sources of potential contamination.

The initial study was funded by the Northern Water Resources Studies Program of DIAND, with the support of the Department of Fisheries and Oceans (DFO). In 1988, fish were collected at the Slave River site alone. The resulting data were given to the NWT Department of Health who arranged to have a health assessment done by the Medical Services Branch of Health and Welfare Canada (now Health Canada). No recommendations on dietary restrictions were made, but further monitoring was recommended.

The study was expanded in 1989 to include fish from the Hay River, as well as from Leland Lake (a control site) which is part of the Slave River system. Leland Lake was considered the control site because there was no possibility of the fish moving between the two rivers and Leland Lake.

In 1990, this study became part of a much larger one to characterize the baseline ecological conditions of the Slave River near the Alberta-NWT border. The Slave River Environmental Monitoring Program is an ongoing Arctic Environmental Strategy study that involves the measurement of a variety of contaminants in water, sediment and fish. The 1990 mercury levels were from fish from the same sites as in the 1989 research.

This report summarizes the data from all three years, and attempts to present a regional context by comparing the data to other data from the NWT obtained through DFO's commercial fisheries testing program. In addition, the report presents the data in a format suitable for a health assessment by Health Canada (HC) as a follow-up to the interim evaluation of the 1988 data.

1.1 NATURE OF MERCURY

1.1.1 PHYSICAL PROPERTIES

Mercury is a metal found naturally in volcanic areas, and is associated with the weathering and erosion of many types of rocks. Within the southern NWT, there are several geological zones with relatively high mercury content. The edge of the Canadian Shield is one such zone, with particularly elevated areas of geochemical mercury found around Great Bear and Great Slave Lakes in the NWT, Lake Athabasca in Alberta (Cameron and Jonasson, 1972) and the Rocky Mountains of B.C. and Yukon. The off-Shield headwaters of the Mackenzie River basin constitute another broad band of high mercury mineralization (Jonasson and Sangster, 1974).

In a Swedish study, Meili (1991a) reported that the majority of the mercury load into forest lakes results from atmospheric deposition onto catchment soils and subsequent transport into streams. The contribution from bedrock erosion is small. Of the mercury transported atmospherically, part is from natural sources, through degassing and weathering of the earth's crust, volatilization of inorganic mercury from exposed soil, and volcanic action. Further Scandinavian studies (such as Johansson et al., 1991, and Meili, 1991b) have detected an increase in atmospheric deposition (and, hence, transport) over the past hundred years. These increases are associated with anthropogenic sources from industrialized Europe.

Mercury in water and sediment exists mainly in an inorganic form. However, anaerobic conditions in water bodies, especially in the presence of a high organic load, are conducive to converting inorganic mercury to an organic state by bacterial methylation. As a result of this methylation, much of the mercury adsorbed to sediment particles can become bioavailable and be absorbed into the tissues of detritivores. Concentrations are generally higher in piscivores or predatory fish (CCREM, 1987) because mercury bioaccumates and biomagnifies. Most of the mercury found in fish tissues is organic (Bloom, 1992).

1.1.2 HUMAN HEALTH ASPECTS

The health hazards of mercury consumed in the diet have been well documented (Tsubaki and Irukayama, 1977). Mercury acts as an enzyme and protein inhibitor which can lead to neurological illnesses that affect vision, speech, hearing and coordination. It may also cause some birth defects and result in death, as observed after prolonged consumption of heavily contaminated fish in Minamata, Japan. Less severe cases than those in Japan have occurred elsewhere (Health and Welfare Canada, 1979) and the response of health authorities has been to establish guidelines for mercury levels in fish and issue consumption guidelines in several jurisdictions.

In Canada, the Health Protection Branch of HC has established an acceptable marketing limit of 0.5 ppm for total mercury concentration in fish products. The recommended guideline for frequent consumption of fish is 0.2 ppm. For the purposes of health evaluations it is assumed that total mercury in a fish is equivalent to the organic mercury.

Data collected in this study confirm this assumption. Figure 1 plots total mercury against methylmercury for all data 1988-1990 and shows a positive correlation ($r = 0.987$, $p = 0.0000$). In this data set, most of the fish (48 of 55) had methylmercury concentrations which were greater than 70% of total mercury concentrations. Of the seven fish with lower methylmercury concentrations, all were whitefish. Overall, methylmercury made up 88% of the total mercury concentration. This high percentage justifies the use of total mercury rather than methylmercury values in health assessments.

1.2 STUDY HYPOTHESES

The original transboundary focus of this study determined the sampling locations. The Slave River at Fort Smith is a suitable location to detect any waterborne contamination entering the NWT from areas upstream in Alberta in the Mackenzie River drainage basin. Originally it was believed that the mercury detected in NWT fish was associated with industrial point-source inputs in Alberta. In the past, potential anthropogenic sources of mercury in Alberta were associated with chlorine production at pulp mills, pesticides for agriculture and forestry, and direct use of mercury by industry. For the most part, these point sources ceased in the early 1970s. Another downstream source is organic loading from pulp mills with high biological oxygen demand effluent that stimulates mercury methylation. Inorganic mercury is also released from volcanic and other metalliferous rocks found in the Cordillera and the Canadian Shield. Conditions conducive to conversion of inorganic mercury to methylmercury are prevalent in the waters of northern Alberta and southwestern NWT.

All of the above factors were considered in the design of the 1989 and 1990 sampling programs. A site on the Hay River was sampled to represent another large, north-flowing river with its headwaters in Alberta. Fish were also taken from Leland Lake, located in the Slave River watershed. The latter location can be considered a control site because it provided the same fish species for comparison, but is not open to upstream influences. It is also useful as a site at which to monitor the long range transport of atmospheric pollutants in fish sampled for other purposes.

This study will consider the following:

- differences in mercury concentrations between three fish species;
- differences in fish mercury concentrations between three locations; and
- comparisons of mercury concentrations in this study with other NWT studies.

The underlying hypothesis is that the fish from the Slave River and Hay River will contain higher mercury levels than fish from a location not influenced by upstream development (i.e. Leland Lake). The second hypothesis is that fish that feed on other fish will contain higher mercury levels because of biomagnification (i.e. walleye and pike having higher values than whitefish). The third hypothesis is that the mercury concentration of fish will increase with age.

2.0 METHODOLOGY

2.1 FIELD SAMPLING

Samples of dorsal muscle tissue were taken from walleye (*Stizostedion vitreum vitreum*), northern pike (*Esox lucius*) and lake whitefish (*Coregonus clupeaformis*) collected from the Slave River, the Hay River and Leland Lake (Figure 2). Sampling was conducted during the open water season for each location, as this offers the best opportunity of obtaining the desired species. Bottom set gill nets of 89 and 114 mm mesh size were used. Net lengths varied with sites, however the gill nets generally did not exceed 46 m in length. In the Slave River, 23 m nets were used at some locations due to high water velocities.

The Slave River sample locations were immediately downstream from the Rapids of the Drowned and within eddies where local people fish. Leland Lake was sampled at the north end. The Hay River was sampled along the east side of Vale Island which is located at the mouth of the river, near where it enters Great Slave Lake.

The following procedures were followed to minimize contamination of fish tissue samples:

- fish were removed from the nets within a 24-hour period and placed on ice;
- all biological information such as fork length, weight, sex and level of maturity was obtained as soon as possible upon removal from the net;
- a stainless steel knife was used for dissection and removal of the tissue sample; and
- approximately 100-150 g of muscle tissue (with skin and rib bones) was removed from each fish and placed into a whirl pak bag.

All samples were labelled on the outside of the whirl pak and all tissues were frozen in a chest freezer on site immediately after dissection. Samples were then stored at approximately -20°C until laboratory analysis. Samples were packed in dry ice and shipped to the DFO's Inspection Laboratory at the Freshwater Institute in Winnipeg for mercury analyses.

2.2 ANALYTICAL METHODS

Upon receipt at DFO's Inspection Laboratory in Winnipeg, samples were logged in and maintained in cold storage (-20°C) until analysis. In preparation for the analytical procedure and analyses, samples were thawed and an appropriate weight of tissue was removed and placed in sample containers.

Details of the analytical procedure are described in Hendzel and Jamieson (1976). Total mercury is determined by oxidizing the organic mercury in a 0.1 - 0.5 g tissue sample to inorganic mercury with a 1:4 mixture of concentrated sulphuric and nitric acids. This is left in an aluminum block at 180°C overnight. The samples are then brought up to a constant volume (25 mL) with distilled water and mixed. The mercuric compounds are reduced to elemental mercury with stannous sulphate in a hydroxylamine sulphate-sodium chloride solution. The elemental mercury is sparged from the solution with a stream of air and passed through an absorption cell in the light path of a mercury lamp. Absorption is measured at 253.7 nm. The detection limit is 0.01 ppm, assuming a sample weight of 0.25 g.

Methylmercury was determined by releasing the protein-bound methylmercury of the sample with a solution of acidic sodium bromide and copper sulphate. The methylmercuric bromide was partitioned into methylene chloride and an aliquot of this solution was digested using the method described for total mercury.

2.3 QUALITY ASSURANCE AND CONTROL

A dogfish flesh standard reference sample, which was prepared by the National Research Council of Canada and certified to contain 0.73 ppm of mercury, was analyzed with each set of samples.

2.4 DATABASE

2.4.1 FISH SPECIES

Northern pike, walleye and lake whitefish were selected as the sample species for the following reasons:

- these species are abundant at the sampling sites;
- walleye and northern pike are piscivorous species (fish eaters) and therefore high on the aquatic food chain;
- whitefish are nonpiscivorous species which place them lower on the aquatic food chain than either walleye or northern pike; and
- these species are an important food source to local people, therefore mercury levels are relevant to human consumption.

2.4.2 PARAMETERS

The mercury data are presented in units of milligram of the metal per kilogram of fish tissue mass, in wet weight of tissue. This equates to an equivalent parts per million ratio. Each fish was analyzed for total mercury and 10-20% of the fish samples were also analyzed for methylmercury.

Field measurements such as length and weight were taken prior to processing and freezing. Length measurements consist of fork length in millimetres, as measured from the tip of the snout to the fork in the tail. Weight measurements consist of the whole fish weight in grams. The size of fish obtained is influenced by the size of the gill net used in sampling.

The aging of the fish was done by DFO. Cliethrums from northern pike, operculums from walleye and dorsal scales from lake whitefish were used for age determination.

2.5 DATA ANALYSES

Data from the various years were pooled, where appropriate, by location and species in order to provide larger and more representative sets for analyses.

In order to examine differences in mercury concentrations in fish among species and sites, data were analyzed using nonparametric population tests. These types of statistical tests can be used on data that may not meet all of the conditions required for regular parametric tests. The most important parametric condition is that the sample data be from a normally distributed population. That condition does not hold true for fish sampled in this study since specific size gill nets were used that exclude smaller (younger) and very large (older) fish. The particular tests used were the Spearman Rank Correlation Coefficient Test and the Kolmogorov-Smirnov Two-Sample Test. The Spearman Rank Correlation Coefficient Test was used to measure the association between two variables. The Kolmogorov-Smirnov Two-Sample Test is a test of whether two independent samples have been drawn from the same population or from populations with the same distribution (Siegel, 1956). For all tests, the data (mercury concentrations were of primary interest, but the tests were also run for fish ages) for each species at each site were compared and population differences, if any, computed. The significance level was set at 0.05 or 95% probability of correct acceptance.

All tests were conducted using Statsgraphics Plus Version 6 by Manugistics.

3.0 RESULTS AND DISCUSSION

The results of an initial investigation of the data follow. A more detailed statistical evaluation is beyond the scope of this report.

3.1 RELATIONSHIP BETWEEN LENGTH AND AGE

Most studies that consider mercury concentrations in fish recognize the relationship between mercury levels and fish length. It is generally assumed that the greater the length, the greater the mercury concentration. Dietary consumption limits also recognize this relationship and use fish length as a limiting factor (i.e. eat only fish less than X mm in length). However, if the mercury concentration is a function of time of exposure, then fish age should be a better factor than length. These factors are inter-related, but the relationship between concentration and age may be better than the one between concentration and length because length and weight can be affected by environmental conditions. During adverse conditions, growth will slow while exposure and uptake of mercury will continue. Thus, it can be argued that the use of age data may better explain the accumulation of mercury in fish. Although gill net size may have introduced bias in our study, the fish obtained represent the size normally taken for consumption.

The relationship between age and length was explored with the samples grouped by species and sex. It was expected that the relationship between age and length would change with species sex and location. The data are presented in Figures 3 to 5 for walleye, pike and whitefish. It is apparent that the age/length relationship does vary with species. Walleye and pike show strong correlations between age and length ($r = 0.749$, $p = 0$ and $r = 0.678$, $p = 0$, respectively), and only slight differences are apparent between sexes (walleye, males $r = 0.723$, $p = 0$ and females $r = 0.850$, $p = 0$; pike, males $r = 0.652$, $p = 0$ and females $r = 0.709$, $p = 0$). In contrast, a very poor correlation is found with whitefish (all fish $r = -0.0650$, $p = 0.540$; males $r = -0.258$, $p = 0.165$; females $r = -0.0620$, $p = 0.634$). The data for this species display a wide range of lengths over a small age range.

3.2 RELATIONSHIP BETWEEN MERCURY CONCENTRATION AND AGE

Specific data on which the following analyses are based can be found in the Appendix. Summary data for the Slave River, Hay River and Leland Lake are presented in Tables 1 to 3.

For the purpose of species and site comparisons, mercury concentrations have been plotted against fish ages. The walleye data are shown in Figures 6 to 8 for the Slave River, Hay River and Leland Lake. Fish age varied among the three sampling locations. Differences were also observed among ages and mercury concentrations between locations. There is a very weak relationship ($r = 0.0546$, $p = 0.589$) between fish ages and mercury concentrations in walleye from the Slave River. Walleye from the Hay River also show a weak correlation ($r = 0.465$, $p = 0.0067$). In contrast, Leland Lake walleye show a good relationship between mercury concentrations and fish ages ($r = 0.762$, $p = 0.0012$).

It is interesting to note that Slave River walleye had the highest mercury concentration, but the concentration showed no relationship with age. The oldest walleye were from the Leland Lake population and showed a strong relationship between mercury concentration and fish age.

The relationship between pike mercury concentrations and age is shown in Figures 9 to 11, for the Slave River, Hay River and Leland Lake. Unequal data records (3 years for the Slave River, 1 year for the Hay River and 2 years for Leland Lake) and a wide spread in the ages of the pike made comparisons difficult. The Slave River pike indicate a poor correlation ($r = 0.185$, $p = 0.144$) while pike from the Hay River have a good relationship ($r = 0.773$, $p = 0.0005$) between mercury concentration and age. Pike from Leland Lake have a weak correlation ($r = 0.0354$, $p = 0.049$).

The whitefish data are shown in Figures 12 to 14, for the Slave River, Hay River and Leland Lake. Unlike walleye and pike, whitefish fish age ranges were similar at the three locations. No relationship between mercury concentration and age was apparent for whitefish in either the

Slave or Hay Rivers ($r = -0.147$, $p = 0.430$ and $r = 0.0112$, $p = 0.944$, respectively). There is an apparent correlation ($r = 0.664$, $p = 0.0038$) in the Leland Lake population.

Thus, it can be concluded that there are very clear differences among locations and fish species when mercury concentrations and age are examined. The hypothesized pattern can be observed in some cases, however six of the nine relationships showed no correlation between fish age and mercury concentration. Biological differences among species may explain some of the variability. Factors such as feeding niche, the associated bioavailability of mercury, the sampling of different populations, or the ranges in age may have affected the correlations.

3.3 MERCURY CONCENTRATIONS IN FISH AMONG SAMPLE SITES

The data was compared using the Kolmogorov-Smirnov Two-Sample Test. The results are in Tables 4 and 5, in the form of difference matrices (i.e. the sample populations compared are different or not different). The null hypothesis for this test is that there is no significant difference between mercury concentrations (Table 4) or age values (Table 5) for the species or sites being compared. The acceptance of this hypothesis is indicated by a "no significant difference between populations" symbol of "Reject." Not all species were available for all sites or years for this analysis.

The main findings are that pike from the Slave River, Hay River and Leland Lake showed no statistical differences for mercury concentration. There were no statistical differences between whitefish from the Slave and Hay River sites, but Leland Lake whitefish were statistically different with respect to all other species and locations. The mercury values of the Slave River walleye were not significantly different from pike for any of the three sampling sites, yet were different from walleye from the Hay River and Leland Lake. The walleye from Leland Lake and Hay River differed statistically from each other and from the other two species at all sites.

Thus, pike in this study are similar in mercury concentration whatever the site, and the Slave River walleye are statistically indistinguishable from the pike as well. This statistical association for mercury body-burden could reflect the similarity of feeding niche for pike and walleye. There were no differences between the Slave River and Hay River whitefish, but Leland Lake whitefish were different from both. The Slave River and Hay River sites are both big, riverine ones with connections to Great Slave Lake, while Leland Lake whitefish were from an isolated lake site and were most likely a separate population. Leland Lake was chosen as a control site outside the influence of waterborne pollutants flowing from Alberta into the NWT. The similarity between it and the Slave and Hay Rivers for mercury concentrations in pike and walleye seems to indicate that mercury contamination of some fish species could be associated with pollutants other than those transported by north-flowing rivers.

The statistical analysis of the age data was not conclusive, with fewer population associations than those found for mercury concentrations. Possibly, this is a result of the bias against the younger and smaller fish imposed by the sampling technique. The age ranges for pike at the Slave River and Leland Lake sites were similar, but differences were apparent for all other species and sites. However, Slave River whitefish and Hay River walleye exhibited similar age ranges with no obvious explanation.

3.4 REGIONAL COMPARISONS OF MERCURY DATA

In order to better understand the significance of mercury concentrations in the fish from the three sites, a regional comparison was undertaken. The three sites examined in this study were compared with similar sites in the NWT that were part of the DFO commercial fisheries database. The DFO data are from different time periods (1975 to 1990) and because the mercury sources in the area are predominantly atmospheric and natural, strong temporal trends may not exist. Nevertheless, this potential source of error will be taken into consideration.

Locations where fish were obtained for analyses by DFO are shown in Figure 15. Analyses were restricted to fish from water bodies in southwestern NWT. The regional comparison was by fish species. The analyses were therefore limited to the same three species used in this study.

The mercury concentrations in walleye are shown in Figure 16, with the Slave River, Hay River and Leland Lake values plotted to the left. The range and mean mercury levels for the other sites are plotted in general ascending order to the right, following the plots of the study data. The HC health guideline value for mercury (0.5 ppm) is also plotted. It can be observed that three sites (Lac Ste. Thérèse, Trout Lake and Muskeg River) have mean values (1.23 ppm, 0.83 ppm and 0.51 ppm, respectively) exceeding the HC guideline.

The data on fish from Trout Lake (and to some extent the Muskeg River) raise some concerns. Walleye from these two sites have relatively high mercury concentrations, but are not expected to be greatly influenced by geological sources. Walleye mercury concentrations generated in another study (Swyripa et al., 1993) found a mean mercury concentration in Trout Lake of 0.133 ppm (a maximum of 0.233 ppm and a minimum of 0.028 ppm). These data are an order of magnitude lower than the DFO data plotted in Figure 16. This discrepancy cannot be explained with certainty, however data were generated in different years. The latter data may be more representative of the actual conditions at Trout Lake. The 1991 data set may represent the present fish population more accurately than the 1977 data due to a numerically larger sample population (20 versus 7 walleye). In addition, differences due to physical size should not be overlooked. The 1977 fish samples had a mean fork length of 591 mm while the 1991 fish had a mean fork length of 474 mm. The 1977 walleye samples were therefore larger and older which suggests that there was a greater chance that mercury bioaccumulation had occurred.

The pike mercury concentration data are shown in Figure 17. Site values are again plotted to the left. Although most of the sites exhibit ranges that exceed the health limit (0.5 ppm), only one site, Lac Ste. Thérèse, plotted all sample values (a maximum of 2.51 ppm, a minimum of 0.62 ppm and a mean of 1.45 ppm) above the limit. Mercury levels in fish from the three study sites are in the low end for this species and were generally lower than the regional data.

The whitefish mercury data are shown in Figure 18. None of the whitefish mercury levels were above the health guideline of 0.5 ppm. Fish from the three study sites contained mercury concentrations that were at the low end of the regional range. It is apparent that whitefish generally do not accumulate mercury to the same extent as the other two species. This could be due to species-specific differences in uptake of the metal, differences in feeding behaviour or differences in exposure. It should be noted that some of the sites with elevated mercury levels in other fish species (Lac Ste. Thérèse, Trout Lake and Muskeg River) did not have data for whitefish.

Although the DFO database did not contain data that was evenly distributed over time, it did provide useful comparisons for all three fish species. From this preliminary analysis, it can be concluded that the three study locations contained fish with mercury concentrations lower than other locations in the same region. The regional comparison indicates that one site, Lac Ste. Thérèse, appears to have mercury concentrations in walleye and pike substantially above other sites. This may indicate high natural mercury contamination and it is recommended that fish at this lake be studied further. A health evaluation by the appropriate agency should also be done.

In a study of mercury concentrations in Alberta fish (Moore et al., 1986), data exist for the same species sampled in southwestern NWT. Similar concentrations were found in fish from the Athabasca River (ibid). Walleye (a mean value of 0.386 ppm) generally had higher mercury levels than pike (a mean value of 0.109 ppm) followed by whitefish (a mean value of 0.0804 ppm). The average mercury concentrations in fish were also similar to those measured for the Slave and Hay Rivers and Leland Lake. Of the Alberta lake sites, several contained fish with mercury concentrations exceeding the health guideline. Interestingly, these lakes were not affected by anthropogenic point sources. Fish from lakes located on the Precambrian Shield had the highest mercury levels. This finding is consistent with the findings of the NWT regional comparison.

4.0 SUMMARY AND CONCLUSIONS

This report presents and interprets data from three years of study on mercury contamination in fish from the Slave and Hay Rivers as well as Leland Lake. The study was initiated as part of a water quality assessment of the Slave River. Since it is difficult to measure mercury accurately in the water column, fish were selected as the measurement medium. Mercury also bioaccumulates. Trace amounts concentrate in biotic tissues over time, thereby allowing an evaluation of exposure to the contaminant. In addition, data from fish tissues enable HC to make evaluations relating to dietary consumption, using guidelines or recommended limits, for contaminants such as mercury. These data will be provided to the Northwest Territories health authorities if such an evaluation is warranted.

Three species of fish (walleye, pike and lake whitefish) were sampled over three years (1988 to 1990). The species were chosen because they are resident in the waters of interest and are important to local residents for consumption. Slave River data are for three years for some fish species, with shorter data records at the other sites. Total mercury in fish tissue is measured and expressed in ppm wet weight. The form of mercury that has been implicated as a serious health hazard is the methylated form which is more easily accumulated in biotic cells. A 10-20% sub-sample was selected at random for the analysis of methylmercury and to assess the relationship between total mercury and methylmercury in fish. A strong correlation was found between the two forms of mercury with the methylmercury making up over 70% of the total mercury. This result validates the use of total mercury analysis, which is more easily determined, instead of methylmercury analysis for determining concentrations in fish.

Strong positive correlations were found between fish age and length for both walleye and pike, but not for whitefish. The size of the gill net may have introduced bias to the length data. Since age is a better measure of exposure, further statistical analysis used age as the independent variable. Fish length is important for application of consumption guidelines.

The relationship between fish age and mercury concentration varied between locations. In the Slave River, the average mercury concentration in walleye and pike was the same. This mercury concentration was substantially higher than the whitefish average. In the Hay River, the highest average mercury concentration was found in pike, with walleye second and whitefish third. In Leland Lake fish, the average mercury concentration was highest in walleye followed by pike and whitefish. There was no consistent pattern of increased mercury concentration in fish with age, although three correlations are worth noting: pike in the Hay River, walleye in Leland Lake and whitefish in Leland Lake.

Statistical analyses were carried out to ascertain if the data for specific species and locations were similar or not. Pike in this study were similar in mercury concentration whatever the site. Slave River walleye were indistinguishable from pike at any of the sites, but were statistically different to walleye from either Hay River or Leland Lake. Since Leland Lake pike were similar in mercury concentration to pike from both the Slave and Hay Rivers, and even walleye from the Slave River, this could be an indication that mercury contamination of some fish species (those high in the food chain) could be associated with pollutant sources other than those transported by the north-flowing rivers. There were no differences between the Slave River and Hay River whitefish, but the Leland Lake whitefish were different from both.

In comparison to species from other nearby lakes and rivers in the southwestern NWT, the three species of Slave River, Hay River and Leland Lake fish contain mercury levels in the low end of the range. The average mercury concentration for each species at the Slave and Hay Rivers and Leland Lake was well below the HC limit for marketing fish. This was not true for all fish in the DFO commercial fisheries database. Those from three sites (Muskeg River, Lac Ste. Thérèse and Trout Lake) exceeded the marketing limit. Recent data may cast doubts on some of the higher values from the earlier data. The regional pattern for mercury contamination did not indicate that anthropogenic point sources of mercury from upstream or local developments were increasing mercury levels in the fish tested. In fact, the highest mercury concentrations in fish were found in remote lakes and may reflect conditions for bioaccumulation, fish age, food chain uptake effects, conditions for mercury methylation and mercury deposition from the atmosphere and geological sources. This finding agrees with other research on mercury in fish from waters in the Peace and Athabasca basins, and elsewhere in Alberta.

The main conclusions from this study are:

- the relationship between fish age and mercury concentration is not consistent and can be obscured by factors such as sampling bias, fish condition in a given lake, etc;
- at all sites and most likely due to trophic status, walleye and pike have greater mercury concentrations than whitefish;
- no differences in mercury concentrations occur between sites for the three fish species tested. Little or no increase in mercury concentration appears in fish as a result of upstream activities in the Slave and Hay Rivers; and
- fish from the three sites were compared to similar data on mercury in fish from adjacent rivers and lakes. The fish from the three sites had mercury concentrations at the low end of the regional range.

5.0 AUTHORS' NOTES

The authors felt that some of the information and techniques learned while doing this study should be included in the report as possible guidelines for any future work. Some of the authors' comments include:

- it is essential to have a control site in order to evaluate impact, and test hypotheses on outside influences;
- it is preferable to have large sample sizes in order to evaluate inherent variability, but annual variation does not appear to be as great as inter-species variation;
- the species of fish selected for study should represent the feeding niche of importance, as well as reflect local consumption patterns if the data are to be used in health evaluations;
- recent data on fish from one of the comparative sites suggest that caution be used in interpreting mercury data from earlier work;
- the study data should be evaluated by HC, Medical Services Branch, in association with the NWT's Health and Social Services, against the available guideline value, along with some consideration of the other regional data used for comparison; and
- any consumption limits proposed by HC should be expressed in terms of the number of fish by species (and location) that can be safely consumed, as suggested in the 1986 report for Alberta by Moore et al.

PART II

HEALTH EVALUATION

6.0 DATA SET FOR EVALUATION

The data set in the Appendix presents the information collected on each individual fish. The data are grouped by year, location and species. The 1991 data have been included here, although they were not part of the analytical study. These data recently became available and should be included so that the health evaluation is based on all available information.

Table 6 presents the distribution of the 1988 to 1990 fish mercury data with respect to the two concentrations generally used in an evaluation. The two levels (Health and Welfare Canada, 1979) are:

- 0.5 ppm, the Health Protection Branch guideline for commercial fish; and
- 0.2 ppm, the Medical Services Branch recommended level for those who consume large quantities of fish.

These two levels of mercury concentrations in fish have been used to estimate the safe weekly consumption of fish, based upon assumptions of consumption and human size (assumed weight, and type of fish tissue eaten). The consumption rates are equivalent to 0.42 kg at 0.5 ppm mercury concentration, and 1.05 kg at 0.2 ppm.

High percentages of walleye and pike tissue samples contained concentrations greater than the 0.2 ppm recommended level. A small percentage of the whitefish samples from Leland Lake (the control) exceeded this level; however, whitefish concentrations at the other sites were well below it. A small percentage of pike from the three sites exceed the higher, marketing limit. The pattern for walleye was inconsistent. The Slave River had the greatest number of fish exceeding the limit, followed by Leland Lake. The Hay River had none. The whitefish tissue samples did not exceed the marketing limits of 0.5 ppm.

Mercury concentrations in a relatively large proportion of walleye and pike samples fell between the recommended level and the commercial guideline. Because these species are consumed by local residents, it is necessary to examine the importance of factors such as fish age or size (weight or length) on mercury concentration. This may permit HC to further examine the fish suitable for consumption. The data set in the Appendix contains all the collected relevant information from which HC can select the useful biotic factors.

Information that can be applied at the site would be preferable (e.g. safe numbers of a species, by weight or length, that can be consumed safely over a period of time). This approach has been used in Alberta (Alberta Environment Centre, 1983; Moore et al., 1986), and in Ontario where the provincial government has recommended consumption levels based on the length of the fish caught. The World Health Organization (in association with Japanese health authorities) has set a maximum tolerable weekly intake standard that takes into account mercury concentrations, meal size and human weight.

APPENDIX
DATA SET FOR STUDY

YEAR	STATION	FISH SPECIES	SAMPLE NUMBER	SEX	AGE (yrs)	LENGTH (mm)	WEIGHT (g)	TOTAL MERCURY (ppm)	METHYL-MERCURY (ppm)
1988	Slave River	Walleye	7	M	14	457	1150	0.37	
1988	Slave River	Walleye	8	M	10	416	850	0.22	
1988	Slave River	Walleye	9	M	6	402	800	0.36	
1988	Slave River	Walleye	10	M	7	399	700	0.25	
1988	Slave River	Walleye	11	M	7	387	750	0.27	
1988	Slave River	Walleye	12	M	10	415	800	0.23	0.20
1988	Slave River	Walleye	13	F	8	450	1100	0.19	
1988	Slave River	Walleye	14	M	8	418	750	0.27	
1988	Slave River	Walleye	15	M	10	422	800	0.73	0.70
1988	Slave River	Walleye	16	F	6	375	600	0.39	
1988	Slave River	Walleye	17	M	7	365	600	0.39	
1988	Slave River	Walleye	18	M	10	403	750	0.28	
1988	Slave River	Walleye	19	M	9	420	825	0.27	
1988	Slave River	Walleye	20	M	8	401	750	0.30	
1988	Slave River	Walleye	21	F	6	377	600	0.40	0.38
1988	Slave River	Walleye	22	M	8	415	750	0.23	
1988	Slave River	Walleye	23	M	9	369	600	0.30	
1988	Slave River	Walleye	24	F	9	459	1200	0.25	
1988	Slave River	Walleye	25	M	9	367	600	0.50	0.49
1988	Slave River	Walleye	26	M	10	435	900	0.25	
1988	Slave River	Walleye	27	M	6	345	500	0.25	
1988	Slave River	Walleye	28	M	7	409	800	0.16	
1988	Slave River	Walleye	29	M	8	368	600	0.13	
1988	Slave River	Walleye	30	M	8	407	850	0.27	
1988	Slave River	Walleye	31	M	7	357	525	0.22	
1988	Slave River	Walleye	32	M	9	392	650	0.21	
1988	Slave River	Walleye	33	M	9	409	800	0.30	0.27
1988	Slave River	Walleye	34	M	8	362	500	0.21	
1988	Slave River	Walleye	35	M	10	379	600	0.40	
1988	Slave River	Walleye	56	F	8	402	800	0.21	
1988	Slave River	Walleye	57	M	9	400	750	0.80	
1988	Slave River	Walleye	62	F	9	508	1500	0.49	
1988	Slave River	Walleye	63	F	9	494	1400	0.21	
1988	Slave River	Walleye	64	F	9	459	1100	0.25	
1988	Slave River	Walleye	65	F	9	450	1100	0.19	
1988	Slave River	Pike	1	F	11	711	2650	0.42	0.38
1988	Slave River	Pike	2	M	8	581	1650	0.29	
1988	Slave River	Pike	4	M	9	558	1300	0.29	
1988	Slave River	Pike	5	F	9	573	1900	0.46	
1988	Slave River	Pike	6	F	8	539	1300	0.38	0.36
1988	Slave River	Pike	51	M	7	531	1150	0.37	
1988	Slave River	Pike	52	M	8	545	1250	0.31	0.29
1988	Slave River	Pike	53	F	10	555	1250	0.33	
1988	Slave River	Pike	54	F	10	543	1400	0.22	0.20
1988	Slave River	Pike	55	F	15	657	2500	0.35	
1988	Slave River	Pike	67	M	7	500	900	0.38	
1988	Slave River	Pike	68	F	15	633	2050	0.17	0.16

YEAR	STATION	FISH SPECIES	SAMPLE NUMBER	SEX	AGE (yrs)	LENGTH (mm)	WEIGHT (g)	TOTAL MERCURY (ppm)	METHYL-MERCURY (ppm)
1988	Slave River	Pike	69	M	12	543	1275	0.27	
1989	Slave River	Walleye	2	M	11	441	975	0.52	0.45
1989	Slave River	Walleye	3	M	6	367	600	0.35	
1989	Slave River	Walleye	4	F	10	454	1150	0.32	
1989	Slave River	Walleye	5	M	9	386	600	0.35	
1989	Slave River	Walleye	6	F	6	376	600	0.27	
1989	Slave River	Walleye	7	F	6	431	1000	0.38	
1989	Slave River	Walleye	8	M	10	425	850	0.38	
1989	Slave River	Walleye	9	M	8	373	750	0.40	
1989	Slave River	Walleye	10	M	8	350	550	0.37	
1989	Slave River	Walleye	11	M	8	418	850	0.42	
1989	Slave River	Walleye	12	M	6	371	600	0.26	
1989	Slave River	Walleye	13	M	10	410	750	0.41	
1989	Slave River	Walleye	14	F	9	430	975	0.27	
1989	Slave River	Walleye	15	F	10	412	700	0.30	
1989	Slave River	Walleye	16	M	7	342	500	0.36	
1989	Slave River	Walleye	17	M	6	346	525	0.29	
1989	Slave River	Walleye	18	M	9	457	1100	0.23	
1989	Slave River	Walleye	19	M	6	365	575	0.41	
1989	Slave River	Walleye	20	M	6	391	750	0.26	
1989	Slave River	Walleye	21	F	11	490	1600	0.44	
1989	Slave River	Walleye	22	M	7	375	650	0.50	
1989	Slave River	Walleye	23	F	11	474	1375	0.23	
1989	Slave River	Walleye	24	F	10	447	1050	0.20	
1989	Slave River	Walleye	25	M	6	410	750	0.41	
1989	Slave River	Walleye	26	M	8	386	750	0.43	
1989	Slave River	Walleye	27	M	6	418	850	0.30	
1989	Slave River	Walleye	28	M	9	373	625	0.43	
1989	Slave River	Walleye	29	M	6	381	625	0.33	
1989	Slave River	Walleye	30	M	6	342	550	0.39	
1989	Slave River	Walleye	31	M	6	403	800	0.33	
1989	Slave River	Walleye	32	M	8	389	675	0.59	0.52
1989	Slave River	Walleye	33	M	6	370	650	0.40	
1989	Slave River	Walleye	34	M	6	345	500	0.25	
1989	Slave River	Walleye	35	M	9	379	650	0.49	
1989	Slave River	Walleye	36	M	8	372	625	0.23	
1989	Slave River	Pike	1	F	9	725	2750	0.35	
1989	Slave River	Pike	48	F	10	614	1900	0.52	0.48
1989	Slave River	Pike	49	F	8	623	1800	0.38	
1989	Slave River	Pike	50	M	12	600	1750	0.54	
1989	Slave River	Pike	52	M	5	484	750	0.19	
1989	Slave River	Pike	53	M	5	454	700	0.28	
1989	Slave River	Pike	54	M	8	545	1150	0.46	
1989	Slave River	Pike	55	F	8	584	1650	0.36	
1989	Slave River	Pike	56	M	7	491	850	0.53	0.46
1989	Slave River	Pike	57	F	5	517	1000	0.35	
1989	Slave River	Pike	58	F	8	561	1175	0.33	
1989	Slave River	Pike	59	F	7	534	1250	0.33	
1989	Slave River	Pike	60	M	6	482	750	0.34	
1989	Slave River	Pike	61	F	5	469	750	0.17	
1989	Slave River	Pike	62	F	8	468	1350	0.29	
1989	Slave River	Pike	69	F	6	525	1075	0.33	

YEAR	STATION	FISH SPECIES	SAMPLE NUMBER	SEX	AGE (yrs)	LENGTH (mm)	WEIGHT (g)	TOTAL MERCURY (ppm)	METHYL-MERCURY (ppm)
1989	Slave River	Pike	70	F	9	597	1975	0.28	
1989	Slave River	Pike	71	F	8	559	1150	0.44	
1989	Slave River	Pike	72	F	9	620	1700	0.25	
1989	Slave River	Pike	73	M	7	547	1275	0.29	
1989	Hay River	Walleye	14	F	7	417	1100	0.27	
1989	Hay River	Walleye	15	F	7	355	600	0.17	
1989	Hay River	Walleye	16	F	8	412	850	0.23	
1989	Hay River	Walleye	17	F	4	327	500	0.20	
1989	Hay River	Walleye	18	F	8	380	700	0.27	
1989	Hay River	Walleye	19	M	7	339	550	0.23	
1989	Hay River	Walleye	20	F	6	369	650	0.32	0.30
1989	Hay River	Walleye	21	F	6	380	750	0.25	
1989	Hay River	Walleye	22	F	7	369	650	0.22	
1989	Hay River	Walleye	23	F	7	365	650	0.28	
1989	Hay River	Walleye	24	F	8	388	725	0.19	
1989	Hay River	Walleye	25	F	7	370	600	0.27	
1989	Hay River	Walleye	26	F	7	344	500	0.24	
1989	Hay River	Walleye	27	F	5	328	475	0.15	
1989	Hay River	Walleye	28	F	5	363	600	0.20	
1989	Hay River	Walleye	29	F	5	335	500	0.20	
1989	Hay River	Walleye	30	F	5	364	625	0.23	
1989	Hay River	Walleye	31	F	6	347	550	0.22	
1989	Hay River	Walleye	32	M	7	370	600	0.18	
1989	Hay River	Walleye	33	F	8	367	600	0.18	
1989	Hay River	Walleye	34	F	9	427	1000	0.23	
1989	Hay River	Walleye	35	F	6	340	450	0.12	
1989	Hay River	Walleye	36	F	10	506	1700	0.30	
1989	Hay River	Walleye	37	M	5	364	550	0.10	
1989	Hay River	Walleye	38	M	6	364	600	0.15	
1989	Hay River	Walleye	57	F	7	338	500	0.18	
1989	Hay River	Walleye	58	F	6	345	500	0.16	
1989	Hay River	Walleye	59	F	7	361	550	0.15	
1989	Hay River	Walleye	60	F	8	351	500	0.21	
1989	Hay River	Walleye	61	F	8	380	650	0.22	
1989	Hay River	Walleye	62	F	10	475	1425	0.28	
1989	Hay River	Walleye	63	F	10	462	1800	0.23	
1989	Hay River	Walleye	64	F	9	444	1200	0.32	0.32
1989	Hay River	Walleye	65	M	11	411	1000	0.27	
1989	Hay River	Walleye	66	F	9	427	1050	0.22	
1989	Hay River	Pike	1	F	11	738	2650	0.36	
1989	Hay River	Pike	2	F	7	596	1300	0.27	
1989	Hay River	Pike	3	F	11	693	2150	0.44	
1989	Hay River	Pike	4	M	10	620	1650	0.46	
1989	Hay River	Pike	5	M	7	614	1550	0.30	
1989	Hay River	Pike	6	M	7	539	1150	0.24	
1989	Hay River	Pike	7	M	8	546	1275	0.34	
1989	Hay River	Pike	8	M	6	545	1400	0.32	
1989	Hay River	Pike	9	M	7	560	1325	0.21	
1989	Hay River	Pike	10	M	9	639	1750	0.48	0.35
1989	Hay River	Pike	11	M	5	438	775	0.19	
1989	Hay River	Pike	12	M	8	569	1300	0.31	
1989	Hay River	Pike	13	M	8	625	1800	0.31	

YEAR	STATION	FISH SPECIES	SAMPLE NUMBER	SEX	AGE (yrs)	LENGTH (mm)	WEIGHT (g)	TOTAL MERCURY (ppm)	METHYL-MERCURY (ppm)
1989	Hay River	Pike	39	M	9	646	1750	0.28	
1989	Hay River	Pike	40	M	12	555	1775	0.35	
1989	Hay River	Pike	51	M	9	653	2050	0.26	
1989	Hay River	Pike	52	F	13	725	3100	0.59	0.58
1989	Hay River	Pike	53	M	11	640	2100	0.33	
1989	Hay River	Pike	54	F	7	666	2050	0.27	
1989	Hay River	Pike	55	M	5	548	1850	0.19	
1989	Hay River	Pike	56	M	8	526	1150	0.28	
1989	Hay River	Whitefish	41	F	9	416	1050	0.05	
1989	Hay River	Whitefish	42	F	8	380	800	0.06	
1989	Hay River	Whitefish	43	F	9	374	750	0.05	
1989	Hay River	Whitefish	44	M	11	434	1800	0.09	0.03
1989	Hay River	Whitefish	45	M	9	371	750	0.06	
1989	Hay River	Whitefish	46	F	9	397	900	0.08	
1989	Hay River	Whitefish	47	F	8	382	850	0.04	
1989	Hay River	Whitefish	48	F	11	424	1200	0.09	0.05
1989	Hay River	Whitefish	49	M	9	397	825	0.03	
1989	Hay River	Whitefish	50	M	10	395	950	0.05	
1989	Leland Lake	Walleye	17	F	15	577	2400	0.50	0.43
1989	Leland Lake	Walleye	18	M	14	500	1625	0.36	
1989	Leland Lake	Walleye	19	M	18	463	1300	0.48	
1989	Leland Lake	Walleye	20	M	14	484	1325	0.40	
1989	Leland Lake	Walleye	21	F	12	472	1450	0.41	
1989	Leland Lake	Walleye	22	F	8	414	850	0.25	
1989	Leland Lake	Walleye	23	M	18	458	1175	0.48	
1989	Leland Lake	Walleye	24	M	16	455	1000	0.73	0.61
1989	Leland Lake	Walleye	31	F	14	568	2450	0.54	
1989	Leland Lake	Pike	1	F	5	474	700	0.17	
1989	Leland Lake	Pike	2	F	8	501	800	0.45	
1989	Leland Lake	Pike	3	F	8	597	1250	0.52	0.48
1989	Leland Lake	Pike	4	F	9	628	1800	0.44	
1989	Leland Lake	Pike	5	M	6	498	900	0.24	
1989	Leland Lake	Pike	6	M	6	536	1100	0.28	
1989	Leland Lake	Pike	7	M	8	538	950	0.37	
1989	Leland Lake	Pike	8	F	8	507	975	0.39	
1989	Leland Lake	Pike	9	F	8	499	800	0.59	0.56
1989	Leland Lake	Pike	10	M	10	515	950	0.26	
1989	Leland Lake	Pike	11	F	6	486	900	0.26	
1989	Leland Lake	Pike	12	F	9	630	1850	0.35	
1989	Leland Lake	Pike	13	M	6	476	750	0.19	
1989	Leland Lake	Pike	14	M	10	596	1750	0.34	
1989	Leland Lake	Pike	15	M	7	518	1075	0.44	
1989	Leland Lake	Pike	16	F	6	518	950	0.24	
1989	Leland Lake	Pike	25	F	11	568	825	0.50	
1989	Leland Lake	Pike	26	F	4	408	500	0.16	
1989	Leland Lake	Pike	27	F	5	529	925	0.37	
1989	Leland Lake	Pike	28	F	7	506	925	0.19	
1989	Leland Lake	Pike	29	M	8	510	875	0.40	
1989	Leland Lake	Pike	30	F	14	664	2200	0.28	
1989	Leland Lake	Whitefish	32	F	10	472	1600	0.14	
1989	Leland Lake	Whitefish	33	M	9	418	1100	0.09	
1989	Leland Lake	Whitefish	34	F	8	431	1250	0.11	

YEAR	STATION	FISH SPECIES	SAMPLE NUMBER	SEX	AGE (yrs)	LENGTH (mm)	WEIGHT (g)	TOTAL MERCURY (ppm)	METHYL-MERCURY (ppm)
1989	Leland Lake	Whitefish	35	M	10	448	1350	0.11	
1989	Leland Lake	Whitefish	36	F	7	369	800	0.05	
1989	Leland Lake	Whitefish	37	M	12	472	1500	0.13	
1989	Leland Lake	Whitefish	38	M	8	398	1025	0.06	
1989	Leland Lake	Whitefish	39	M	8	415	1000	0.11	
1989	Leland Lake	Whitefish	40	F	9	413	1150	0.12	
1989	Leland Lake	Whitefish	41	F	12	480	1400	0.16	0.14
1990	Slave River	Walleye	21	M	11	407	776	0.64	
1990	Slave River	Walleye	22	F	7	387	588	0.41	0.39
1990	Slave River	Walleye	23	M	9	391	580	0.56	
1990	Slave River	Walleye	24	M	10	406	744	0.29	
1990	Slave River	Walleye	25	M	8	404	751	0.25	
1990	Slave River	Walleye	26	M	9	356	556	0.45	
1990	Slave River	Walleye	27	F	7	412	699	0.30	
1990	Slave River	Walleye	94	M	12	443	1132	0.35	
1990	Slave River	Walleye	95	F	11	495	1321	0.48	
1990	Slave River	Walleye	96	M	12	453	1052	0.29	
1990	Slave River	Walleye	97	M	9	440	945	0.23	
1990	Slave River	Walleye	98	M	11	478	1284	0.75	
1990	Slave River	Walleye	99	M	13	446	1131	0.41	0.39
1990	Slave River	Walleye	100	M	10	440	1075	0.26	
1990	Slave River	Walleye	101	M	10	454	1122	0.23	
1990	Slave River	Walleye	102	M	7	437	1096	0.35	
1990	Slave River	Walleye	103	M	14	431	960	0.38	
1990	Slave River	Walleye	104	F	7	427	857	0.39	
1990	Slave River	Walleye	105	F	9	462	1155	0.29	
1990	Slave River	Walleye	106	M	7	469	1049	0.40	
1990	Slave River	Walleye	107	M	11	488	1239	0.42	0.44
1990	Slave River	Walleye	108	F	7	455	1032	0.37	
1990	Slave River	Walleye	109	M	10	423	828	0.33	0.34
1990	Slave River	Walleye	110	M	10	470	1188	0.27	
1990	Slave River	Walleye	111	F	9	469	1197	0.27	0.25
1990	Slave River	Walleye	112	F	7	438	1060	0.44	0.42
1990	Slave River	Walleye	113	F	12	438	1046	0.26	
1990	Slave River	Walleye	144	F	11	457	1180	0.26	
1990	Slave River	Walleye	147	M	7	391	652	0.21	
1990	Slave River	Pike	28	F	7	571	1130	0.20	
1990	Slave River	Pike	32	F	7	555	1239	0.26	
1990	Slave River	Pike	33	M	6	506	715	0.49	
1990	Slave River	Pike	34	M	6	536	1070	0.26	0.26
1990	Slave River	Pike	35	M	10	561	1231	0.41	
1990	Slave River	Pike	36	M	6	506	910	0.38	
1990	Slave River	Pike	37	F	6	513	920	0.18	
1990	Slave River	Pike	88	F	7	624	1777	0.46	
1990	Slave River	Pike	89	F	12	698	2327	0.27	
1990	Slave River	Pike	90	F	8	585	1582	0.39	
1990	Slave River	Pike	91	F	7	646	2100	0.48	0.50
1990	Slave River	Pike	92	M	8	603	1726	0.40	
1990	Slave River	Pike	93	M	12	628	1785	0.43	
1990	Slave River	Pike	124	M	8	510	900	0.60	0.61
1990	Slave River	Pike	125	F	10	715	2486	0.43	
1990	Slave River	Pike	126	M	9	623	1640	0.24	0.23

YEAR	STATION	FISH SPECIES	SAMPLE NUMBER	SEX	AGE (yrs)	LENGTH (mm)	WEIGHT (g)	TOTAL MERCURY (ppm)	METHYL-MERCURY (ppm)
1990	Slave River	Pike	127	M	8	549	1360	0.23	
1990	Slave River	Pike	149	F	9	582	1523	0.26	0.28
1990	Slave River	Pike	150	F	7	545	1144	0.28	
1990	Slave River	Pike	151	F	6	506	866	0.19	
1990	Slave River	Pike	152	M	6	476	880	0.30	
1990	Slave River	Pike	153	F	8	604	1481	0.35	
1990	Slave River	Pike	154	F	10	622	1683	0.39	
1990	Slave River	Pike	155	F	6	517	791	0.25	
1990	Slave River	Pike	156	F	6	530	1078	0.33	
1990	Slave River	Pike	217	F	7	613	1735	0.25	
1990	Slave River	Pike	218	M	8	516	1031	0.47	
1990	Slave River	Pike	219	F	6	554	1140	0.44	0.40
1990	Slave River	Pike	220	F	6	511	971	0.32	
1990	Slave River	Pike	221	F	6	547	1125	0.31	
1990	Slave River	Whitefish	58	F	12	382	836	0.09	
1990	Slave River	Whitefish	59	M	10	384	801	0.09	
1990	Slave River	Whitefish	60	F	8	381	814	0.13	
1990	Slave River	Whitefish	61	F	10	394	818	0.04	
1990	Slave River	Whitefish	62	M	11	352	674	0.10	0.07
1990	Slave River	Whitefish	63	M	11	408	904	0.07	
1990	Slave River	Whitefish	64	F	11	376	783	0.10	0.09
1990	Slave River	Whitefish	65	M	10	361	603	0.08	
1990	Slave River	Whitefish	66	M	10	346	524	0.07	
1990	Slave River	Whitefish	67	F	11	414	924	0.08	
1990	Slave River	Whitefish	68	F	12	410	1006	0.10	
1990	Slave River	Whitefish	69	M	8	353	672	0.05	
1990	Slave River	Whitefish	70	M	11	400	891	0.07	
1990	Slave River	Whitefish	71	F	8	383	790	0.10	
1990	Slave River	Whitefish	72	F	12	364	680	0.07	
1990	Slave River	Whitefish	73	M	10	360	838	0.05	
1990	Slave River	Whitefish	74	M	11	393	848	0.05	
1990	Slave River	Whitefish	75	M	10	384	808	0.06	0.05
1990	Slave River	Whitefish	76	M	10	345	616	0.02	
1990	Slave River	Whitefish	77	F	9	412	1005	0.09	
1990	Slave River	Whitefish	78	F	9	415	1004	0.09	
1990	Slave River	Whitefish	79	M	10	415	1025	0.10	0.06
1990	Slave River	Whitefish	80	F	8	340	554	0.09	
1990	Slave River	Whitefish	81	F	10	395	926	0.09	0.05
1990	Slave River	Whitefish	82	F	10	415	1014	0.09	
1990	Slave River	Whitefish	83	F	9	370	766	0.08	
1990	Slave River	Whitefish	84	F	6	382	730	0.13	
1990	Slave River	Whitefish	85	M	12	380	926	0.03	
1990	Slave River	Whitefish	86	F	8	370	792	0.06	
1990	Slave River	Whitefish	87	F	9	366	573	0.03	0.03
1990	Hay River	Whitefish	1	F	11	900	386	0.08	
1990	Hay River	Whitefish	2	M	9	795	388	0.07	0.04
1990	Hay River	Whitefish	3	F	8	740	385	0.06	0.06
1990	Hay River	Whitefish	4	F	8	820	387	0.10	
1990	Hay River	Whitefish	5	F	8	735	381	0.08	
1990	Hay River	Whitefish	6	F	7	710	387	0.08	
1990	Hay River	Whitefish	7	F	8	675	365	0.06	0.05
1990	Hay River	Whitefish	8	F	12	785	388	0.06	

YEAR	STATION	FISH SPECIES	SAMPLE NUMBER	SEX	AGE (yrs)	LENGTH (mm)	WEIGHT (g)	TOTAL MERCURY (ppm)	METHYL-MERCURY (ppm)
1990	Hay River	Whitefish	9	F	8	635	369	0.08	
1990	Hay River	Whitefish	10	F	10	595	377	0.06	
1990	Hay River	Whitefish	11	F	9	740	383	0.05	
1990	Hay River	Whitefish	12	F	9	715	364	0.09	
1990	Hay River	Whitefish	13	F	10	855	406	0.08	
1990	Hay River	Whitefish	14	F	8	765	380	0.06	
1990	Hay River	Whitefish	15	F	8	815	386	0.08	
1990	Hay River	Whitefish	16	F	9	900	398	0.06	0.05
1990	Hay River	Whitefish	17	F	9	660	362	0.07	
1990	Hay River	Whitefish	18	F	11	970	416	0.08	
1990	Hay River	Whitefish	19	M	9	710	385	0.04	
1990	Hay River	Whitefish	20	F	9	675	372	0.08	0.04
1990	Hay River	Whitefish	21	F	8	690	365	0.08	
1990	Hay River	Whitefish	22	F	10	790	386	0:10	
1990	Hay River	Whitefish	23	F	10	890	420	0.08	
1990	Hay River	Whitefish	24	F	10	695	378	0.05	
1990	Hay River	Whitefish	25	F	8	590	371	0.08	
1990	Hay River	Whitefish	26	F	8	785	375	0.09	
1990	Hay River	Whitefish	27	F	10	810	379	0.13	0.07
1990	Hay River	Whitefish	28	M	8	730	366	0.10	
1990	Hay River	Whitefish	29	F	8	660	368	0.06	
1990	Hay River	Whitefish	30	F	8	655	368	0.10	
1990	Leland Lake	Walleye	70	F	18	529	1724	0.58	
1990	Leland Lake	Walleye	71	F	15	510	1625	0.55	0.51
1990	Leland Lake	Walleye	72	M	13	445	1012	0.45	
1990	Leland Lake	Walleye	73	M	14	486	1225	0.41	
1990	Leland Lake	Walleye	74	M	14	444	1052	0.46	0.48
1990	Leland Lake	Walleye	75	F	16	546	1799	0.50	
1990	Leland Lake	Walleye	76	M	14	485	1284	0.49	
1990	Leland Lake	Walleye	77	F	14	496	1357	0.44	
1990	Leland Lake	Walleye	78	M	9	407	880	0.37	
1990	Leland Lake	Walleye	79	M	10	412	776	0.34	
1990	Leland Lake	Pike	49	F	8	592	1450	0.43	
1990	Leland Lake	Pike	50	F	9	559	1061	0.30	
1990	Leland Lake	Pike	51	M	7	514	923	0.37	
1990	Leland Lake	Pike	52	F	9	770	2880	0.36	
1990	Leland Lake	Pike	53	F	10	665	2489	0.30	0.33
1990	Leland Lake	Pike	54	M	8	529	1052	0.26	0.25
1990	Leland Lake	Pike	55	M	8	540	1132	0.38	
1990	Leland Lake	Pike	56	F	8	551	1023	0.39	
1990	Leland Lake	Pike	57	M	8	560	1200	0.34	
1990	Leland Lake	Pike	58	M	10	525	1204	0.36	
1990	Leland Lake	Whitefish	59	M	9	415	1058	0.06	
1990	Leland Lake	Whitefish	60	F	9	430	1278	0.16	
1990	Leland Lake	Whitefish	61	M	9	530	1152	0.09	
1990	Leland Lake	Whitefish	62	M	10	423	1034	0.10	0.08
1990	Leland Lake	Whitefish	63	F	12	489	1516	0.23	0.22
1990	Leland Lake	Whitefish	64	F	11	445	1347	0.13	
1990	Leland Lake	Whitefish	65	M	8	432	1178	0.10	
1990	Leland Lake	Whitefish	66	F	11	436	1316	0.14	
1990	Leland Lake	Whitefish	67	M	8	418	1106	0.13	
1990	Leland Lake	Whitefish	68	F	8	387	809	0.07	

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FIGURES

Figure 1

Relationship of Total Mercury to Methylmercury in Fish

SPECIES: All

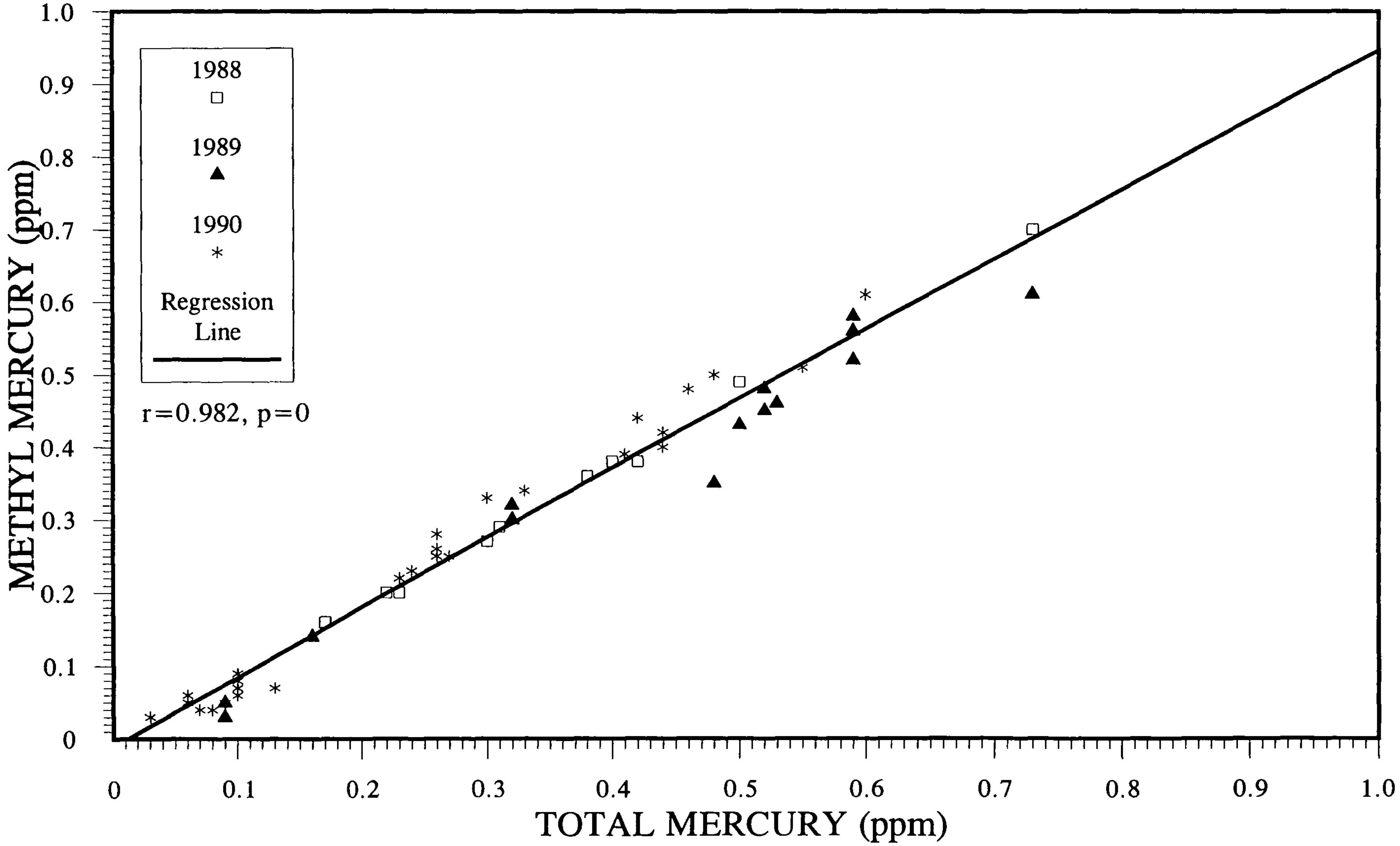


Figure 2
Map of Field Sampling Sites

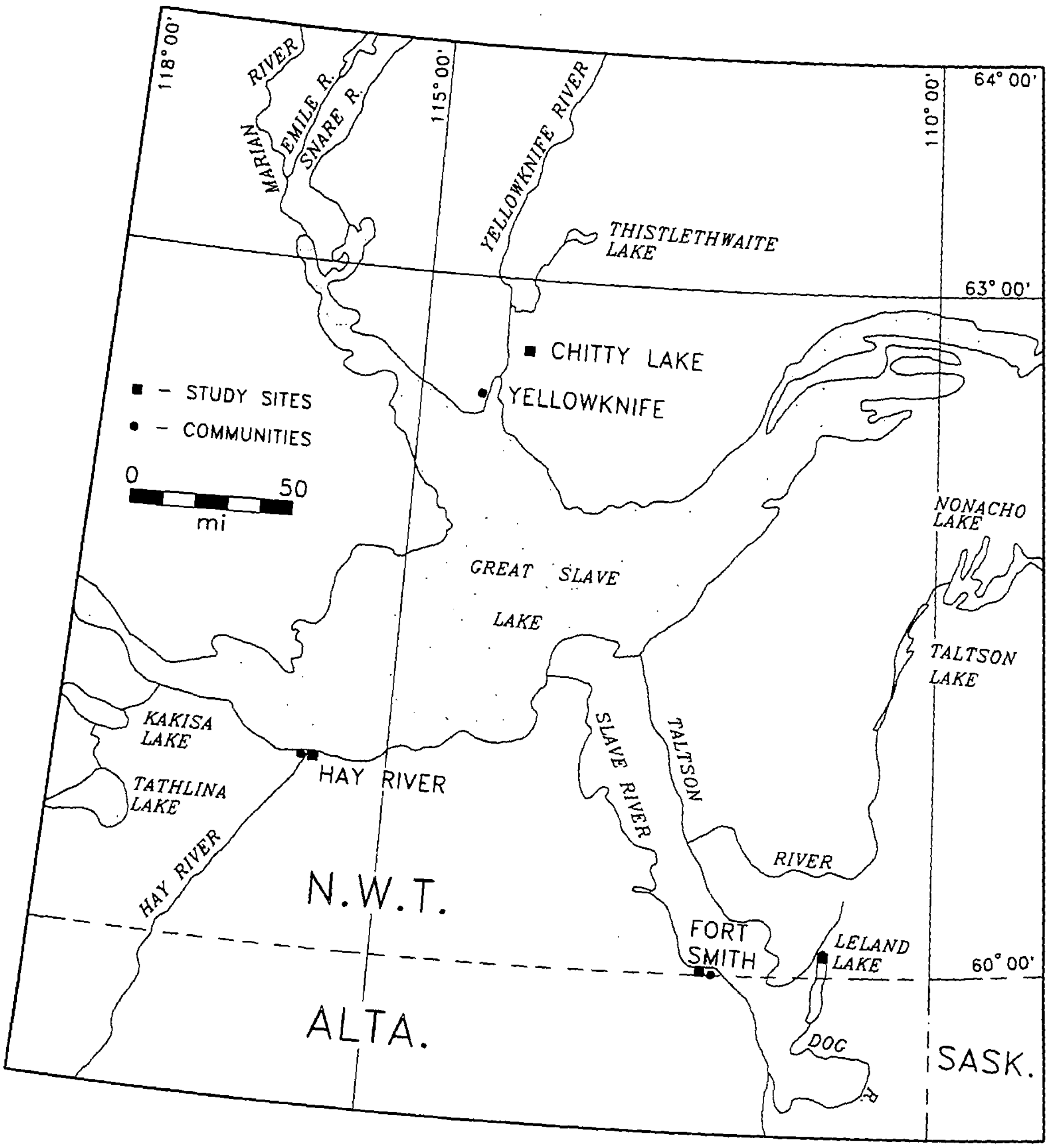


Figure 3

Fish Age Against Fish Length for all Locations

SPECIES: Walleye

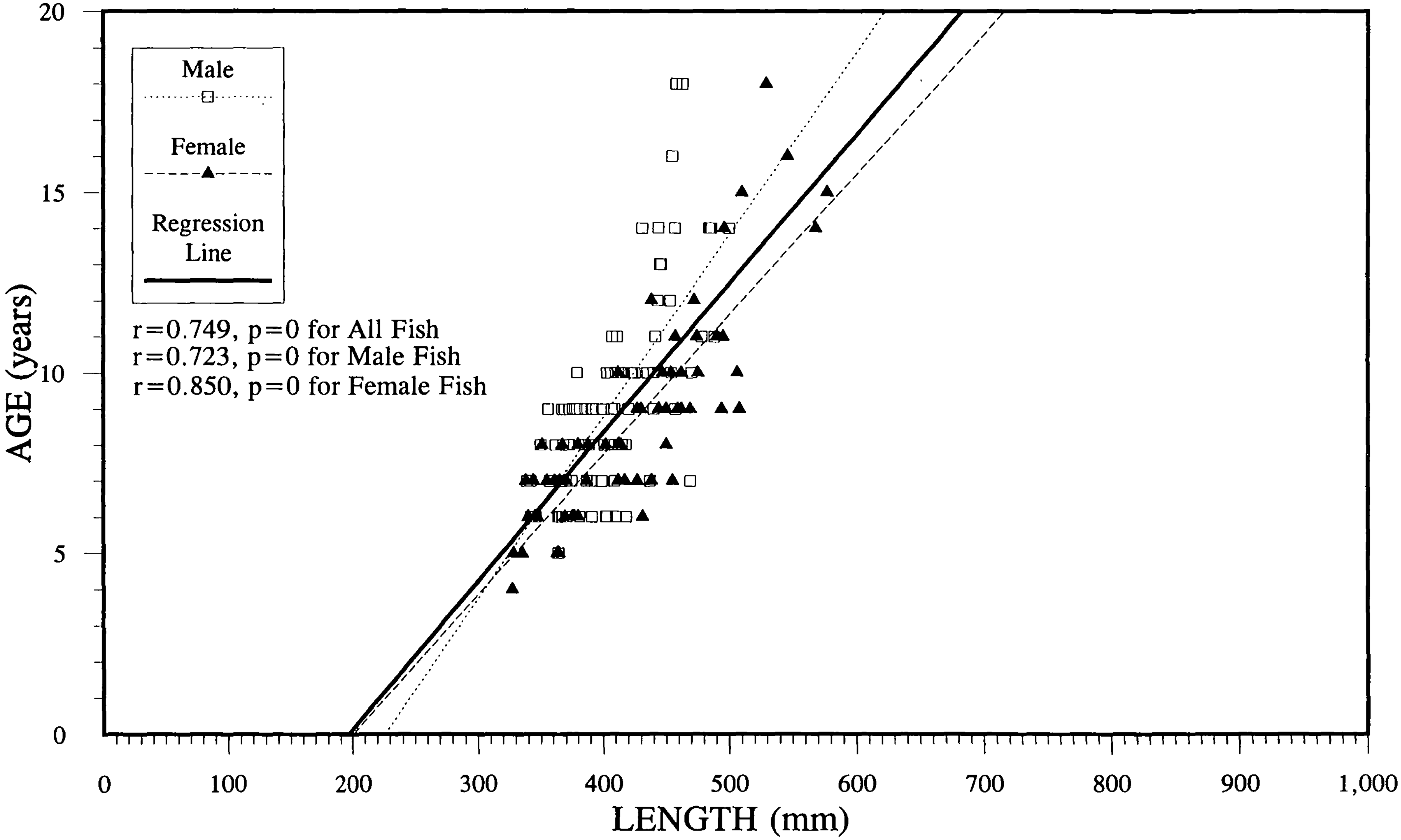


Figure 4

Fish Age Against Fish Length for all Locations

SPECIES: Pike

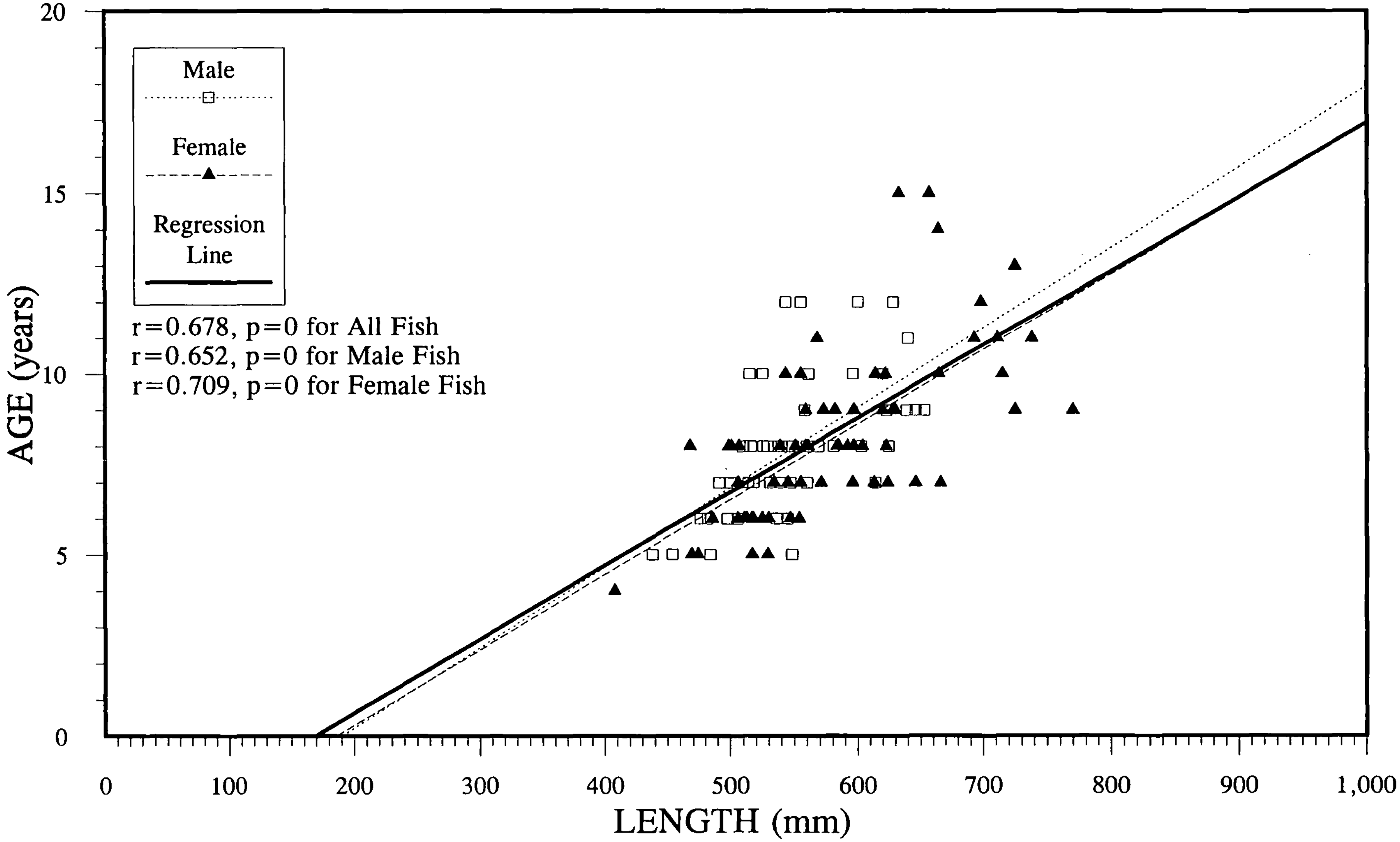


Figure 5

Fish Age Against Fish Length for all Locations

SPECIES: Whitefish

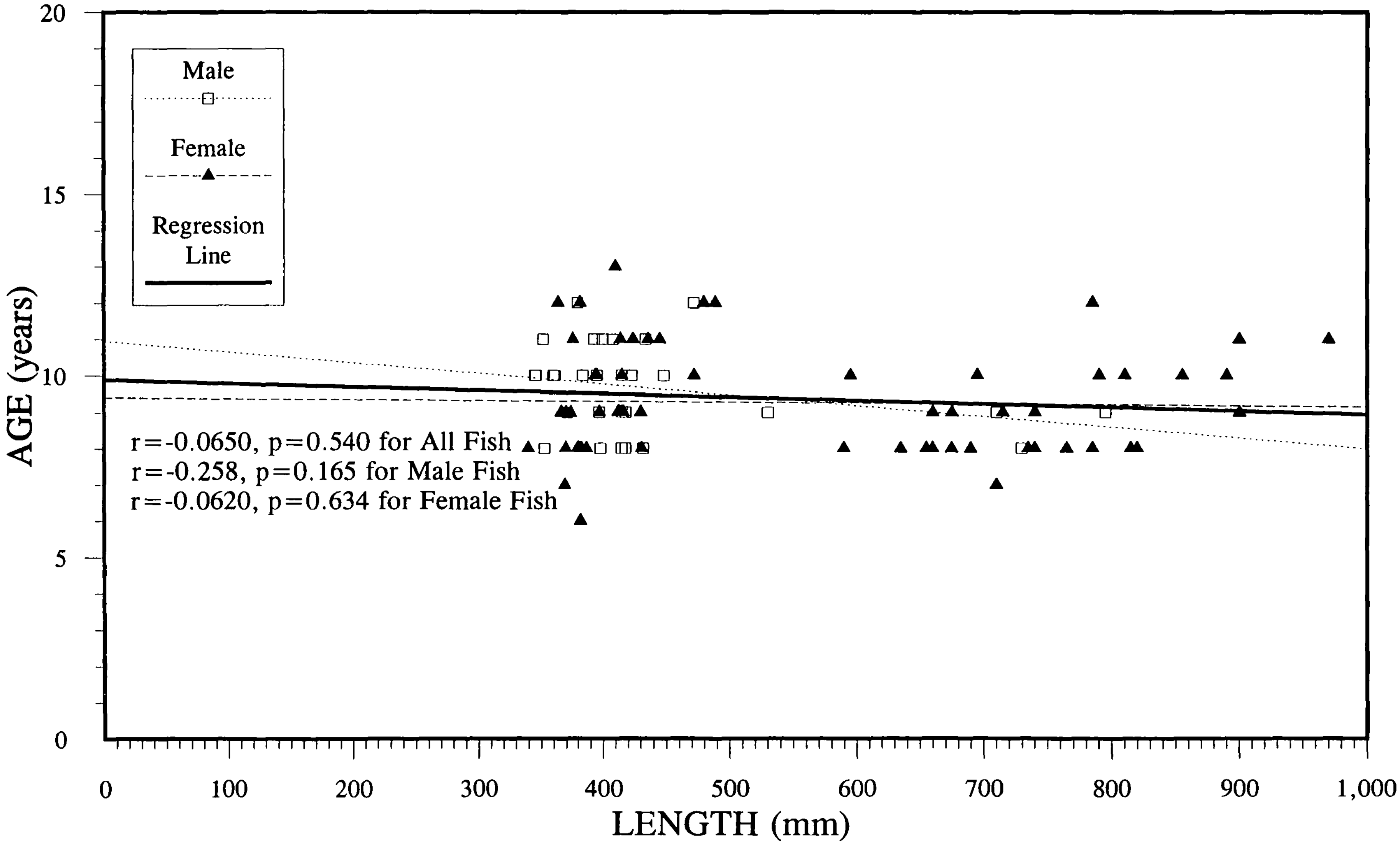


Figure 6
Fish Age Against Total Mercury in the Slave River
SPECIES: Walleye

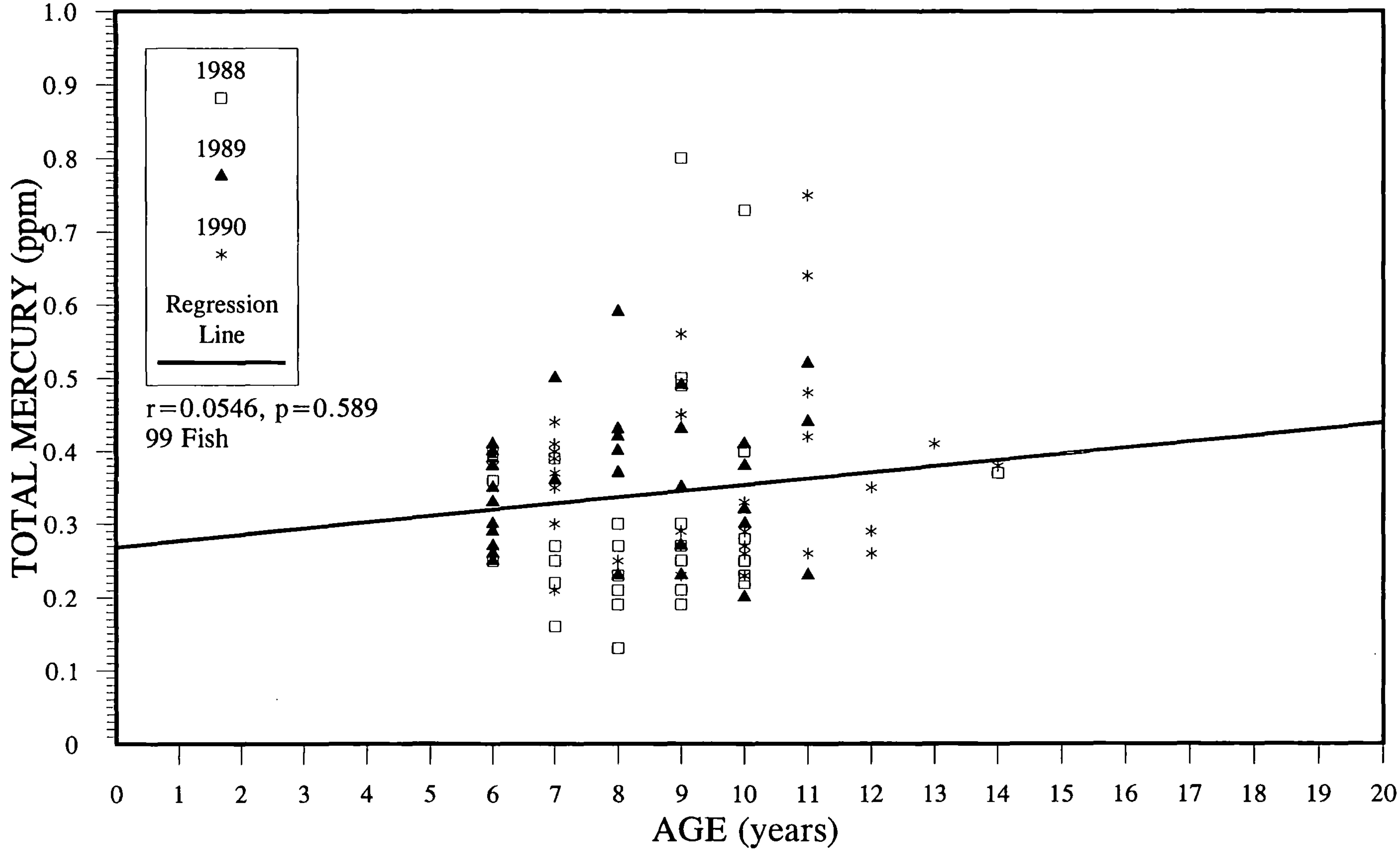


Figure 7

Fish Age Against Total Mercury in the Hay River

SPECIES: Walleye

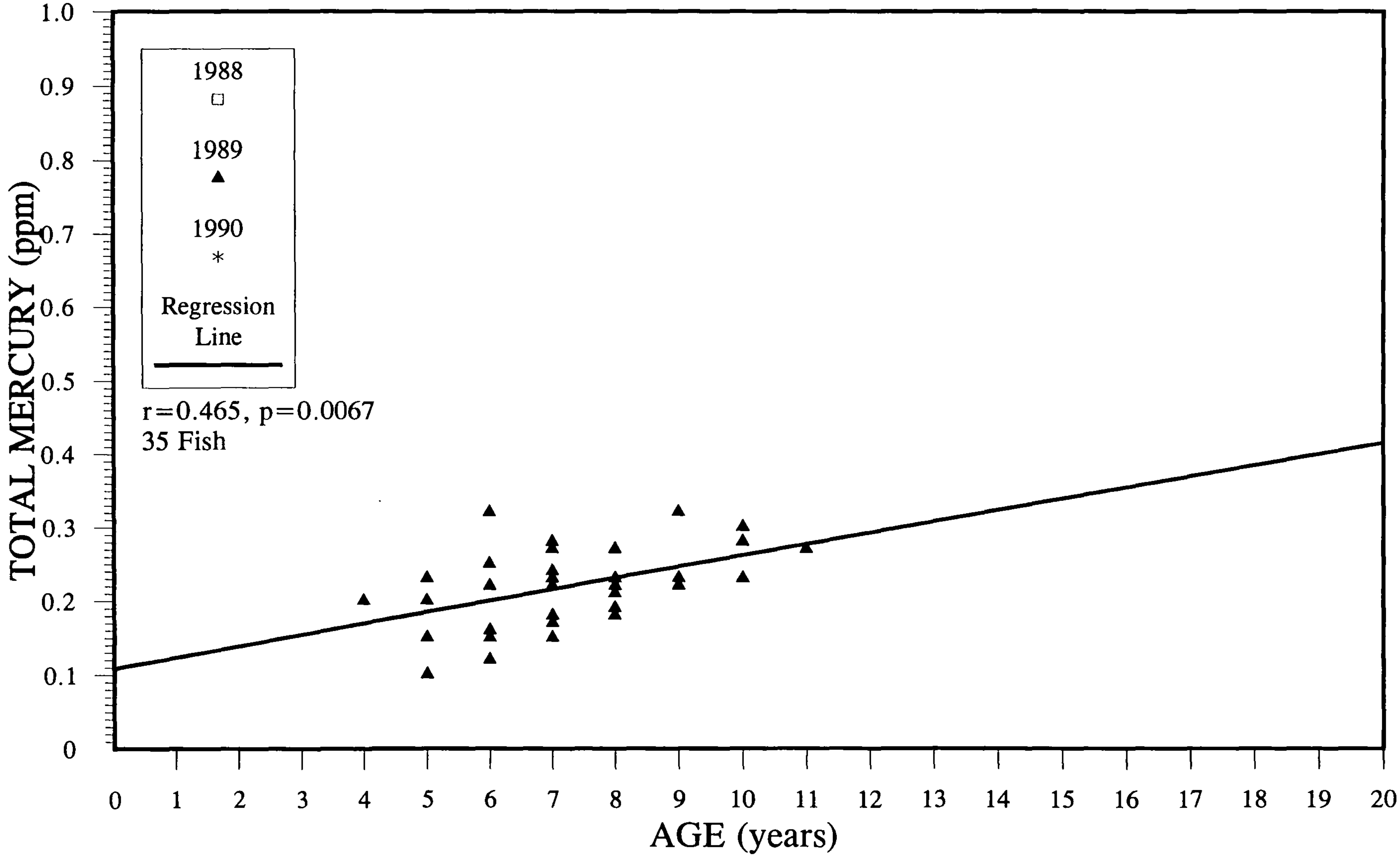


Figure 8

Fish Age Against Total Mercury in Leland Lake

SPECIES: Walleye

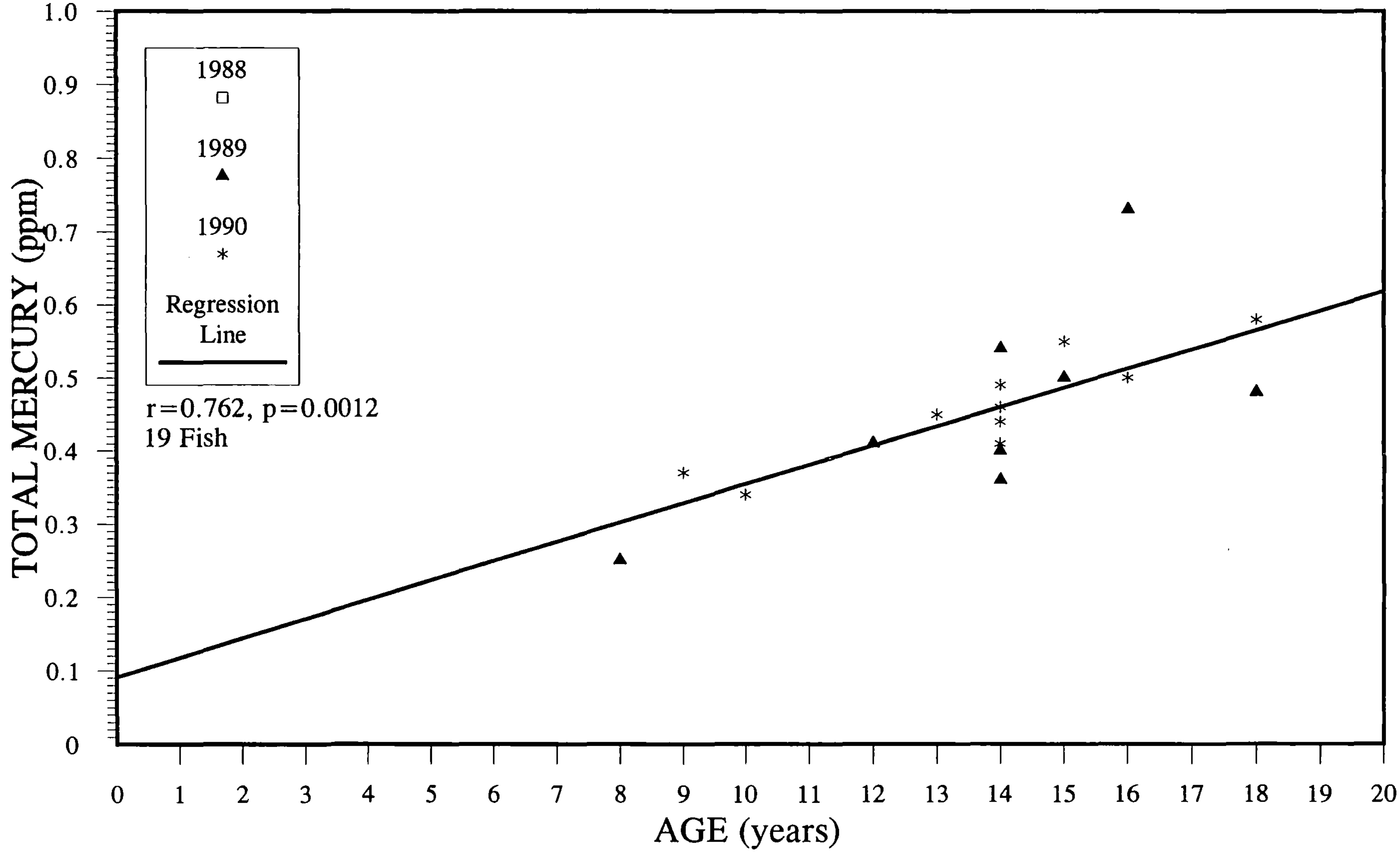


Figure 9

Fish Age Against Total Mercury in the Slave River

SPECIES: Pike

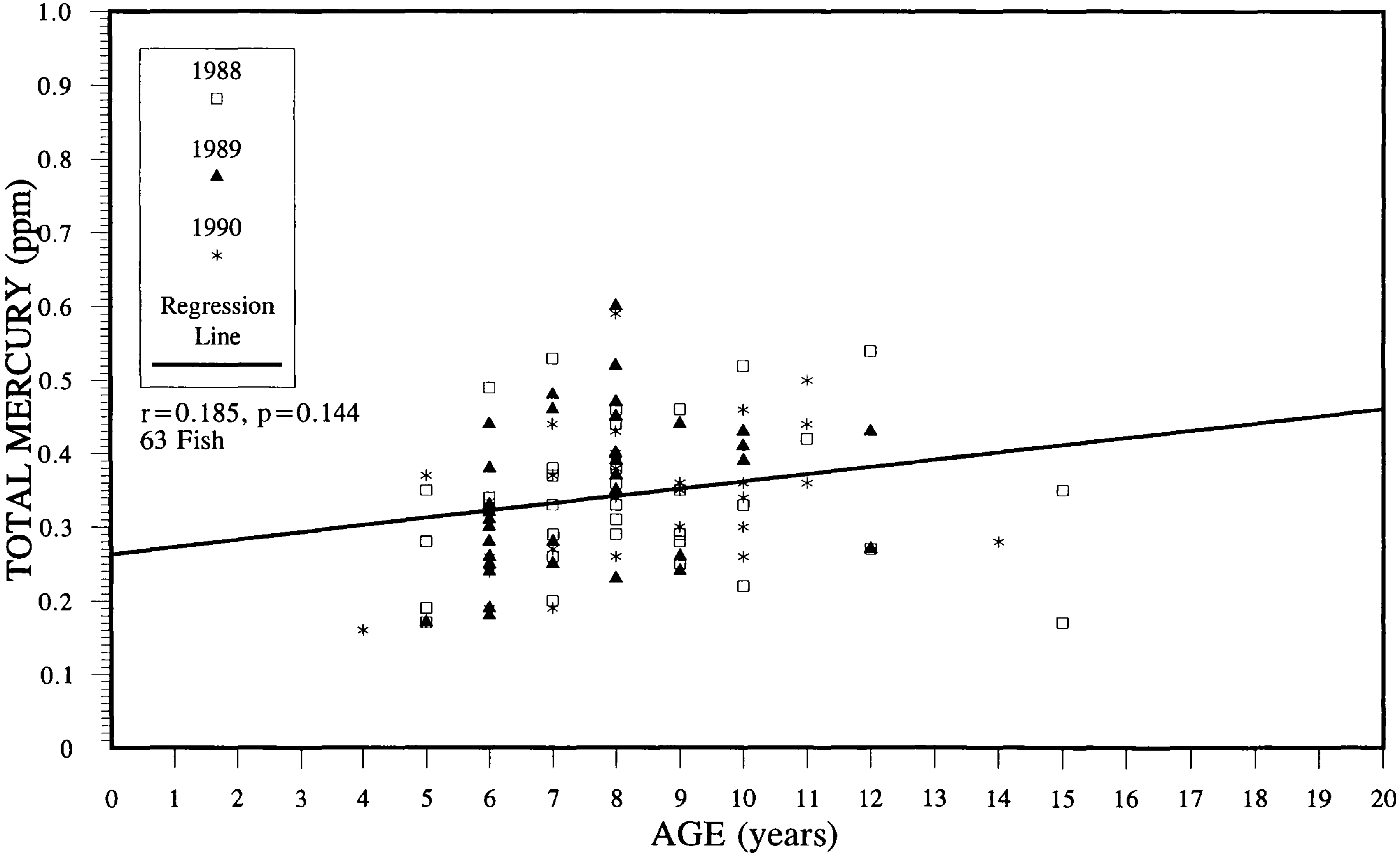


Figure 10

Fish Age Against Total Mercury in the Hay River

SPECIES: Pike

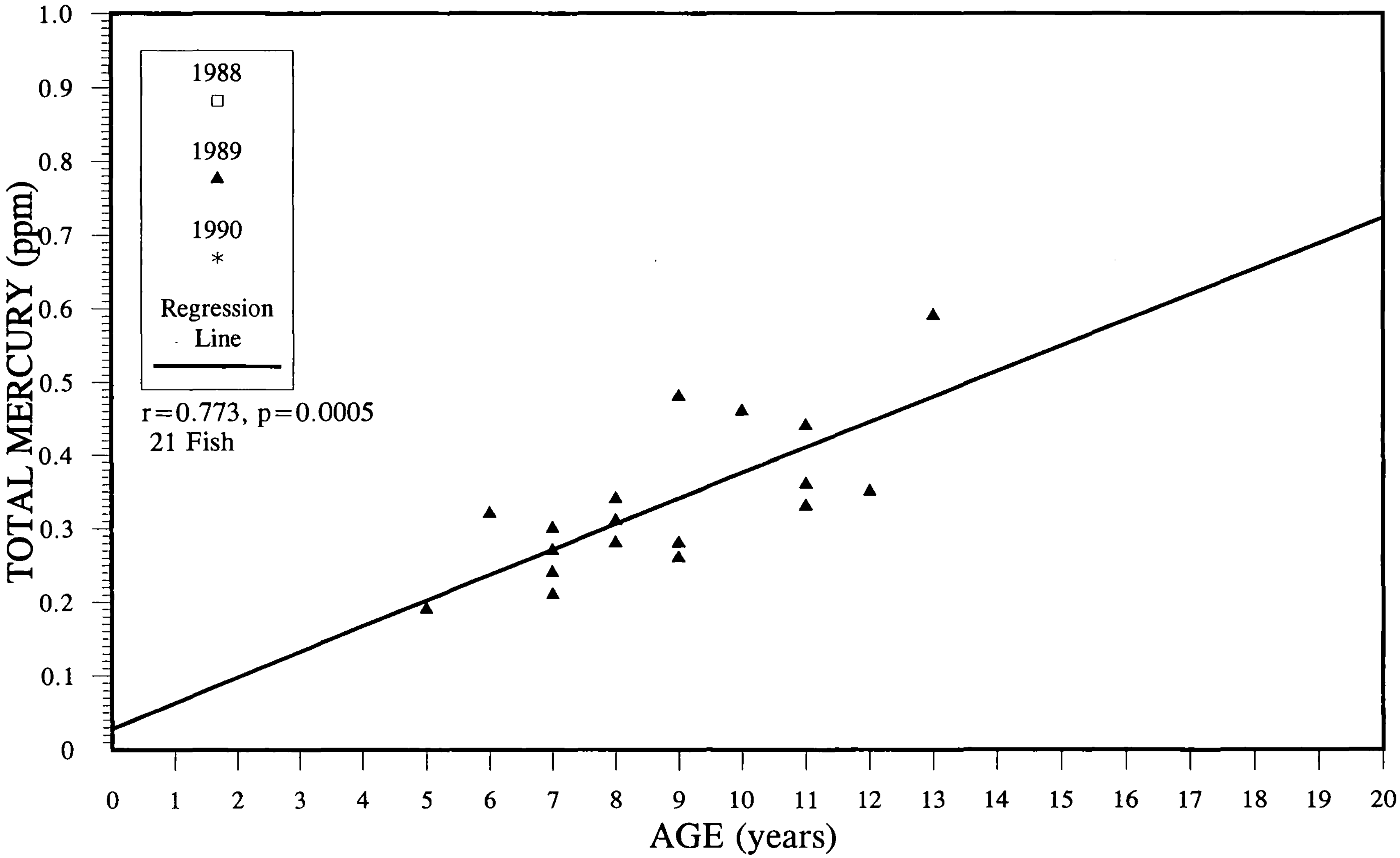


Figure 11

Fish Age Against Total Mercury in Leland Lake

SPECIES: Pike

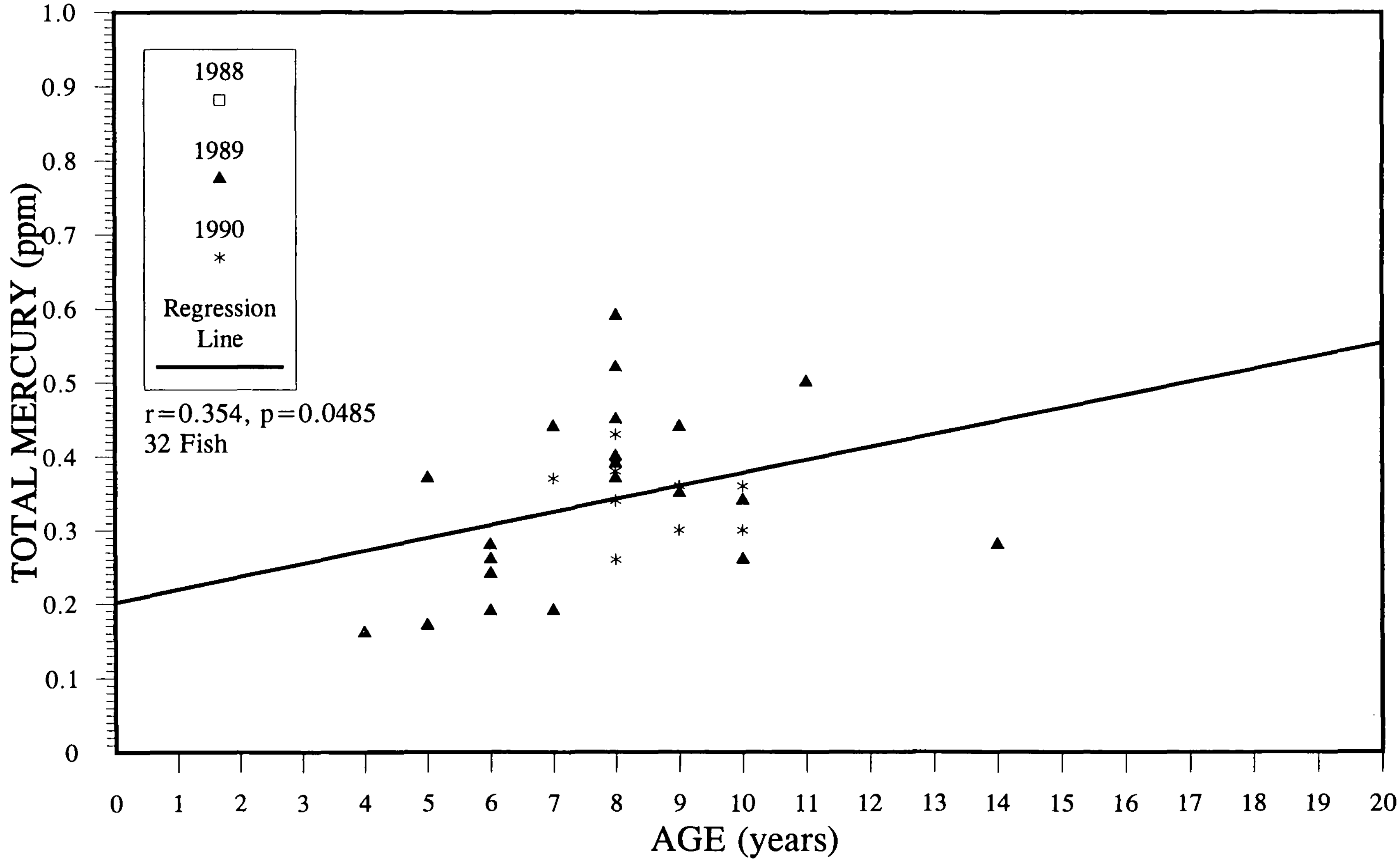


Figure 12

Fish Age Against Total Mercury in the Slave River
SPECIES: Whitefish

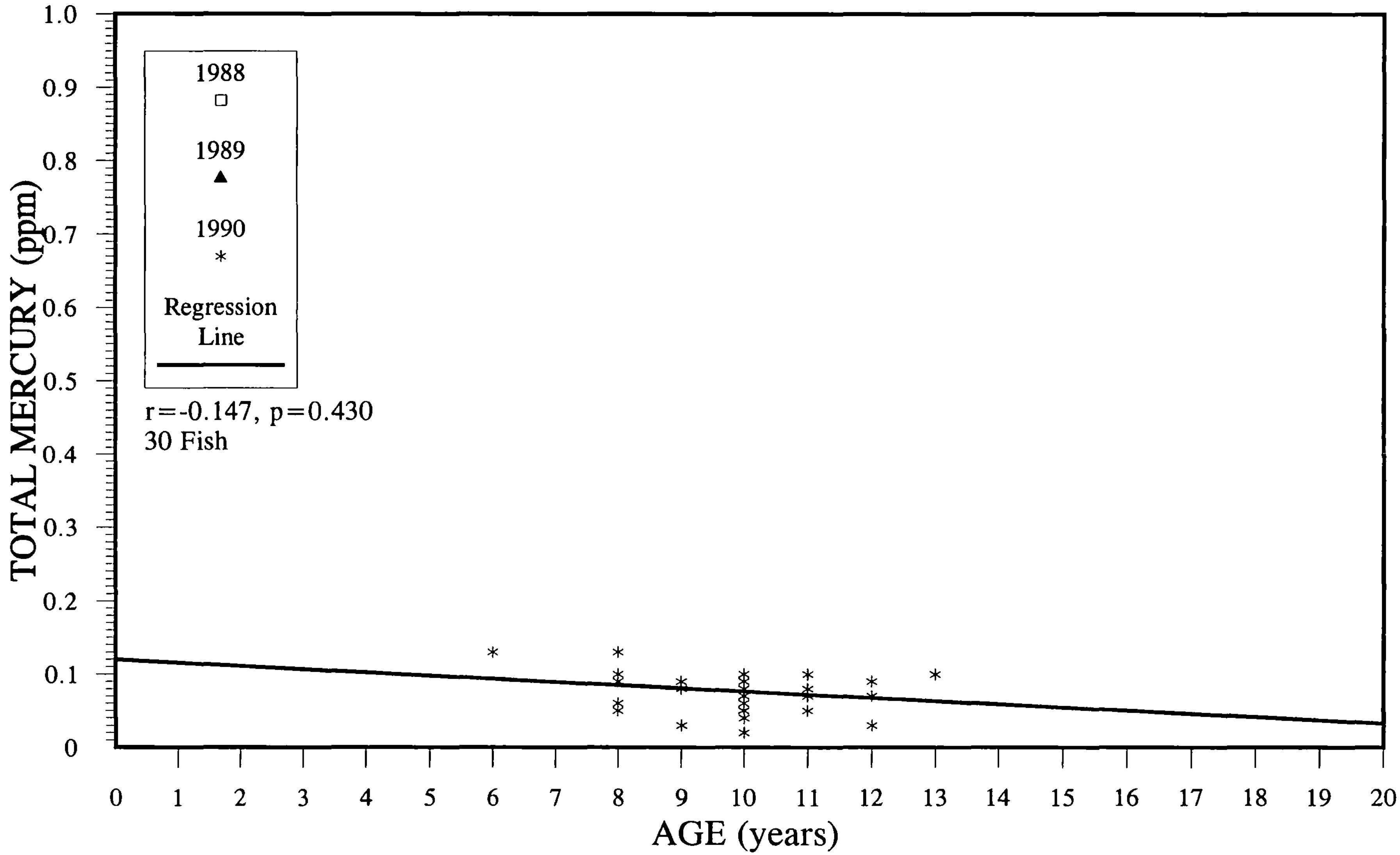


Figure 13

Fish Age Against Total Mercury in the Hay River

SPECIES: Whitefish

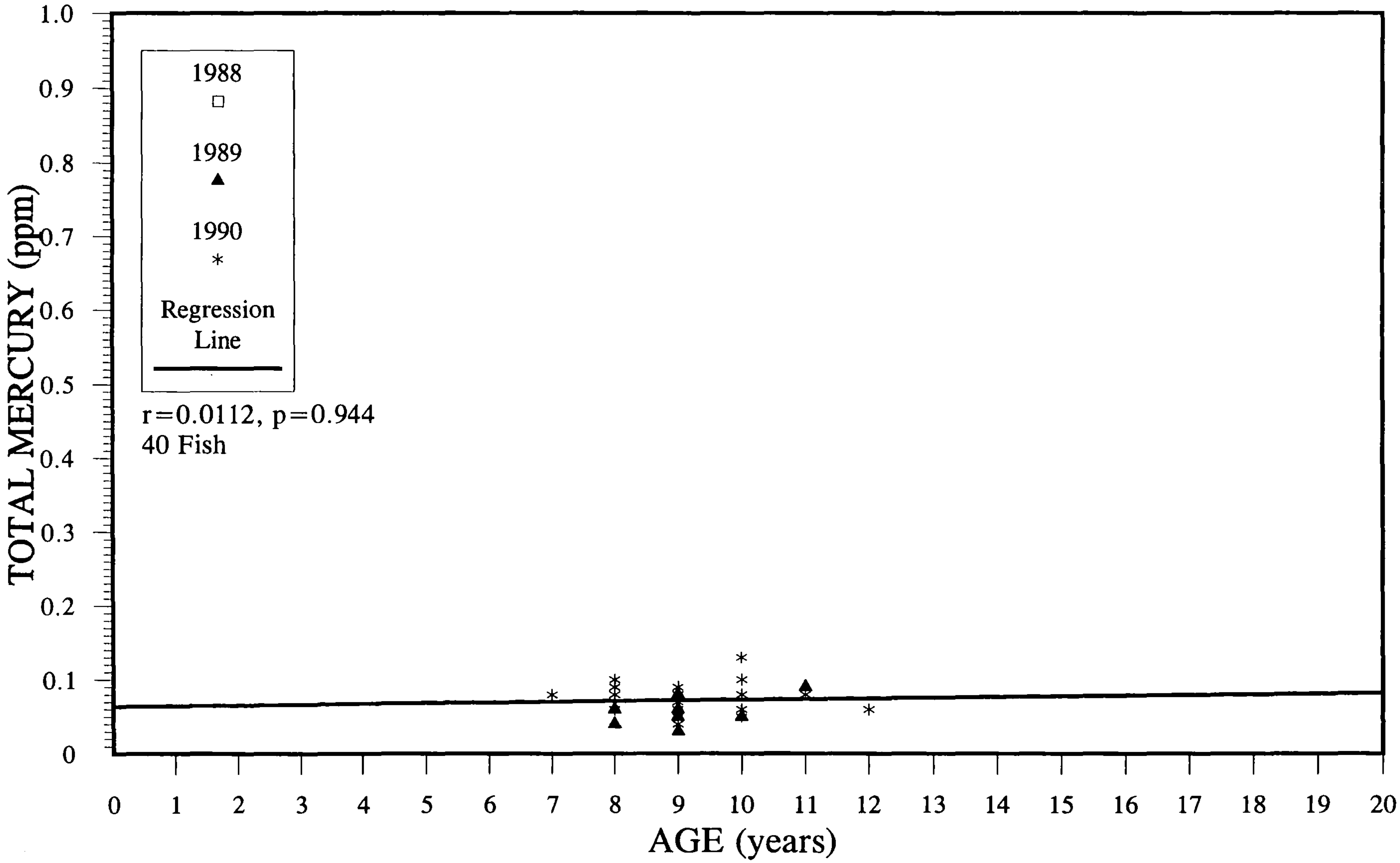


Figure 14

Fish Age Against Total Mercury in Leland Lake

SPECIES: Whitefish

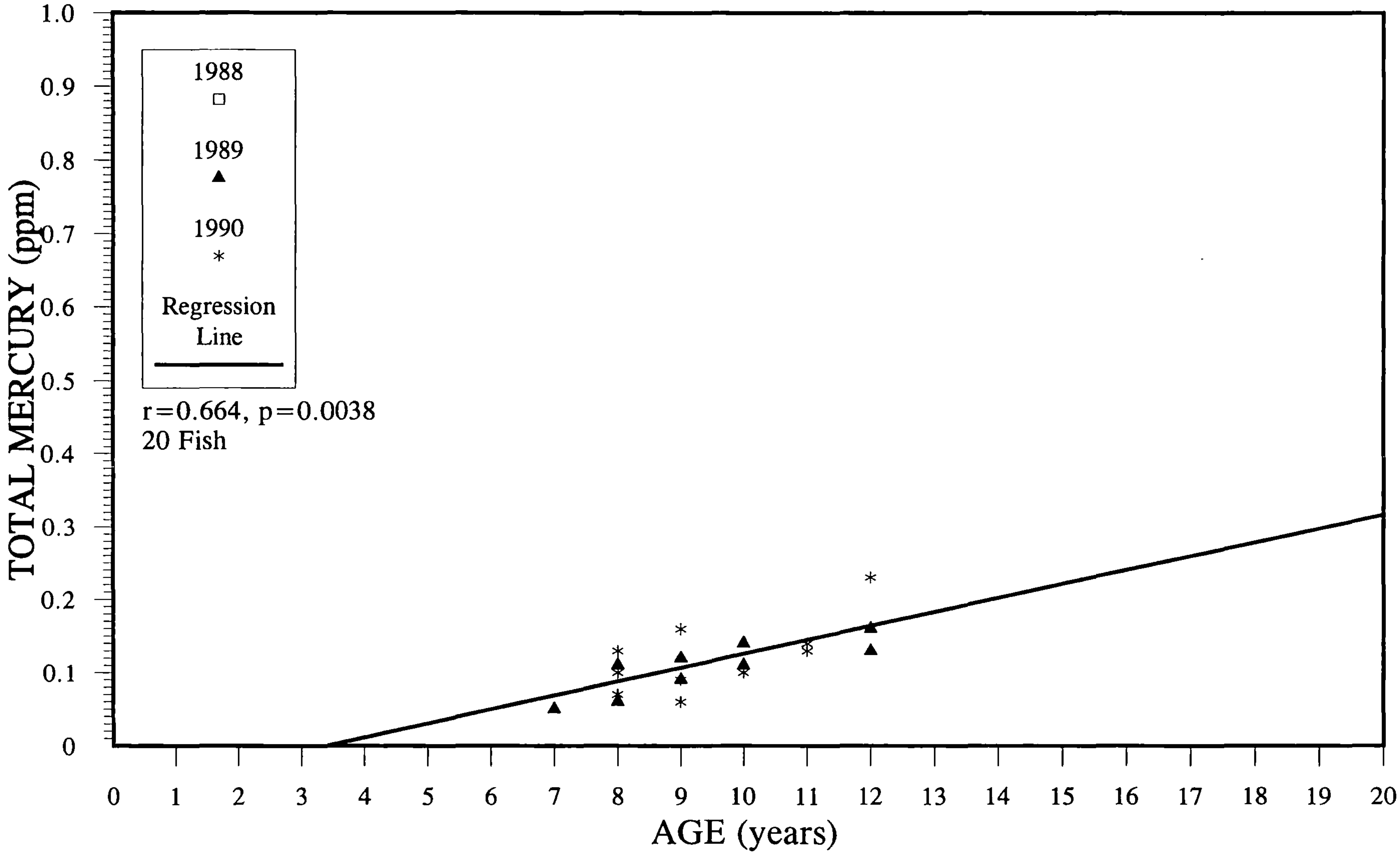


Figure 15
Map of Sites For Comparative Regional Data

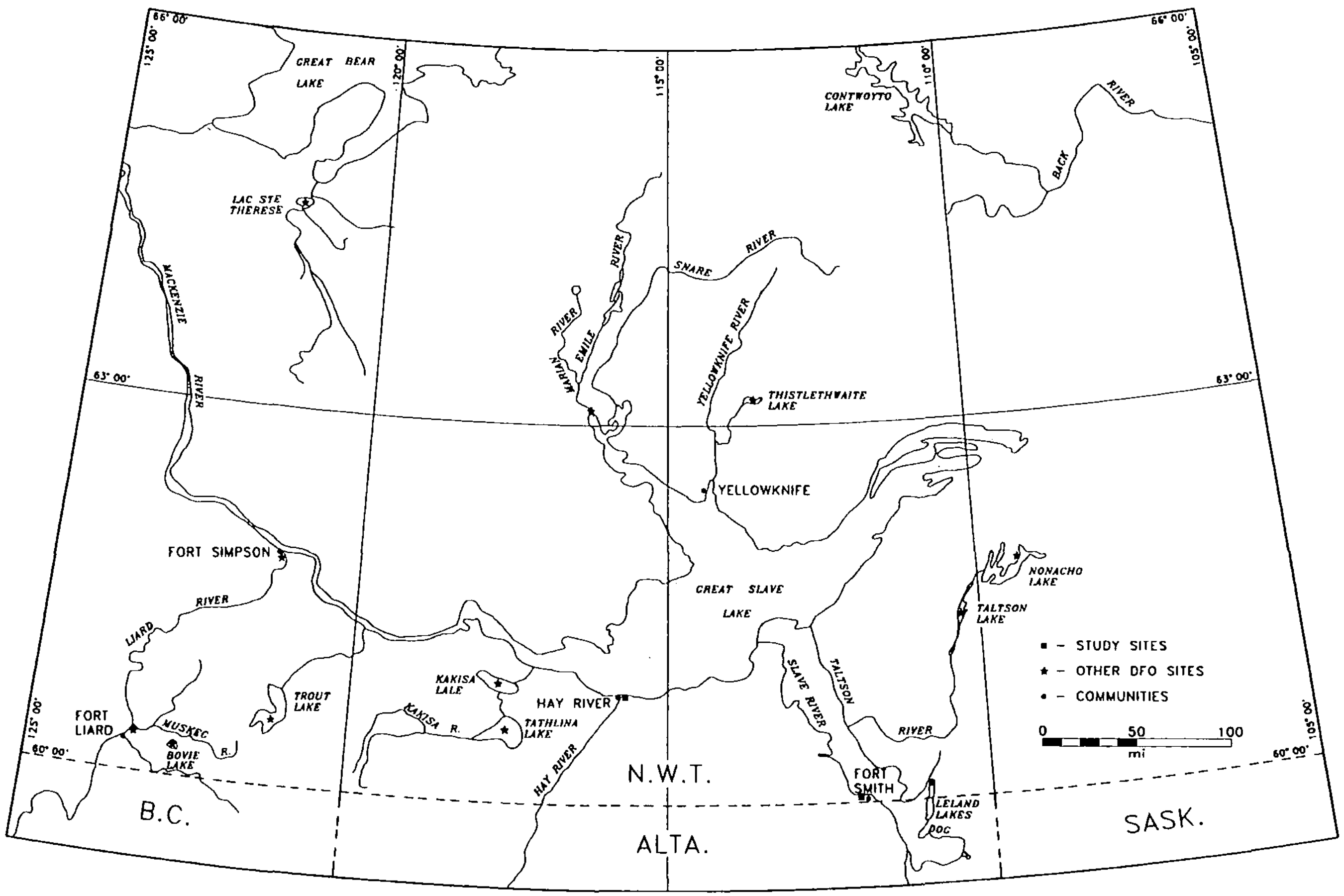


Figure 16

Regional Comparison of Mercury Values
SPECIES: Walleye

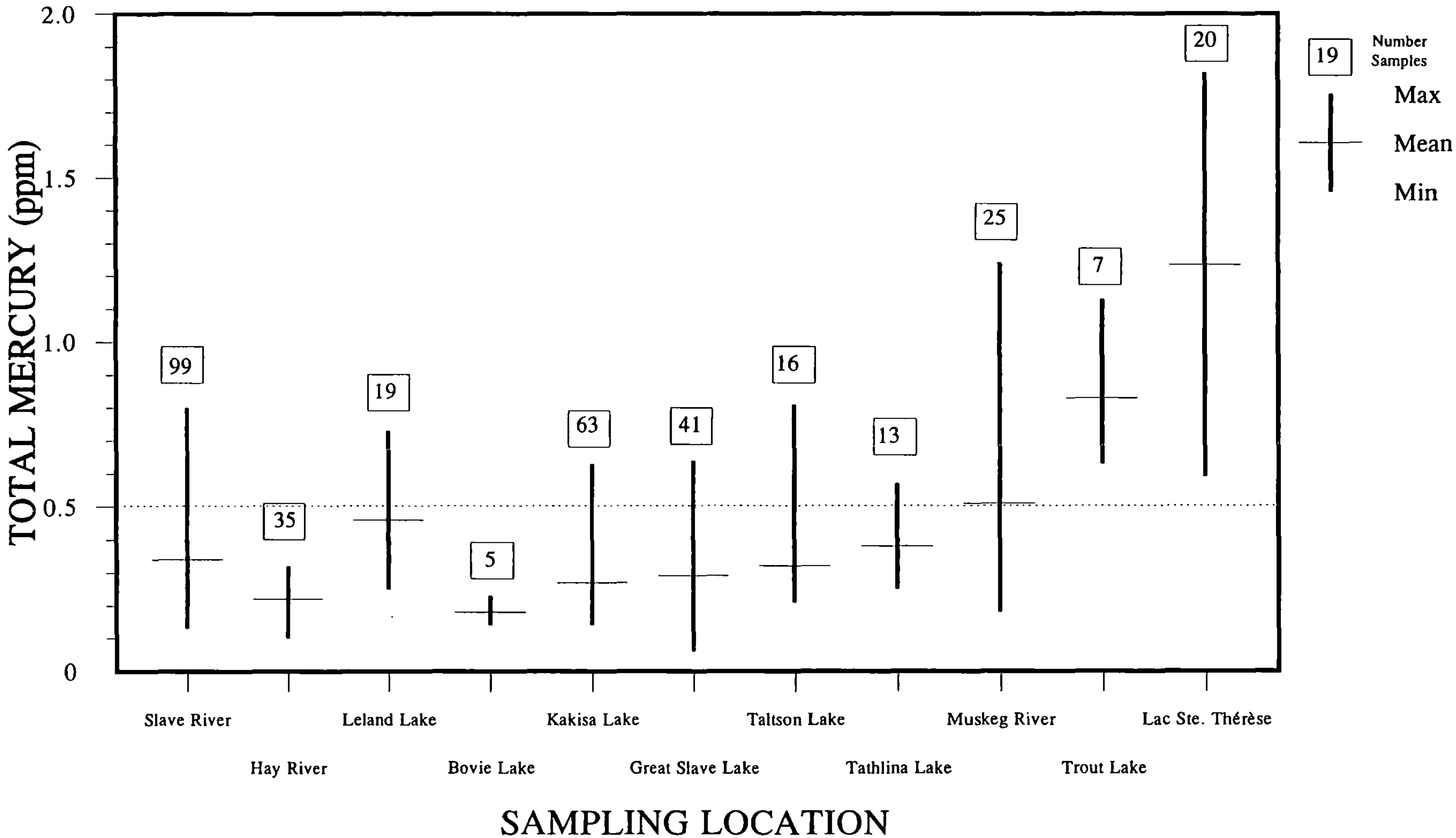


Figure 17

Regional Comparison of Mercury Values

SPECIES: Pike

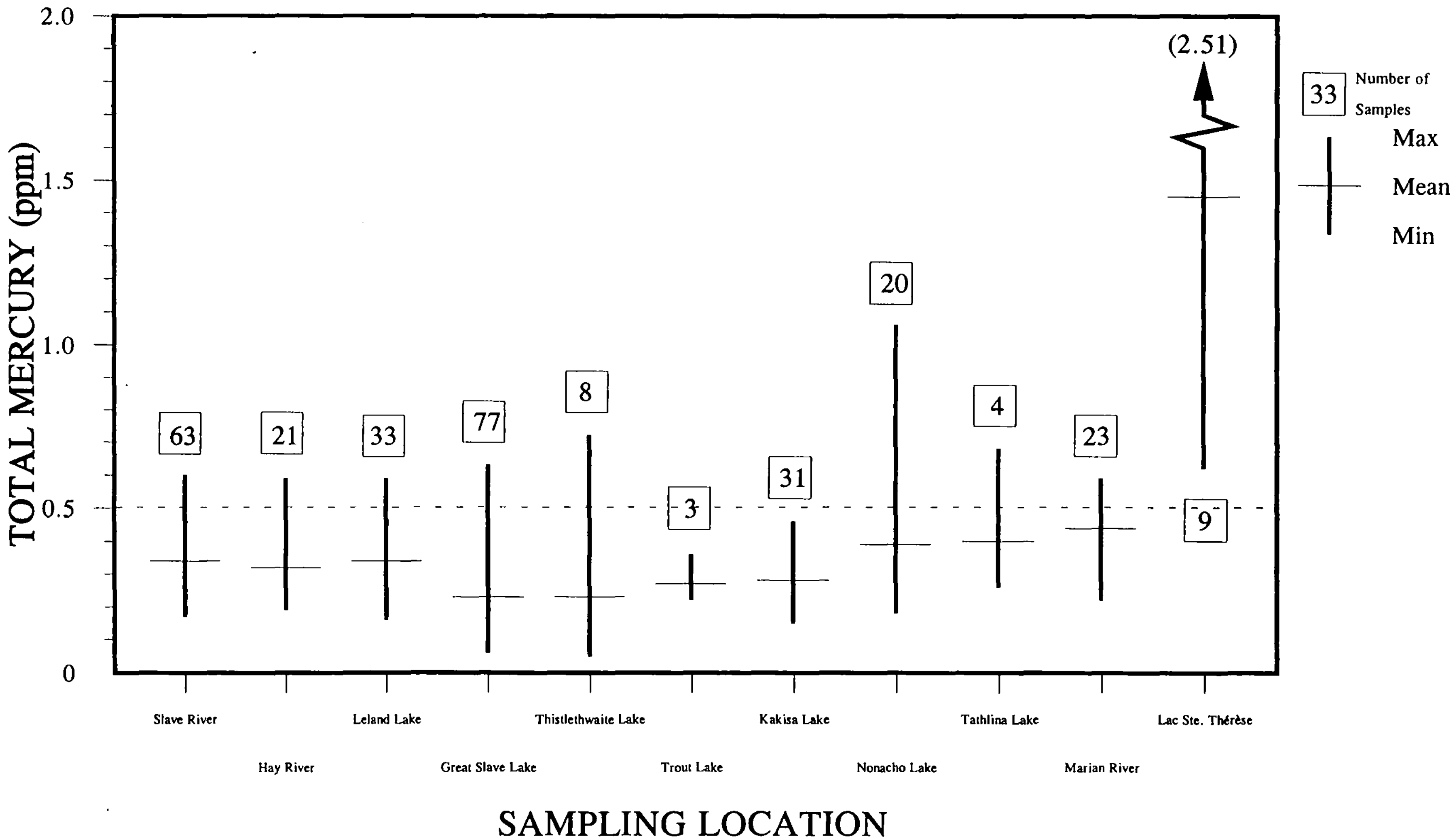
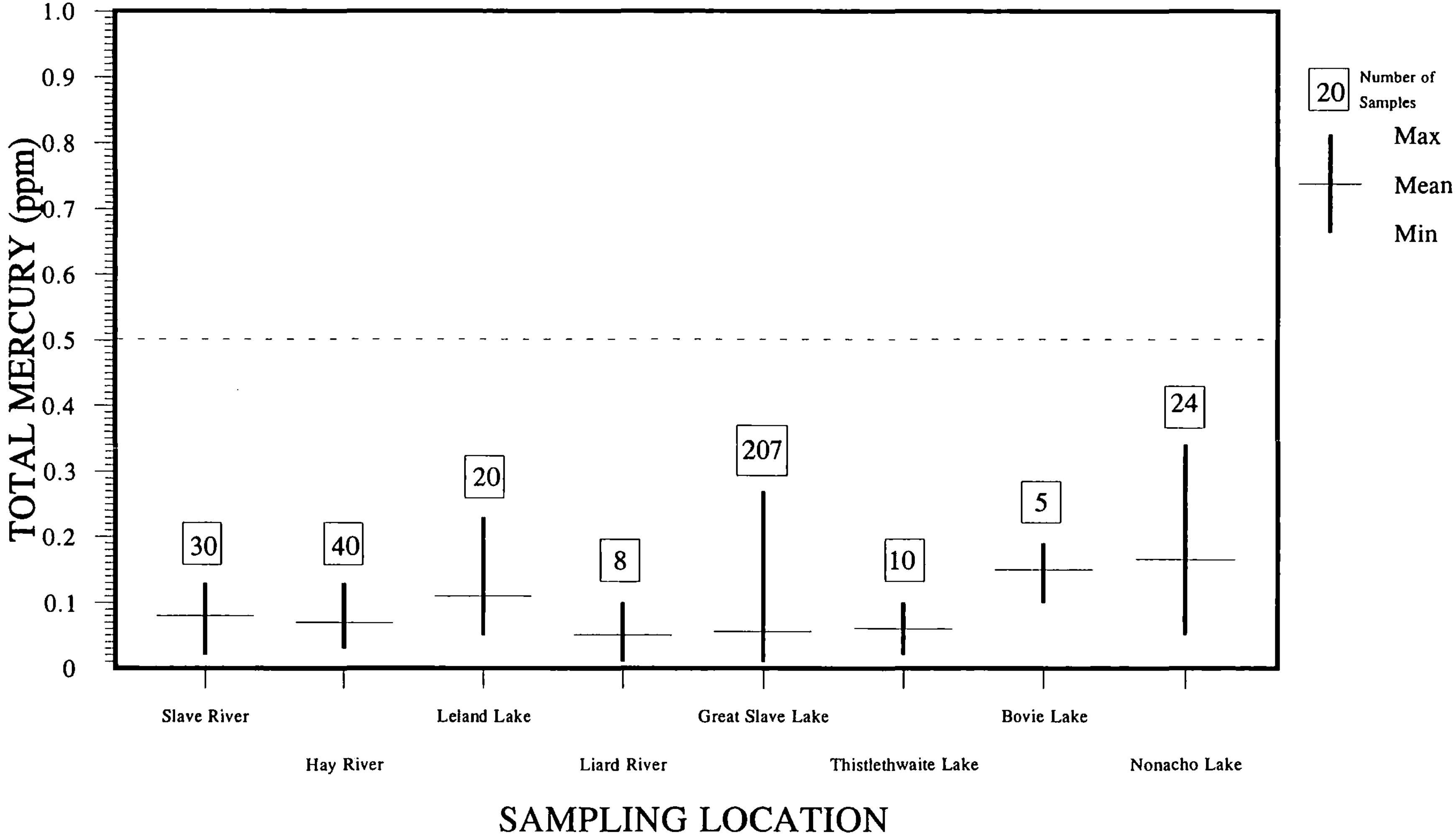


Figure 18

Regional Comparison of Mercury Values

SPECIES: Whitefish



TABLES

Table 1
Summary Data for Slave River Fish

Slave River for 1988

FISH	NUMBER OF SAMPLES			LENGTH (mm)			WEIGHT (g)			AGE		TOTAL MERCURY (ppm)		
SPECIES	Total	Male	Female	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
Walleye	35	26	9	345	508	408	500	1500	810	6	14	0.13	0.80	0.31
Pike	13	6	7	500	711	575	900	2650	1583	7	15	0.17	0.46	0.33

Slave River for 1989

FISH	NUMBER OF SAMPLES			LENGTH (mm)			WEIGHT (g)			AGE		TOTAL MERCURY (ppm)		
SPECIES	Total	Male	Female	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
Walleye	35	27	8	342	490	397	500	1600	775	6	11	0.20	0.59	0.36
Pike	20	7	13	454	725	550	700	2750	1338	5	12	0.17	0.54	0.35

Slave River for 1990

FISH	NUMBER OF SAMPLES			LENGTH (mm)			WEIGHT (g)			AGE		TOTAL MERCURY (ppm)		
SPECIES	Total	Male	Female	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
Walleye	29	19	10	356	495	437	976	1321	556	7	14	0.21	0.75	0.36
Pike	30	11	19	476	715	568	715	2486	1345	6	12	0.18	0.60	0.34
Whitefish	30	17	13	340	415	382	524	1025	805	6	12	0.02	0.13	0.08

Slave River for 1988, 1989 and 1990

FISH	NUMBER OF SAMPLES			LENGTH (mm)			WEIGHT (g)			AGE		TOTAL MERCURY (ppm)		
SPECIES	Total	Male	Female	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
Walleye	99	72	27	342	508	413	500	1600	846	6	14	0.13	0.80	0.34
Pike	63	24	39	454	725	564	700	2750	1392	5	15	0.17	0.60	0.34
Whitefish	30	17	13	340	415	382	524	1025	805	6	12	0.02	0.13	0.08

Table 2
Summary Data for Hay River Fish

Hay River for 1989

FISH SPECIES	NUMBER OF SAMPLES Total	Male	Female	LENGTH (mm) Min	Max	Mean	WEIGHT (g) Min	Max	Mean	AGE Min	Max	TOTAL MERCURY (ppm) Min	Max	Mean
Walleye	35	5	30	327	506	380	450	1800	750	4	11	0.10	0.32	0.22
Pike	21	16	5	429	738	604	775	3100	1710	5	13	0.19	0.59	0.32
Whitefish	10	4	6	371	434	397	750	1800	988	8	11	0.03	0.09	0.06

Hay River for 1990

FISH SPECIES	NUMBER OF SAMPLES Total	Male	Female	LENGTH (mm) Min	Max	Mean	WEIGHT (g) Min	Max	Mean	AGE Min	Max	TOTAL MERCURY (ppm) Min	Max	Mean
Whitefish	30	3	27	590	970	750	362	420	381	7	12	0.04	0.13	0.08

Hay River for 1989 and 1990

FISH SPECIES	NUMBER OF SAMPLES Total	Male	Female	LENGTH (mm) Min	Max	Mean	WEIGHT (g) Min	Max	Mean	AGE Min	Max	TOTAL MERCURY (ppm) Min	Max	Mean
Walleye	35	5	30	327	506	380	450	1800	750	4	11	0.10	0.32	0.22
Pike	21	16	5	438	738	604	775	3100	1710	5	13	0.19	0.59	0.32
Whitefish	40	7	33	371	970	662	362	1800	533	7	12	0.03	0.13	0.07

Table 3
Summary Data for Leland Lake Fish

Leland Lake for 1989

FISH	NUMBER OF SAMPLES			LENGTH (mm)			WEIGHT (g)			AGE		TOTAL MERCURY (ppm)		
SPECIES	Total	Male	Female	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
Walleye	9	5	4	414	577	488	850	2450	1508	8	18	0.25	0.73	0.46
Pike	22	8	14	408	664	532	500	2200	1080	4	14	0.16	0.59	0.34
Whitefish	10	5	5	369	480	432	800	1600	1218	7	12	0.05	0.16	0.11

Leland Lake for 1990

FISH	NUMBER OF SAMPLES			LENGTH (mm)			WEIGHT (g)			AGE		TOTAL MERCURY (ppm)		
SPECIES	Total	Male	Female	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
Walleye	10	6	4	407	546	476	776	1799	1273	9	18	0.34	0.58	0.46
Pike	10	5	5	514	770	581	1441	2880	923	7	10	0.26	0.43	0.35
Whitefish	10	5	5	387	553	441	809	1516	1179	8	12	0.06	0.26	0.12

Leland Lake for 1989 and 1990

FISH	NUMBER OF SAMPLES			LENGTH (mm)			WEIGHT (g)			AGE		TOTAL MERCURY (ppm)		
SPECIES	Total	Male	Female	Min	Max	Mean	Min	Max	Mean	Min	Max	Min	Max	Mean
Walleye	19	11	8	407	577	482	776	2450	1385	8	18	0.25	0.73	0.46
Pike	32	13	19	408	770	547	500	2880	1193	4	14	0.16	0.59	0.34
Whitefish	20	10	10	369	530	436	800	1600	1198	7	12	0.05	0.23	0.11

Table 4
Statistical Test Results for Total Mercury

	SLAVE R. Pike	SLAVE R. Whitefish	HAY R. Walleye	HAY R. Pike	HAY R. Whitefish	LELAND L. Walleye	LELAND L. Pike	LELAND L. Whitefish
SLAVE R. Walleye	Accept	Reject	Reject	Accept	Reject	Reject	Accept	Reject
SLAVE R. Pike		Reject	Reject	Accept	Reject	Reject	Accept	Reject
SLAVE R. Whitefish			Reject	Reject	Accept	Reject	Reject	Reject
HAY R. Walleye				Reject	Reject	Reject	Reject	Reject
HAY R. Pike					Reject	Reject	Accept	Reject
HAY R. Whitefish						Reject	Reject	Reject
LELAND L. Walleye							Reject	Reject
LELAND L. Pike								Reject

NOTES: The significance level was set at 0.05 for the Kolmogorov-Smirnov Two-Sample Test in which the null hypothesis assumes that the two samples come from the same distribution. Therefore, a rejection of the null hypothesis indicates that there is a significant difference between the distributions, ie. they are not from the same population.

Table 5
Statistical Test Results for Fish Age

	SLAVE R. Pike	SLAVE R. Whitefish	HAY R. Walleye	HAY R. Pike	HAY R. Whitefish	LELAND L. Walleye	LELAND L. Pike	LELAND L. Whitefish
SLAVE R. Walleye	Reject	Reject	Reject	Accept	Accept	Reject	Reject	Reject
SLAVE R. Pike		Reject	Reject	Accept	Reject	Reject	Accept	Reject
SLAVE R. Whitefish			Reject	Reject	Accept	Reject	Reject	Reject
HAY R. Walleye				Reject	Reject	Reject	Reject	Reject
HAY R. Pike					Reject	Reject	Accept	Reject
HAY R. Whitefish						Reject	Reject	Accept
LELAND L. Walleye							Reject	Reject
LELAND L. Pike								Reject

NOTES: The significance level was set at 0.05 for the Kolmogorov-Smirnov Two-Sample Test in which the null hypothesis assumes that the two samples come from the same distribution. Therefore, a rejection of the null hypothesis indicates that there is a significant difference between the distributions, ie. they are not from the same population.

Table 6
Summary of HC Health Guideline Levels for Mercury in NWT Study Fish

SITE: SPECIES	Number of Fish Sampled	* Number of fish > 0.2 ppm	* Percentage of fish > 0.2 ppm	** Number of fish > 0.5 ppm	** Percentage of fish > 0.5 ppm
SLAVE RIVER: Walleye	99	95	96	7	7
Pike	63	57	90	4	6
Whitefish	30	0	0	0	0
HAY RIVER: Walleye	35	21	60	0	0
Pike	21	19	90	1	5
Whitefish	40	0	0	0	0
LELAND LAKE: Walleye	19	19	100	4	21
Pike	32	28	86	2	6
Whitefish	20	1	5	0	0

NOTES: * 0.2 ppm – Medical Services Branch (HC) recommended level for those who consume large quantities of fish [safe weekly fish consumption of 1.05 kg].

** 0.5 ppm – Health Protection Branch (HC) guideline for commercial fish [safe weekly fish consumption of 0.42 kg].