

**Progress Report on Hudson River Mammals: Polychlorinated Biphenyl (PCB) Levels in  
Mink, Otter, and Muskrat and Trapping Results for Mink, the Upper Hudson River  
Drainage, 1998-2000.**

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**Abstract**

Mink (*Mustela vison*), river otters (*Lontra canadensis*)<sup>1</sup>, and muskrats (*Ondatra zibethicus*) were collected from the upper Hudson River drainage during the 1998-1999 and 1999-2000 trapping seasons. Liver samples from 162 animals (102 mink, 40 otter, and 20 muskrats) were analyzed for lipids and PCBs as Aroclors. PCB concentrations were elevated for mink and otters collected from the Hudson River drainage between Hudson Falls and Troy. Ranges (means) for PCB levels were 0.541 to 139 (13.0) and 18.5 to 431 (172) µg total PCBs/g lipid for 35 mink and 4 otter, respectively, collected from the towns<sup>2</sup> located between Hudson Falls and Troy. Maximum PCB levels in mink and otters exceed criteria of Leonards *et al.* (1994) for reproductive impairment by factors of 2.8 and 8.6, respectively. Maximum PCB levels in mink and otters exceed criteria of Smit *et al.* (1996) for potential health impairment by factors of 6.6 and 20.5, respectively. Levels of PCBs in mink and otters collected from upstream of Hudson Falls were generally below no-effect levels for adverse toxicological effects as defined by Smit *et al.* (1996). Levels of PCBs in muskrats were markedly lower than levels in either mink or otters. Levels of PCBs in mustelids were similar to those in a study conducted in 1982-1984 suggesting that levels have not decreased in the upper Hudson River drainage in the past 16 years. To further refine the assessment of levels of PCBs in mink and otters, liver samples are currently being analyzed for congener-specific levels.

Research staff trapped for mink in the upper Hudson River drainage during the 1999-2000 trapping season. A lower take of mink relative to trapping effort was evident for trap sites located within one home range (6 km) of PCB-contaminated sections of the river between Fort Edward and Troy compared to sites at least one home range from the river or upstream of Hudson Falls. The number of mink trapped per 1000 trap nights for sites near the contaminated sections was 3.5; for upstream or distant sites the number was 26.2. To further investigate the apparent decrease in abundance of mink near the contaminated sections, a more extensive assessment of mink abundance, which uses scent stations equipped with track boards to monitor mink activity, is underway.

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1 formerly *Lutra canadensis*, Wilson, D. E., and D. M. Reeder (eds.) 1993 Mammal Species of the World. Smithsonian Institution Press, 1206 p.

2 "Town" is a political subdivision of county government in New York State

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## **Introduction**

The loading of PCBs in the Hudson River was the highest of any major river system in the United States (Horn *et al.* 1979). An electrical capacitor manufacturing plant located at Hudson Falls, New York, and its sister plant, located approximately 2 km downstream at Fort Edward, New York, discharged PCBs into the Hudson River starting in 1947. Between 1966 and 1974, these plants purchased 35,000 metric tons of PCBs representing approximately 15% of domestic sales of PCBs (Horn *et al.* 1979). From the 1940's to 1977 up to 1.33 million pounds of PCBs were discharged into the upper Hudson River. Historic discharges and continuing releases from fractured bedrock and erosion of contaminated soils and sediments have contaminated river water, sediments, floodplains, and fish, wildlife, and other biota with PCBs.

Analysis of a small number of mink and river otters collected from the Hudson River region of New York State between 1982 and 1984 suggests that high levels of PCB contamination were present in populations of these mustelids in the Hudson River drainage (Foley *et al.* 1988). The maximum level in mink was greater than levels known to cause reproductive failure in ranched mink (Foley *et al.* 1988). This degree of contamination suggests that reproductive impairment and a consequent decrease in abundance may be present in wild populations of mink and otters in riparian habitats of the Hudson River drainage. Although PCB levels in mustelids collected from the Hudson River region between 1982 and 1984 were the highest of any collected from 8 regions (ecozones) of New York State, the number of animals collected in this region was too small to quantify the extent of contamination in the populations. The goal of our current study is to provide additional information on the extent of contamination and its potential effect on mink, river otters, and muskrats in the Hudson River ecosystem. This progress report provides preliminary results of PCB levels in mink, otters, and muskrats, as well as trapping information.

In 1998 we initiated a study designed to address concerns regarding environmental contaminants, including PCBs, in the Hudson River drainage. An initial objective of this study was to describe the geographic distribution of mink, river otters, and muskrats with elevated levels of PCBs within the upper Hudson River watershed. We hypothesized that: 1) mink, otters, and muskrats collected near the most contaminated section of the Hudson River (*i.e.*, main-stem section between Hudson Falls and Troy) would have higher PCB concentrations than animals collected further away; and 2) these higher PCB concentrations could potentially impair health and reproduction of these species. We examined these hypotheses by 1) comparing PCB levels in animals collected in drainage areas between Hudson Falls and Troy with PCB levels outside of these areas; 2) comparing these levels to health and reproductive effects criteria from the literature; and 3) comparing the number of mink trapped adjusted for trapping effort within one home range of this contaminated section with mink take in areas outside this home range. To meet these objectives, PCBs as Aroclors were measured in mink, river otters, and muskrats collected primarily from the upper Hudson River during the 1998-1999 and 1999-2000 trapping

seasons and research staff trapped for mink in the upper Hudson River drainage during the 1999-2000 trapping season.

Effect levels for potential health and reproductive impairment related to PCB exposure in mink and otter are presented in the literature. Leonards *et al.* (1994) summarized toxicological studies of mink and developed a model of PCB toxicity for mink based on reproductive success. PCB levels that affect the number of mink kits produced and kit survival were developed for body burdens from modeling efforts. Smit *et al.* (1996) examined a variety of potential toxicological responses of European otter to PCBs. The effects of PCBs on hepatic Vitamin A reduction in European otter was selected as a critical effect for the development of proposed health criteria for otters. Effect levels for PCBs in otters were proposed based on models of PCB accumulation and dose-response relationships between PCB levels and hepatic Vitamin A. Depressed levels of hepatic Vitamin A are associated with increased susceptibility to infection. We compared PCB levels in mustelids from the Hudson River with these effect levels.

## **Materials and Methods**

### *PCB Levels in Mammals*

Research staff trapped for mink during 1999-2000 and collected mink, otters, and muskrats from trappers in the upper Hudson River drainage during the 1998-1999 and 1999-2000 seasons. A few road-killed mink were also collected. Three road-killed mink collected by US Park Service personnel during 1989-1993 and 2 otters trapped during 1997 were also included in the study. A small number of mustelids was also collected from trappers in the lower Hudson River and Mohawk River drainages. Carcasses were stored at -20 degrees C at the New York State Department of Environmental Conservation Hale Creek Field Station.

Carcasses were transferred to the veterinary laboratory at Cornell University, thawed, and necropsied. Livers were removed, weighed, homogenized, and maintained in glass jars at -20 degrees C. Hepatic samples were transferred on dry ice to Axys Analytical Services, Ltd. Upon transfer to the laboratory, samples were thawed, homogenized manually, and sub samples from 162 animals (102 mink, 40 otters, and 20 muskrats) were analyzed for PCB's as Aroclors (1016/1242 or 1242, 1248, 1254, and 1260), and lipid content. Eleven percent of the samples were analyzed in duplicate; spiked laboratory reference (fish tissue) and blank samples were analyzed with each analytical batch containing up to 9 samples.

Axys Method CL-T-03/Ver.3 for PCB congeners and PCBs as Aroclor equivalents in tissues was employed. Samples were spiked with a suite of isotopically labeled surrogate standards, soxhlet extracted in dichloromethane and cleaned up by gel permeation chromatography. The extracts were split into two fractions (F1/F2 and F3/F4) on Florisil; the (F1/F2) fraction was spiked with an isotopically labeled recovery (internal) standard just prior to instrumental analysis. The F1/F2 fraction was analyzed for PCBs by either high-resolution gas chromatography/mass spectroscopy (GC/MS) or low resolution GC/MS. A gravimetric determination of lipid content was performed for duplicate aliquots of extract prior to chromatographic column clean up of the extract. The average percent lipid from the two aliquots

of each sample was reported. The total PCB level for each sample was calculated from the sum of levels reported for each Aroclor. Total PCB levels were reported as  $\mu\text{g/g}$  lipid.

Sample batches contained up to 9 samples plus quality-control samples (a blank, a duplicate, and a spiked reference sample). The batches were processed as a unit through the entire analytical process and the sample data were evaluated in relation to the batch quality-control sample results. The mean percent recovery in spiked reference samples was 92, 95, 93, and 97% for Aroclors 1016/1242, 1242, 1254 and 1260, respectively. For duplicate analyses, the mean percent difference was 19, 7.7, 4.9, and 7.3% for Aroclors 1016/1242, 1254, 1260 and lipid. Aroclors were not detected in blank samples. The mean limit of detection for blanks was 1.32, 0.204, 1.25, and 0.838  $\text{ng/g}$  for Aroclors 1016/1242, 1242, 1254, and 1260, respectively. Aroclor 1248 was not reported separately from Aroclor 1242. All reported levels were corrected for percent recovery based on internal standards.

The following criteria of Leonards *et al.* (1994) and Smit *et al.* (1996) were applied in a preliminary evaluation of potential toxicological responses in Hudson River mink and otter:

- 1) Less than 9  $\mu\text{g}$  total PCB's/g lipid is considered a proposed safe level for mink and otters based on an  $\text{EC}_1$  for body burdens in European otter affecting hepatic retinol (Vitamin A) level.
- 2) Equal to or greater than 21  $\mu\text{g}$  total PCB's/g lipid is considered a critical level for health impairment in mink and otters based on an  $\text{EC}_{90}$  for body burdens in European otter affecting hepatic retinol level.
- 3) Equal to or greater than 50  $\mu\text{g}$  total PCB's/g lipid is considered a critical level for reproductive impairment in mink and otters based on  $\text{EC}_{50}$  for reduction in litter size in mink. The ranges for critical levels for reduction in litter size and reduction in kit survival were 40 to 60 and 79 to 118  $\mu\text{g}$  total PCB's/g lipid, respectively, based on tissue with 2 to 3% lipid.

### *Trapping Survey for Mink*

Research staff experienced in trapping mink maintained a trap line for mink in Saratoga, Washington, and Warren Counties from October 30 to December 30, 1999. A total of 171 trap sets for mink were maintained at 71 sites located primarily at stream-road intersections within the upper Hudson River drainage (Figure 1). Most sets were made in trail, tunnel, or water channel locations and were not baited. Five sets were baited with muskrat or salmon oil. Foot-gripping traps (size-1.5 and 1.75, coil spring; size-1, 1.5, 1.75, and 11, long-spring; and size-1, stop-loss) in drowning sets and body-gripping traps (size-55, 110, 120, and 220, Conibear) were used. Trapping effort was expressed as the number of nights each set was capable of catching mink. Respective mink take and trap nights were summed for two classes of sites: 1) sites less than one home range (6 km) from the main channel of the Hudson River between Fort Edward and Troy and 2) sites either equal to or greater than one home range (6 km) from the main channel of the Hudson River between Fort Edward and Troy or upstream of Hudson Falls.

Adjustments in trap-night calculation were made for sprung or inactive traps according to Nelson and Clark (1973). Mink take was reported relative to trapping effort for each class of sites.

## Results

### *PCB Levels in Mammals*

Mink with PCB concentrations equal to or greater than 9 µg total PCBs/g lipid were collected from the main channel or tributaries entering the upper Hudson River between Hudson Falls and Troy and from immediately upstream of Hudson Falls (Figure 2). Ranges (means) for PCB levels were 0.541 to 139 (13.0) µg total PCBs/g lipid for 35 mink, collected from the towns between Hudson Falls and Troy. Mink with elevated levels were also collected from the Mohawk River drainage (15.0 µg total PCBs/g lipid, Montgomery County), and from the lower Hudson River drainage (41.3 µg total PCBs/g lipid, Columbia County). PCB contamination in mink tended to be greater at collection sites closest to the main channel of the upper Hudson River between Hudson Falls and Troy (Figure 3).

Six otters with PCB levels equal to or greater than 9 µg total PCBs/g lipid were collected from the upper Hudson River drainage (Figure 4). Four of these otters were collected from either tributaries or the main channel of the upper Hudson River between Hudson Falls and Troy. Ranges (means) for PCB levels were 18.5 to 431 (172) µg total PCBs/g lipid for 4 otter, collected from the towns between Hudson Falls and Troy. The remaining 2 otters were collected from tributaries that enter the Hudson River upstream of Hudson Falls. Otters with elevated PCB levels were also collected in close proximity to the Mohawk River (168 µg total PCBs/g lipid, Montgomery County), from the lower Hudson River drainage (1 otter, 11.3 µg total PCBs/g lipid, Columbia County; 3 otters, 31.0 to 47.9 µg total PCBs/g lipid, Rensselaer County; and 2 otters, 24.9 and 29.1 µg total PCBs/g lipid, Westchester County), and near Lake George (48.9 µg total PCBs/g lipid, Warren County). As with mink, PCB contamination in otters was typically greater at collection sites closest to the main channel of the upper Hudson River (Figure 5).

Levels of PCBs in muskrats collected from 3 main-channel locations on the upper Hudson River between Hudson Falls and Troy, a single location upstream of Hudson Falls, and a single location on the Hoosic River ranged from non-detectable to 2.18 µg total PCBs/g lipid (Figure 6).

Ten towns adjacent to the main channel of the Hudson River between Hudson Falls and Troy occupy 64-km strips of land (that vary in width from 5 to 15 km) on either side of the Hudson River (Figure 7). With the exception of the Town of Fort Edward (where no mustelids were collected), each town within these strips of land between Hudson Falls and Troy produced at least one mink or otter with a PCB level equal to or greater than 9 µg total PCBs/g lipid. Ranges (means) for PCB levels were 0.541 to 139 (13.0) and 18.5 to 431 (172) µg total PCBs/g lipid for 35 mink and 4 otter, respectively, collected from these towns. For 12 mink collected less than 1 km from the main channel of the upper Hudson River within these towns, PCB levels ranged from 1.39 to 139 (32.9) µg total PCBs/g lipid. For towns not within the designated area

and from which no mustelid was collected with PCB levels equal to or greater than 9 µg total PCBs/g lipid, the range (mean) for PCB levels was 0.128 to 8.67 (2.40) µg total PCBs/g lipid for a total of 52 mink. Similarly, the range (mean) for PCB levels was 1.31 to 8.31 (4.08) µg total PCBs/g lipid for a total of 25 otters collected from towns that produced no mustelids with PCB levels equal to or greater than 9 µg total PCBs/g lipid.

For 4 otters collected from towns adjacent to the Hudson River between Hudson Falls and Troy, PCB levels exceeded the proposed safe level of 9 µg total PCBs/g lipid (Table 1). For these otters, the maximum (431 µg total PCBs/g lipid) and mean (172 µg total PCBs/g lipid) levels for PCBs in liver exceeded the EC<sub>50</sub>-effect level equal to an internal body concentration of 50 µg total PCBs/g lipid proposed by Leonards *et al.* (1994) as a criterion for reproductive impairment (based on reduced litter size). Similarly, maximum and mean levels for PCBs in otter livers exceeded the EC<sub>90</sub>-effect level equal to or greater than 21 µg total PCBs/g lipid in liver proposed by Smit *et al.* (1996) as a criterion for health impairment (based on the dose-response relationship between PCBs and hepatic retinol).

For mink, the maximum level for PCBs (139 µg total PCBs/g lipid) exceeded the EC<sub>50</sub>-effect level for reproductive impairment and the EC<sub>90</sub>-effect level for health impairment. The mean level of PCBs (13.0 µg total PCBs/g lipid) for mink collected from towns adjacent to the Hudson River between Hudson Falls and Troy exceeded the EC<sub>1</sub>-effect level equal to 9 µg total PCBs/g lipid in liver proposed by Smit *et al.* (1996) as a safe level (based on the dose-response relationship between PCBs and hepatic retinol). However, the mean level for mink from towns adjacent to the river did not exceed the EC<sub>90</sub>-effect level for health impairment proposed by Smit *et al.* (1996). For 12 mink collected less than 1 km from the main channel of the Hudson River within these towns, the mean level of PCBs (32.9 µg total PCBs/g lipid) exceeded the EC<sub>90</sub>-effect level for health impairment proposed by Smit *et al.* (1996). The proportion of mink exceeding the proposed safe level and health and reproductive criteria was greater for those mink collected less than 1 km from the Hudson River within towns between Hudson Falls and Troy as compared to all mink collected from these towns (Table 1).

### *Trapping Survey for Mink*

Thirty-one mink were taken during the two-month trapping period. Results indicate a substantial decrease in mink take relative to trapping effort for sites near the contaminated sections of Hudson River downstream of Fort Edward to Troy compared to sites at least 6 km from the river or upstream of Hudson Falls (Table 2).

## **Discussion**

### *PCB Levels in Mammals*

Geographically, the distribution of mink and otters with elevated levels of PCBs (equal to or greater than 9 µg total PCBs/g lipid) in the upper Hudson River drainage is associated with the major sources of contaminants to the upper Hudson River as determined by TAMS Consultants (2000). A comparison of contaminant levels in mink and otters indicates otters are more severely contaminated with PCBs than mink within the upper Hudson River drainage. Geographic comparisons suggest that, for those mustelids with elevated levels of PCBs, contaminated otters are distributed more widely than contaminated mink.

For mustelids collected from the upper Hudson River drainage, a comparison of PCB levels with criteria of Leonards *et al.* (1994) and Smit *et al.* (1996) suggests the following:

- 1) The impact of PCBs on otter health and reproduction may be severe for otters in areas adjacent to the Hudson River between Hudson Falls and Troy.
- 2) PCBs may affect health and reproduction of mink in close proximity to the main channel of the contaminated sections of the river.
- 3) PCBs may affect the health and reproduction of otters more severely than mink.

The distribution of PCB-contaminated mink and otters suggests that sources of PCB contamination may exist in the upper Hudson River in addition to the major sources of contaminants from Hudson Falls to Troy. Mink and otter with elevated levels of PCBs were collected upstream of Hudson Falls suggesting these animals may have become either contaminated downstream prior to migrating upstream or may have been exposed to PCBs from minor sources of PCBs upstream of Hudson Falls. Sources of PCBs apparently exist in the Mohawk River drainage as well as the lower Hudson River drainage as suggested by levels of PCB contamination in mustelids.

Differences in the severity of PCB contamination among mink, otters, and muskrats may be related to ecological differences. Mink and otter consume both aquatic and terrestrial prey. A recent study indicates that the floodplain soils and shrews of the Hudson River between Fort Edward and Stillwater are contaminated with PCBs (SEA Consultants, 2001). This study suggests that mink and otters foraging in these floodplains may be consuming contaminated terrestrial prey as well as contaminated aquatic prey. The diet of river otter is more specialized toward aquatic prey than mink (Gilbert and Nancekivell 1982) and the potential for PCB accumulation is likely greater in aquatic prey than terrestrial prey. The greater prominence of aquatic prey in the diet may result in a greater dietary exposure and accumulation of PCBs in river otters than mink. The river otter has a longer life span than the mink (Wilson and Ruff 1999); this difference may also result in accumulation of PCBs to greater maximum levels in otters. In contrast to mustelids, muskrats are almost entirely herbivorous and relatively short-lived (Wilson and Ruff, 1999). Consequently, muskrats have a low potential for accumulation of PCBs as reflected in the low PCB levels in muskrats from the upper Hudson River drainage. The greater distribution of contaminated otters as compared to contaminated mink within the upper Hudson River drainage is likely related to the greater home range (25 to 50 km for males) of otters (Eagle and Whittman 1987, Chanin 1985, Bluett 1984, and Linscombe et al 1982) as compared to the smaller home range of male mink(6km). Assuming mink and river otter are



similar in toxicological sensitivity to PCBs, the greater propensity of otters to accumulate PCBs suggests that health and reproductive success are potentially affected to a greater extent in otters than mink.

In 1982-1984, 4 mink and 1 otter were collected from towns adjacent to the Hudson River between Hudson Falls and Troy (Figure 8). Liver samples ranged from 8.69 to 135  $\mu\text{g}$  total PCBs/g lipid for mink collected during 1982-1984. Liver samples ranged from 6.34 to 80.6  $\mu\text{g}$  total PCBs/g lipid for 3 mink and ranged from 0.541 to 139  $\mu\text{g}$  total PCBs/g lipid for 32 mink collected from these towns, respectively, during 1989-1993 and 1998-2000. The range (approximately an order of magnitude) in contaminant levels for mink collected during 1982-1984 was similar to the ranges in PCB levels in mink collected during 1989-1993 and 1998-2000. Maximum levels were nearly identical (135 vs. 139  $\mu\text{g}$  total PCBs/g lipid) for mink collected during 1982-1984 and 1998-2000. A liver sample from a single otter collected during 1982-1984 was 119  $\mu\text{g}$  total PCBs/g lipid; the level for this otter is within the range of PCB levels for otters collected from the upper Hudson River drainage during 1998-2000.

The comparison based on limited data for PCB levels over the past 16-year period suggests no measurable decrease in PCB contamination levels in mink and otters. The lack of decrease in PCB levels in mink and otters is consistent with the observation that PCB levels in fish in the upper Hudson River have remained at high levels during the same period (Sloan 1999, NYSDEC 2001). However, the paucity of data from 1982-1984 for towns adjacent to the upper Hudson River downstream of Fort Edward restricts detection to only relatively large decreases in PCB levels in mink and otters. Although an undetected decrease may have occurred during the past 16-year period, that decrease was not sufficient to reduce PCB levels in mink and otters to levels that are below the criteria of Leonards *et al.* (1994) and Smit *et al.* (1996) for impairment of health and reproduction.

A number of caveats are apparent in the comparison of PCB levels in Hudson River mustelids to criteria of Leonards *et al.* (1994) and Smit *et al.* (1996). Physiological differences between European otter (*Lutra lutra*) and North American mustelids warrant caution in using health criteria developed for European otter to evaluate North American mink and river otter. Similarly, reproductive differences between mink and otters suggest that criteria for reproductive impairment derived from mink may not be fully adequate to evaluate potential for reproductive impairment in otters. Furthermore, mustelid species apparently vary in their sensitivity to PCBs; the ferret (*Mustela putorius furo*) is more tolerant than mink to PCB contamination (Ringer et al 1981). Although these caveats suggest that a comparison with criteria derived by Leonards *et al.* (1994) and Smit *et al.* (1996) may not assess the health and reproductive impairment of mink and otters in the upper Hudson River drainage with complete certainty, the magnitude by which maximum PCB levels in mink and otters exceed criteria suggests that it is reasonable to suspect that PCBs pose a risk to the health and reproduction of river otters and mink in the upper Hudson River drainage.

#### *Trapping Survey for Mink*

Trapping results suggest a reduction in the relative abundance of mink in habitat within 6 km of the upper Hudson River downstream of Fort Edward. No obvious difference in habitat

quality was observed to account for the difference in relative mink abundance. However, further assessment of other factors such as habitat quality and the concentration of other contaminants relative to mink abundance is anticipated.

### **Continuing Research**

To further refine the assessment of potential toxicity of PCBs in mink and otters from the Hudson River, congener-specific PCB levels in mink and otters collected from the upper Hudson River drainage are being determined. Forty-one mink and 26 otters, including 31 animals equal to or exceeding 9 µg total PCBs/g lipid are currently being analyzed for congener-specific levels of PCBs. To serve as a “baseline,” 24 mink and 12 otters that have levels less than 9 µg total PCBs/g lipid are also being analyzed. Potential dioxin-like toxicity will be assessed using toxicity-equivalency-quotient methods for congener-specific data.

To further investigate the apparent decrease in abundance of mink, the relative occurrence of mink is being assessed in a less-contaminated watershed, as well as the contaminated sections of the upper Hudson River watershed. An investigation using scent stations equipped with track boards to monitor mink activity is currently being conducted on the contaminated sections of the upper Hudson River with similar surveys on the Mohawk River as reference location.

We have in progress or in planning additional studies that evaluate ecological factors, including environmental contaminants other than PCBs, related to the health, reproduction, and population status of mink and otters. The progress of these studies will be presented in future reports or publications, as results become available.

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## **TABLES**

Table 1. Frequency (percent) of mink and otters with PCB levels equal to or greater than specific PCB criteria of Leonards *et al.* (1994) and Smit *et al.* (1996) for animals collected from towns adjacent to the Hudson River between Hudson Falls and Troy.

Spp.	Collection Area	Sample Size	Proposed Safe Level ( $\geq 9 \mu\text{g}$ total PCBs/g lipid )	EC <sub>90</sub> for Health Impairment ( $\geq 21 \mu\text{g}$ total PCBs/g lipid)	EC <sub>50</sub> for Reproductive Impairment ( $\geq 50 \mu\text{g}$ total PCBs/g lipid)
Mink	Towns between Hudson Falls and Troy	35	10 (29)	6 (17)	2 (6)
Mink	< 1 km from Hudson River within towns between Hudson Falls and Troy	12	7 (58)	6 (50)	2 (17)
Otter	Towns between Hudson Falls and Troy (all collected < 10 km from Hudson River)	4	4 (100)	3 (75)	2 (50)

Table 2. Comparison of catch per unit effort for mink for locations within the upper Hudson River drainage,

1999-2000 season

Location	Number of Mink	Adjusted Trap-Nights	Catch/1000 Trap-Nights
Sites within 6 km of the Hudson River, south of Fort Edward	10	2828	3.5
Sites north of Hudson Falls or, if south, > 6 km from the Hudson River	21	801	26.2



## **FIGURES**

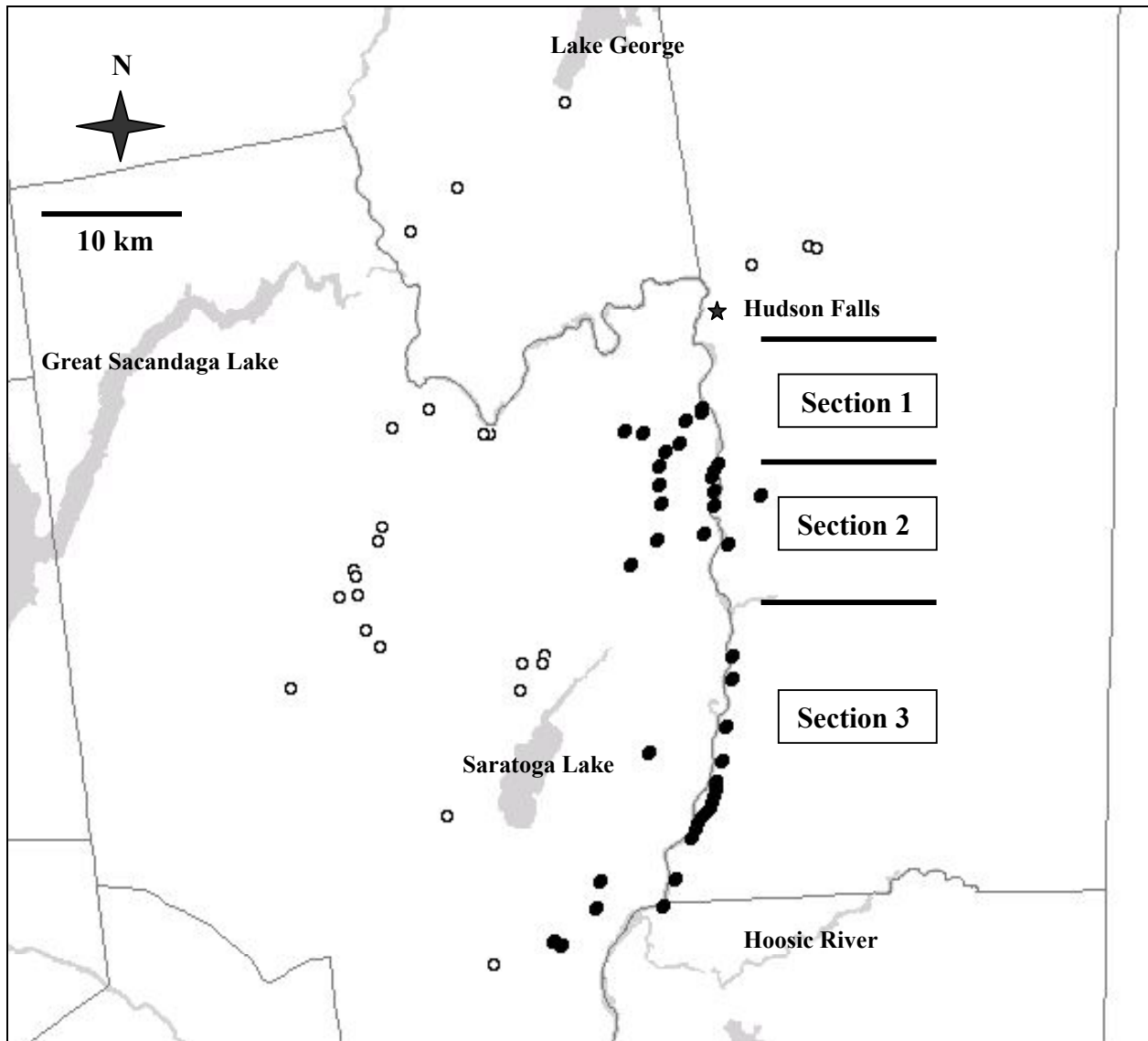


Figure 1. Trap sites (71) for the mink trap line maintained by research staff during the 1999-2000 season. Open circles indicate either sites equal to or greater than 6 km from the main channel of the upper Hudson River from Fort Edward to Troy (Troy is not shown) or sites upstream of Hudson Falls. Closed circles indicate sites less than 6 km from the upper Hudson River downstream of Fort Edward. Location of a number of sites is obscured due to overlapping symbols. PCB contaminated reaches of the upper Hudson River are identified by EPA as Sections 1, 2, and 3; sediments are contaminated with PCBs at mean levels of 42, 26, and 9 mg/kg, respectively (TAMS Consultants 2000).

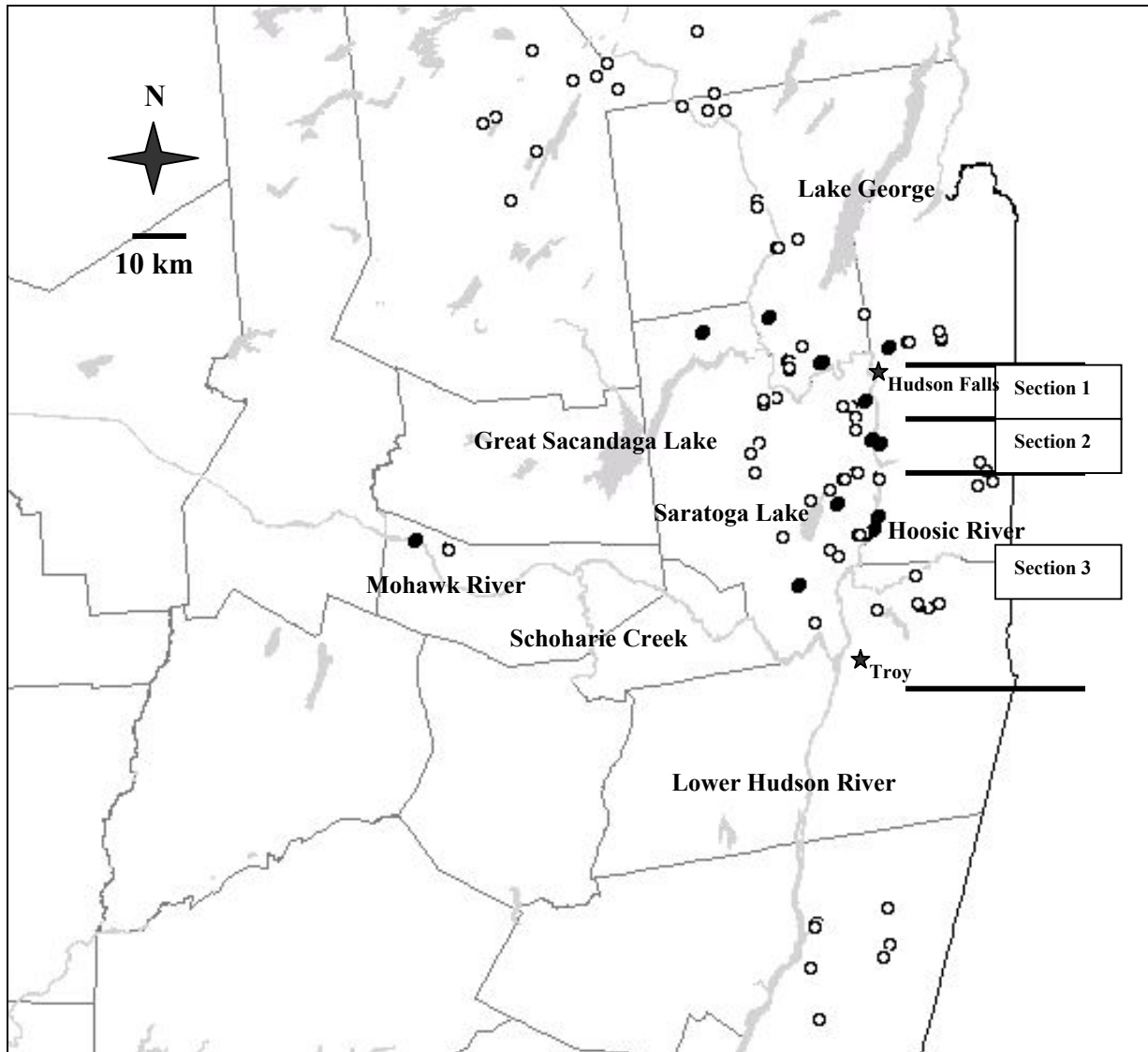


Figure 2. Location of mink (102) trapped either by research staff during the 1999-2000 season or collected from trappers during the 1998-1999 and 1999-2000 seasons. Open circles indicate mink with levels less than  $9 \mu\text{g}$  total PCBs/g lipid; closed circles indicate levels equal to or greater than  $9 \mu\text{g}$  total PCBs/g lipid. Location for a number of sites is obscured due to overlapping symbols. PCB contaminated reaches of the upper Hudson River are identified by EPA as Sections 1, 2, and 3; sediments are contaminated with PCBs at mean levels of 42, 26, and  $9 \text{ mg/kg}$ , respectively (TAMS Consultants 2000).

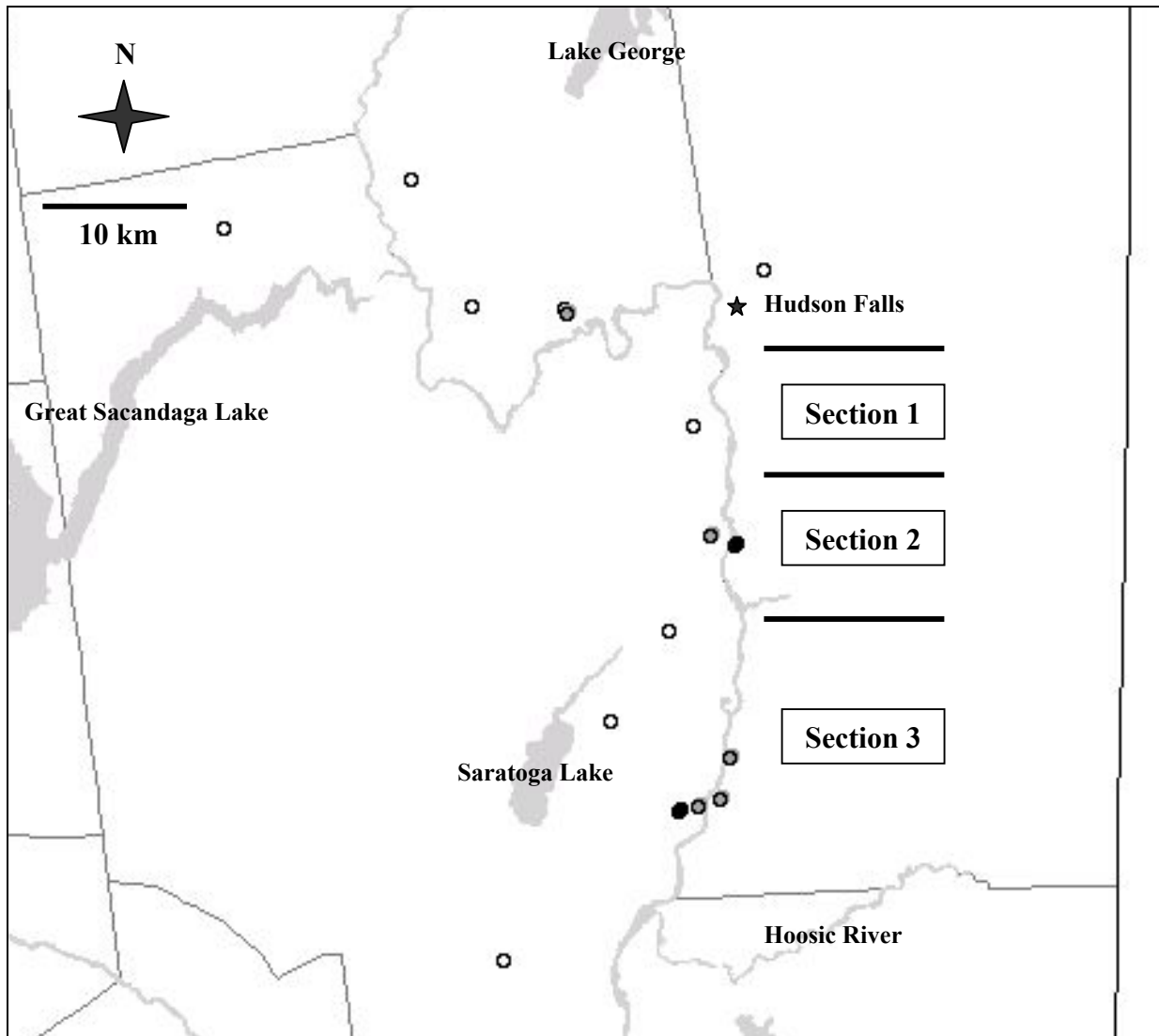


Figure 3. Location of mink with PCB levels equal to or greater than 9 µg total PCBs/g lipid trapped by research staff during 1999-2000 or collected from trappers during 1998-1999 and 1999-2000 seasons. Open circles indicate mink with levels ranging from 9 to less than 21 µg total PCBs/g lipid. Gray circles indicate levels ranging from 21 to less than 50 µg total PCBs/g lipid. Closed circles indicate levels ranging from 50 to 139 µg total PCBs/g lipid. Location for a number of sites is obscured due to overlapping symbols. Sites are not indicated for mink with elevated levels from the Mohawk River (Montgomery County, 15.0 µg total PCBs/g lipid) and lower Hudson River ( 41.3 µg total PCBs/g lipid). PCB contaminated reaches of the upper Hudson River are identified by EPA as Sections 1, 2, and 3; sediments are contaminated with PCBs at mean levels of 42, 26, and 9 mg/kg, respectively (TAMS Consultants 2000).

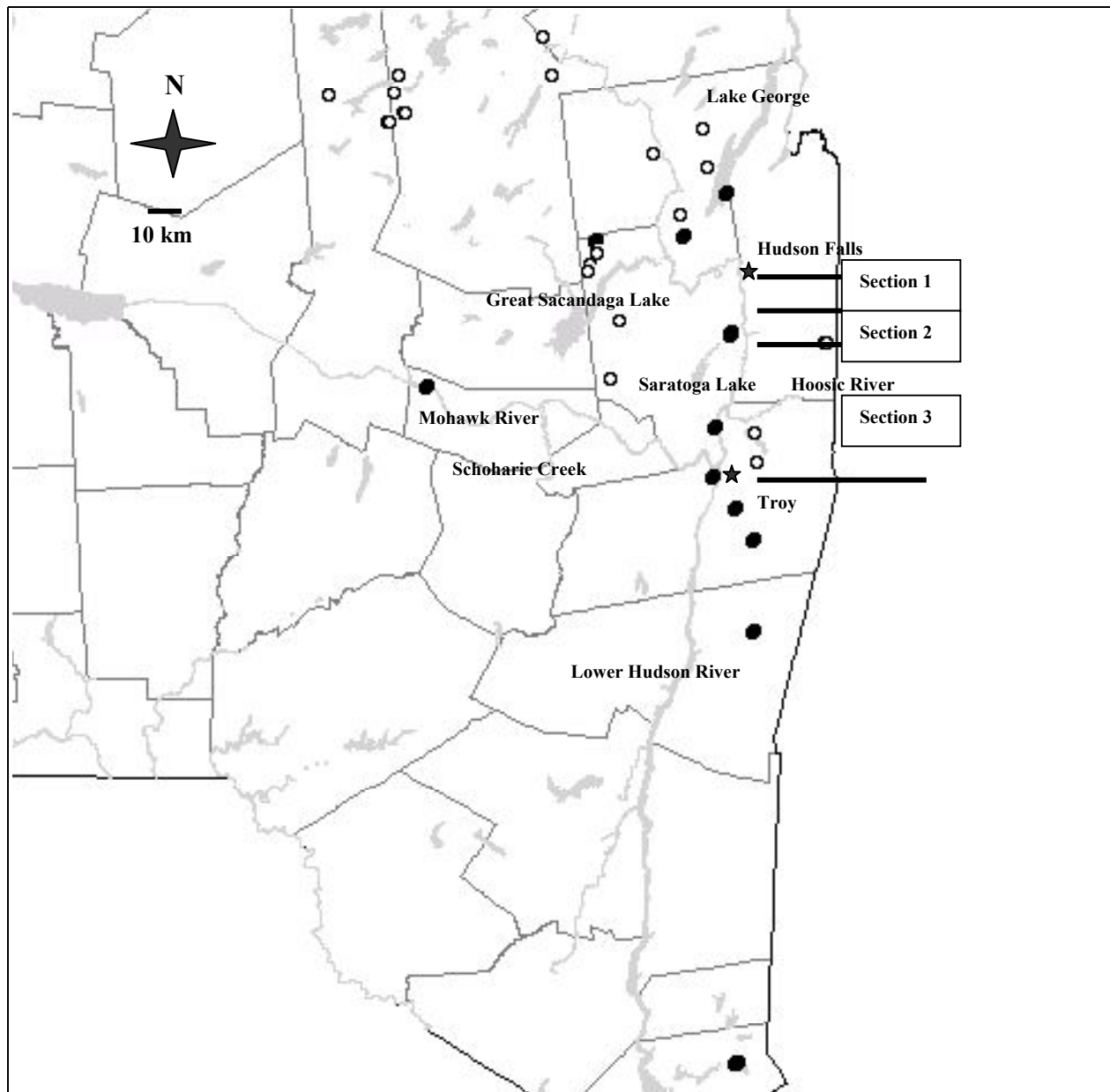


Figure 4. Location of otters (40) collected from trappers during 1998-99 and 1999-2000 seasons. Open circles indicate otters with levels less than  $9 \mu\text{g}$  total PCBs/g lipid; closed circles indicate levels equal to or greater than  $9 \mu\text{g}$  total PCBs/g lipid. Location for a number of sites is obscured due to overlapping symbols. PCB contaminated reaches of the upper Hudson River are identified by EPA as Sections 1, 2, and 3; sediments are contaminated with PCBs at mean levels of 42, 26, and  $9 \text{ mg/kg}$ , respectively (TAMS Consultants 2000).

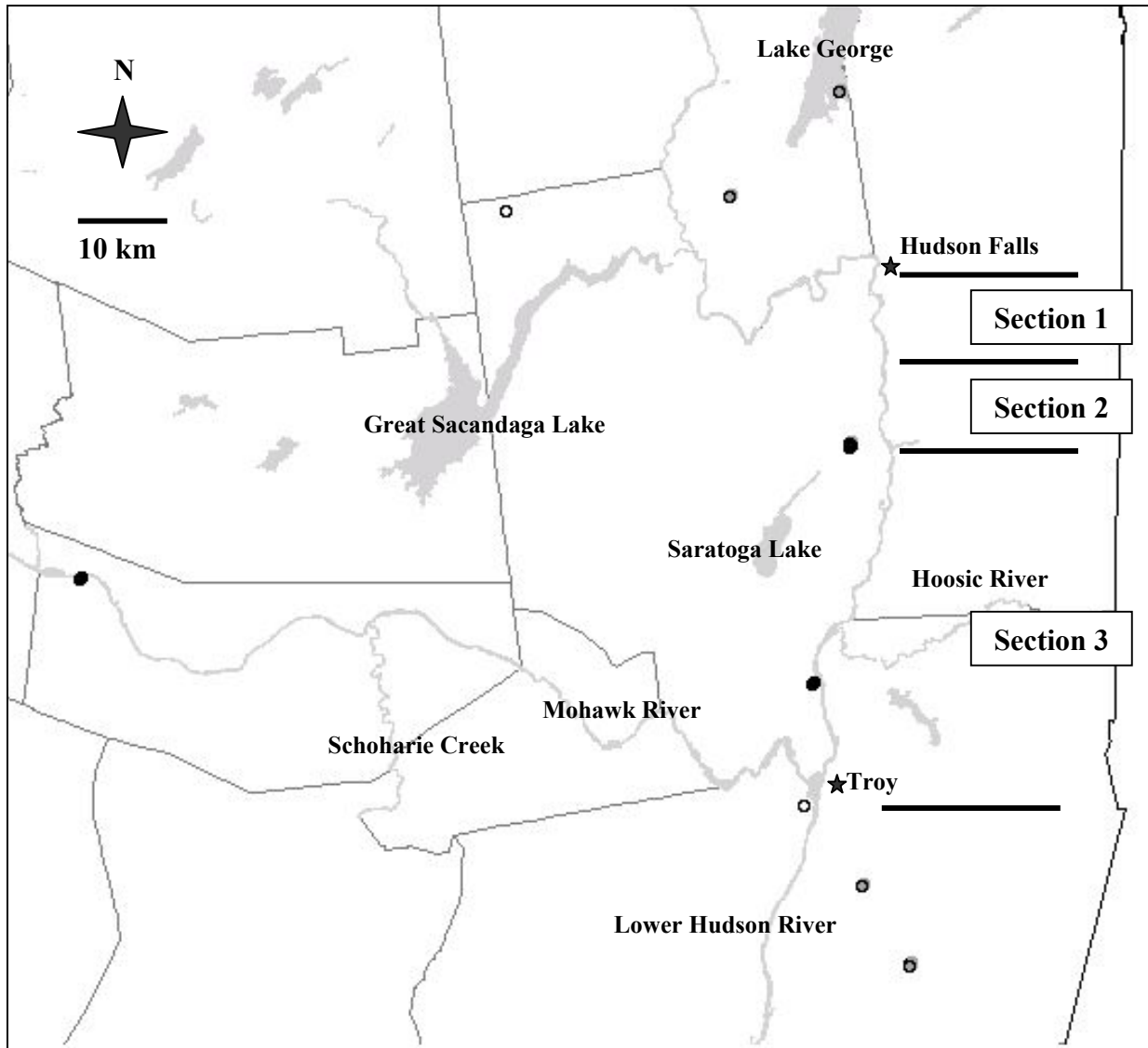


Figure 5. Location of otters with PCB levels above equal to or greater than  $9 \mu\text{g}$  total PCBs/g lipid trapped by trappers during 1998-99 and 1999-2000 seasons. Open circles indicate otters with levels ranging from 9 to less than  $21 \mu\text{g}$  total PCBs/g lipid. Gray circles indicate levels ranging from 21 to less than  $50 \mu\text{g}$  total PCBs/g lipid. Closed circles indicate levels ranging from 50 to  $431 \mu\text{g}$  total PCBs/g lipid. Location for a number of sites is obscured due to overlapping symbols. Sites for otters collected from Columbia (1 otter;  $11.3 \mu\text{g}$  total PCBs/g lipid) and Westchester Counties (2 otters;  $24.9$  and  $29.1 \mu\text{g}$  total PCBs/g lipid) are not presented. PCB contaminated reaches of the upper Hudson River are identified by EPA as sections 1, 2, and 3; sediments are contaminated with PCBs at mean levels of 42, 26, and  $9 \text{ mg/kg}$ , respectively (TAMS Consultants 2000).

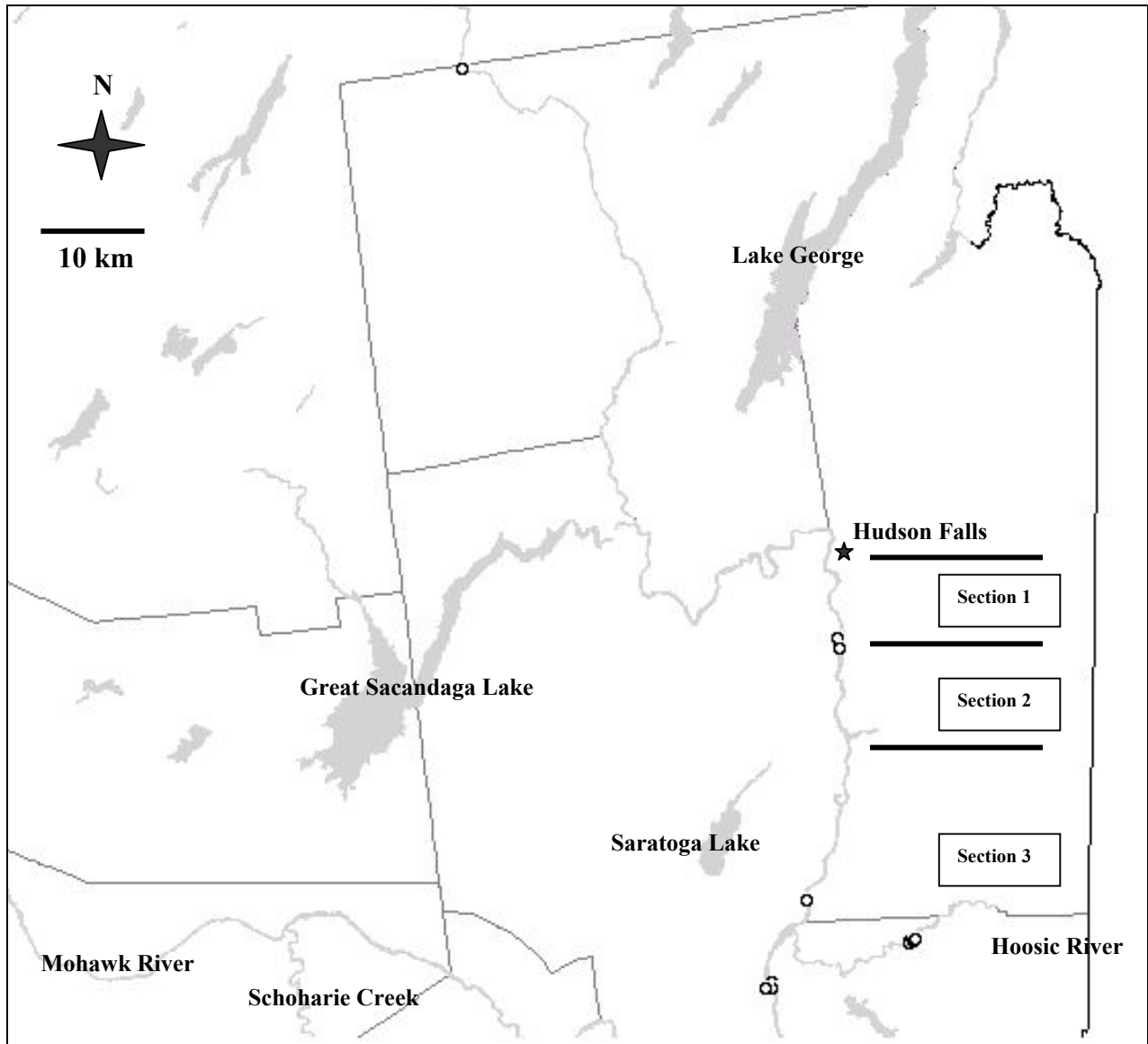


Figure 6. Location of muskrats (open circles) (20) collected from trappers during 1998-1999 and 1999-2000 seasons. PCB levels in muskrats ranged from non-detectable to 2.18  $\mu\text{g}$  total PCBs/g lipid. Location for a number of sites is obscured due to overlapping symbols. PCB contaminated reaches of the upper Hudson River are identified by EPA as Sections 1, 2, and 3; sediments are contaminated with PCBs at mean levels of 42, 26, and 9 mg/kg, respectively (TAMS Consultants 2000).

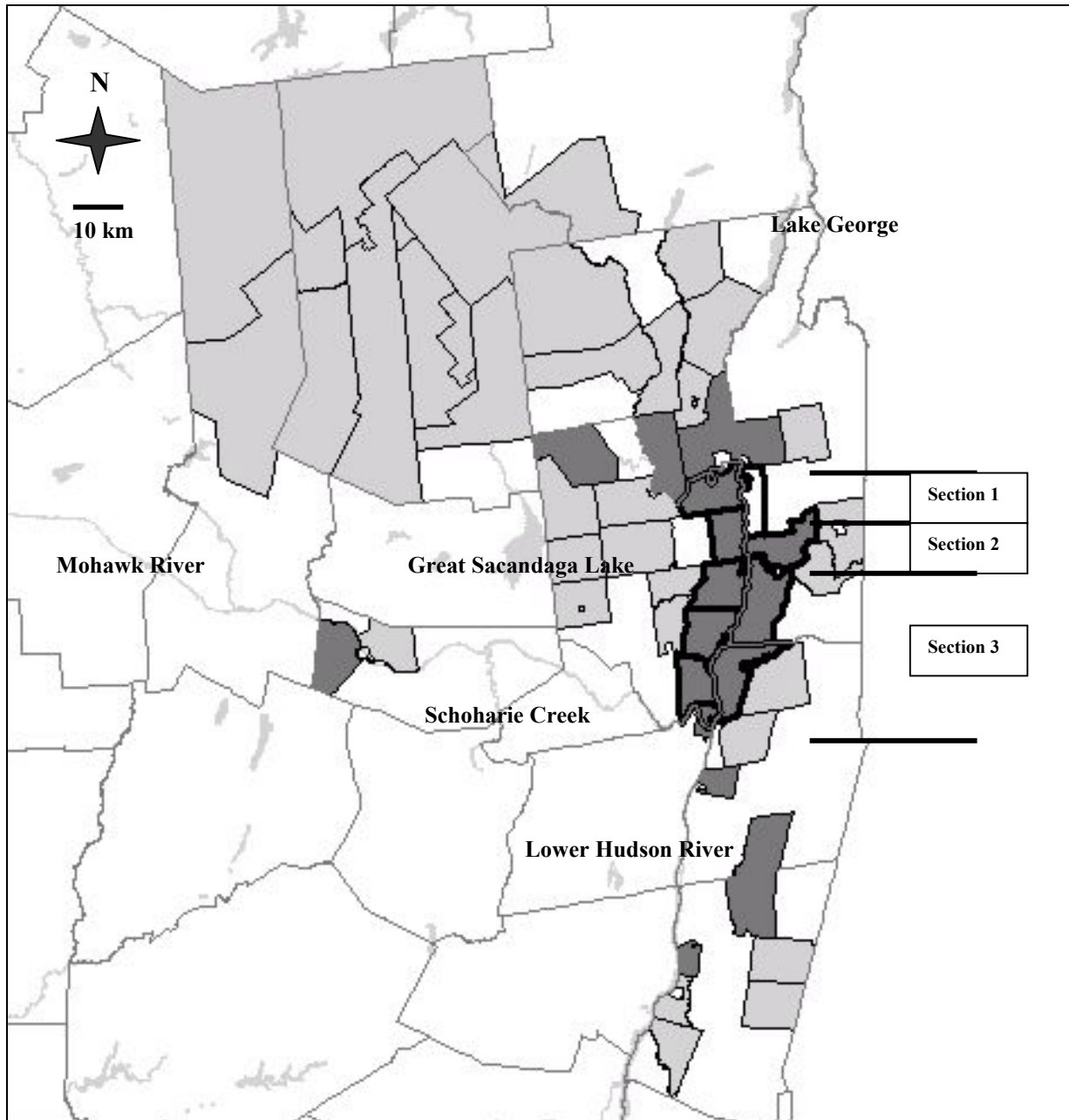


Figure 7. Towns from which trappers or research staff trapped mink and/or otters during 1998-1999 and 1999-2000. At least one mink or otter with a PCB level equal to or greater than  $9 \mu\text{g}$  total PCBs/g lipid was collected within towns indicated in dark gray. PCB levels in all mink or otters collected within towns in light gray were less than  $9 \mu\text{g}$  total PCBs/g lipid. PCB levels of mink and otters collected within towns outlined in black were compared with mink and a single otter collected from these towns during 1982-1984. PCB contaminated reaches of the upper Hudson River are identified by EPA as Sections 1, 2, and 3; sediments are contaminated with PCBs at mean levels of 42, 26, and  $9 \text{ mg/kg}$ , respectively (TAMS Consultants 2000).



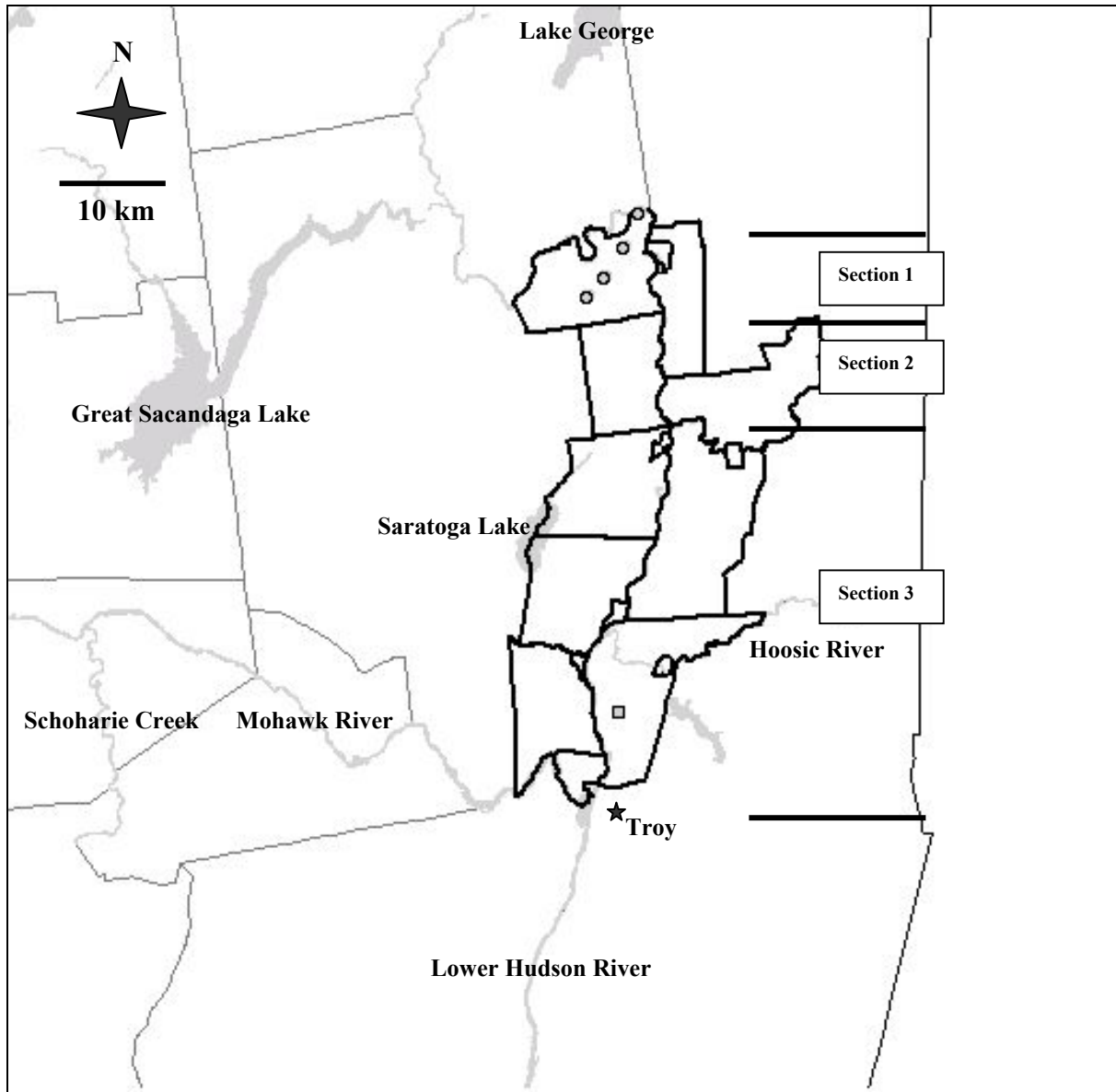


Figure 8. Mink and otter collected from trappers during 1982-1984. Circles indicate the collection sites of mink; a square indicates the collection site of a single otter. For towns outlined in black, PCB levels of mink and otters collected during 1982-1984 were compared to levels in mink and otters collected during 1998-1999 and 1999-2000 seasons. PCB contaminated reaches of the upper Hudson River are identified by EPA as Sections 1, 2, and 3; sediments are contaminated with PCBs at mean levels of 42, 26, and 9 mg/kg, respectively (TAMS Consultants 2000).