Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

C S A S

Canadian Science Advisory Secretariat

S C C S

Secrétariat canadien de consultation scientifique

Research Document 2004/109

Document de recherche 2004/109

Status, Trend, and Recovery Considerations in Support of an Allowable Harm Assessment for Atlantic Whitefish (*Coregonus huntsmani*)

Considérations au titre de l'état, des tendances et du rétablissement du corégone atlantique (*Coregonus huntsmani*) pour l'évaluation des dommages admissibles

R.G. Bradford, D.A. Longard, and P. Longue

Department of Fisheries and Oceans
Science Branch, Maritimes Region
P.O. Box 1006
Dartmouth, Nova Scotia, B2Y 4A2

ISSN 1480-4883 (Printed/Imprimé)

Canada

TABLE OF CONTENTS

ABSTRACT

The Atlantic whitefish (*Coregonus huntsmani*) occurs only in the Province of Nova Scotia. They are listed and protected as endangered under the Canada *Species at Risk Act* (*SARA*). Under *SARA* there is a requirement to determine if there is scope for allowable harm to a listed species, any part of its critical habitat, or the residences of its individuals. In support of these determinations, this document updates to 2004 information concerning the species distribution, status, trends, and recovery feasibility and timeframe. Data sources include historical information, directed research, public consultations, and 'data-mining' of files held by government agencies. The results indicate that Atlantic whitefish area of occupancy has declined by at least one-half since 1982. The species distribution is now restricted to the Petite Rivière, wherein life-cycle closure is certain only for a lake resident population that occupies the 16km^2 aggregate area of Minamkeak, Milipsigate and Hebb lakes. Recovery will require expansion of the area of occupancy. This is unlikely to occur without direct human intervention, namely through provision of fish passage and stocking either to repatriate the species within the Tusket-Annis drainage or to create additional lake resident populations in vacant habitat. There is no specified timeframe for recovery.

Atlantic whitefish have survived within the three Petite Rivière lakes even though the lakes have been subject to extensive human activity, and alteration. Measures to protect the species from the most significant sources of human-induced harm within the lakes have not been enacted until recently. These facts, in combination, indicate a tolerance to harm arising from human activities. Recovery is therefore concluded to be feasible even though human-induced harm is greater than zero.

RÉSUMÉ

Le corégone atlantique (*Coregonus huntsmani*) n'est retrouvé que dans les eaux de la Nouvelle-Écosse. Il est inscrit à la liste des espèces en voie de disparition de la *Loi sur les espèces en péril* (LEP), en vertu de laquelle il est protégé. La LEP exige que soit établi s'il existe un niveau de tolérance de dommages admissibles à une espèce inscrite, à toute partie de son habitat essentiel ou à la résidence des individus de l'espèce. À l'appui de ces exigences, le présent document fait le bilan jusqu'à 2004 des données sur la répartition du corégone atlantique, son état et ses tendances, et établit la possibilité et le calendrier de son rétablissement. Des données historiques, les résultats de recherche dirigée, des consultations publiques et l'exploration des données contenues dans les dossiers de divers organismes gouvernementaux ont servi à sa préparation. Les résultats indiquent que la zone d'occupation du corégone atlantique a diminué d'au moins 50 p. 100 depuis 1982, l'espèce n'étant maintenant retrouvée que dans la rivière Petite, où il n'est certain que seule une population limnicole, confinée à la superficie totale de 16 km^2 des lacs Minamkeak, Milipsigate et Hebb, y complète son cycle vital. Le rétablissement de l'espèce nécessitera donc un agrandissement de sa zone d'occupation. Il est peu probable que cela se produira sans intervention humaine directe, à savoir la construction d'une passe à poissons et l'ensemencement, soit pour ramener l'espèce dans le bassin hydrographique de la Tusket-Annis ou établir d'autres populations limnicoles dans les parcelles d'habitat inoccupées. Aucun calendrier de rétablissement n'est établi.

Le corégone atlantique est encore retrouvé dans les trois lacs tributaires de la rivière Petite même si ces plans d'eau ont connu beaucoup d'activités anthropiques et de perturbations. Des mesures visant à protéger l'espèce des principales sources de dommages anthropiques dans ces lacs n'ont été prises que récemment. Ces faits, ensemble, indiquent qu'elle tolère ce type de dommages. Il est donc conclu qu'il est possible qu'elle se rétablisse malgré le fait que les dommages anthropiques si situent à un niveau plus que nul.

INTRODUCTION

First described by Huntsman (1922) and determined a Canadian endemic species by Scott (1987) the Atlantic whitefish (*Coregonus huntsmani*) occurs only in the Province of Nova Scotia (Edge 1984; Scott and Scott 1988). Atlantic whitefish were declared endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1984 on the basis of a global distribution restricted to two river drainages and pronounced decline in abundance in recent decades (Edge 1984). Re-assessment of the species by COSEWIC in 2000 indicated a continued decline in abundance, an absence of mitigation of threats identified in the previous assessment, and new threats (Edge and Gilhen 2001). The Atlantic whitefish is currently listed and protected as endangered under the Canada *Species at Risk Act* (*SARA*).

SARA authorizes the competent Minister (Department of Fisheries and Oceans (DFO)) to enter into an agreement or issue a permit authorizing otherwise prohibited activities affecting a listed wildlife species, any part of its critical habitat, or the residences of its individuals. DFO has developed an evaluation framework to allow determination of whether or not permits can be issued that allow for harm. In Phase I of the framework specific information on species distribution, status, trends, and recovery feasibility and timeframe is required to support the scientific assessment of allowable harm.

Systematic survey information to document the historical and present distribution and trends of both lake resident and anadromous Atlantic whitefish was not available to support either the 1984 or 2000 COSEWIC assessments. It is not possible to infer absence of the species in specific locations or to assess change with time in distribution/abundance on the basis of information contained within Edge (1984) and Edge and Gilhen (2001). These data are necessary to support a determination of the level of allowable harm associated with human activities that may pose a threat to either the survival or recovery of the species. However, since the time of the 2000 COSEWIC species status review DFO and partners have acquired information relevant to an assessment of the species distribution, status and trends, as a result of directed research, public consultations, and ‘data-mining’ of files held by government agencies.

This document is divided into two parts with Part One containing the record of information current to 2004 of relevance to assessment of species distribution, status and trends. The principle objectives are to 1) resolve to the extent possible the historical and current distribution of both anadromous and lake resident Atlantic whitefish, and 2) determine to the extent possible the timing of change in distribution/abundance of both life-history variants.

Part Two provides formal statements on species status, trajectory, recovery feasibility, and timeframe for recovery as required under Phase I of the DFO Framework to Address Permitting Requirements under Section 73 of *SARA* (Rice 2004). This information is used to support a determination of whether or not recovery is feasible under circumstances where human-induced mortality is greater than zero.

PART ONE: ATLANTIC WHITEFISH DISTRIBUTION, STATUS AND TRENDS

DATA SOURCES: HISTORICAL TO 1998

There is consensus that the Atlantic whitefish has not been a widely distributed species, at least since the time of its first description[1]. The species historically occupied a disjunct distribution, with inferred spawning affinities limited to the Tusket-Annis rivers and Petite Rivière drainages (Fig. 1) of southwestern Nova Scotia (Edge and Gilhen 2001). Anadromous specimens are known for the Tusket-Annis drainage whereas both anadromous and lake resident populations have been reported from the Petite Rivière drainage (e.g., Huntsman 1922; Piers 1927; Vladykov and MacKenzie 1935; Livingstone 1953; Gilhen 1974; Edge 1984; Scott and Scott 1988; Edge and Gilhen 2001). The 2000 COSEWIC assessment concluded that a remnant anadromous population may exist in the Tusket-Annis (Edge and Gilhen 2001), and that both lake resident and anadromous populations persist in the Petite Rivière (Edge and Gilhen 2001).

The 2000 COSEWIC assessment was largely based upon information available as of 1998. The information available to COSEWIC to assess Atlantic whitefish distribution are summarized below. The records are organized into those which were either confirmed or not confirmed with positive identifications by scientific authorities. Uncertainties associated with interpretation of the data are then discussed.

TUSKET-ANNIS RIVERS

Confirmed Reports

Confirmed presence of Atlantic whitefish date to 1940 following the return to informed taxonomists of a single specimen from Yarmouth Harbour (Edge et al. 1991). First confirmed records of occurrence of anadromous Atlantic whitefish date to 1951 and 1982 for the Tusket and Annis rivers (Fig. 2) respectively (Edge et al. 1991). There are no records of species presence, as either lake resident or anadromous, for the time prior to construction of a hydroelectric dam in 1929. Catch data from traps installed in the fishways at the Powerhouse Dam and Lake Vaughn Diversion Dam indicate that upstream migrant adult Atlantic whitefish (n =86) were relatively common during October-November 1954 (Edge and Gilhen 2001). The last confirmed capture of an Atlantic whitefish on the Tusket River was May 1964 (Edge et al. 1991). The October 1982 captures of two, presumably anadromous, specimens in a non-tidal section of the lower Annis River (Edge 1984) is the only record of species presence for that river system, and the last record of occurrence of the species in the Tusket-Annis area. None were reported from the fish counting facility installed in one of the Tusket River fishways during October-November 1982.

[1] References prior to Scott (1987) used either Sault whitefish or Acadian whitefish as common names, the respective scientific names were *C. labradoricus* and *C. canadensis*.

Unconfirmed Reports

Atlantic whitefish appear to have been common up to the mid-1950's, as evidenced in the fish trap records of 1954. A memorandum from Mr. Ross Jones, Fishery Officer, Wedgeport, N. S contains the following information: "One of the fishermen James Hatfield of Pleasant Lake, Yarmouth Co. told me that he caught a whitefish in his gaspereau net in April of this year (1977). He said it is the first one he had caught in 7 or 8 years. The fish was 17 inches long. He said he has always set gaspereau nets and at one time years ago it was common to catch 50 to 100 whitefish during the year..." (from Gilhen 1977).

Atlantic whitefish were reportedly intercepted in the gaspereau gillnet fishery operated within the tidal portions of the Annis River up to the early 1980's (Edge and Gilhen 2001). The Atlantic Whitefish Conservation and Recovery Team received a verbal report of a possible capture in May, 1996 in the river channel below the Lake Vaughn Dam by a gaspereau dipnet fisher[2] (also reported in Edge and Gilhen 2001)). Otherwise, all reported incidental captures of Atlantic whitefish in the April-June gaspereau fishery appear to be from estuarial gillnet fisheries.

Sources of Uncertainty

Information concerning the status and trend of Atlantic whitefish in the Tusket-Annis drainage should be considered incomplete for several reasons. First, the record of fish monitoring activities on the Tusket River contained within the 2000 COSEWIC report is incomplete. Upstream and downstream movements of Atlantic salmon (*Salmo salar*) have been monitored annually since 1998 and, while not specifically intended to assess presence of Atlantic whitefish, they do provide a basis to assess recent occurrences of the species. Second, few of the lakes located within the Tusket-Annis drainage had been assessed specifically for species composition of their fish assemblages by the time of the 2000 COSEWIC assessments. Therefore the status of lake resident Atlantic whitefish in the Tusket-Annis, both before and since construction of the power dams in 1929, cannot be considered resolved. Third, there are unpublished records of lake whitefish (*C. clupeaformis*) occurrences in both the Annis and Tusket rivers. In light of previous reports of occasional forays of lake whitefish into tidal waters (southwest New Brunswick; Scott and Scott 1988) the mis-identification of lake whitefish as Atlantic whitefish cannot be dismissed as the basis for at least some of the unconfirmed reports from the public, the May, 1996 report, for example.

[2] Comments from Mr. Danny Dukeshire recorded in the December 5, 2000 minutes as follows "…caught a whitefish about 5 years ago – 11-12 inches long – not certain if was lake or Atlantic whitefish."

PETITE RIVIÈRE

Confirmed Reports

The occurrence of a freshwater-resident population of Atlantic whitefish in this river was supported with collections of the animal from the wild (Edge 1984). Reported occurrences of Atlantic whitefish as recently as 1997 in the Petite Rivière estuary (Table 1) were supported with positive identifications of specimens returned by commercial fishers to taxonomists (Edge et al. 1991; J. Gilhen, A. Hebda, Nova Scotia Museum of Natural History, personal communication).

Unconfirmed Reports

Reports of incidental captures of Atlantic whitefish by anglers fishing lakes located within the Petite Rivière were received by DFO from the public since the onset of public consultations in 1999 (R.G. Bradford, unpublished data). Captures reported by anglers fishing the three lakes (Minamkeak, Milipsigate, Hebb; Fig. 3) known to support lake resident Atlantic whitefish are consistent with the known distribution of the species. Several of the reports of incidental captures were from lakes located below Hebbville Dam (Fig. 3).

Sources of Uncertainty

None of the fish reportedly captured in lakes other than those reported from Minamkeak, Milipsigate, and Hebb lakes were returned to authorities for positive identification. In combination with incomplete lake survey data for the drainage system, the distribution of Atlantic whitefish within the Petite Rivière should be regarded as unknown.

The presence of Atlantic whitefish in Minamkeak Lake has particular significance in light of the 1903 diversion of this lake from the Medway River (Fig. 4) to the Petite Rivière (Edge and Gilhen 2001). There are no records of Atlantic whitefish presence in Minamkeak Lake prior to the diversion. None of the lakes in the Medway River system that would have received water from Minamkeak Lake have been systematically surveyed to determine species composition of their fish assemblages. Presence of Atlantic whitefish in Minamkeak Lake could therefore be a consequence of their prior existence in the Medway or as a consequence of colonization from Milipsigate-Hebb lakes.

Presence of Atlantic whitefish in the Petite Rivière estuary as recent as May, 1997 (Edge and Gilhen 2001) although not in dispute does not resolve the status of an assumed anadromous run for several reasons. First, the history of dam construction/removal on the Petite Rivière proper is lengthy; access to potential spawning and rearing habitat above the barriers in all years is questionable; and there does not appear to have been specific provisions for upstream and downstream fish bypass at all sites (Bradford et al. 2004).

Second, there is no information available to inform on either run-timing or former abundance of anadromous spawners. One resident of Petite Rivière, who has first-hand knowledge of May-June occurrences of Atlantic whitefish in the

estuary, has indicated no comparable knowledge[3] of species occurrence in the main river below Fancy's Lake (Fig. 3). The likelihood of life-cycle closure among anadromous Atlantic whitefish either historically or currently cannot be assessed, nor distinguished from occurrences of any seawater-adapted fish that have strayed from the population known to persist in the upper portions of the drainage.

OTHER LOCATIONS

Confirmed Reports

Edge and Gilhen (2001) report recent captures of Atlantic whitefish by recreational rainbow smelt (*Osmerus mordax*) anglers in the LaHave Estuary (Fig. 5) during February 1995 (n =1) and on 24 May 1997 (n =1). The LaHave River lies to the immediate east of the Petite Rivière. Other reported captures beyond the physical boundaries of the Tusket, Annis, and Petite rivers and estuaries cited by Edge and Gilhen (2001) occurred more than 30 years ago (8 September 1919, Weymouth, N.S. (n =2); 12 June, 1940, Yarmouth Harbour, N.S. (n=1), and 31 May, 1958, Halls Harbour, N.S. (n =1)). Of these the Yarmouth Harbour and Hall's Harbour specimens were returned to authorities for positive identification.

Unconfirmed Reports

There are no other reports of possible occurrences of Atlantic whitefish beyond the Tusket-Annis and Petite Rivière drainages on record as of 1998.

Sources of Uncertainty

The interpretation by Edge and Gilhen (2001) of the LaHave Estuary specimens as likely strays from the Petite Rivière is probable but not conclusive in the absence of information regarding status of Atlantic whitefish in the LaHave River. The river of origin of the samples collected at Weymouth, Yarmouth Harbour, and Hall's Harbour is not known. The Tusket-Annis drainage is the nearest of the two drainages known to have supported Atlantic whitefish to the reported capture locations.

DATA SOURCES: ACQUIRED SINCE 1998

Information available to support assessment of the distribution, status and trend of Atlantic whitefish include public consultations, science activities conducted to support the recovery strategy, monitoring data in the possession of the DFO that had not been previously considered in the context of Atlantic whitefish status, and archival lake survey data.

[3] "Mr. Bell in 60 years has never angled or seen whitefish on the Petite River itself, i.e., between Fancy Lake and the Petite River estuary, nor has he ever spoken to anyone else who has. He is aware that anglers do catch whitefish in Fancys Lake during the trout fishery each spring." (As recorded in August 10, 1999 notes by Mr. Bob Barnes, former DFO co-chair of the Atlantic Whitefish Conservation and Recovery Team.)

PUBLIC CONSULTATIONS

Recreational Angler Reports and Interviews

A notice published in the Nova Scotia Angling Summary every year since 2000 has invited the public to report any suspected occurrences of Atlantic whitefish to DFO. Each report was followed up with an interview during which a standard questionnaire (Appendix I) was completed in order to record the timing, location, and nature of the occurrence. Interviews were also initiated by the DFO with individuals residing in the areas of the Tusket-Annis or Petite Rivière who were known to have prior and/or current knowledge of the species.

Traditional Ecological Knowledge

Between 13-16 August, 2002 Acadia First Nation members from the Wildcat, Shelburne, and Yarmouth reserves were visited and asked to relate their knowledge of the Atlantic whitefish. The information was recorded within the standard questionnaire. Emphasis was placed on recording the experiences of elders and individuals experienced in the harvest of local fishes.

SCIENCE ACTIVITIES

Tusket-Annis Rivers

Lake Surveys

As part of a Habitat Stewardship Program initiative, Nova Scotia Power Incorporated and the DFO surveyed lakes within the Tusket-Annis drainage during the summer-autumn of both 2001 and 2002 in order to assess habitat suitability for future repatriation of Atlantic whitefish. The complete report is available as NSPI (2003). Briefly, 20 lakes were surveyed for fish species composition and relative abundance throughout the Tusket River and Annis River watersheds (Fig. 2). Sampling within the Tusket River was further divided into the Carleton River and the Tusket River proper, which differ significantly in water acidity, being respectively of relatively high (annual mean 5.7) and low (annual mean 5.0) pH. The mean annual pH of the Annis River is not known. Mean pH (5.4) of the lakes in the Annis River that were surveyed during the summers of 2001 and 2002 was comparable to the mean pH (5.6) of lakes surveyed on the Carleton River during the same time period (NSPI 2003).

Each lake was surveyed once using three to four research nets were set, always with two nets set at ~10m depth and below the halocline when oxygen concentrations were greater than 2mg/l at depth and with one or two nets set at depths of 2-3 m to provide a representative evaluation of the presence/absence of fish species in the lake. The research nets, 30m in length, consisted of four equally long panels with differing mesh sizes (3.0cm, 5.5cm, 6.5cm and 8.0cm stretched). Nets were set in mid-late afternoon and left to fish overnight. Catch per net per mesh was identified to species.

Fishway Monitoring

The Habitat Stewardship Project also included a component to monitor fish movements. Upstream bypass facilities at the Powerhouse and Lake Vaughn dams were monitored during 2001 and 2002. Downstream fish movements through the bypass facility located in the Powerhouse Dam were monitored in 1999 and 2000.

Upstream

In 2001, traps lined with 60mm Vexar screens were installed in the Lake Vaughn and Powerhouse fish ladders on 11 June[4] and monitored daily until 8 August. The fishway was de-watered on that date to allow for dam maintenance which continued until 29 October. Fish traps were re-installed at both locations on 29 October and monitored daily, until 20 December. The traps were not in operation on 3 or 4 November. Therefore, any Atlantic whitefish that may have ascended the fishway on those days would have done so undetected.

The traps were re-installed in the Lake Vaughn and Powerhouse fish ladders during autumn, 2002 in order to determine presence of adult anadromous Atlantic whitefish. Monitoring commenced on 23 September. The trap was checked daily up to 18 October and every second day thereafter until 24 November when the trap was removed from the fishway.

Downstream

A fish trap was operated from 18 April – 11 June, 2001 in the bypass (the fourth bay) of the Powerhouse Dam in order to specifically monitor for any downstream migrant Atlantic whitefish. DFO possesses records of downstream monitoring at this site for the year 1999.

Additional information regarding fish monitoring at these facilities are available within DFO files for the years 1998-2000.

Petite Rivière

Lake Surveys

Hebb, Milipsigate, Minamkeak Lakes

Since 2000 monitoring has been an integrated activity with the collection of broodstock to support captive rearing of Atlantic whitefish at the DFO Mersey Biodiversity Centre. Logistic constraints have limited adult collection/monitoring activities to Hebb and Milipsigate lakes. Owing to the uncertain status of the populations, and uncertainty as to the extent to which the research activities result in harm to Atlantic whitefish, activities were restricted to those thought to minimize risk of mortality. Adult sampling was therefore restricted to the May-June and September-November periods to reduce the possibility of thermal stress during the warmer months. Angling with barbless hooks, pool seining and trapnetting were the principle means of capture. No fish were sacrificed to support science activities with the following exception. Gillnets were deployed in Minamkeak Lake for one

[4] Between 5 May and 20 June, visual counts of gaspereau migrating through to Lake Vaughn were recorded for 15 minutes every half hour. No Atlantic whitefish were observed passing upstream

night during spring, 2004 in order to verify continued presence of Atlantic whitefish in the lake following an illegal, successful introduction of smallmouth bass (*Micropterus dolomieu*) in the mid-1990's (NSDAF 2004).

Efforts to collect Atlantic whitefish larvae and juveniles from Hebb and Milipsigate lakes with a variety of gear (light traps, minnow pots, fyke nets, beach seine) were not successful and are not considered further as a tool for determination of Atlantic whitefish presence.

Other Lakes in the Petite Rivière

Fish assemblage information as determined from research gillnet surveys was acquired between 2001 and 2004 for six lakes (Fig. 3) situated above Hebbville Dam that may offer supporting habitat to lake resident populations and six lakes (Fig. 3) situated below the dam that may offer supporting habitat to either wholly lake resident or anadromous fish. Sampling protocols were as described above for Tusket-Annis lakes.

Medway River Lakes

Lakes within the Medway River system 1) which shared a secondary drainage (Salters Brook, Fig. 4) with Minamkeak Lake prior to the 1903 diversion of the lake into the Petite Rivière, or 2) reportedly contained previously undocumented populations of coregonids were surveyed as time permitted during May to August, 2001 to 2004. Sampling protocols were as described above for the Tusket-Annis lake surveys.

Estuary

Confirmed presence of Atlantic whitefish in the Petite Rivière estuary as recently as 1997 (Table 12) prompted two efforts to collect and assess the status of a suspected anadromous run. The first occurred between 19 October – 23 November 1999 in a direct effort to collect mature adults. The second occurred between 18 April – 7 June, 2000, in an effort to assess Atlantic whitefish abundance and susceptibility to capture in the May-June gaspereau fishery.

On both occasions a 15m (l) x 3m (w) x 1.5m (d) T-type trapnet (2.5 cm stretch mesh) was installed to sample the fish assemblage of the estuary, at a site a few hundred meters below the head of tide (Fig. 3). The trapnet was set at least five days per week and was fished every 24 hours. Total catch per species was recorded.

ARCHIVAL LAKE SURVEY DATA

Several hundred lakes within Nova Scotia had been surveyed with gillnets since 1945, either by federal/provincial resource agencies or private industry. The database is currently maintained by the Nova Scotia Department of Agriculture and Fisheries (Jason LeBlanc, NSDAF, Pictou, N.S. personal communication). These data were considered by Edge and Gilhen (2001) and will be referred to in this document where required to provide a species context to reported occurrences of 'whitefish'.

DFO FISH COUNTING/MONITORING FACILITIES

LaHave River

Information relevant to an assessment of Atlantic whitefish presence in the LaHave River estuary (Fig. 5) has been acquired by DFO on three prior occasions. A trapnet was installed in the estuary to capture adult Atlantic salmon between May-August, 1983, May-June 1998 and May-June 1999 (Peter Amiro, DFO, Dartmouth, N.S., personal communication). The mesh size (5cm stretch) of the trap would likely have retained only relatively large-bodied Atlantic whitefish (e.g., records of anadromous Atlantic whitefish captures in gaspereau gillnet fisheries indicate they can be intercepted in nets with stretch mesh sizes varying approximately from 4.7cm - 5.8cm (R.G. Bradford personal observation).

A fish counting facility has been operated by DFO in the Morgans Falls fishway (Fig. 5) every year since 1972, generally from May to mid-October, but with activities extending into early November in some years (Peter Amiro, personal communication). The front of the trap is constructed of 1.25cm vertical rods on 3.8cm centers which allow escapement of gaspereau. Therefore, capture of only large-bodied Atlantic whitefish ascending the fishway might be anticipated.

Downstream (bypass) assessments have been conducted generally during May every year since 1996 at a facility installed in the Morgans Falls Powerhouse (Peter Amiro, personal communication).

A trap was installed and operated in the Indian Falls fishway on the North Branch LaHave River (Fig. 5) on three occasions; June-November, 1975, May-November 1983, and May-October, 1999 with protocols similar to the Morgans Falls trap (Peter Amiro, personal communication).

RESULTS

PUBLIC CONSULTATIONS

Recreational Angler Reports and Interviews

There were 39 responses to the request for information published in the Nova Scotia Angling Summary. Twenty of the respondents offered information over a decade old that supported the description of the species historical distribution within the Petite Rivière presented in Edge and Gilhen (2001). However, six persons indicated they had not captured any Atlantic whitefish while angling for other species in Minamkeak Lake. Two of the 20 respondents offered information relating to their angling experiences on Rocky and Crooked lakes within the Medway River drainage (Fig. 4). Neither reported an Atlantic whitefish capture.

Six of the 39 respondents offered information concerning possible recent occurrences of Atlantic whitefish beyond the described historical distribution of the species. One from Mira River, Cape Breton may represent a mis-identified lake whitefish which are known to be present (Table 1). Mis-identified lake whitefish is also the probable explanation for a reported occurrence in Chezzetcook Lake (Table 1). Two additional respondents reported having captured whitefish in lakes within the Medway River system; one from Shingle Lake (Fig. 4), which was

determined to be a lake whitefish (the specimen was returned to authorities, the lake was subsequently surveyed), and another from Upper Salters Lake (Fig. 4), a waterbody not known to support coregonids (Table 1). A single Atlantic whitefish was reportedly angled by another respondent on the LaHave River during May, 2004. There are no documented occurrences of any coregonid species within this river system (Table 1). However, this represents the second unconfirmed report of an Atlantic whitefish occurrence within the non-tidal portions of the LaHave River, the other having been a verbal second hand report to the senior author and which dated back over a decade.

Eight of the 39 respondents reported recent occurrences of Atlantic whitefish in the Petite Rivière drainage. None of these were confirmed by taxonomists. Of the seven reports from below Hebbville Dam (Table 1), four were from the main stem of the river. Three (Wallace Lake, Little Beaver Lake, and Branch Lake) were from secondary tributaries.

Five respondents indicated no prior knowledge Atlantic whitefish.

No information was volunteered by persons dwelling in the Tusket-Annis area.

Traditional Ecological Knowledge

A total of 16 Acadia First Nation people were interviewed. Of the 16, nine indicated awareness of the existence of Atlantic whitefish, eight of the nine from the Yarmouth reserve, and one from the Wildcat reserve (Table 2). One respondent from Yarmouth reported capturing an Atlantic whitefish during the 1950's while angling in the vicinity of Kemptville, N.S., which straddles both the Carleton and Tusket drainages. The sole respondent from the Wildcat reserve reported having angled Atlantic whitefish from the Wildcat River portion of the Medway River area during the 1940's.

SCIENCE ACTIVITIES

Tusket-Annis Rivers

Lake Surveys

The first archival lake survey record for the Tusket-Annis drainages occurred in 1952 (Table 3). There were no reported captures of Atlantic whitefish from any of the lakes surveyed between 1952 and 2002 (Table 3). Lake whitefish, first detected in the Carleton branch of the Tusket River in 1952, have since been shown to be present in six of 10 lakes surveyed to date (Table 3), which may explain the capture of a whitefish reported by the Acadia First Nation band member (Table 1).

There are no records of lake whitefish presence, in either the Tusket River proper or the Annis River, contained in any of the lake survey data (archival or recent). However, DFO possesses a single scale sample from a lake whitefish captured in the Annis River in 1962 by an unidentified member of the public (R.G. Bradford unpublished data). The method used to collect the specimen is not known. This record has significance as an indication that the species may have

been present in the Annis River prior to an illegal introduction of chain pickerel (*Esox niger*), a non-native species whose occurrence in the river was first reported in 1976 (Jason LeBlanc, personal communication). Their presence was not confirmed with a gillnet lake survey until 1990 (Table 3).

A comparison of the list of species present in the Annis River as of 1981 (see Table 3), with the species recorded in lake surveys since 1981 indicates that soft-rayed species may now be either absent or rare (Table 4). The rare designation has been assigned to species where only a single specimen was captured (see Table 5).

Fishway Monitoring

There are no records of adult Atlantic whitefish captures during operation of the upstream fishway traps in any of the years of operation since 1998 (Tables 6, 7, 8). Similarly, there are no records of Atlantic whitefish captures through the downstream bypass facility in any years of sampling by DFO at the facility (Table 8).

Petite Rivière

Lake Surveys

Presence of Atlantic whitefish in each of Hebb Lake, Milipsigate Lake and Minamkeak Lake was verified with capture of specimens (Table 9). None were captured in any of the other nine lakes surveyed within the river drainage (Table 9; Fig. 3). None were captured in the four lakes sampled within the Salters Brook sub-drainage of the Medway River. Lake whitefish were confirmed present in Shingle and Little Ponhook lakes in the main Medway River (Table 9; Fig. 4). These lakes are located upstream and downstream respectively of the Wildcat Reserve. It is therefore possible that the reported capture of an Atlantic whitefish by an Acadia First Nation band member was a lake whitefish.

Estuary

No Atlantic whitefish were captured in the trapnet set within the Petite Rivière estuary during autumn, 1999 (Table 10) or spring, 2000 (Table 11). All historical reports of Atlantic whitefish captures from the estuary which were positively identified by Nova Scotia Museum of Natural History taxonomists occurred during the months of May or June (Table 12).

LaHave River and Estuary

There were no reported captures of Atlantic whitefish from the LaHave River Estuary during DFO trapnet operations in the years 1983, 1998, or 1999 (Table 13). None were reported captured during either upstream (since 1972) or downstream (since 1996) fish passage monitoring at Morgans Fall, or in the Indian Falls fishway trap (1975, 1983, 1999) (Table 13). Only one of the two reported captures of Atlantic whitefish by smelt anglers (the winter fishery; J. Gilhen, Nova

Scotia Museum of Natural History, personal communication)) in the LaHave River estuary was returned to authorities for positive identification (Table 12).

DISCUSSION

HISTORICAL DISTRIBUTION

All available data supports the general description of historical species distribution (e.g., Edge 1984; Edge and Gilhen 2001). An anadromous run of Atlantic whitefish occurred on the Tusket River, however, there are no data to indicate the distance ascended upriver beyond Lake Vaughn. A former run of anadromous Atlantic whitefish on the Annis River was possible in light of the capture of two adult fish above the head of tide during October, 1982. There is no evidence that lake resident populations occurred historically on either of these river systems.

Absence of Atlantic whitefish in the catch from surveys of lakes on the Medway River that were at one time connected to Minamkeak Lake indicate that the species is endemic to the Petite Rivière. Presence of Atlantic whitefish in Minamkeak Lake is likely a consequence of colonization from Milipsigate/Hebb lakes sometime after the diversion of Minamkeak Lake into the Petite Rivière in 1903. Reported occurrences of Atlantic whitefish within the Petite Rivière Estuary have been substantiated with positive identifications of several specimens returned to taxonomists (Table 12). However, there are no data to either support or refute existence of a viable anadromous run (i.e., successful life-cycle closure). All reported captures in the estuary occurred during May or June (Table 12). There are no records of reproductively mature adults either in the estuary or above the head of tide during the late autumn – early winter period when ascension of the river to spawn could be anticipated on the basis of the known run-timing of the historical Tusket River population (Edge and Gilhen 2001).

There are no data to indicate historical occurrences of self-sustaining Atlantic whitefish populations in any other Nova Scotia river drainage.

CURRENT DISTRIBUTION

There are no credible records of occurrence of anadromous Atlantic whitefish on the Tusket-Annis system more recent than October 1982. The run has since been extirpated from these drainages.

Lake resident Atlantic whitefish are found only in Minamkeak, Milipsigate, and Hebb lakes in the Petite Rivière drainage. There is no evidence to indicate a viable anadromous run occurs on the Petite Rivière, although since the attempts to assess run strength were not based on complete counts (trapnet catches are a sub-sample only), the persistence of a run below the limit of detection cannot be discounted. Atlantic whitefish reported from the estuary could perhaps be more narrowly defined as seawater-tolerant strays from the lake resident population as opposed to anadromous.

The interpretation (Edge and Gilhen 2001) that occurrences of Atlantic whitefish in the LaHave River Estuary represent strays from the adjacent Petite Rivière Estuary is supported by the absence of Atlantic whitefish occurrences in samples of fish collected from the river (e.g., DFO fish counting facilities).

TRENDS

Tusket-Annis Rivers

Narrow interpretation of the information available from the Tusket-Annis drainages indicates the anadromous population had experienced a pronounced decline in abundance during the 1950's. Extirpation of the population occurred sometime after 1982. These dates provide important reference points for consideration of allowable harm since the physical presence of a hydroelectric generating facility on that river since 1929 is not likely to be the sole factor responsible for extirpation. A record of changes with time in hydroelectric generation practices, provision of fish passage, and reservoir management (documented in Bradford et al. 2004) may therefore provide an indication of which factors need to be considered in the context of allowable harm as it pertains to recovery and the prospects for successful repatriation of the species to the river.

Reported high bycatch of anadromous Atlantic whitefish in the April-June gaspereau gillnet fishery during the 1940's and 1950's cannot be discounted as a factor contributing to the decline and eventual extirpation of the species from the river.

Petite Rivière

Available data indicate that lake resident Atlantic whitefish have remained secure at least until the time of the illegal introduction of smallmouth bass into the upper lakes during the mid-1990's (NSDAF 2004). The population likely expanded in both distribution and abundance through colonization of Minamkeak Lake following the diversion of Minamkeak Lake into the Petite Rivière in 1903. There are no quantitative data available to assess the numerical abundance of the lake resident population.

Trend in anadromous Atlantic whitefish abundance cannot be assessed other than to state that life-cycle closure does not appear to occur at present.

STATUS

Atlantic whitefish are now extirpated from one of the two rivers that defined the global distribution of the species. Their distribution has therefore declined by one-half since 1982. Loss of the Tusket-Annis population, and an absence of evidence for successful life-cycle closure of sea-run Atlantic whitefish on the Petite Rivière, indicates that the species is no longer anadromous. Life-cycle closure is now a certainty only for Atlantic whitefish resident within the 16km^2 aggregate area of Minamkeak, Milipsigate and Hebb lakes of the Petite Rivière.

PART TWO: APPLICATION OF FRAMEWORK

The DFO framework to evaluate permitting requirements under Section 73 of *SARA* consists of three phases 1) an initial scoping of whether recovery of the species is feasible if human activities which affect the species were to continue, 2) an assessment of the boundary conditions within which important human activities must operate if recovery is deemed possible and 3) development of specific options that are consistent with the provisions of Section 73 of *SARA*, which can be applied to those activities.

Phase I considerations are addressed here. There is neither age and/or stage structured abundance data or relative indices of abundance available to assess Atlantic whitefish status and trajectory. Therefore relative indicators of spatial occupancy (e.g. area of presence/absence) will be applied to the following elements of Phase I.

1. What is present/recent species trajectory?

Atlantic whitefish area of occupancy has declined by at least one-half since 1982 as a result of the extirpation of the species from the Tusket-Annis drainage. The global distribution of the species is now restricted to the Petite Rivière.

2. What is present/recent species status?

Loss of the Tusket-Annis population, in combination with an absence of evidence for successful life-cycle closure of sea-run Atlantic whitefish on the Petite Rivière, indicates that the species is no longer anadromous. Life-cycle closure is now a certainty only for Atlantic whitefish resident within the 16km^2 aggregate area of Minamkeak, Milipsigate and Hebb lakes of the Petite Rivière. The Petite Rivière population has been presumed secure, at least until recently (Bradford et al. 2004). Smallmouth bass were illegally introduced into one of the lakes during the mid-nineteen nineties (NSDAF 2004), their colonization of the remaining two lakes is likely. The consequences for survival of Atlantic whitefish are not known at present, thus casting uncertainty on species status.

3. What is expected order of magnitude/target for recovery?

Range expansion beyond the currently occupied three lakes within the Petite Rivière is the recovery target. This is unlikely to occur without direct human intervention, through provision of fish passage to facilitate range extention of the extant population to the Petite Rivière estuary and adjacent coastal zone, repatriation of Atlantic whitefish to the Tusket-Annis drainage via direct stocking, and creation of additional lake resident populations beyond the boundaries of the Petite Rivière through stocking. The expected order of magnitude for recovery is, minimally, equivalence with their known historical area of occupancy.

4. What is expected general time frame for recovery to the target?

There is no specified timeframe for recovery.

5. Recovery feasibility with human-induced mortality greater than zero

The goal of the Atlantic whitefish recovery strategy is to: *Achieve the long-term viability of the Atlantic whitefish in Nova Scotia* (DFO 2005). Fulfillment of this goal will require an effort to extend the geographic range of the species beyond its current distribution within Minamkeak, Milipsigate, and Hebb lakes (DFO 2005). Recovery cannot be acheived through mitigation of human activities within the species current distribution alone; i.e., Atlantic whitefish are at risk because of a collapse in area of occupancy, and not completely as a result of threats arising from human-activities within their present area of occupancy.

The fact of the species survival within lakes subject to extensive human activity (see Bradford et al. 2004), and in spite of an absence (to the time of their listing under *SARA*) of explicit measures to protect the animal from the most significant sources of human harm (Bradford et al. 2004), indicates Atlantic whitefish possess a degree of resilience to human-induced harm. Recovery is therefore concluded to be feasible even though human-induced harm is greater than zero. Details concerning the biological and technical feasibility of Atlantic whitefish recovery are provided in the recovery strategy (DFO 2005).

ACKNOWLEDGEMENTS

We thank Dan Hasselman and Blythe Mahaney for providing field and technical support well beyond the call of duty. Rachael Pictou conducted the interviews with Acadia First Nation. Ken Meade and Carys Burgess coordinated the Nova Scotia Power Incorporated Habitat Stewardship Program. We also thank John Gilhen and Andrew Hebda, Nova Scotia Museum of Natural History, for their sustained and unwavering dedication to conservation of the Atlantic whitefish. Kim Robichaud-LeBlanc and Karen Rutherford provided valuable comment on early versions of the manuscript.

REFERENCES

Bradford, R.G., H. Schaefer, and G. Stevens. 2004. Scope for human-induced mortality in the context of Atlantic Whitefish (*Coregonus huntsmani*) survival and recovery. DFO Can. Sci. Advis. Sec. Res. Doc. 2004/110.

Department of Fisheries and Oceans (DFO). 2005. National Recovery Strategy for the Atlantic whitefish (*Coregonus huntsmani*). Halifax, 34p.

Edge, T.A. 1984. Preliminary status of the Acadian whitefish (*Coregonus canadensis*). Canadian Field-Naturalist 98: 86-90.

Edge, T.A., and J. Gilhen. 2001. Updated status report on the endangered Atlantic whitefish, *Coregonus huntsmani*. Canadian Field-Naturalist 115: 635-651.

Edge, T.A., D.E. McAllister, and S.U. Qadri. 1991. Meristic and morphometric variation between endangered Acadian whitefish, *Coregonus huntsmani*, and the lake whitefish, *Coregonus clupeaformis*, in the Canadian Maritime Provinces and the State of Maine, USA. Canadian Journal of Fisheries and Aquatic Sciences 48: 2140-2151.

Gilhen, J. 1974. The fishes of Nova Scotia's lakes and streams. Nova Scotia Museum, Halifax, N.S. 49 pages.

Gilhen, J. 1977. A report on the status of the Atlantic whitefish, *Coregonus canadensis*, in the Tusket River Watershed, Yarmouth County, Nova Scotia, including recommendations to ensure its survival. (Submitted to Dr. Don E. McAllister, 30 October 1977).

Huntsman, A. J. 1922. The fishes of the Bay of Fundy. Contributions to Canadian Biology 3: 49-72.

Livingstone, D.A. 1953. The freshwater fishes of Nova Scotia. Proceedings of the Nova Scotia Institute of Science 1950-1951, 23: 90 p.

Nova Scotia Department of Agriculture and Fisheries (NSDAF) 2004. Addressing the threats of introduced predators; stewardship of Atlantic whitefish (*Coregonus huntsmani*) in the Petite Riviére watershed, Lunenburg County through targeted outreach, education and volunteer dependent surveys. Inland Fisheries Division, Pictou, N.S. v + 37p.

Nova Scotia Power Incorporated (NSPI) 2003. Stewardship of Atlantic whitefish (endangered) habitat within the Tusket River, Nova Scotia. Nova Scotia Power Incorporated, Halifax, N.S. vi + 72 pages.

Piers, H. 1927. *Coregonus labridoricus*, the sault Whitefish, an interesting addition to the freshwater fish fauna of Nova Scotia. Transactions of the Nova Scotia Institute of Science 16: 92-95.

Rice, J. 2004. Proceedings of the National Science Advisory Meeting on Section 73 Permits under the Species at Risk Act March 8-10, 2004. DFO Can. Advis. Proceed. Ser. 2004/005.

Scott, W.B. 1987. A new name for the Atlantic whitefish: *Coregonus huntsmani* to replace *Coregonus canadensis*. Canadian Journal of Zoology 65: 1856-1857.

Scott, W.B., and M.G. Scott. 1988. Atlantic fishes of Canada. Canadian Bulletin of Fisheries and Aquatic Sciences. No. 219: 731 pages.

Vladykov, V.D. and R.A. McKenzie. 1935. The marine fishes of Nova Scotia. Proceedings of the Nova Scotia Institute of Science. Vol. XIX, Part 1.

TABLES

Table 1. Summary of reported occurrences of Atlantic whitefish outside of their known area of occupancy from the public since 1999 and availability of information to confirm species presence (Directed = directed research surveys, Archival = previously surveyed by industry or a government agency).

Drainage	Reported Location	Year	Lake Survey Data	
			Directed	**Archival**
Mainland Nova Scotia				
Chezzetcook	Chezzetcook Lake	1999	Not Surveyed	*C. clupeaformis*
Morris Lake Brook	Morris Lake	1999	Not Surveyed	Not Surveyed
Medway	Shingle Lake	2000	*C. clupeaformis*	None captured
	Upper Salters Lake	'recent'	None captured	Not Surveyed
LaHave	Main River	2004	Not surveyed	Not Surveyed
Cape Breton	Mira River	1999	*C. clupeaformis*	*C. clupeaformis*
Petite Rivière				
Below Hebbville Dam	Fancy's Lake	1999	None captured	None Captured
		2004		
	Wallace Lake	1980's	None captured	None Captured
	Branch Lake	2000	None captured	Not Surveyed
	Little Beaver Lake	2001	None captured	Not Surveyed
	main stem of river	2000	Not surveyed	Not Surveyed
	main stem of river	2001	Not surveyed	Not Surveyed
Above Hebbville Dam	No Reports		None captured	None Captured

Table 2. Summary of information acquired from interviews conducted between 13-16 August, 2002 with 16 Acadia First Nation elders or individuals experienced in the harvest of local fishes.

Reserve	Interviews (n)	Respondents Reporting		Capture Location/Year
		Knowledge	**Capture**	
Yarmouth	9	8	1	Kemptville (Carleton branch, Tusket) ,1950's
Shelburne	6	0	0	
Wildcat	1	1	1	Wildcat River (Medway River), 1940's
Totals	**16**	**9**	**2**	

Table 3. Years of reported presence of species captured in gillnets during lake surveys in the Tusket, Annis, and Carleton rivers by federal, provincial, and independent agencies showing species presence by year of survey (AW =Atlantic whitefish, BT =brook trout, BB =brown bullhead, CP =chain pickerel, LW =lake whitefish, RS =rainbow smelt, SM =smallmouth bass, WP =white perch, WS =white

		Species									
River	**Lake**	**AW**	**BT**	**BB**	**CP**	**LW**	**RS**	**SM**	**WP**	**WS**	**YP**
Annis	Brazil			81	01, 02				81, 01, 02	81	81
	Ellenwood			02	90, 02				90, 02	02	90, 02
	Annis		81	81	01, 02				81, 01, 02		81, 01, 02
Carleton	Kempt Back		86, 99, 02	86		86, 02		99	86, 99, 02	86. 99	86, 02
	Fanning		02	86					86, 02	86, 02	86, 02
	Lower Crawley		02								02
	Mink		53, 83, 02	52, 83		52, 83, 99, 01, 02		99, 02	52, 83, 99	52, 83, 99	52, 83, 99
	Nowlans			83					83, 02	83	83
	Ogden			86		02	02	99, 02	86, 99, 02	86, 99, 02	86
	Parr		02	86		86		02	86, 02	86, 02	86, 02
	Petes		02			02		02		02	
	Porcupine		02			02			02	02	68, 02
	Wentworth			82					82	82	82, 02
Tusket	Beaverhouse		02	85				02	85, 02	85, 02	85
	Gillfillan								99		99
	Great Barren		90, 99	90						99, 02	90, 99, 02
	Vaughn			79				99, 02	79, 99, 02	79, 99, 02	79
	Pearl		85, 02	85					85	85	85, 99
	Solomon		86, 02								86, 02
	Sunday			86					86, 02	86, 02	86, 02

Surveys conducted by DFO, NS Inland Fisheries & Aquaculture, NSPI

Table 4. (A) Species presence/absence or rarity in the Carleton and Annis Rivers prior to 1981. (B) Species presence/absence or rarity after 1981 (P =Present, A =Absent, R =Rare). Rare has been assigned where only a single specimen was captured.

A	**Information Prior to 1981**	
Species/Espèce	**Annis**	**Carleton**
Chain pickerel	P	A
White perch	P	P
Yellow perch	P	P
Smallmouth bass	A	P
Brown bullhead catfish	P	P
Brook trout	P	P
Rainbow smelt	No Record	P
Lake whitefish	P	P
White sucker	P	P

B	**Information after 1981**	
Species/Espèce	**Annis**	**Carleton**
Chain pickerel	P	A
White perch	P	P
Yellow perch	P	P
Smallmouth bass	A	P
Brown bullhead catfish	R	P
Brook trout	A	P
Rainbow smelt	No Record	P
Lake whitefish	A	P
White sucker	R	P

Table 5. Total catch, mean catch (fish/net/night) +/- standard deviation of fish sampled with gillnets in the Annis, Carleton and Tusket rivers lakes in 2001 and 2002.

River: Annis	**Species**									
Net nights =12	**Brook Trout**	**Brown Bullhead**	**Chain Pickerel**	**Alosa**	**Lake Whitefish**	**Rainbow smelt**	**Small-mouth bass**	**White Perch**	**White Sucker**	**Yellow Perch**
Total Catch	0	1	38	0	0	0	0	169	1	11
Mean Catch (Fish/net/night)	0	0.08	3.17	0	0	0	0	14.08	0.08	0.92
St Dev	0	-	2.72	0	0	0	0	13.86	-	2.31

River: Carleton	**Species**									
Net nights =34	**Brook Trout**	**Brown Bullhead**	**Chain Pickerel**	**Alosa**	**Lake Whitefish**	**Rainbow smelt**	**Small-mouth bass**	**White Perch**	**White Sucker**	**Yellow Perch**
Total Catch	24	2	0	29	88	1	18	357	23	4
Mean Catch (Fish/net/night)	0.71	0.06	0	0.85	2.59	0.03	0.53	10.5	0.68	0.12
St Dev	1.56	0.34	0	2.93	7.46	-	1.76	26.44	2.24	0.33

River: Tusket	**Species**									
Net nights = 23	**Brook Trout**	**Brown Bullhead**	**Chain Pickerel**	**Alosa**	**Lake Whitefish**	**Rainbow smelt**	**Small-mouth bass**	**White Perch**	**White Sucker**	**Yellow Perch**
Total Catch	5	3	0	2	0	0	11	13	22	6
Mean Catch (Fish/net/night)	0.22	0.13	0	0.09	0	0	0.49	0.57	0.96	0.26
St Dev	0.6	0.63	0	0.29	0	0	2.29	1.56	1.99	0.86

.

Table 6. Total catch by species in traps installed in the Lake Vaughn and Powerhouse dams fishways, Tusket River, 2001 (Source: NSPI 2003). MSW =Multi Sea Winter

Location of Fish Trap	Species	Total #
Lake Vaughn Dam	Atlantic salmon (MSW)	5
	Atlantic salmon (grilse)	2
	Atlantic salmon (smolt)	2
	Brook trout	4
	Gaspereau	*
	Smallmouth bass	41
	White perch	7
	White sucker	4
	Whitefish (*Coregonus sp*.)	0
Powerhouse Dam	Smallmouth bass	5
	Gaspereau	*
	Whitefish (*Coregonus sp*.)	0

* Gaspereau were identified as young-of-the-year, migrating down from lakes, and therefore only presence and not total numbers were recorded.

Table 7. Total catch by species in traps installed in the Lake Vaughn and Powerhouse dams fishways (Source: NSPI 2003).

Location of Fish Trap	Species	Total #
Lake Vaughn	Atlantic salmon (grilse)	15
	Atlantic salmon (MSW)	1
	White perch	7
	White sucker	1
	Gaspereau (YOY)	*
	Whitefish (*Coregonus sp*.)	0
Powerhouse	Atlantic salmon (grilse)	15
	Whitefish (*Coregonus sp*.)	0

* Gaspereau were identified as young-of-the-year, migrating down from lakes, and therefore only presence and not total numbers were recorded.

Table 8. Start and end dates of DFO monitoring of upstream and downstream fish movements through the Tusket River fishways.

Year	Start	End
Upstream		
1998	June 4	October 27
1999	June 3	November 11
2000	May 31	November 12
2001	June 4	July 30
2002	June 11	October 7
Downstream		
1999	April 8	May 26
2001	April 18	June 11

Table 9. Presence of adult whitefish sp. as determined by gillnetting in lakes on the Petite and Medway Rivers 2001 to 2004.

Drainage	Sub-Area	Lake	Presence/Absence	
			Atlantic whitefish	Lake whitefish
Petite	above Hebb's dam	Hebb	present	absent
		Milipsigate	present	absent
		Minamkeak	present	absent
	below Hebb's dam	Andrew	absent	absent
		Demone	absent	absent
		Saint George	absent	absent
		Fancy's	absent	absent
		Fitch Long	absent	absent
		Little Beaver	absent	absent
		Branch	absent	absent
		Wallace	absent	absent
		Moose	absent	absent
Medway	main river	Shingle	absent	present
		Molega	absent	absent
		Little Ponhook	absent	present
	Salters Brook	Long	absent	absent
		Upper Salters	absent	absent
		Rocky	absent	absent
		Crooked	absent	absent

Table 10. Daily catch by species with a trapnet set in the Petite Rivière estuary, October-November, 1999.

Date	Atlantic herring	Gaspereau	Hake	Mummichog	Pollock	Sea raven	Rainbow smelt	Sculpin	Atlantic tomcod	White perch	White sucker	Winter flounder	Frog
20-Oct		1	3				6			1	1		
21-Oct			1				5		26	2			
22-Oct		1					8		2				
23-Oct										2			
24-Oct							1		2				2
25-Oct					3		6		6	1			
26-Oct		2			4		5	1	4	2			
27-Oct							4						
28-Oct		4			5		33		4	5			
29-Oct							2						
30-Oct					1								
31-Oct		2			3	1	44			4		1	
1-Nov		1					7		2				
2-Nov					2		1		2				
3-Nov		1					3		1				
4-Nov		3			1		2						
5-Nov		1					4						
7-Nov		20			8		82		6				
8-Nov		2			11		17	1					
9-Nov	35	2			2		4						
10-Nov													
11-Nov							6						
12-Nov													
13-Nov					2		3			2			
14-Nov					5		3	1	5	2			
15-Nov					1		7						
16-Nov					2		8		1				
17-Nov								1					
18-Nov					2		4		1	1			
19-Nov				1			3	1	13	2			
20-Nov					1			1	1				
21-Nov		2			1		9	2	10				
22-Nov							2	1					
23-Nov		1	1					2	1	2			
Totals	**35**	**43**	**5**	**1**	**54**	**1**	**279**	**11**	**87**	**26**	**1**	**1**	**2**

Table 11. Daily catch by species with a trapnet set in the Petite Rivière estuary, April-June, 2000.

Date	Atlantic herring	Gaspereau	Juvenile gaspereau	American shad	Atlantic silverside	Adult A. Salmon	Juv. A. Salmon	Brook trout	Rainbow smelt	Green Crab	Atlantic tomcod	White perch	Pollock	Juv. pollock	Winter flounder	Lamprey
18-Apr		11					21		39						1	
19-Apr	1	40	15				7		146	4						
20-Apr		12					12	1	47							
21-Apr		5	5				7		26							
26-Apr		309	3				2		11	26						
28-Apr							6									
29-Apr		3	18				2									
1-May		16	15				1		8	5	1					
2-May		52	104				12		6	5						
3-May		89	9,222				34		186							
4-May		96	52				9		6							
5-May		19	5				2		2	30						
9-May		269	160				15		89						1	
10-May		86	15	1			14		17							
11-May		55	419				3		10							
16-May		82	10	1			17		150						1	
17-May		432	35				195		436							
18-May		1,482	1	1			18		49							
19-May		1,311					41		62							
24-May	12	876	11				279		99							
26-May		751		2	1		50		40			1	1		1	
31-May		1,976	9	3	1		36		50							1
1-Jun		249	2				19		166							1
6-Jun		797	3				3		6							
7-Jun	17	163	885		4		5	1	69			2	1			
21-Jun		3,375					1						410			
29-Jun	1	58	171	2		1							30	8		
30-Jun		70	6						1				534	1		
Totals	**31**	**12,684**	**11,166**	**10**	**6**	**1**	**811**	**2**	**1,721**	**70**	**1**	**3**	**976**	**9**	**4**	**2**

Table 12. Catalogue number of specimens of Atlantic whitefish (*Coregonus huntsmani*) at the Nova Scotia Museum of Natural History including location and date collected.

Catalogue No.	Location Collected	Date Collected
5225	Milipsigate Lake	9 May 1923
5454	Petite Rivière	5 May 1924
5455	Petite Rivière	5 May 1924
10017	Petite Rivière estuary	10 May 1989
10018	Petite Rivière estuary	15 May 1989
10268	LaHave River	not recorded
10275	Petite Rivière estuary	1 June 1992
10277	Milipsigate Lake/Minamkeak Lake	20 April 1992
11862	Petite Rivière estuary	22 May 1997
85537	Hebb Lake	2000
87259	Milipsigate Lake	not recorded

Table 13. Dates of operation of three DFO trapping facilities on the LaHave River 1972 to 2004.

Location	Year	Dates of Operation		Atlantic whitefish captures
		Start	End	
LaHave estuary trap	1983	May-21	Aug-07	0
	1998	mid May	end of June	0
	1999	mid May	end of June	0
Morgans Falls fishway	1972	May-01	Nov-03	0
	1973	May-02	Nov-09	0
	1974	May-08	Oct-31	0
	1975	May-07	Nov-17	0
	1976	May-05	Oct-28	0
	1977	May-16	Nov-07	0
	1978	May-17	Nov-10	0
	1979	May-07	Nov-13	0
	1980	May-05	Oct-31	0
	1981	May-15	Oct-30	0
	1982	Apr-26	Oct-29	0
	1983	Apr-29	Nov-15	0
	1984	Apr-30	Nov-02	0
	1985	Apr-30	Nov-01	0
	1986	May-07	Nov-03	0
	1987	May-04	Nov-06	0
	1988	May-09	Nov-04	0
	1989	May-08	Nov-03	0
	1990	May-03	Nov-08	0
	1991	May-06	Nov-05	0
	1992	May-05	Nov-06	0
	1993	May-07	Oct-29	0
	1994	May-19	Nov-14	0
	1995	May-08	Nov-03	0
	1996	May-06	Nov-01	0
	1997	May-30	Nov-11	0
	1998	May-08	Oct-03	0
	1999	May-10	Oct-26	0
	2000	May-23	Nov-02	0
	2001	May-23	Oct-30	0
	2002	May-27	Oct-25	0
	2003	May-26	Oct-28	0
	2004	mid May	Oct-15	0
Indian Falls fishway	1975	Jun-06	Nov-18	0
	1983	May-02	Nov-15	0
	1999	May-01	Oct-27	0

FIGURES

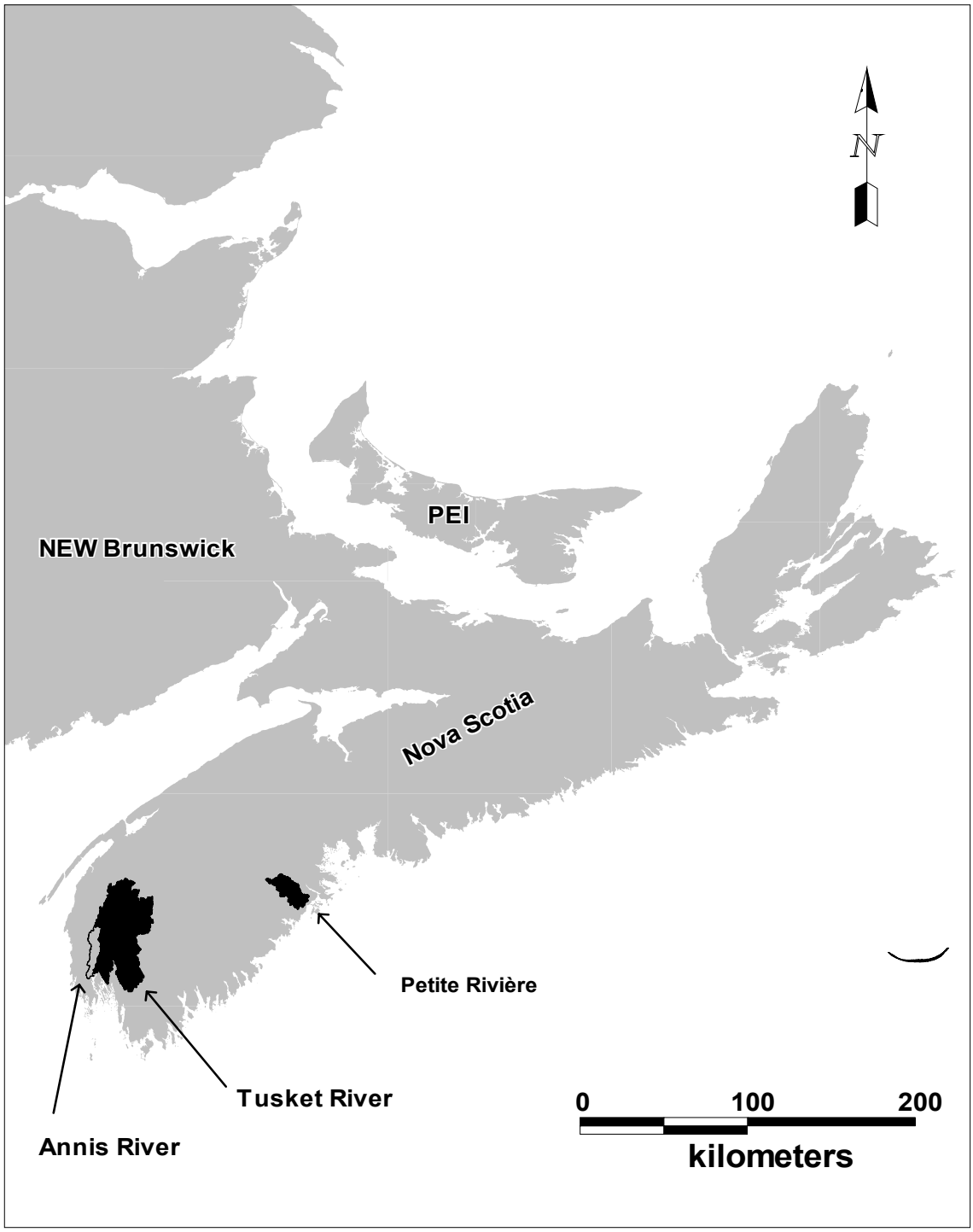

Figure 1. Location of the Petite Rivière and Tusket and Annis rivers, Nova Scotia.

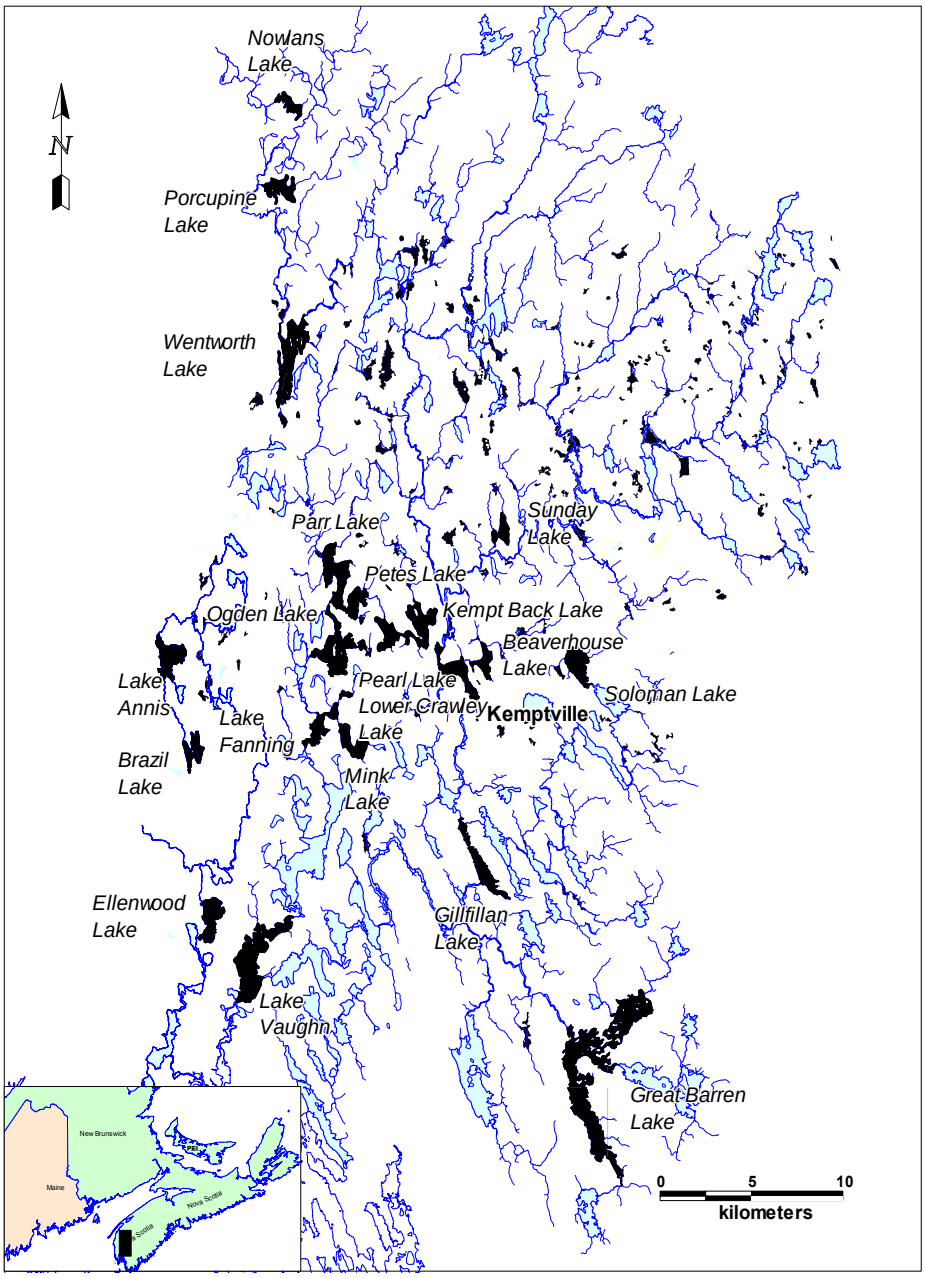

Figure 2. Map of the Tusket and Annis Rivers showing location of places referred to in the text. Lakes surveyed with gillnets are indicated in dark shade.

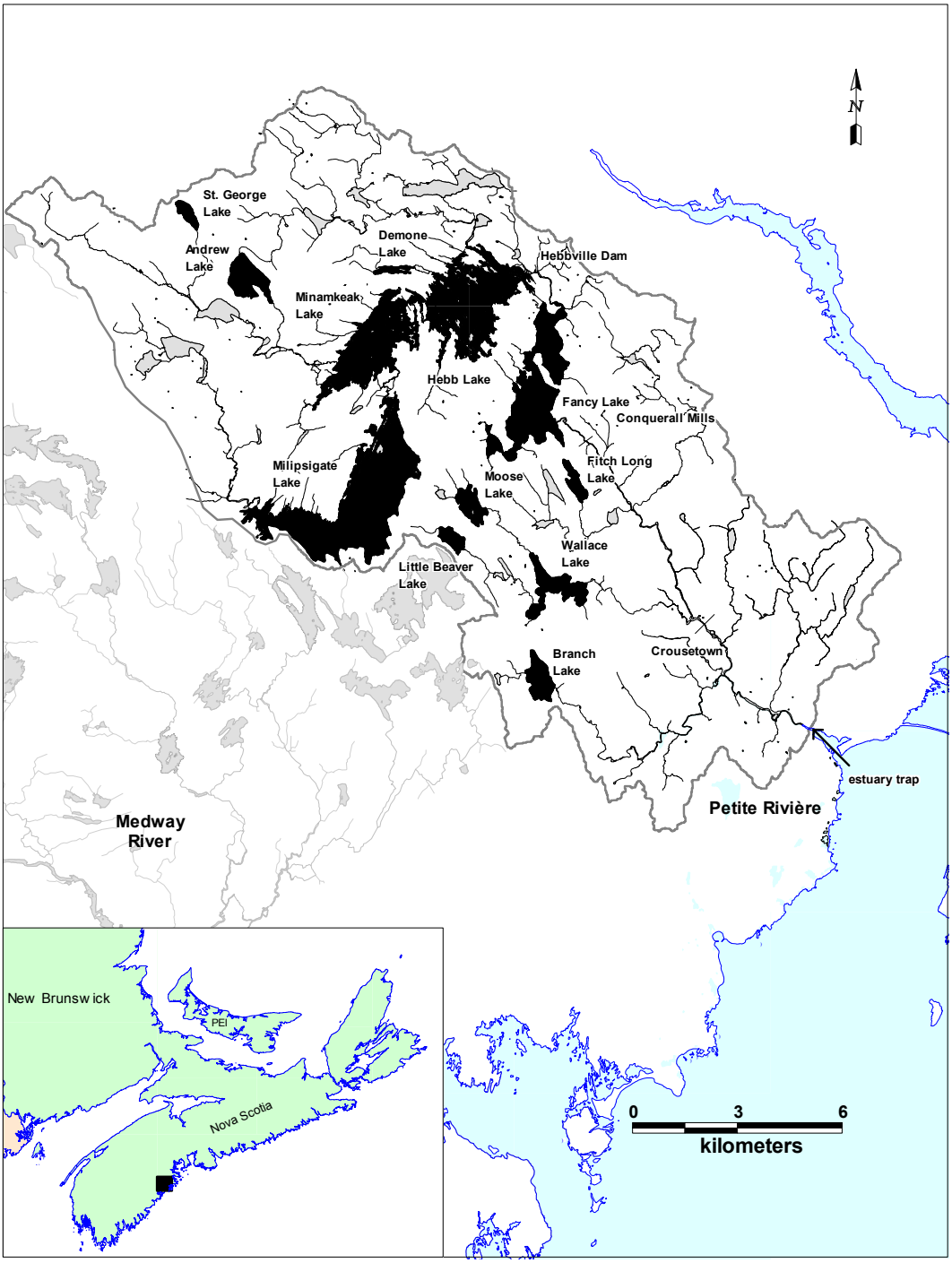

Figure 3. Map of the Petite Rivière showing location of sites referred to in the text. Lakes surveyed with gillnets are indicated in dark shade. Dams are located at Crousetown, Conqueral Mills, and Hebbville.

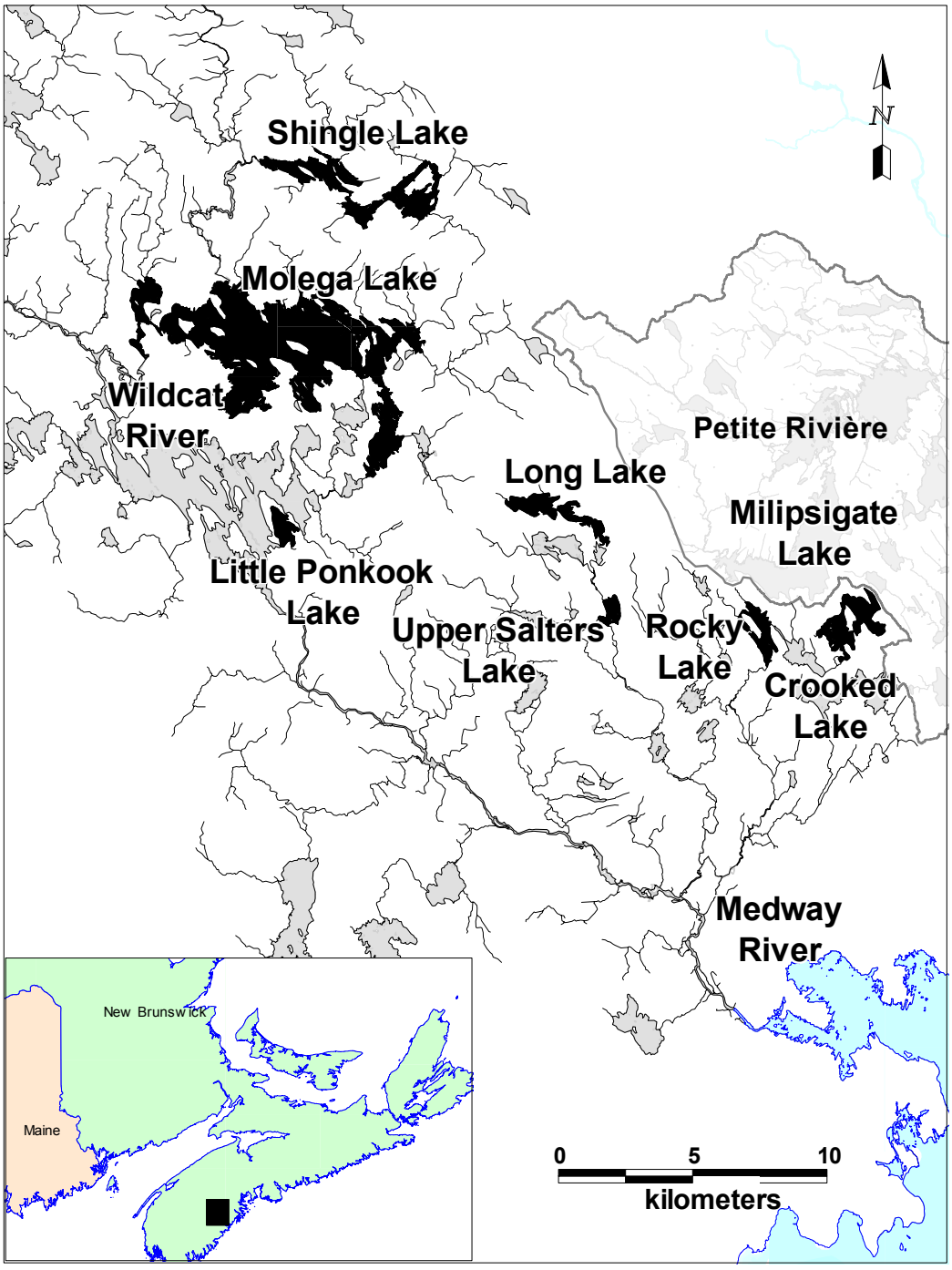

Figure 4. Map of the Medway River showing location of lakes (dark shaded) surveyed with gillnets as well as the proximity of the river to the Petite Rivière.

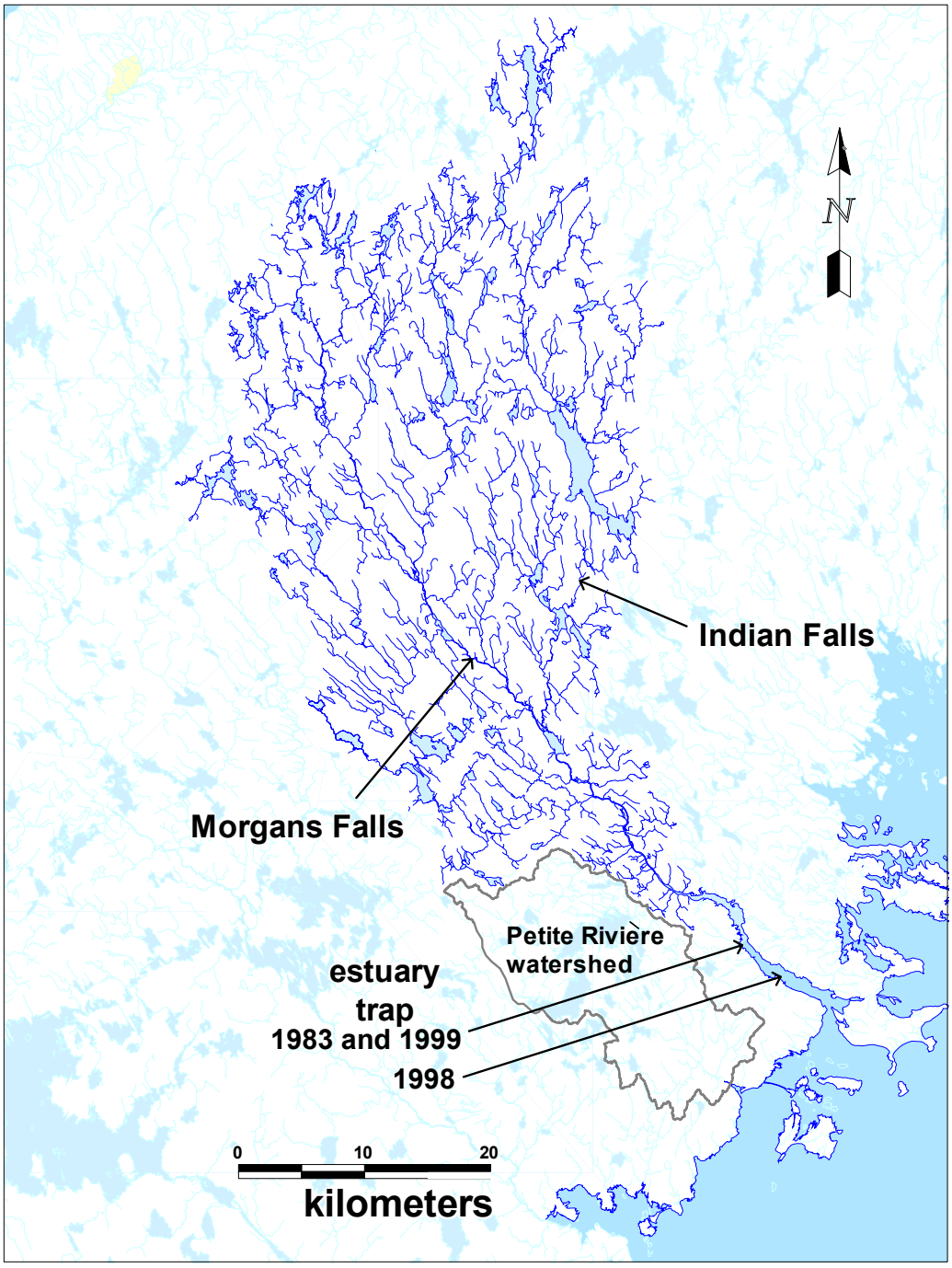

Figure 5. Map of LaHave River showing location of sampling sites referred to in the text as well as the rivers proximity to the Petite Rivière.

APPENDIX I Standard questionnaire used to record information provided by the public at large and Acadia First Nation concerning suspected captures or prior knowledge of Atlantic whitefish.

Fisheries and Oceans Canada | Pêches et Océans Canada

ATLANTIC WHITEFISH PUBLIC INFORMATION QUESTIONNAIRE

PERSON INTERVIEWED	INTERVIEWER
Name:	Name:
Address:	Affiliation:
Phone:	Date of Interview:
e-mail:	

Interview initiated by _____ interviewer conducted - in person ☐

_____ interviewee - telephone ☐

written correspondence ☐

Questions/Issues to be addressed

1. Which watershed do you live on? _____

2. How long have you lived there? _____

3. Do you, or anyone in your family angle in the Petite River watershed?

☐ Yes ☐ No

If yes, who _____ and in what areas?_____

4. How long have you fished in this area?(What years?)_____

5. What were you/they fishing for? _____

6. What species of fish is usually found in your catch?_____

7. (a.) Have you, or anyone in your family ever seen a Whitefish(es)?

☐ Yes ☐ No

(b.) If yes, what have you called this type of fish?_____

Where did you see it? Watershed _____

Waterbody(s)_____

When did you see it? Year(s) _____ Month/Season _____

_____

_____

How did you catch it?

recreational angling ☐ Gear type: lure, bait, etc. _____

commercial fishing ☐ Gear type: gillnet, trap, etc. _____

other ☐ Specify _____

8. What was the approximate size range(s) of the Atlantic whitefish you caught? Specify units (inches, cms, lbs, grams)

_____

9. Have you had occasion to encounter Atlantic whitefish since last report?

☐ Yes ☐ No

Specify:

_____

_____

_____

10. What other waterbodies have you fished or have familiarity with, but where no Atlantic whitefish were observed.

Watershed:

_____

Waterbody:

_____

When: Year(s) _____ Month/Season _____

Associated Activity: recreational angling ☐

commercial fishing ☐

other (specify) ☐
ie: diving/boating, etc.

11. Do you know of other individuals who may have information on Atlantic whitefish?

Name:_____

Address:_____

Phone:_____

12. What conservation measures, if any, do you believe are needed to protect the Atlantic whitefish?

_____

_____

_____

_____

13. Would you like to receive additional information on Whitefish meetings and ongoing research activities? ☐ **Yes** ☐ **No**

Additional Notes/Comments: