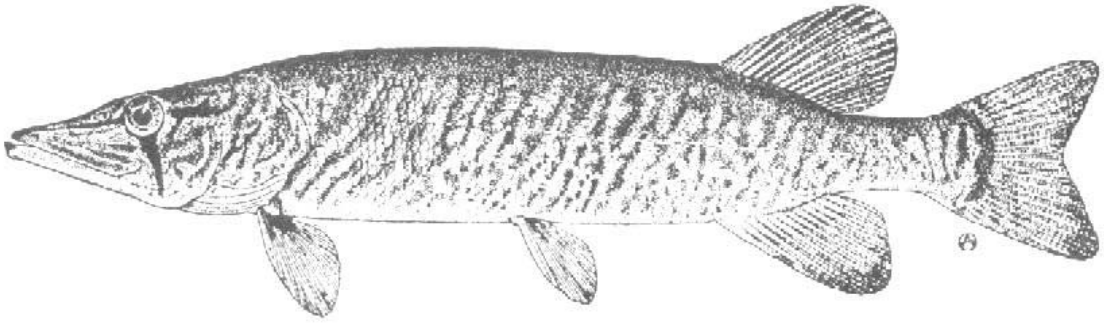
COSEWIC
Assessment and Status Report

on the

Grass Pickerel
Esox americanus vermiculatus

in Canada



SPECIAL CONCERN
2005

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur le brochet vermiculé (*Esox americanus vermiculatus*) au Canada.

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Grass pickerel — Drawing by A. Odum – male, 219 mm, Jones Creek, Leeds County, Ontario, from Scott and Crossman (1973).

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COSEWIC
Assessment Summary

Assessment Summary – May 2005

Common name
Grass pickerel

Scientific name
Esox americanus vermiculatus

Status
Special Concern

Reason for designation
A subspecies known from 10 locations between Lake St. Louis, Quebec and Lake Huron, Ontario. Its usual habitat is shallow water with abundance of aquatic vegetation. An overall decline of approximately 22% in the area of occupancy has been observed. This decline appears to be related to degradation and loss of habitat due to channelization and dredging operations in wetland habitats where this species occurs.

Occurrence
Ontario, Quebec

Status history
Designated Special Concern in May 2005. Assessment based on a new status report.

COSEWIC
Executive Summary

Grass Pickerel
Esox americanus vermiculatus

Species Information

Grass pickerel *Esox americanus vermiculatus* is a subspecies of *Esox americanus* redfin pickerel, family Esocidae. A small form, it is usually less than 30 cm in length, otherwise with features typical of the family: subcylindrical body, dorsal and anal fins far back on the body, snout protracted and well-armed with teeth.

Distribution

In Canada, it is limited to extreme southwestern Quebec and southern Ontario. In the United States, it is found in various states west of the Appalachian Mountains from western New York southwest to eastern Texas.

Habitat

The grass pickerel is characteristic of warm, slow moving streams, isolated pools of such streams, and shallow bays of lakes. It is always associated with extensive submergent and emergent aquatic vegetation characteristic of the fishes in the family.

Biology

Principal spawning time in Canada is spring, shortly after ice has disappeared. Development and growth are fairly rapid. Life expectancy in Canada may be as long as 7 years, but shorter in southern populations. Food of newly hatched individuals is various macroscopic invertebrates, changing gradually to fishes, crayfishes, and the immature stages of aquatic insects, especially dragonflies.

Population Sizes and Trends

Population numbers fluctuate depending on water conditions. At times, an estimated 100 individuals have been reported in the isolated pools of typical streams. This species appears to leave those parts of streams in which they have been recorded if the condition deteriorates as a result of development, road and bridge building, or increased acidification.

Limiting Factors and Threats

All conditions resulting in low water levels, loss of aquatic vegetation, decreased water transparency, and lowering of stream temperatures are threats to the grass pickerel.

Special Significance of the Species

This fish is often the top predator in the communities of which it is characteristic. Early stages of the highly prized muskellunge may be vulnerable to grass pickerel predation.

Existing Protection or Other Status Designations

There are no direct protective measures directed at this species, but an extensive number of statutes and acts of the governments of the areas in which it lives provide indirect protection. The conservation status of *Esox americanus* (of both the subspecies, redfin and grass pickerel) is generally secure throughout its range.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

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COSEWIC Status Report

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Grass Pickerel

Esox americanus vermiculatus

in Canada

2005

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TABLE OF CONTENTS

List of figures

List of tables

SPECIES INFORMATION

Name and classification

Class:	Actinopterygii
Order:	Esociformes
Family:	Esocidae
Genus:	*Esox*
Species:	*Esox americanus* Gmelin 1789
Subspecies:	*Esox americanus vermiculatus* Lesueur 1846
Common names	
English:	grass pickerel
French:	brochet vermiculé (Bergeron et Dubé 2000).

In the Fifth Edition of the American Fisheries Society's list of Common and Scientific Names of Fishes from the United States and Canada (Robins *et al.* 1991) two subspecies of *Esox americanus* were recognized, and listed, separately. For the sixth edition (Nelson *et al.* 2004), a decision was made not to list subspecies. As a result the only listing is "*Esox americanus* Gmelin 1789, redfin pickerel." Redfin pickerel is the common name of the nominate subspecies. Originally considered a full species (Cuerrier 1944, Legendre 1952), these pickerels have more recently been considered subspecies (Crossman 1962a, Lachance 2001). Writers will still have the freedom to refer separately to the valid subspecies (Crossman 1966, Reist and Crossman 1987, Nelson *et al.* 2004), to make it clear which populations are being discussed. This alternative was chosen for this Status Report, especially since the redfin pickerel subspecies does occur in Canada, with a limited distribution in Quebec (see Lachance 1997, 2001).

As presently recognized, the family Esocidae has five species. However, Lopez *et al.* (2000) suggested including in it species presently in the family Umbridae. They would divide the family into two subfamilies—Esocinae, with *Esox* and *Novumbra*, and Dallinae with *Dallia*. They would restrict Umbridae to the three species in the genus *Umbra*. These results were confirmed using nuclear DNA (Lopez *et al.* 2004). For a considerable period, the family was placed in the suborder Esocoidei of the order Salmoniformes. As a result of the need to dismantle the order Salmoniformes, most workers have placed the pikes and related species in a separate order Esociformes.

As defined here, the family has a circumpolar distribution in the northern hemisphere. Only the amur pike, *Esox reicherti,* does not occur naturally in North America. The natural distribution of the smaller pickerels is limited to eastern North America.

Description

The grass pickerel (Figure 1) is often mistaken for the young of the northern pike, *Esox lucius* or, less often, for that of the muskellunge, *Esox masquinongy*. The original

use of the English common name pickerel—the diminutive of the word pike—is the basis for the common names of the two smaller species: chain pickerel, *Esox niger*, and redfin and grass pickerels, *Esox americanus*. The grass pickerel has the usual pike-like body—long, relatively shallow, and cylindrical to subcylindrical. When considering individuals of the various species in the family at the same length, the small pickerels will be more cylindrical, and the others more laterally compressed (Crossman 1962a). Other distinguishing family characters include the posterior location of the dorsal and anal fins, the large mouth ("duck-billed snout"), well armed with teeth, and forked tail. In the grass pickerel, body colouration is variable, but usually consists of a green to brownish background, with 12 to 24 irregular, more or less vertical, narrow, dark bars, and a middorsal brownish stripe. Dark, preorbital, suborbital, and postorbital bars are obvious on the head. The fins lack strong colour and markings. Juveniles have a prominent pale lateral band that breaks up as the fish grows (see Figure 1, A, B, and C).

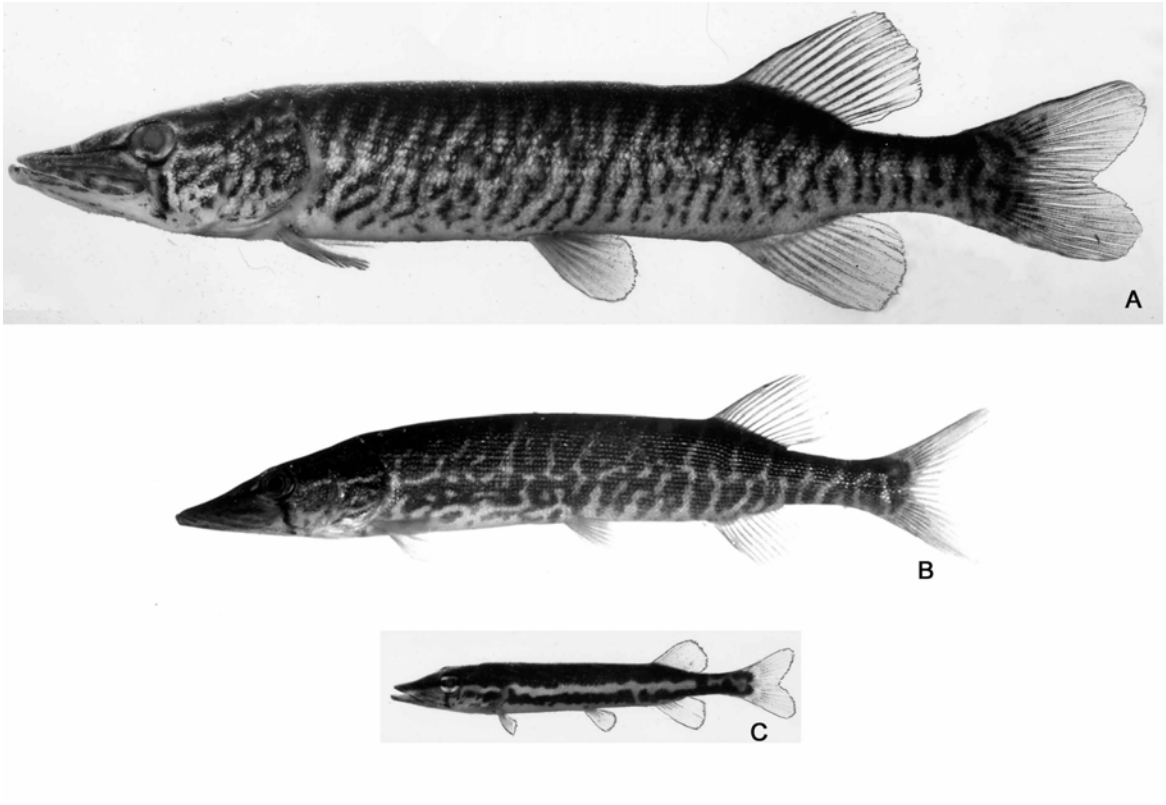

Figure 1. Grass pickerel, *Esox americanus vermiculatus*, A. Adult, 25.4 cm; B. juvenile, 16 cm; C. Young-of-Year, 10.2 cm TL. A and C from Crossman 1962a; B. Photo by E. Holm © ROM.

The grass pickerel is distinguished from the northern pike and muskellunge by: small adult size; less laterally compressed body; the possession of obvious, oblique, black, suborbital, preorbital and postorbital bars (the latter two are absent to inconspicuous in the larger species); fully scaled cheeks and opercula, vs. one or both half-scaled; fewer than 10 submandibular pores, vs. 10 or more; notched (cardioid) scales on flanks, other than those associated with the lateral line, and also between the pelvic fins; and 11 to 13 branchiostegal rays, vs. 13 to 19. It is distinguished from chain pickerel by its 11-13 branchiostegal rays, vs. 14-17, and the absence of the dark, chain-like pattern over a pale or yellowish background on the sides typical of the chain pickerel only. The grass pickerel is distinguishable from the redfin pickerel by a longer, narrower snout with a slightly concave dorsal configuration, vs. a shorter, broader snout with a flat, to convex upper surface; a branchiostegal ray formula of 4+7 or 4+8 (those on anterohyal+those on the posterohyal bones, see Crossman 1960), vs. 5+5 or 5+8; fewer than 5 cardioid scales in a vertical row of scales on the flank, vs. more than 5; fewer than 5 cardioid scales in the angle between the pelvic fins, vs. 5 or more; only yellow paired fins, vs. orange to red, at spawning time (Scott and Crossman 1973).

Designatable units

Crossman (1966) believed that the two subspecies intergraded across a broad front in the US tributaries to the Gulf of Mexico from the St. Johns River in Florida to the Biloxi River, Mississippi. In that area, individuals had a confusing array of character values. Recent genetic work (Butler, Crossman and Wilson, unpublished) indicated that the Atlantic (*Esox americanus americanus*) and Mississippian (*Esox americanus vermiculatus*) populations are genetically distinct using both nuclear and mtDNA marker systems. The intergrades represented a third unique form (M. Butler, Trent University, Peterborough, Ontario; personal communication). These results indicate that the grass pickerel and the redfin pickerel are evolutionary significant units and, therefore, qualify as designatable units of *Esox americanus*.

It has been suggested (P. Dumont, Quebec Natural Resources, Wildlife and Parks, Longueil, QC; personal communication 2005) that there are three populations in Quebec: Lac St-François, Coteau, and Lac Saint-Louis. These three sections of the St. Lawrence are effectively separated by a series of natural obstacles. The section between Lac Saint François and Lac Saint-Louis was closed between 1912 and 1958 by a series of dams and weirs; however, there is no genetic, or other evidence that suggests that these populations are reproductively isolated from each other or from those in Ontario, so at this time there are no eligible units below the sub-species level.

DISTRIBUTION

Global range

The natural distribution of the grass pickerel (Figure 2) is largely restricted to the west of the Appalachian Mountains, in the systems of the Great Lakes and the

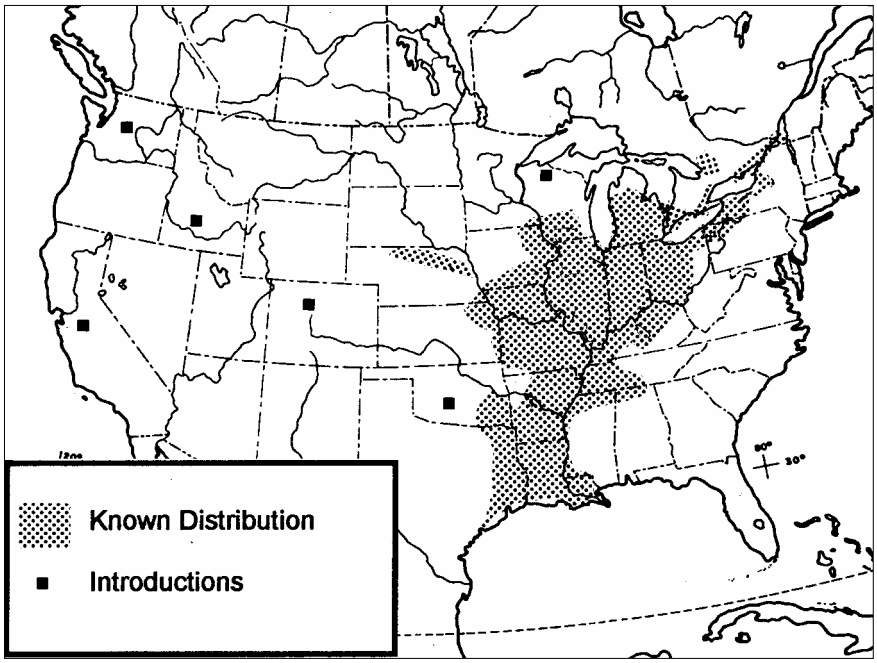

Figure 2. North American (global) distribution.

Mississippi River (Crossman 1980). It extends from the St. Lawrence River system near Montreal, Quebec, through northwestern New York State, including the Finger Lakes, Lake Champlain and Adirondacks Park, through western Pennsylvania, southwest through western Kentucky to the northwestern corner of Alabama (Tennessee River), south through western Mississippi to Louisiana, west to the Brazos River in Texas, northward through southeastern Oklahoma, widespread in Arkansas, Missouri, eastern Iowa, southeastern Minnesota and southwestern Wisconsin, across Illinois, Indiana, southern Michigan, to southern Ontario. There is an isolated area of distribution in northcentral Nebraska, and in central northern Wisconsin. The northern limit of distribution is Rice Creek of the Manitowish River System, Vilas Co. (46°07'N, 89°45'W), central north Wisconsin (Serns and McKnight 1977). These northern Wisconsin populations may exist as a result of introductions, or they could be a glacial relict associated with the unglaciated area of Wisconsin.

Successful introduced populations exist in western NY, MD, western PA, WA, UT, CO and ID. It was introduced in CA and later extirpated (Buss 1963, Wydoski and Whitney 1979, Crossman 1980, Fuller *et al.* 1999). Hybridization is common where one of the two pickerels occurs in waters inhabited by the chain pickerel (Raney 1955, Crossman and Buss 1965) or, to a lesser extent, the northern pike (Serns and McKnight 1977).

The grass pickerel and the chain pickerel occur in the same habitats in many states from Missouri southward.

Canadian range

As presently known from extensive collecting, the Canadian range (Figure 3), is interrupted and represented by several populations somewhat concentrated in separated areas. In Quebec, Cuerrier (1944) first recorded the species at Île Perrot at the mouth of the Ottawa River. The grass pickerel is currently known in three sections of the St. Lawrence River; Lake St-François (in 1941), a questionable record; a section of the river immediately downstream of Lake St-François, Coteau du lac (in 1970); and in Lake St-Louis including Île Perrot, Ruisseau Saint-Jean, and Lachine (1941-1988) [P. Dumont, Ministère des Ressources naturelles et de la Faune, Quebec; personal communication]. This includes a 1985 record extending the distribution downstream in Lac St-Louis to near Lachine. In 1994, the species was captured farther upstream in the nearby Ontario portion of Lake St. Francis. This suggests little movement since 1941, but possibly the establishment of newer populations. Pollution around Montreal has been suggested as a possible reason for the narrow gap (now Îles de Contrecoeur to Lac St-Louis near Lachine) between the territories of the two subspecies in Quebec. Mongeau *et al.* (1974) did not include a distribution point for the Rivière Châteauguay, as given earlier by Cuerrier *et al.* (1946).

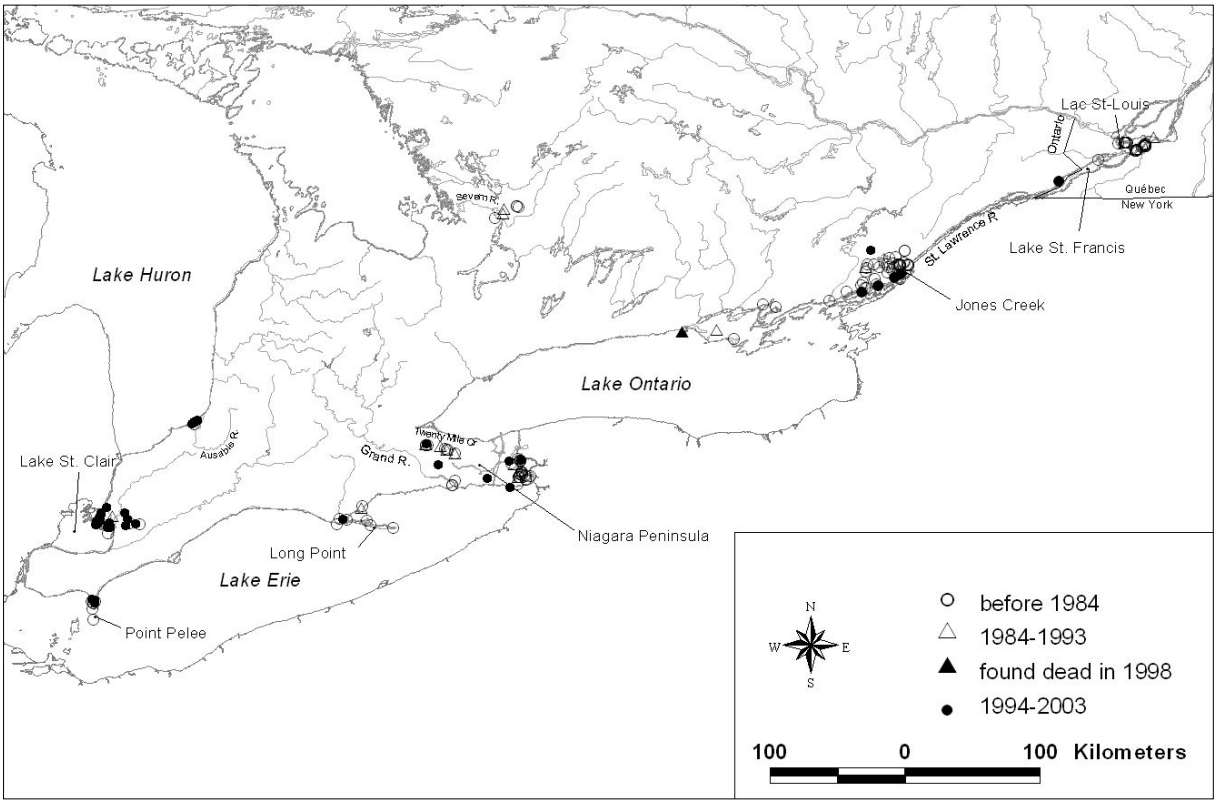

Figure 3. Distribution of grass pickerel, *Esox americanus vermiculatus*, in Canada, indicating two time periods of collecting or reporting.

The distribution continues upstream into Lake Ontario in shallow bays and small streams with a concentration in the tributaries to Lake Ontario and the St. Lawrence River from Brockville to Gananoque. It continues as far west as western Quinte waters near Deseronto, Ontario. Extensive collecting has failed to locate the grass pickerel in the Canadian tributaries to Lake Ontario from Presqu'ile Park west of the Bay of Quinte, to Hamilton. There is a population in the upper reaches of Twenty Mile Creek, a tributary of Lake Ontario, southeast of Hamilton. As a result of barriers to upstream movement from Lake Ontario, it would seem likely that the origin of that population is a result of some past headwater contact with that of the nearby Grand River, a tributary of Lake Erie. The grass pickerel is known from virtually all of the streams tributary to the Upper Niagara and Welland rivers south to the area of Fort Erie, Ontario. On the north shore of Lake Erie, populations occur (or occurred) in the Grand River, Long Point area, and Point Pelee. In spite of the existence of suitable waters in the intervening areas, no records exist there. Populations occur in the upper portion of Lake St. Clair (Walpole Island), and tributaries of Lake St. Clair: the Sydenham River, Little Bear Creek and Maxwell Creek. They are found in the Lake Huron watershed, near Grand Bend, Ontario (Old Ausable Channel, the former river bed of the Ausable River now a slough that drains into “The Cut” of the Ausable River).

Inland populations occur in the Severn River system in Kahshe Lake, Bass Lake and Gartersnake Creek. In 1972, the species was reported from Lake Couchiching (the northern extension of Lake Simcoe) and Hoaglands Marsh (Ontario Ministry of Natural Resources, field identification), but these records cannot be verified.

HABITAT

Habitat requirements

The usual habitat is water of neutral or slightly basic nature, clear to tea coloured, with very slow to no flow, generally shallower than 2 m, with abundant to dense submerged, floating and emergent aquatic vegetation. Range of pH in Ontario habitats was 6.26-8.32 (Scott and Crossman 1973). Ming (1968) reported grass pickerel from fast-flowing mountain streams. The vegetative composition is similar to that in which the other pickerels, northern pike, and muskellunge are found, which includes representatives of *Potamogeton, Ceratophyllum, Nymphaea, Nuphar* and *Chara.* Complete floral lists of grass pickerel habitats in the northern and southern parts of the distribution are available (Crossman 1962a, Ming 1968). The habitat is characteristically small, clear, productive streams, ponds, and shallow bays of larger bodies of water, usually with mud bottoms. One exception to this involves the Ontario population in Twenty-Mile Creek (tributary to western Lake Ontario) in which substrate often consisted of gravel and flat limestone rocks (Gorrie 1975). In Oklahoma, they were sometimes found in rock or gravel pools without vegetation. In those cases, this fish was associated with a brush pile or overhanging bush. It can survive in isolated pools of seasonally temporary streams, and even when isolated in roadside ditches, providing dissolved oxygen is adequate (Ming 1968).

A detailed description of the Jones Creek habitat was provided by Crossman (1962a): water was stained brown with pH 7.65. Current speed varied from none to 0.5 feet (0.15 m) per second. Depth was 1.5-5.5 feet (0.5-1.7 m) and could fluctuate drastically, substrate was largely mud with some clay and rock. Cover consisted of extensive undercut banks and woody debris, and aquatic vegetation was diverse and often very abundant. Maximum water temperature was 84°F (29°C). Banks were variable, either marshy or consisting of shrubs or trees when the stream ran through pasture. The fish community was diverse consisting of 24 different species.

Serns and McKnight (1977) reported the habitat in Wisconsin. The water had a methyl orange alkalinity of 57.0 m/l, and a conductivity of 118 µmhos at 25.0°C. Substrate in Wisconsin habitats was characterized by Becker (1983) as sand (21%), gravel (21%), mud (17%), clay (13%), rubble (13%), silt (8%), and boulders (8%).

Habitat trends

In some of the tributaries of the Niagara River where the grass pickerel was caught close to heavily travelled roads in the early 1960s, there has been a deterioration of the habitat and vegetation. It is now found farther upstream in more typical and undisturbed habitat (E.J. Crossman, personal observations).

Yagi (2004) described the habitat and its trend in the Niagara region, as follows:

> "The grass pickerel has specific habitat requirements as it is only found in wetland-associated streams with organic soils. Most of these habitats include creeks that may at sometime been channelized for agricultural drainage purposes but are normally not actively maintained and may not flow during some months but always have at minimum, permanent pool habitat.
>
> Habitat of this nature has been lost by at least 80% in Niagara since human settlement. This type of habitat is very vulnerable to drainage activities (new drains and drain maintenance), extreme weather changes, fisheries and wetland management activities, temperature changes, channelization and fragmentation from road construction. The isolated nature of the pool habitat makes them especially vulnerable to the potential for over harvest (predation, research collections, and bait or angler harvest).
>
> An analysis of the amount of current and historic habitat available for grass pickerel has not been done at a provincial, regional or local scale. Since this species is found only associated with organic based wetland streams, it may be possible to determine the amount of potential habitat available for each tributary. Then the amount of habitat available versus the amount occupied by this species may be used as a suitable index for trend through time monitoring purposes and a standard way to compare between tributaries and areas".

Habitat protection

This is a poorly known, somewhat secretive, fish, which lives in areas of little interest to humans. In most areas, small maximum size and nature of the habitat renders them of little or no importance to anglers. It is, therefore, protected only by general statutes that attempt to maintain, for various human interests, the high environmental quality of such bodies of water. Many of the habitats are in agricultural situations, where siltation from breakdown of stream banks by farm animals and chemicals used as herbicides or insecticides could be harmful.

Four of the populations are in parks, which give them protection from habitat destruction: Pinery Provincial Park, Point Pelee National Park, Long Point Provincial Park and St. Lawrence Islands National Park. The population in the St. Clair delta is under jurisdiction by the Walpole Island First Nation.

In Quebec, habitat is generally protected by the "Loi sur la qualité de l'environnement" (environmental quality act). Fish habitat is also protected by the "Loi sur la conservation et la mise en valeur de la faune" (act respecting the conservation and development of wildlife) which, under articles 128.1 to 128.18, controls activities that could modify biological, physical or chemical components peculiar to fish habitat. The "Loi sur les espèces menacées ou vulnérables" (act respecting threatened or vulnerable species) makes additional provision for the protection of the habitat of threatened or vulnerable species.

BIOLOGY

General

This is a warmwater fish with an affinity for vegetation, capable of surviving in small bodies of water without flow in summer and covered by ice in winter. At different times of the year, it occupies different sections of the habitat described. Its main spawning period is in the spring when water is plentiful and new growth of vegetation has started. It shares these habitats with a variety of other warmwater species such as suckers, catfishes, sunfishes, pikes, and minnows. It is a sight predator, with young fish feeding on a wide variety of organisms starting with small invertebrates, shifting largely to fishes and crayfishes as they grow. Adult grass pickerel are cannibalistic at certain times (Crossman 1962a). Females grow to larger sizes than males. Maximum scale ages vary over the distribution from 4 yr in Wisconsin, Ohio and Oklahoma (Kleinert and Mraz 1966, Trautman 1981 and Ming 1968) to 7 yr in Ontario (Crossman 1962a). Age from cleithra would be more dependable. Maximum recorded size in Canada (Severn River) is 328 mm TL (total length) and 204 g, and in the United States (Ohio) 381 mm TL and 397 g (Scott and Crossman 1973).

Reproduction

Very few details of the actual spawning activity of this fish have been reported. It has been considered to occur in, or at, the edge of pads of vegetation. Toner (1943) reported that spawning pickerel stay closer to shore than do northern pike. He noted that a large female grass pickerel is associated with a number of smaller males as in other esocids. Adults reach sexual maturity in the first year of life in Wisconsin, but apparently only in the second year in Ontario. No nest is built and neither eggs nor young are provided any parental care. The eggs are demersal, slightly adhesive, and adhere to vegetation. Neither reproductive migration nor homing are known, but McNamara (1937) suggested male grass pickerel were the first fishes to move upstream after the ice has disappeared, the females followed later, and spawning takes place in temporary floodplain marshes. Spawning takes place in late February to March in Oklahoma (Ming 1968), April in Pennsylvania and Wisconsin (Buss 1962, Kleinert and Mraz 1966), and late March to early May in Ontario (Crossman 1962a). In Ontario, spawning takes place in water temperatures approximately 8-12°C, eggs hatch in 11-15 days at temperatures of 7.8-8.9°C, and the time period between spawning to initiation of feeding by young involves 2-5 weeks depending on water temperature. In Pennsylvania, it was recorded that the grass pickerel runs with the northern pike to a quiet vegetated area to spawn (Buss 1963).

Details on developing newly hatched individuals from Ontario were provided by Leslie and Gorrie (1985) and for the Ohio River system by Yeager (1990).

The grass pickerel, apparently unlike its sister subspecies, has long been known to spawn in the late summer to winter. Evidence for this includes: the presence of individuals late in the year (October-December) that were similar in size to those in June (Lagler and Hubbs 1943, Crossman 1962a and Ming 1968); presence of two age classes of individuals less than 78 mm TL in October: 2 individuals, 33 and 42 mm, with 6 and 12 circuli, and 4 larger individuals with 26-39 circuli (Crossman 1962a); and presence of ripe females in August-November (Crossman 1962a, Kleinhart and Mraz 1966). Kleinhart and Mraz (1966) suggested that grass pickerel spawn more than once per year due to the occurrence of eggs of varying ripeness and size in the same individual.

Physiology

This subspecies is adapted to high temperatures. Final preferred temperature (experimentally determined) is 25.6°C, and maximum water temperature in some successful habitats was 28.9°C. Tolerance level for dissolved oxygen was recorded at 0.3-0.4 ppm (Cooper and Washburn 1949). Although the esocid fishes are generally considered to be primary freshwater species, there is a varying amount of saltwater tolerance. The highest salinity known for *Esox americanus americanus* was 14 ppt (Schwartz *et al.* 1982).

Movements/dispersal

Movements associated with spawning, particularly where habitats are ice covered in winter, are given under Reproduction, above. Grass pickerel, when undisturbed, are often observed near shore, or at the outer edge of patches of vegetation, oriented with the head toward the shore or vegetation. There is vertical distribution with the younger individuals near the surface and the adults in deeper water, if it exists. Movements within streams do not appear to be extensive, but they must move in regard to lowering water levels and become concentrated in deeper, even isolated pools.

Nutrition and interspecific interactions

Considerable detail on size of pickerel and number and volume of food items consumed were presented by Crossman (1962a), Kleinert and Mraz (1966), and Ming (1968). The food of individuals less than 50 mm length in Jones Creek consisted of Cladocera, Amphipoda, Ostracoda, Odonata, and less frequently Diptera, Plecoptera, Hemiptera and Isopoda (Crossman 1962a). In Oklahoma, some pickerel in this size range had eaten fishes and tadpoles (Ming 1968). In Ontario, grass pickerel 50-100 mm in length started feeding on fishes, but the diet was mainly Trichoptera, Odonata, and crayfishes (Crossman 1962a). In Ontario, frogs and tadpoles were infrequently eaten although they were very abundant. The diet of individuals in larger length groups shifted gradually such that fishes and crayfishes dominated, but nymphs of aquatic insects still appeared. This pattern appears general since it agrees with that recorded for Oklahoma (Ming 1968) and Tennessee (Rice 1942), although grass pickerel in Oklahoma ate a number of other aquatic vertebrates.

Cannibalism occurred infrequently, and there appears to be no evidence that this fish gorges on fishes. In Ontario, rarely were there more than two fishes in the stomach of a grass pickerel.

Interactions with other species of fishes were limited to predation and food. In Jones Creek, there were 22 other species of fishes, but the grass pickerel preyed on only nine. The central mudminnow*, Umbra limi*, and the golden shiner, *Notemigonus crysoleucas* were dominant prey items. Golden shiners were preyed upon in relation to their relative abundance rather than selection (Crossman 1962a), but Crossman (1962b) suggested that the grass pickerel selected for the central mudminnow. Ming (1968) noted that, in Oklahoma, of 76 species of fishes captured, only 44 of them could be said to be "closely associated" with the grass pickerel. Those species were in the following families: Lepisosteidae, Amiidae, Clupeidae, Cyprinidae, Catostomidae, Ictaluridae, Anguillidae, Centrarchidae, Percidae, Sciaenidae and Atherinidae.

Becker (1983) indicated that, in Wisconsin, grass pickerel are eaten by catfishes (Ictaluridae), sunfishes (Centrarchidae), yellow perch (*Perca flavescens*), and grass pickerel. Extensive accounts of diets of common piscivorous birds—osprey (*Pandion haliaetus*), common loon (*Gavia immer*), double crested cormorant (*Phalacrocorax auritus*), common merganser (*Mergus merganser*), belted kingfisher (*Ceryle alcyon*),

and great blue heron (*Ardea herodias*)—in the Birds of North America Series (Poole and Gill, eds., 1992-2002) were checked. None of the literature surveyed indicated that the grass pickerel was eaten by any of these fish-eating birds that are common in the same habitats. An assumption prevails that grass pickerel may be detrimental to northern pike, and Kleinert and Mraz (1966) suggested that management efforts should be made that would prevent the spread of the pickerel.

Grass pickerel are known in nature to hybridize with redfin pickerel, chain pickerel, and northern pike (Serns and McKnight 1977, Schwartz 1962, Schwartz 1981). Artificial hybrids between muskellunge and grass pickerel lived at least 18 months (Tenant and Billy 1963, Crossman and Buss 1965).

Jones Creek individuals were parasitized by 11 organisms, mostly trematodes, in virtually all internal organs. Only three protozoans appeared dense enough to affect the health of grass pickerel (Crossman 1962a, see also Ming 1968).

Behaviour and adaptability

Other than the apparent habit of individuals orienting with the head toward the shore around the edge of a pond, the behaviour of this fish is not markedly different from that well documented for the better-known esocid species. The nature of the habitats occupied in rather significant numbers suggests this fish is highly adaptable. The ability of the grass pickerel to become established in areas outside its native range as a result of accidental or authorized introductions also suggests adaptability.

POPULATION SIZES AND TRENDS

Some authors writing about conditions in the habitats farther south suggest that, compared to earlier accounts, it is possible that population sizes and territory occupied are diminished (Ming 1968). A problem involved in such time-period comparisons is that, in the past, this form was poorly known and often mistaken for the young of larger esocids.

Trautman (1981) indicated a decline in populations in Ohio in the period starting before 1901 to 1921. However, his distribution map included populations not known previously in the period 1922-1955. There were a smaller number of such populations noted for 1955-1980. It is difficult to be certain whether these data represent shifts in population numbers or intensification of collecting effort.

Since 1970, the species has been collected in several new locations in Canada, and repeat sampling at some sites suggests that the populations there are as strong as they were previously. At a few locations there appears to be a decline in numbers (*see* below).

Quebec

Although there is a 1985 record extending the range a short distance downstream in Lake St-Louis, the grass pickerel appears to be very rare and declining in Quebec

(Dumount pers. comm.). Extensive sampling in Lake St-Louis from 1988 to 2003 (100 seine hauls around Île Perrot and the Archipelago of Îles de la Paix in 1988-1989; 57 gill net sets in 1988-1990; 46 seine stations and 78 gill net stations in 1997, 50 seine hauls around Îles de la Paix and Dowker Island in 2003) yielded only a single specimen in 1988.

Sampling effort in Lake St-François (46 stations in 1968 in deep water, 43 seine net stations and 73 gill net stations in 1996) yielded no grass pickerel.

Ontario

The species is extant at several locations (Jones Creek, Niagara River tributaries, Point Pelee) that have been sampled repetitively on several occasions. Collecting at some Ontario sites suggests population sizes are rather large for the nature of the habitat. For example, 58 specimens (30-220 mm TL) were captured in a pond on Long Point in 1973 (ROM 28989), and 99 adult specimens (120-216 mm TL) were captured in a seine haul in a small creek on the Niagara Peninsula in 1982 (ROM 43510) and 101 in 2003 (Yagi 2004). Apparently new, or previously unknown, populations were reported recently in drains of the Welland River, Maxwell Creek, Sydenham River, and the upper waters of the Gananoque River system (St. Lawrence River).

Unlike the Quebec situation, effort farther upstream in Lake St. Francis on the Ontario side was successful in capturing a single specimen in 1994 in Cooper's marsh (ROM 69378).

The majority of records from Jones Creek, the St. Lawrence River and eastern end of Lake Ontario occurred prior to 1984. This is likely the reflection of more intensive sampling by individuals such as G.C. Toner and E.J. Crossman between 1934 and 1960. Grass pickerel have also been captured in more recent and less intensive sampling programs. It is likely that the species is stable here.

Table 1. Abundance of grass pickerel in the tributaries of the Upper Niagara River in 2003.

	Frenchmans Creek	Miller Creek	Baker Creek	Black Creek	Beaver Creek	Boyers Creek	Usshers Creek	Total
Grass pickerel	0	0	12	28	101	11	20	172
Total fish caught	3375	940	324	497	798	403	746	7083
Percent **n**	0.00%	0.00%	3.70%	5.63%	12.66%	2.73%	2.68%	2.43%

Note: In 1979 there were no grass pickerel caught in 9 sample stations on the Upper Niagara tributaries. In 2003 all of the 1979 stations were re-sampled as closely as possible to the 1979 sites and grass pickerel represented 3.88% of the total catch (**n** = 72 of 1854 fish) in those stations. Tables 1 and 2 after Radford (2003).

Table 2. Abundance of grass pickerel in the tributaries of the Welland River in 2003.							
	Lyons Creek	**Hunters Drain**	**Tee Creek**	**Grassy Brook**	**Drapers creek**	**Oswego Creek (Can borough Weir)**	**Total**
Grass pickerel	1	0	11	3	0	7	22
Total fish caught	119	55	329	230	301	388	1422
Percent **n**	0.84%	0.00%	3.34%	1.30%	0.00%	1.80%	1.55%

Yagi (2004) described the situation in the Niagara peninsula as follows (see also Table 3): "Consistent and repeatable fish community station data for our inland tributaries for the purposes of trend through time analysis is not readily available. For example, our best comprehensive study is a one time sampling effort in 1979 of the Upper Niagara tributaries, which has been repeated in its entirety for the first time in 2003. Relying solely on this information to establish a fish community trend is dangerous at best, as the water quality, habitat, watershed land use, invasive species presence and even weather conditions can account for a significant amount of the variation between these years".

Table 3. Locations of grass pickerel in Niagara region and information on sampling history, method and potential data limitations (*see* Yagi 2004 for detail).

Tributary Name	Most Recent Sample Date	Grass Pickerel Present	Sampling Method	Data Available	Potential Limitations of Data
Point Abino Drain	1999 (pre-maintenance) 2000 (post maintenance) 2001 (2 yr post maintenance).	1999 – yes. 2000- no. 2001- yes (declined levels).	Standardized biomass sampling available (location/effort).	Historic, recent, specific project monitoring, presence/absence, relative abundance, biomass estimate, fish community, and habitat pre and post.	Historic data available.
Wainfleet Bog Drains	2000 (pre drain blockage) post blockage assessment not completed.	Historic yes see ROM. 2000-yes. Post unknown.	Minnow traps and seine net sites.	Historic and recent presence/absence, biomass estimate, relative abundance, habitat, temperature, and pH.	Some historic sample sites may be different to recent. Post assessment incomplete.
Usshers Creek	1998-yes-upstream of mouth at Willoughby Rd. 2003-yes upstream of mouth.	Station at Mouth 1971 -ROM- 2. 1974-ROM-1. 1976-ROM-2. 1979 – MNR-No. 1982-CMN-1. 1998-ROM-1. 2003-MNR-0.	Standardized biomass sampling available (location/effort).	Historic and recent and specific project monitoring. Temperature and flow change with base flow augmentation for Golf Course Development in Oct. 2001. Habitat pre and post.	Some historic sample sites may be different to recent. Mostly sampled at mouth, 1 stn at QEW.
Oswego Creek	2003- weir area sampled.	Historic? (MNR). 1998- upstream of weir @Indian Rd- MNR-2 isolated pools 1998 study). 2003 – 7 grass pickerel found near weir.	Standardized biomass sampling available (location/effort).	Bypass channel completed in 2003. Weir in place since 1970s.	Some historic sample sites may be different to recent. Post-assessment incomplete, need to sample isolated pools upstream of weir.

Table 3. Locations of grass pickerel in Niagara region and information on sampling history, method and potential data limitations (*see* Yagi 2004 for detail).

Tributary Name	Most Recent Sample Date	Grass Pickerel Present	Sampling Method	Data Available	Potential Limitations of Data
Tee Creek	2003 – yes 11 fish found in 1 isolated pool (online pond remnant).	Major Drain channelizations through habitat in 1992. Abundance decline.	Standardized biomass sampling available (location/effort).	Historic and recent presence/absence, biomass estimate, and relative abundance.	Some historic sample site may be different to recent. Major habitat change from historic to present.
Miller Creek	2003 none all stations. Habitat no longer suitable.	Historic STN 1 1974-MNR-3. STN2 @Sutherland rd. 1974-MNR-7. Historic 1979 –MNR-0 Post 1979 (MNR records).	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Some historic sample sites may be different to recent.
Frenchmans Creek	2003 none all stations. Habitat no longer suitable.	Historic 2.5km east of Ridgeway-1960-CMN-1.@QEW 1971-ROM-2. 1974-MNR-2. 1979-MNR-1. Historic 1979 –0 at mouth. Post 1979? (MNR records).	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance Frenchman's Creek restoration implementation projects 1990 to present.	Some historic sample sites may be different to recent.
Baker Creek	2003 – yes (12 found),	@ mouth 1958-ROM-4. 1974-MNR-3. 1976-ROM-8. Historic 1979 –0. Post 1979 (MNR records)	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Some historic sample sites may be different to recent.
Black Creek	2003 – yes (28 found).	@College Rd. 1974-MNR-4 Historic 1979 –0. Post 1979 (MNR records). @ Mouth 1989-ROM-3.	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Some historic sample sites may be different to recent.
Beaver Creek	2003 – yes (101 found).	@Bowen Rd. 1971-ROM-3 1974-ROM-6 1982-ROM-99 1989-ROM-20 Historic 1979 –0. Post 1979? (MNR records).	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Some historic sample sites may be different to recent.
Boyers Creek	2003 – yes (11 found).	Historic 1979 –0. Post 1979? (MNR records).	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Some historic sample sites may be different to recent.
Hunters Drain	2003 none found. Habitat no longer suitable.	Historic. 1999 (MNR records).	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Historic data may not be available.
Grassy Brook	2003- yes (3 found) location matches.	67 km W of mouth 1999-ROM-1 Historic (MNR records).	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Historic data may not be available.
Lyons Creek	2003 – yes (1 found).	Historic presence 1958-ROM-1 @QEW. Historic (MNR records).	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Historic data may not be available
Drapers Creek	2003- none found. Habitat no longer suitable.	Historic (MNR records).	Standardized biomass sampling available (location/effort).	Presence/absence. Biomass estimate. Relative abundance.	Historic data may not be available.

Pre-1979 sampling of the Upper Niagara tributaries shows Miller Creek with an abundance of grass pickerel in one location. In 1979 there were no grass pickerel caught in 9 sample stations on the Upper Niagara tributaries. No standardized fish sampling was completed on those stations in the years following except for Usshers Creek in 1999. In 2003 all of the 1979 stations were re-sampled as closely as possible to the 1979 sites and grass pickerel represented 3.88% of the total catch (n = 1854 fish) in those stations" (see Tables 1, 2).

The data in Table 1 suggests that grass pickerel have not declined in the upper Niagara River tributaries and may actually have increased (although note caution in interpreting this data, above and Table 3). Since there is little historical data available for the Welland River tributaries, it is not possible to determine trends there.

The species was known to occur in tributaries of the lower Grand River around Dunnville in 1949-1959. In 2001-2003, nearly every drain that could be shocked in the Dunnville area was electrofished by the Grand River Conservation Authority. During this sampling several juvenile individuals of *Esox* were captured in two drains. These were identified as northern pike (K. Killins, Grand River Conservation Authority; Cambridge, Ontario, personal communication). This evidence suggests that there has been a decline of grass pickerel in the lower Grand River.

In upper Twenty Mile Creek (western Lake Ontario), where grass pickerel occurred in the 1990s, intensive collecting in 2003 yielded much fewer grass pickerel. The habitat appeared changed as a result of bridge repairs (N. Mandrak, Department of Fisheries and Oceans, Burlington, Ontario; personal communication).

At Point Pelee, the grass pickerel continues to show up in low numbers in surveys since the capture of 21 specimens in 1949. In 1997, 6 individuals were captured in 5 of 15 collections (Royal Ontario Museum (ROM), unpublished data) and, in 2002, 9 individuals were captured in 3 of 117 collections (H. Surette, University of Guelph, Guelph, Ontario; personal communication). Differences in the higher frequency of capture in the 1997 survey may be caused by differing techniques (primarily electrofishing in 1997 vs. primarily trap netting and seining in 2002). But it may also reflect a declining population of grass pickerel in Point Pelee.

In Lake St. Clair, recent surveys by ROM and the Walpole Island First Nation documented many captures of the species in marshes at the northern end of the lake. In 1999, 80 specimens were captured at 23 of 91 sites; in 2001, 43 specimens were captured at 8 of 10 sites; and, in 2002, 5 specimens were captured at 2 of 5 sites. The species was particularly abundant in diked marshes (ROM, unpublished data).

The population in the Old Ausable Channel appears to be stable. In 1997, 4 specimens were captured at 4 sites, and in 2003, 8 specimens were captured at 7 sites.

The status of the Severn River population is uncertain but the species is rare there. In 1987, 20 specimens were caught and live-released by the Ministry of Natural

Resources in the South Kahshe River. In 1988, 2 specimens were captured in Kahshe Lake (G. Arnett, Ministry of Natural Resources, Bracebridge, Ontario; personal communication). In 2001, walleye index-netting surveys in Kahshe Lake captured no grass pickerel (Bob Bergmann, Ministry of Natural Resources, Bracebridge, Ontario; personal communication). It could not be easily determined if the randomly located sample sites were in suitable grass pickerel habitat (i.e. shallow heavily vegetated). There is no evidence of recent surveys in Sparrow Lake (B. Allen, Ministry of Natural Resources, personal communication).

LIMITING FACTORS AND THREATS

Changes resulting from urban development create habitats less suitable than those in creeks, which flowed previously through agricultural settings. Silting of streams by the activity of cattle can be damaging. In areas surrounding presently known populations, clearing emergent and submergent vegetation from streams, ponds connected to streams, or quiet bays of larger bodies of water would reduce suitable habitat and prevent the expansion of the range of the grass pickerel. Failure of year classes has been traced to declining water levels stranding fingerlings and adults in nursery areas (Kleinert and Mraz 1966). Becker (1983) cited winter mortality associated with the low oxygen levels in reduced water depth; although Cooper and Washburn (1949) indicated tolerance for oxygen levels of 0.3-0.4 ppm. The major threat is the destruction and degradation of wetland habitat. Foster (1979) found that increases in turbidity had a negative impact on grass pickerel feeding in Long Point Bay.

Yagi (2004) noted the following: “The Department of Fisheries and Oceans have classified drains that do not flow year round as type F habitat. This means that drain maintenance can occur when the drain is not flowing. Pool habitat where this species is residing over the summer is greatly affected by this practice”. Presumably the water level in the pool, and therefore the available habitat for grass pickerel, would be reduced when this drain maintenance occurs. In Ohio, Trautman (1981) indicated that the grass pickerel decreased in number or became extirpated wherever ditching, dredging, or other forms of channelization destroyed its habitat.

The redfin pickerel is now known from Contrecoeur, Quebec, a distance of approximately 57 km from Lac St-Louis. If it disperses upstream into Lac St-Louis, it may hybridize with or replace the grass pickerel (P. Dumont pers. comm.), if it still occurs there.

SPECIAL SIGNIFICANCE OF THE SPECIES

The grass pickerel is often the top predator playing an important role in its habitat. In Canada, it is rarely, if ever, thought of as a food or game species, or baitfish. Becker (1983) indicated that the larval and swim-up stages of the highly prized muskellunge are highly vulnerable to grass pickerel predation where the two occur together. In contrast

he stated that, according to Richardson (1913), grass pickerel fry 51-64 mm TL fed on carp fry (*Cyprinus carpio*) in Illinois. In many parts of its range in the USA, it is considered a "nuisance species" or "a youngster's fish".

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Although there are no specific statutes or regulations to protect this fish, they are protected indirectly by a number of statutes. The Ontario Fishery Regulations do not include members of the family Esocidae in the list of species that can be captured for bait, or used as bait. The following Acts applied by various ministries of the Government of Ontario provide indirect protection: Lakes and Rivers Improvements Act, Environmental Assessment Planning Act, Ontario Water Resources Act, Canadian Environmental Assessment Act, Federal Fisheries Act, Navigable Waters Protection Act, Conservation Authorities Act, Public Lands Act, Fish and Wildlife Conservation Act.

Because it is a species of wetland streams, the grass pickerel is listed as “Locally Significant" in the Ontario wetland evaluation system. A wetland receives some point value (and presumably greater protection) if the grass pickerel is present in a wetland (A. Yagi, Ontario Ministry of Natural Resources, Niagara Area, Guelph District, Vineland, Ontario; personal communication).

Quebec fishing regulations exclude the grass pickerel from the list of species that can be captured and used as bait. Grass pickerel is included in the pikes and pickerels group, protected by a closed fishing season of five weeks (between March 31 and the beginning of May) and a total limit of capture and possession of 6. Commercial fishing of this species is not allowed. As this is a very rare species, of small size, it is not of interest for sport and commercial fishing.

Also, in the distribution area, where most of the captures had been reported, on the south shore of Lac Saint-Louis, more than 500 ha of marshes has been protected in the watershed of Ruisseau Saint-Jean, on Saint-Bernard Island and in the Léry and Maple Grove sectors. These habitat protection and improvement projects are the results of a cooperation between Héritage Saint-Bernard and Faune Québec (the MRNF).

TECHNICAL SUMMARY

Esox americanus vermiculatus
Grass Pickerel — Brochet Vermiculé
Ontario, Quebec

Extent and Area information	
• *extent of occurrence* (*EO*) (from Figure 3, includes land area)	100,000 km^2
• *trend in EO*	Stable
• *are there extreme fluctuations in EO (>1 order of magnitude)?*	No
• *area of occupancy (AO)* (based on stream lengths in km) 1. Severn River - Sparrow to Bass Lake - ca 26 km^2 2. Old Ausable Channel - 0.5 km^2 3. Lake St. Clair (incl. Walpole Island, Little Bear Creek, Sydenham River) - ca 260 km^2 4. Point Pelee ca 4 km^2 5. Long Point ca 140 km^2 6. Lower Grand River ca 1.9 km^2 7. upper Niagara River tributaries, Welland River drainage, and Point Abino - ca 1.3 km^2 8. Twenty Mile Creek ca 1 km^2 9. Eastern Lake Ontario & upper St. Lawrence River (incl. Jones Creek, upper Gananoque) - ca 100 km^2 10. Lake St. Francis to Lac St-Louis. - ca 150 km^2	Total AO – ca 685 km^2
• *trend in AO* (3 locations in the upper Niagara Ontario now have no suitable habitat and no pickerel, and there is a general decline in the AO in Quebec where 1 location may be lost = 22% of AO)	Decline
• *are there extreme fluctuations in AO (>1 order magnitude)?*	No
• *number of extant locations* (10 locations which may represent more than 10 populations)	10
• *trend in # locations*	Decline
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend*	Some decline
Population information	
• *generation time (average age of parents in the population)*	3-4 years
• *number of mature individuals (capable of reproduction) in the Canadian population)*	Unknown
• *total population trend:*	Decline in some areas
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater*	Unknown
• *are there extreme fluctuations in number of mature individuals (>1 order of magnitude)?*	Unknown

• *is the total population severely fragmented?*	Yes. The populations in 9/10 areas are significantly isolated from one another
• *list each population and the number of mature individuals in each* Listed by location, there may be more than one population at locations 1, 3, 7, 9 and 10. There may be 3 populations at location 10 – Lac St-François, Coteau and Lac St-Louis. The number of mature individuals at any one location is not known, but would certainly not be large, perhaps in the 10s for the single population locations and in the 100s or low thousands for eastern Lake Ontario and the upper St. Lawrence.	1. Severn River 2. Old Ausable Channel 3. Lake St. Clair (incl. Walpole Island, Little Bear Creek) 4. Point Pelee 5. Long Point 6. Lower Grand River 7. Upper Niagara River (including Welland River drainage) 8. Twenty Mile Creek 9. Eastern Lake Ontario & upper St. Lawrence River (incl. Jones Creek, upper Gananoque) 10. Lake St. Francis to Lac St-Louis
• *specify trend in number of populations (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	No
Threats (actual or imminent threats to populations or habitats)	
- urbanization and agriculture practices through effects on reduction in flow and channelization and pollution through herbicides - siltation - removal of vegetation - low water levels caused by water extraction, and drought - diversion of cold or cool water into pickerel habitat - destruction and degradation of wetland habitat	
Rescue Effect (immigration from an outside source)	
• *does species exist elsewhere (in Canada or outside)?*	Yes (outside)
• *status of the outside population(s)?* Only neighbouring populations – see below for status of other US locations	New York (S4) Pennsylvania (S4) Ohio (S?) Michigan (S5)
• *is immigration known or possible?*	Yes
• *would immigrants be adapted to survive here?*	Yes
• *is there sufficient habitat for immigrants here?*	Yes
Quantitative Analysis	Not Applicable

Existing Status

Nature Conservancy Ranks (NatureServe 2003)

Global – G3

National

US – N5

Canada – N4

Regional

US: Al – S5, AK – S? AR – S4, CO – SE, CT – S4, DE – S5, FL – S?, GA – S4S5, IL – S5, IN – S4, IA – S3, KY – S4S5, LA – S5, ME – S?, MD – S5, MA – S5, MI – S5, MS – S5, MO – S?, NE – S4, NH – S4, NJ – S5, NY – S4, NC – S5, OH – S?, OK – S5, PA – S4, RI – S5, SC – S?, TN – S5, TX – S3, VT – S4, VA – S4, WA – SE, WV – SU, WI – S4

Canada: ON – S3, QC – S4

Wild Species 2000 (Canadian Endangered Species Council 2001)
Canada – NA
ON – 3, QC – 2

COSEWIC – Special Concern (May 2005)

Status and Reasons for Designation

Status: Special Concern	**Alpha-numeric code**: Met criterion for Threatened, B2ab(ii,v), but designated Special Concern because there is a rescue effect and the species is not likely to become Endangered or Extirpated in the near future.
Reasons for Designation: A subspecies known from 10 locations between Lake St. Louis, Quebec and Lake Huron, Ontario. Its usual habitat is shallow water with abundance of aquatic vegetation. An overall decline of approximately 22% in the area of occupancy has been observed. This decline appears to be related to degradation and loss of habitat due to channelization and dredging operations in wetland habitats where this species occurs.	
Applicability of Criteria **Criterion A** (Declining Total Population): Not Applicable – although some decline has occurred in about 22% of the Area of Occupancy at 3 of 10 locations, and there are indications of continuing decline in these areas, threshold values are not met. **Criterion B** (Small Distribution, and Decline or Fluctuation): The area of occupancy (683km^2) is below the minimum threshold for Threatened, and decline has occurred at 3 of 10 locations and is continuing to occur. Therefore qualifies for threatened B2a,b(ii-v). **Criterion C** (Small Total Population Size and Decline): Not Applicable — Total population size is unknown but presumed to be >10,000. Therefore, does not qualify under this criterion. **Criterion D** (Very Small Population or Restricted Distribution): Not Applicable — Number of individuals unknown but presumed to be >10,000. Area of occupancy and number of extant locations are greater than threshold limits. **Criterion E** (Quantitative Analysis): Not Applicable.	

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

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Dr. E. J. Crossman passed away suddenly on 21 December 2003. He was formerly Curator Emeritus (Ichthyology), Centre for Biodiversity and Conservation Biology, Royal Ontario Museum, and Professor Emeritus (Zoology), University of Toronto. His research interests were in biology and distribution of freshwater, principally Canadian, fishes with emphasis on those in the order Esociformes, zoogeography, and introduced fishes.

E. Holm

Mr. Erling Holm is Assistant Curator (Ichthyology), Centre for Biodiversity and Conservation Biology, Royal Ontario Museum, and Collection Manager (Fishes). He has

co-authored 11 status reports, conducted fieldwork in Ontario principally related to species at risk, and coordinates the ROM's annual fish identification workshops.

COLLECTIONS EXAMINED

Specimens were examined from the following institutions: Royal Ontario Museum, Toronto, Ontario and Department of Fisheries and Oceans, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Burlington, ON.