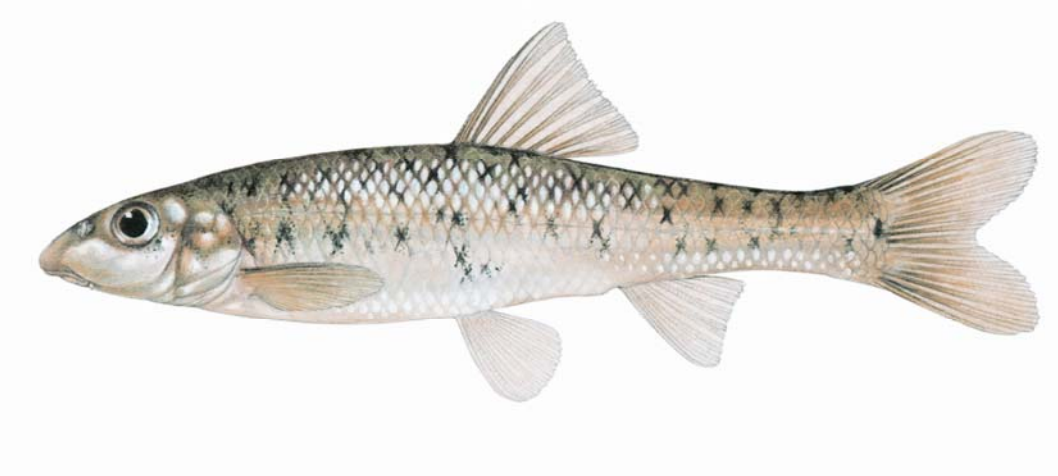
COSEWIC
Assessment and Update Status Report

on the

Gravel Chub
Erimystax x-punctatus

in Canada



EXTIRPATED
2008

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC. 2008. COSEWIC assessment and update status report on the gravel chub *Erimystax x-punctatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 21 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Previous reports:

COSEWIC. 2000. COSEWIC assessment and update status report on the gravel chub *Erimystax x-punctatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 9 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Parker, B., P. McKee and R.R. Campbell. 1987. Update COSEWIC status report on the gravel chub *Erimystax x-punctatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-9 pp.

Parker, B., and P. McKee. 1985. COSEWIC status report on the gravel chub *Erimystax x-punctata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 13 pp.

Production note:
COSEWIC would like to acknowledge Robert R. Campbell and Scott M. Reid for writing the update status report on the gravel chub *Erimystax x-punctatus* in Canada, prepared under contract with Environment Canada, overseen and edited by R. Campbell and C. Renaud COSEWIC Freswater Fishes Specialist Subcommittee Co-chairs.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: 819-953-3215
Fax: 819-994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur le gravelier (*Erimystax x-punctatus*) au Canada – Mise à jour

Cover illustration:
Gravel chub - Illustration by Joe Tomelleri. Used under licence to Fisheries and Oceans Canada.

Catalogue No. CW69-14/549-2008E-PDF
ISBN 978-0-662-48881-1


Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – April 2008

Common name
Gravel chub

Scientific name
Erimystax x-punctatus

Status
Extirpated

Reason for designation
The historic Canadian range of this small minnow was originally a single watershed in southern Ontario. The last record for this species was in 1958 despite extensive, repeated sampling at known sites and other areas of suitable habitat over the last 50 years. Ecosystem restoration of this watershed is underway; however, natural recolonization by the species is not possible because there are no adjacent populations in the Great Lakes watershed.

Occurrence
Ontario

Status history
Last recorded in Thames River drainage, Ontario in 1958. Designated Endangered in April 1985. Status re–examined and designated Extirpated in April 1987. Status re–examined and confirmed in May 2000 and April 2008. Last assessment based on an update status report.

COSEWIC
Executive Summary

Gravel Chub
Erimystax x-punctatus

Species information

The gravel chub is a slender, round-bodied minnow with an average length of 76 mm TL (Total Length) and a maximum length of approximately 100 mm TL. It is the only member of the genus *Erimystax* known to have existed in Canada.

Distribution

The gravel chub is widely distributed in east-central North America. In Canada, the species was only known to occur in southwestern Ontario in the Thames River.

Habitat

In North America, the species was only known to occur in clear to moderately turbid streams with permanent flow. The streams typically have well-defined sand, gravel or rocky riffles, and their currents keep the bottom free of unconsolidated silts and clays. The species tends to avoid areas with macrophytes, larger algae species and aquatic moss species. In Ontario, the species once inhabited sections of the Thames River. These river sections have constant flow and are 1-3 m deep; the bottom is composed of sand, rock and stone with areas of soft organics and silt. The water is turbid here, and there is very little vegetation along the riverbanks.

Biology

Little is known about the gravel chub's general biology. Adult specimens from Canada were 52-57 mm in length and spawning occurs in Kansas sites in early spring. The main food is probably insects attached to the bottom. The gravel chub is also thought to probe under rocks and into crevices with its sensitive snout.

Population sizes and trends

The gravel chub has been reported at only two Canadian sites, but has not been found at these, or other suitable sites in Canada, since 1958.

Limiting factors and threats

The gravel chub has specific habitat needs. It is only found in waters of low turbidity with enough current to keep the bottom silt-free. These conditions limit the species' occurrence. In addition, impoundment of riffle areas is a threat to the gravel chub. It is thought that increased turbidity and siltation may have led to the extirpation of the gravel chub.

Special significance of the species

The Ontario populations were the only representation of the genus *Erimystax* in Canada and the only evidence for the existence of this species in waters of the Great Lakes basin. The greatest importance of this species to man may be as an indicator of habitat degradation due to its sensitivity to siltation.

Existing protection or other status designations

The gravel chub is listed as an Extirpated species under the federal *Species at Risk Act* (SARA). Besides offering legal protection to the species and its habitat, the Act requires the development of recovery strategies.

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 entities (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 science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2008)

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 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 category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' 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. Definition of the (DD) category revised in 2006.

Environment Canada
Canadian Wildlife Service

Environnement Canada
Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

Gravel Chub
Erimystax x-punctatus

in Canada

2008

TABLE OF CONTENTS

List of figures

SPECIES INFORMATION

Name and classification

Kingdom	Animalia
Phylum	Chordata
Class	Actinopterygii
Order	Cypriniformes
Family:	Cyprinidae
Species:	*Erimystax x-punctatus* (Hubbs & Crowe 1956)
Subspecies:	*Erimystax x-punctatus trautmani* (Hubbs & Crowe 1956)

Common name

English:	gravel chub (Nelson *et al.* 2004)
French:	*gravelier* (Coad 1995)
Other:	spotted chub

Morphological description

The gravel chub is a slender, round-bodied minnow (Figure 1) with an average length of 76 mm TL (Total Length) and a maximum length of approximately 100 mm TL (*see* Scott and Crossman (1998) for a detailed description). It is olive-green dorsally with silvery sides and a white belly. The scale margins on the back and sides of the gravel chub are randomly outlined in black resulting in distinct X-, Y- or W-shaped patterns. These markings are sometimes absent in large adults, and were usually faintly evident in Ontario specimens (Scott and Crossman 1998). A small black spot is usually predominant on the base of the caudal fin. The snout is rounded and long, overhanging the mouth, which has small but conspicuous barbels in each corner.

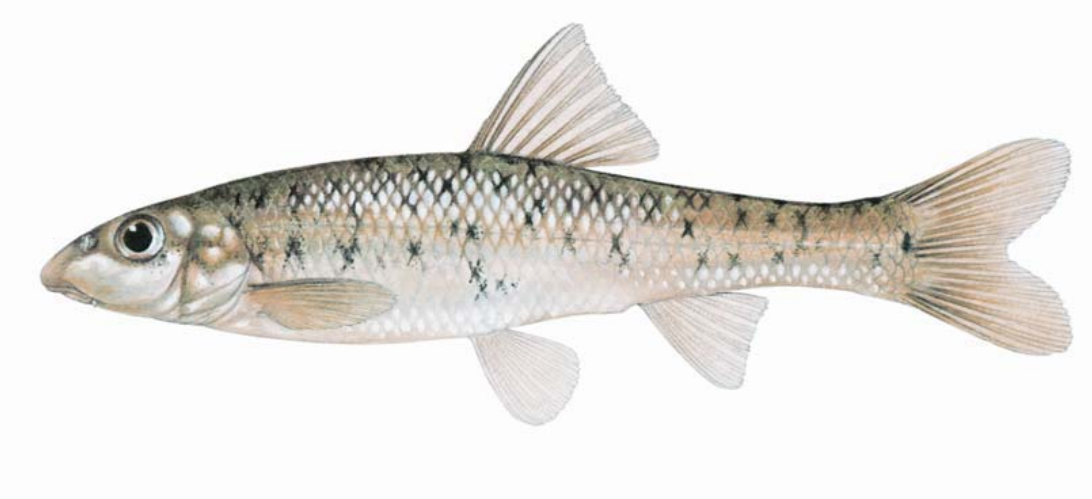


Figure 1. Gravel chub, *Erimystax x-puntatus* (≈ X 2). ©Joseph Tomelleri (permission for use granted under licence to DFO).

Genetic description

Two geographically distinct populations are recognized as subspecies (Gilbert 1980). The nominate subspecies (*E. x. x-punctatus*) occurs west of the Mississippi River, and *E. x-p. trautmani* in the east (Gilbert 1980). Hubbs and Crowe (1956) assigned Canadian populations of gravel chub to the subspecies *E. x. trautmani*, which is morphologically distinct from the subspecies *E. x. x-punctatus*. Genetic validation for the subspecies designation was confirmed by Simons (2004) based on the cytochrome b gene.

Designatable units

All Canadian specimens have been found within the Great Lakes-Upper St. Lawrence Biogeographic Zone of the freshwater Biogeographic Zone classification adopted by COSEWIC. There is no evidence to support the identification of designatable units below the species level.

Eligibility

The gravel chub is a recognized species (Nelson *et al.* 2004) that was formerly considered to be native to Canada, but has been absent from Canadian waters since 1958.

Despite the fact that this species has a disjunct distribution in the United States (U.S.), and is in peril in many areas throughout its range, there is a surprising lack of recent information regarding its habitat and ecology.

Attempts to obtain Aboriginal Traditional Knowledge (ATK) on the species have as yet failed to produce any new information.

DISTRIBUTION

Global range

The gravel chub is found in east-central North America where it has a disjunct distribution (Figure 2), occurring from south-central Arkansas north to southern Minnesota and east to southern Ontario and western New York. The subspecies *E. x. trautmani* is limited to the Ohio River basin in Illinois, Indiana, Ohio, New York, Pennsylvania and Kentucky, and the Thames River, Ontario.

Figure 2. Global distribution of the gravel chub.

Canadian range

In Canada, this species was known only from the Thames River of southwestern Ontario, approximately 300 km from the nearest American records in Ohio (Figures 2 and 3). Last documented extant in 1958, all subsequent attempts to collect individuals of this species have been unsuccessful. The known extent of occurrence would have been less than 200 km^2, and the area of occupancy would have been less than 20 km^2, measured directly by aquatic habitat occupied, or less than 100 km^2 by application of a 1 km^2 grid (*see* COSEWIC 2007).

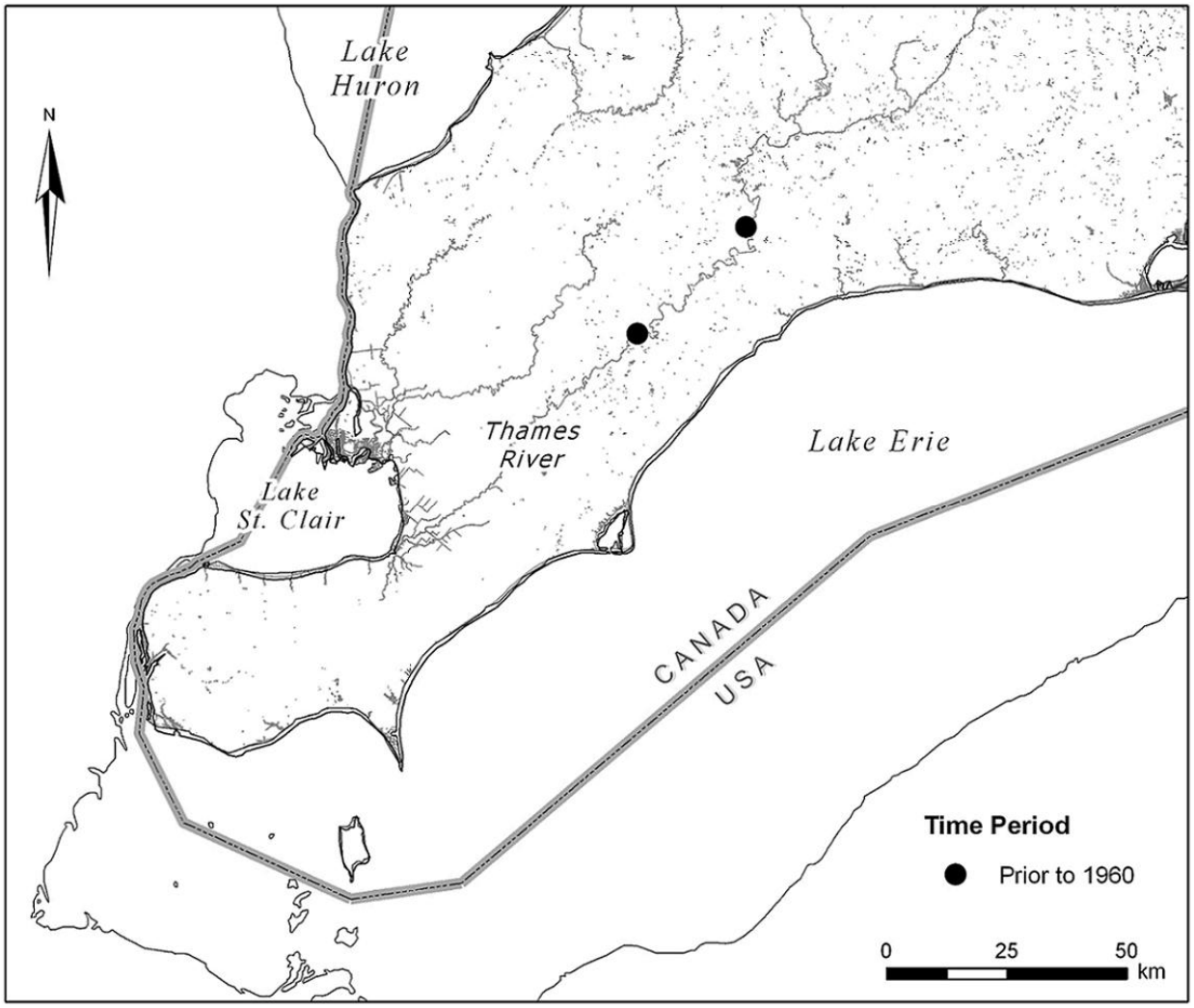


Figure 3. Former Canadian distribution of the gravel chub.

HABITAT

Habitat requirements

The 1923 Thames River gravel chub collection site was located between the mouth of Hogg Creek and a point on the Thames at Muncey (Holm and Crossman 1986). Habitat at this site was described as clear water, fast currents, substrates comprised of clean sand and gravel and depths up to 1.5 m (Parker *et al.* 1987). The river width at the capture location in 1923 is unknown. In the mid-1980s, it was 20-30 m wide and 1-3 m in depth with pool and riffle habitats predominating. Substrate material was composed of sand, rock and stone with areas of soft organics and silt. Water was turbid [Secchi disc reading less than 1 m (Parker and McKee 1980; Holm and Crossman 1986)]. Bank cover was minimal and instream vegetation restricted to encrusting and filamentous algae. Water temperatures ranged from 18 to 25^{o}C in July (Holm and Crossman 1986), 21 to 24^{o}C in August (Parker and McKee 1981), and 12 to

15°C in October (Holm and Crossman 1986). In 1958, nine gravel chub were captured while trawling from Lot 16 in Mosa Township to the eastern limit of the Moravian Indian Reserve (Holm and Crossman 1986). No habitat data is available for this capture location.

Elsewhere in North America, gravel chub have been reported as inhabiting clear to moderately turbid streams with permanent flow and well-defined sand, gravel or rocky riffles where the current keeps the river bottom free of unconsolidated silts and clays (Pflieger 1957; Trautman 1981). In Ohio, gravel chub were found in medium to large streams, at depths of 0.3-1.2 m during the summer, and at 0.6-1.8 m during the winter (Trautman 1981). Trautman (1981) reported that the species avoided areas with macrophytes, larger species of algae and aquatic mosses. Presumably these areas would show silt accumulation. In Wisconsin, gravel chub were collected from turbid waters, devoid of aquatic vegetation, over swift gravel riffles 0.3-0.9 m deep, with a channel width of 9-12 m (Becker 1983). Moore and Paden (1950) described its micro-habitat as small cavities beneath rocks in riffle areas where the current is reduced.

Trends

Aquatic habitats within the Canadian range of the gravel chub have undergone considerable historical transformation. Loss of wetlands and riparian vegetation, shoreline alteration, dredging, stream channelization, discharges of toxic chemicals, increased sediment and nutrient loading have been linked to altered composition and lower productivity of regional fish communities (Dextrase *et al.* 2003; MacLennan *et al.* 2003; Ryan *et al.* 2003). During the last targeted gravel chub survey, riffle habitats were present; however, habitats were affected by high levels of turbidity (Holm and Crossman 1986). In August of 2005, secchi disk readings from the Thames River adjacent to Muncey (0.25 m and 0.38 m) indicate continued high levels of turbidity (Marson *et al.* 2006). Elevated siltation and turbidity in the lower Thames River (Jackson Turbidity Units = 69.5) are primarily the result of agricultural practices in the Thames River watershed (Bailey and Yates 2003). Agriculture represents 78% of land use in the upper watershed and 88% in the lower watershed (Taylor *et al.* 2004).

Nutrients such as nitrogen and phosphorus enter the Thames River through manure and fertilizer spreading, manure spills, sewage treatment effluent and faulty domestic septic systems (Taylor *et al.* 2004). Since the 1970s, phosphorus levels at most sites in the watershed have shown a gradual downward trend but remain above the provincial guidelines (30 ug/L) for the protection of aquatic life. Nitrate and chloride levels in the Thames River have increased over the past 30 years (Taylor *et al.* 2004). High levels of nitrogen and phosphorus can promote algal blooms. Extensive algal coverage would reduce the suitability of affected habitats for gravel chub, and decomposition associated with algal die-offs would reduce dissolved oxygen levels and increase the risk of fish kills (Miltner and Rankin 1998).

In response to these historical and ongoing stresses, species-at-risk recovery strategies are currently being developed and implemented for the Thames River. Actions to protect and improve habitat in the area where gravel chub was formerly known to occur are identified in the Recovery Strategy for Gravel Chub (*Erimystax x-punctatus)* in Canada (Edwards *et al.* 2007), and the Thames River Aquatic Ecosystem Recovery Strategy (TRRT 2005). The Thames River Aquatic Ecosystem Recovery Strategy addresses the recovery needs of the 24 aquatic or semi-aquatic COSEWIC-listed species (7 mussels, 6 reptiles, 11 fishes, including the gravel chub) that either historically inhabited or currently inhabit the Thames River. Habitat improvement goals identified for the Thames River of benefit to gravel chub include reductions in sediment, nutrient and toxic chemical loadings.

Protection/ownership

The *Canadian Environmental Assessment Act*, *Canadian Environmental Protection Act*, *Federal Fisheries Act*, *Canada Water Act*, *Ontario Environmental Protection Act*, *Ontario Environmental Assessment Act*, *Ontario Planning Act* and *Ontario Water Resources Act*, and *Species at Risk Act* may offer some protection through protection of wetlands and habitats of other species.

Most of the land along the lower Thames River is privately owned. Lands adjacent to past gravel chub collection sites include the following First Nation territories: Muncey I.R. 1, Munsee-Delaware First Nation; Oneida I.R. 41, Onyota'a:ka First Nation; and Caradoc I.R. 42, Chippewa of the Thames First Nation.

BIOLOGY

General

Nothing is known of the biology of gravel chub in Canada and little has been reported on this species for American populations (Tautman 1981; Becker 1983). Specimens from the Thames River were 52-57 mm long and, based on data for specimens from Ohio (Trautman 1981), it is probable that the Ontario specimens were adults.

Reproduction

In the United States, gravel chub have been reported to spawn during the spring in areas of rapid current over gravel riffles (Becker 1983; Parker *et al.* 1987). In Kansas, spawning took place in April at a water temperature of 15.5°C (Becker 1983). Non-adhesive eggs are scattered over the gravel substrate where they remain until hatching. No parental care is given (Coker *et al.* 2001).

Survival

There is no information on longevity of the species, but it may live up to 4 years as do other species of the genus and probably matures at 1-2 years of age (see Jenkins and Burkhead 1983).

Diet

The gravel chub is a bottom feeder, thought to eat aquatic insects. Food probably consists of epibenthic insects (Parker and McKee 1980). Davis and Miller (1967) found that taste buds on the barbels were extremely large suggesting that this species feeds by probing under rocks and into crevices with its sensitive snout.

Dispersal/migrations

Unknown. Given the narrow habitat requirements and restricted distribution, populations were probably confined to areas where there was sufficient current to keep the bottom free of silt (*see* Becker 1983). Scott and Crossman (1998) suggested that if gravel areas in preferred habitat become silted over, the gravel chub moves into faster, shallower areas.

Interspecific interactions

The ecological role of the species in the Thames River is not known (Edwards *et al.* 2007). Fish assemblages in the Thames River (Edwards and Mandrak 2006) include such piscivorous predators (McAllister *et al.* 1985) as rock bass (*Ambloplites rupestris*) and smallmouth bass (*Micorpterus dolomieu*), northern pike (*Esox lucius*) and yellow perch (*Perca flavescens*).

Behaviour

Unknown.

Adaptability

The species is susceptible to turbidity and siltation, and apparently does not readily adapt to perturbations in habitat quality (Becker 1983; Trautman 1981). Increases in the range and abundance of gravel chub have been reported since recent improvements to the water quality and habitat of Illinois and Ohio rivers (Retzer 2005, Yoder *et al.* 2005).

Captive propagation of closely related *Erimystax* species has been successfully undertaken (Conservation Fisheries Inc. 2001). An attempt to expand the range of the gravel chub (the western subspecies, *E. x-punctatus punctatus*) along the Rock River, Wisconsin was, however, unsuccessful. Survival during transfer was high, but no gravel chub were recaptured during 2-3 years of follow-up monitoring. Lack of success was attributed to the low number of individuals transferred, a lack of information on population limiting factors, and a lack of quantitative habitat data before the project began (John Lyons, Wisconsin Department of Natural Resources, personal communication 2007).

POPULATION SIZES AND TRENDS

The gravel chub has been reported at only two localities in Canada, both of which were in the Thames River system. The earliest collection was of six specimens from the Thames River, approximately 70 km northeast (downstream) of the Moravian Indian Reserve, in 1923 (Holm and Crossman 1986). Royal Ontario Museum (ROM) collections at or near the same site in 1941 failed to record any specimens of this species. Nine individuals of the species were collected in 1958 from a site southwest of the Moravian Indian Reserve at Muncey (Holm and Crossman 1986). Six of these were catalogued as ROM 20018.

Subsequent attempts to collect this species in the early 1970s by the National Museum of Natural Sciences [now Canadian Museum of Nature (CMN)], ROM and the Ontario Ministry of Natural Resources (OMNR) were unsuccessful as were the efforts of B. Parker and P. McKee in 1971-1980 (Parker and McKee, 1980). The scarcity of collected material indicates that populations were localized. Parker and McKee (1980 1981) suggested that the failure of these attempts specifically directed to locating specimens at previously known sites left the continued existence of Canadian populations in doubt (Scott and Crossman 1998). McAllister and Gruchy (1977) considered the gravel chub to be endangered in Canada and this listing was confirmed by COSEWIC in 1985.

Consequently, staff from ROM undertook two field trips in 1985 (22-26 July and 20-23 October) specifically to sample at or near the two previously known sites. Other suitable habitats were seined and/or electrofished along a 17-km reach, above and below the previous Thames River collection sites (Holm and Crossman 1986). No gravel chub were captured. COSEWIC re-assessed the status of the species in April of 1987 and at that time listed the species as Extirpated from Canada. Sporadic collection efforts between 1985 and 2000 also failed to produce any records of the continued existence of the species in Canada, and the extirpated status was re-examined and re-confirmed by COSEWIC in May 2000.

Substantial sampling effort (mostly seining and electrofishing) was conducted between 2003 and 2006 along the lower Thames River, near former gravel chub collection sites. Using a variety of passive and active gears, Edwards and Mandrak (2006) report that a total of 71 species (including 7 species at risk) were captured in 2003 (51 sites) and 2004 (41 mainstem and 28 tributary sites) from a variety of wadeable and non-wadeable habitats between London and the mouth of the Thames River. No gravel chub were captured. Trawls were only attempted downstream of Chatham, near the confluence of Baptiste Creek. Seine hauls from 13 sites along the Thames River, adjacent to Muncey, yielded 28 species (including two species at risk), but no gravel chub (Marson *et al.* 2006). In 2006, 128 sites were seined between London and Chatham. More than 50 species were captured, but no gravel chub. Sites were characterized by a range of dominant substrate types (silt to cobble), and included both erosional and depositional habitats. Additional seine hauls in faster flowing, gravel runs and riffles also failed to capture gravel chub (A. Dextrase, OMNR, Peterborough, Ontario; personal communication 2007).

There is little likelihood of immigration from populations in the U.S., as the former Canadian sites were approximately 300 km from the nearest American populations of the Ohio River basin (Mississippi River drainage).

LIMITING FACTORS AND THREATS

The gravel chub is considered pollution-intolerant, has narrow habitat requirements, and populations are confined to areas where there is sufficient current to keep the bottom free of silt (see Becker 1983). The species is susceptible to elevated turbidity and increased siltation (Becker 1983). Siltation, or sedimentation, is the filling-in of lakes and stream channels with soil particles, usually as a result of erosion on adjacent land. Turbidity, on the other hand, is a principal physical characteristic of water and is an expression of the optical property that causes light to be scattered and absorbed by particles and molecules rather than transmitted in straight lines through a water sample. It is caused by suspended matter or impurities that interfere with the clarity of the water such as finely divided inorganic and organic matter, soluble coloured organic compounds, and plankton and other microscopic organisms. Typical sources of turbidity include: waste discharges; surface runoff, especially from areas that are disturbed or eroding; algae or aquatic weeds and products of their breakdown, humic acids and other organic compounds resulting from decay of plant material; and high iron, or other mineral concentrations which may give rise to discolouration. Siltation is the key limiting factor for the gravel chub, which requires silt-free substrates. Turbidity may also be limiting depending on the source and current flow. In areas of low current, sedimentation of suspended matter from turbid waters may occur.

Increased siltation was associated with its extirpation from many parts of Ohio (Trautman 1981) and Wisconsin (Becker 1983). In Iowa and Wisconsin, pesticides, sewage and other point-source discharges have also been identified as potential causes for extirpations (Schmidt 2000).

Similar habitat changes in the Thames River drainage may have caused extirpation of the gravel chub in Canada. In 1923, Brown described the Thames River as clear, with a fast current at capture sites and with sand and gravel substrates at capture depths of up to 5 feet (Holm and Crossman 1986). The report of the ROM 1985 collection efforts suggests a shift in environmental conditions adverse to the species as silt and clay was evident at all sites and the water was quite turbid (Holm and Crossman 1986). Turbid conditions were also measured in 2005 during Fisheries and Oceans Canada sampling of the Thames River, adjacent to Muncey (Marson *et al.* 2006). Holm and Crossman (1986) also found an increase in the abundance of species such as the spotfin shiner (*Notropis spilopterus*), known for their tolerance to turbidity and siltation (Trautman 1981). In addition, less tolerant species such as the mimic shiner (*N. volucellus*) and the eastern sand darter (*Ammocrypta pellucida*) were absent or in reduced abundance from previous collections (Holm and Crossman 1986). However Dextrase (pers. comm. 2008), found eastern sand darter relatively abundant throughout these reaches of the Thames in 2006 surveys.

The impoundment of riffles is considered a serious threat to gravel chub populations in the United States (Becker 1983, NatureServe 2007). Dams alter upstream and downstream habitat conditions and act as barriers, fragmenting populations and limiting re-colonization (NatureSeerve 2007; Edwards *et al.* 2007). Most dams in the Thames River watershed are either in the upper watershed or tributaries to the lower and middle Thames River. The most downstream barrier along the mainstem of the Thames River is the Springbank Dam (situated more than 40 km upstream of Muncey in the city of London). When stop-gates are in place from mid-May to early November, it is a barrier to fish passage and creates a small upstream run-of-the-river type impoundment (55 hectares). With the exception of filling the reservoir in mid-May and draining the reservoir in November, the dam has little effect on downstream flows (Reid and Mandrak 2006). Therefore, historic gravel chub habitats in Canada are not expected to be affected by dams.

Silt loads arising from agricultural and urban activities may be the most significant threats to species such as the gravel chub, with narrow habitat requirements for silt-free waters of low turbidity. The Thames River watershed drains an area with one of the highest levels of agricultural land use in the province, and perhaps in all of Canada. Seventy-eight percent of land use in the upper watershed is under agricultural production and 88% in the lower watershed (Taylor *et al.* 2004). Much of the land is systematically tile drained; storm water run-off and tile drainage lead directly to large-scale soil deposits in the river via municipal drains and tributaries. Additionally, livestock grazing and tillage to the stream edge have destroyed riparian vegetation and contributed to bank erosion and sediment loading (Bailey and Yates 2003). The most heavily impacted areas are upstream of former gravel chub collection sites.

Nutrient loading from manure and fertilizers, manure spills; sewage treatment effluents and domestic sewage systems are also a cause for concern (UTRCA 1998; Taylor *et al.* 2004). There are at least 15 sewage treatment plants with varying treatment levels discharging wastewater into the Thames River and bacteria levels are often above acceptable provincial standards (100 *E. coli*/100 ml). Since 1998 periodic algal blooms (leading to reduced dissolved oxygen levels) resulting from nutrient loading and chemical spills (usually oil and fuel), have resulted in episodic fish kills (UTRCA 1998).

SPECIAL SIGNIFICANCE OF THE SPECIES

The Ontario populations were the only representation of the genus *Erimystax* in Canada and the only evidence for the existence of this species in waters of the Great Lakes basin. Scott and Crossman (1998) suggest that the greatest importance of this species to man may be as an indicator of habitat degradation due to its sensitivity to siltation. Smith (1985) indicated that the species was a good indicator of water quality.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

As early as the 1970s the gravel chub was considered to be endangered in Kansas (Platt 1974) and Wisconsin (Anonymous 1979). Gilbert (1980) reported it as now extirpated from many localities where it was formerly found in the U.S. The species has been variously listed as under legal protection in Indiana and Wisconsin, and of special concern in Kansas, Kentucky, Minnesota and New York (Becker 1983, Johnson 1985).

The current global, national (United States and Canada), subnational (state) and provincial status for gravel chub are presented in the Technical Summary.

The gravel chub was last re-examined and designated as Extirpated by COSEWIC in May 2000. In Ontario, the provincial rank is Extirpated (OMNR 2007), while the provincial S Rank from NatureServe is SX (Extirpated) [NatureServe 2007]. The general status ranking for the gravel chub is 1 - (Extirpated) for Canada and Ontario (CESCC 2006).

Gravel chub is considered Apparently Secure globally (G4) and nationally in the United States (N4) [NatureServe 2007]. Its subnational status ranges from SX (Extirpated) in Kentucky to S3? (Apparently Vulnerable) in Arkansas. Only Missouri has not assigned a status (NatureServe 2007).

The gravel chub is listed as an Extirpated species under the federal *Species at Risk Act* (SARA) [EC 2007]. Besides offering legal protection to the species the Act requires development of recovery strategies. Recovery initiatives have been outlined in the Thames River Aquatic Ecosystem Recovery Strategy (TRRT 2005) and the Recovery Strategy for Gravel Chub (*Erimystax x-punctatus*) in Canada (Edwards *et al.* 2007). Recovery teams are in place, but action plans have yet to be developed.

TECHNICAL SUMMARY

Erimystax x-punctatus
Gravel Chub Gravelier
Range of occurrence in Canada: Ontario - Thames River

Extent and Area information

• *extent of occurrence (EO)(km²)* (Historic - Polygon Method) - Current	<200 0
• *specify trend (decline, stable, increasing, unknown)*	Not Applicable
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	No
• *area of occupancy (AO) (km²)* Historic - actual aquatic habitat - using 1 km^2 grid - Current	 <20 <100 0
• *specify trend (decline, stable, increasing, unknown)*	Extirpated
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	No
• *number of extant locations*	0
• *specify trend in # locations (decline, stable, increasing, unknown)*	Not Applicable
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Decline

Population information

• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	2–3 yr?
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	0
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Not Applicable
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	No
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	No
• *list each population and the number of mature individuals in each*	0
• *specify trend in number of populations (decline, stable, increasing, unknown)*	Not Applicable
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	No

Threats (actual or imminent threats to populations or habitats)

1. high levels of turbidity and siltation resulting from urban and agricultural land use practices
2. nutrient loading resulting from agricultural and urban land use practices

Rescue Effect (immigration from an outside source)	No
• *does species exist elsewhere (in Canada or outside)?*	Yes – in the U.S., but not in the Great Lakes watershed that could colonize the Thames River
• *status of the outside population(s)?* States adjacent to lakes Erie and St. Clair.	NY – S1; OH – S3; PA – S1
• *is immigration known or possible?*	Unknown
• *would immigrants be adapted to survive here?*	Unknown
• *is there sufficient habitat for immigrants here?*	No

Quantitative Analysis

Existing Status

Nature Conservancy Ranks (NatureServe 2007)

Global – G4

National

US – N4

Canada NX

Regional

US – AR (S3?), IL (SS1S2), IN (S4), IO (S3), KS (S2S3), KY (SX), MN (S3), MO (SNR), NY (S1), OH (S3), OK (S2S3), PA (S1), WV (S1), WI (S1)

Wild Species 2005 (Canadian Endangered Species Council 2006)

Canada – 1

Ontario – 1

Ontario

Extírpated (OMNR 2007)

COSEWIC

Endangered 1985

Extirpated 1987, 2000, 2008

Status and Reasons for Designation

Status: Extirpated	**Alpha-numeric code:** Not Applicable
Reasons for Designation: The historic Canadian range of this small minnow was originally a single watershed in southern Ontario. The last record for this species was in 1958 despite extensive, repeated sampling at known sites and other areas of suitable habitat over the last 50 years. Ecosystem restoration of this watershed is underway; however, natural recolonization by the species is not possible because there are no adjacent populations in the Great Lakes watershed.	

Applicability of Criteria

Criterion A (Declining Total Population): Not Applicable – no individuals seen since 1958
Criterion B (Small Distribution, and Decline or Fluctuation: Not applicable – no individuals seen since 1958
Criterion C (Small Total Population Size and Decline): Not applicable – no individuals seen since 1958
Criterion D (Very Small Population or Restricted Distribution): Not Applicable – no individuals seen since 1958
Criterion E (Quantitative Analysis): Not Applicable – no data.

ACKNOWLEDGEMENTS

Nick Mandrak, Al Dextrase, and Becky Cudmore provided background information on recent collection efforts and editorial support.

INFORMATION SOURCES

Anonymous. 1979. Wisconsin ups its protection of native animals and plants. Endangered Species Technical Bull. 4(1): 7-12.

Bailey, R. and A. Yates. 2003. Fanshawe Lake ecosystem assessment and recovery strategy, background report. January, 2003. Western Environmental Science and Engineering Research Institute, Department of Biology, University of Western Ontario. 19 pp.

Becker, G.C. 1983. Fishes of Wisconsin. University of Wisconsin Press; Madison, Wisconsin xii + 1052 p.

Canadian Endangered Species Conservation Council (CESCC). 2006. Wild species 2005: the general status of species in Canada. Minister of Public Works and Government Services Canada, Ottawa Ontario. 48 pp.

Coad, B.W. 1995. Encyclopedia of Canadian fishes. Canadian Museum of Nature and Canadian Sportfishing Productions Incorporated.

Coker, G.A., C.B. Portt, and C.K. Minns. 2001. Morphological and ecological characteristics of Canadian freshwater fishes. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2554. pp 33-41.

Conservation Fisheries, Inc. 2001. Captive propagation of chubs of the genus *Erimystax*. American Currents 27 (4):15-16.

COSEWIC. 2007. Committee on the Status of Endangered Wildlife in Canada (COSWIC) Operations and Procedures Manual April 2006, Canadian Wildlife Service, Ottawa, Ontario.

Cross, F.B. 1967. Handbook of fishes of Kansas. University of Kansas Museum of Natural History, Miscellaneous Publication 45: 1-357.

Davis, B.J., and R.J. Miller. 1967. Brain patterns in minnows of the genus *Hybopsis* in relation to feeding habits and habitat. Copeia, 1967 (1): 1-39.

Dextrase, A.J, S.K. Staton, J. L. Metcalfe-Smith. 2003. National Recovery Strategy for Species at Risk in the Sydenham River: An Ecosystem Approach. National Recovery Plan No. 25. Recovery of Nationally Endangered Wildlife (RENEW). Ottawa, Ontario. 73 pp.

EC (Environment Canada). 2007. Species at Risk, Gravel Chub. Environment Canada, Species at Risk Web Site: www.speciesatrisk.gc.ca (Accessed September: 2007).

Edwards, A., and N.E. Mandrak. 2006. Fish assemblage surveys of the lower Thames River, Ontario, using multiple gear types: 2003-2004. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2772. 102 pp.

Edwards, A.L., S.M. Reid, and B. Cudmore. 2007. Recovery strategy for the gravel chub (*Erimystax x-punctatus*) in Canada [Proposed}. Species at Risk Act Recovery Series, Fisheries and Oceans Canada, Ottawa. Viii+19pp.

Gilbert, C.R. 1980. Gravel chub, *Hybopsis x-punctata*, In: Atlas of North American Freshwater Fishes (D.S. Lee *et al.* Eds.). North Carolina Biological Survey Publication No. 1980-12: 196.

Holm, E. and E.J. Crossman. 1986. Report on the search for an Ontario population of *H. x-punctata* and on a search for the species. ROM Rep. to OMNR, Toronto, March 1986.

Hubbs, C.L. and W.R. Crowe. 1956. Preliminary analysis of the American cyprinid fishes, seven new, referred to the genus *Hybopsis*, subgenus *Erimystax*, Occas. Pap. Mus. Zool. Univ. Mich. No. 578.

Jenkins, R.E., and N.M. Burkhead. 1983. Freshwater fishes of Virginia. American Fisheries Society, Bethseda, Maryland.

Johnson. J.E. 1985. Protected fishes of the United States and Canada. Unpubl. MS, 26 p.

MacLennan, D., and R.C. Hass, J. Braunscheidel, J. Francis, L. Halyk, D. Hector, B. Locke, R. McGregor, M. Morencie, A. Murray, E. Roseman, M.V. Thomas, G. Towns. 2003. Fish-community goals and objectives for Lake St. Clair, St. Clair River and Detroit River (St. Clair System). Great Lakes Fish Community Special Publication.

Marson, D, N.E. Mandrak and J. Barnucz. 2006. Sampling the fish communities on First Nations lands on the Thames River, 2005 [draft]. Canadian Technical Report of Fisheries and Aquatic Sciences. 17 pp.

McAllister, D.E. and C.G. Gruchy. 1977. Status and habitat of Canadian fishes in 1976. In: Canada's threatened species and habitats (T. Mosquin and C. Suchal Eds.). Canada Nature Federation Special Publication No. 6: 151-157.

Miltner, R.J., and E.T. Rankin. 1998. Primary nutrients and the biotic integrity of rivers and streams. Freshwater Biology 40:145-158.

Moore, G.A. and J.M. Paden. 1950. The fishes of the Illinois River in Oklahoma and Arkansas. American Midland Naturalist 44 (1): 83 pp.

NatureServe. 2007. NatureServe explorer: an online encyclopedia of life. Version 6.2. NatureServe, Arlington Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 2007).

Nelson, J.S., E.J. Crossman, H. Espinosa-Perez, L.T. Findley, C.R. Gilbert, R.N. Lea and J.D. Williams. 2004. Common and Scientific Names of Fishes from the United States, Canada, and Mexico. 6th Edition. American Fisheries Society Special Publication 29. Bethesda, Maryland. 386 pp.

Ontario Ministry of Natural Resources (OMNR). 2007. Natural Heritage Information Centre – species tracking database. Natural Heritage Information Centre, Peterborough, Ontario. Available http://www.mnr.gov.on.ca/MNR/nhic. (Accessed: September 2007).

Parker, B. and P. McKee. 1980. Rare, threatened and endangered fishes in southern Ontario: status reports. A report for the Department of Supply and Services, Department of Fisheries and Oceans, and National Museum of Natural Sciences. Beak Consultants Ltd., Mississauga, Ontario.

Parker, B. and P. McKee. 1981. Status of the gravel chub *Hybopsis x-punctata*, in Canada. Unpublished COSEWIC Status Rep. Canadian Wildlife Service, Ottawa, Ontario.

Parker, B.J., P. McKee, and R.R. Campbell. 1987. Status of the Gravel Chub, *Hybopsis x-punctata*, in Canada. Canadian Field-Naturalist 102(1); 158-162.
Pflieger, W.L. 1975. The fishes of Missouri. Missouri Department of Conservation. 343 pp.
Platt, D.R. 1974. Rare, endangered and extirpated species in Kansas. Transactions of the Kansas Academy of Science 76: 97-106.
Reid, S.M., and N.E. Mandrak. 2006. Evalution of the potential impact of Springbank dam restoration on black redhorse (*Moxostoma duquesnei*) and other sucker species in the Thames River, Ontario. Canadian Technical Report of Fisheries and Aquatic Sciences 2670: vii + 33 pp.
Retzer, M.E. 2005. Changes in the diversity of native fishes in seven basins in Illinois, USA. American Midland Naturalist 153:121-134.
Ryan, P.A., R. Knight, R. McGregor, G. Towns, R. Hoopes, and W. Culligan. 2003. Fish-community goals and objectives for Lake Erie. Great Lakes Fish Community Special Publication 03-02. 56pp.
Schmidt, K. 2000. Stream survey results for the gravel chub (*Erimystax x-punctatus*), slender madtom (*Noturus exilis*), and bluntnose darter (*Etheostoma chlorosomum*) in southeastern Minnesota. Report prepared by the Native Fish Conservatory.
Scott, W.B., and E.J. Crossman. 1998. Freshwater fishes of Canada. Revised Edition. Galt House Publishing, Oakville, Ontario. 966 pp.
Simons, A.M. 2004. Phylogenetic relationships in the genus *Erimystax* (Actinopterygii: Cyprinidae) based on the cytochrome b gene. Copeia 2004(2): 351-356.
Smith, C.L. 1985. The inland fishes of New York State. New York Department of Environment and Conservation, Albany, New York. 572 pp.
Taylor, I., B. Cudmore, C.A. MacKinnon, S.E. Madzia, and S.L. Hohn. 2004. Synthesis report for the Thames River recovery plan. Upper Thames River Conservation Authority. London, Ontario. 47 pp.
TRRT (Thames River Recovery Team). 2005. The Thames River Aquatic Ecosystem Recovery Strategy [draft]: 2004-2009.
Trautman, M.B. 1981. The fishes of Ohio with illustrated keys. Ohio State Univ. Press, Columbus, Ohio.
UTRCA (Upper Thames River conservation authority). 1998. Manure – farming and healthy fish habitat. Issue 1. Avialable (accessed February 2008): http://www.thamesriver.on.ca/Downloads/downloads_publications.htm
Yoder, C.O., E.T. Rankin, M.A. Smith, B.C. Alsdorf, D.J. Altfater, C.E. Boucher,
R.J. Miltner, D.E. Mishne, R.E. Sanders, and R.F. Thoma. 2005. Changes in fish assemblage status in Ohio's nonwadeable rivers and streams over two decades. Pages 399-430. in J.N. Rinne, R.M. Hughes, and B. Calamusso, editors. Historical changes in large river fish assemblages of the Americas. American Fisheries Society Symposium 45, Bethesda, Maryland.

BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Robert Campbell is a Co-chair of the Freshwater Fishes Species Specialist Subcommittee.

Scott Reid is a member of the Freshwater Fishes Species Specialist Subcommittee. He has co-authored COSEWIC status update reports on black redhorse (*Moxostoma duquesnei*), river redhorse (*M. carinatum*) and spotted sucker (*Minytrema melanops*).

AUTHORITIES CONSULTED AND PERSONAL COMMUNICATIONS

Nicholas E. Mandrak. 2007. Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Ontario L7R 4A6.

Becky Cudmore. 2007. Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Ontario L7R 4A6.

Alan J. Dextrase. 2007, 2008. Ontario Ministry of Natural Resources, Box 7000, Peterborough, Ontario K9J 8M5.

John Lyons, Wisconsin Department of Natural Resources, Monona, Wisconsin 53716-3736.

COLLECTIONS EXAMINED

None.