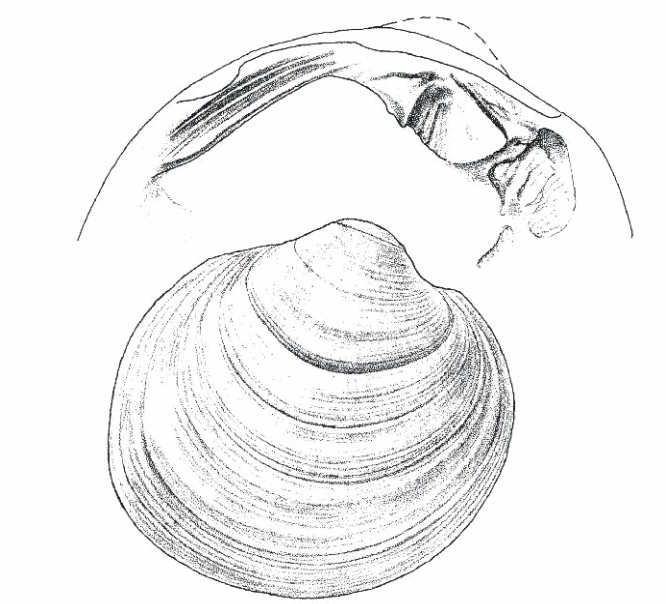
COSEWIC
Assessment and Status Report

on the

Round Hickorynut
Obovaria subrotunda

in Canada



ENDANGERED
2003

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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COSEWIC
Assessment Summary

Assessment Summary – May 2003

Common name
Round hickorynut

Scientific name
Obovaria subrotunda

Status
Endangered

Reason for designation
This species has been lost from about 90% of its former range in Canada. Populations in the Grand and Thames rivers are extirpated and populations in the Sydenham River are declining, all due to the combined effects of pollution and agricultural impacts. Most of the Great Lakes populations have been lost due to impacts of the zebra mussel, and the remaining population in the St. Clair delta near Walpole Island may be at risk. If the Eastern Sand Darter were the host of this species, then the decline of this threatened fish would affect the mussel's survival.

Occurrence
Ontario

Status history
Designated Endangered in May 2003. Assessment based on a new status report.

COSEWIC
Executive Summary

Round Hickorynut
Obovaria subrotunda

Species information

The round hickorynut, *Obovaria subrotunda* (Rafinesque, 1820), is a small freshwater mussel (maximum length in Canada ~ 60 mm) that is easily distinguished from other Canadian species by its almost perfectly round shape. The shell is thick, solid, and dark brown in colour, with a band of lighter colouration along the posterior dorsal surface.

Distribution

The round hickorynut was found throughout the Tennessee, Cumberland, and Ohio river systems in the United States, and also occurred in Lake Erie, Lake St. Clair, and some of their tributaries. In Canada, it was known from the western basin of Lake Erie, Lake St. Clair, and the Welland, Grand, Detroit, Thames and Sydenham rivers. The species is declining throughout its North American range, and has been extirpated from New York. In Canada, it is still extant in the Sydenham River and Lake St. Clair.

Habitat

The round hickorynut is typically found in medium-sized to large rivers, but also occurs in Lake Erie and Lake St. Clair. Its preferred habitat is generally described as rivers with steady, moderate flows, and sand and gravel substrates at depths of up to 2 m. In southeastern Michigan and southwestern Ontario, however, it has mainly been found in murky, low-gradient rivers with clay/sand or clay/gravel substrates. In Lake St. Clair, it currently occupies shallow (<1 m) nearshore areas with firm, sandy substrates.

Biology

The round hickorynut has separate sexes, with females smaller than males. The lifespan is probably at least 10 years. Like other freshwater mussels, *O. subrotunda* is parasitic on fish during its larval stage. Spawning occurs in the summer, and the female mussel holds the embryos over winter until they reach the larval stage the following June. The larvae are then released into the water where they attach to the gills of an

appropriate fish host and form a cyst. After a period of time, the larvae transform into juveniles that drop off the fish and fall to the substrate to begin life as free-living mussels. The host fish for the round hickorynut is unknown, but may be the eastern sand darter (*Ammocrypta pellucida*). Round Hickorynuts, like all freshwater mussels, feed on bacteria and algae that they filter from the water with their gills.

Population sizes and trends

Obovaria subrotunda is a very uncommon species that is clearly declining throughout most of its North American range. In Canada, It has been lost from Lake Erie, the Detroit River, and the offshore waters of Lake St. Clair. It has also been lost from the Grand and Thames rivers, and has significantly declined in the Sydenham River. The only significant population of *O. subrotunda* left in Canada occurs in the shallow waters of the St. Clair delta, but it is not known if the population will continue to survive. The round hickorynut has been lost from ~ 90% of its former range in Canada.

Limiting factors and threats

The round hickorynut has been lost from most of its former range in the Great Lakes due to impacts of the zebra mussel, and the remaining population in the St. Clair delta may be at risk. Populations in the Grand and Thames rivers were likely extirpated due to the combined effects of sewage pollution and agricultural impacts in these heavily populated watersheds. The decline of the Sydenham River population is likely due to agricultural impacts. Predation by muskrats or raccoons may also play a role. If the eastern sand darter is the host of the round hickorynut, then the decline of this threatened fish would affect the mussel's survival.

Special significance of the species

There are six species in the genus *Obovaria*, but only the hickorynut (*O. olivaria*) and round hickorynut (*O. subrotunda*) have ranges extending into Canada. The ring pink (*O. retusa*) is listed as federally endangered in the United States. The American Fisheries Society also considers the round ebonyshell (*O. rotulata*) to be endangered, and three other species, including the round hickorynut, to be of special concern. Thus, most members of this genus appear to be sensitive to environmental degradation.

Existing protection or other status designations

The round hickorynut is listed as endangered in Illinois, Michigan and Alabama, threatened in Tennessee, and special concern in Indiana, and is therefore afforded some protection in these states. There is currently no protection for the round hickorynut in Canada.

Summary of status report

Obovaria subrotunda historically occurred in 12 states and the province of Ontario. Most populations in the United States are in decline. The round hickorynut has been lost from approximately 90% of its historical range in Canada due to impacts of the zebra mussel and poor land use practices. The Sydenham River population is probably close to extirpation, with only scattered individuals still found alive in the system. The only significant population left in Canada is located in a shallow area of Lake St. Clair near Walpole Island. It is not clear at present if this population is successfully reproducing.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives 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 Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* 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.

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.

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COSEWIC Status Report

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2003

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SPECIES INFORMATION

Name and classification

Scientific name: *Obovaria subrotunda* (Rafinesque, 1820)
English common name: round hickorynut
French common name: Obovarie

The recognized authority for the classification of aquatic molluscs in the United States and Canada is Turgeon et al. (1998). The currently accepted classification of this species is as follows:

Phylum Mollusca
Class Bivalvia
Subclass Palaeoheterodonta
Order Unionoida
Superfamily Unionacea
Family Unionidae
Subfamily Lampsilinae
Genus *Obovaria*
Species *Obovaria subrotunda*

Parmalee and Bogan (1998) provide a complete list of synonyms for this species. Specimens from Lake Erie were once considered by some to be a separate species, *O. leibii*, due to their smaller size, more regular and distinct growth rests, and lighter colour (Ortmann 1919).

Description

The round hickorynut, *Obovaria subrotunda* (Rafinesque, 1820) is easily recognized by its circular shape, centrally located beaks, unsculptured and unrayed periostracum, and relatively small size. It may be occasionally confused with smooth specimens of *Quadrula pustulosa*, which, however, have a bright golden-yellow periostracum. The type locality is "l'Ohio" (the Ohio River). The following description of the species was adapted from Clarke (1981), Strayer and Jirka (1997) and Parmalee and Bogan (1998). The shell is circular to subcircular and thick. The surface is smooth except for prominent growth rests. The periostracum is generally dark brown or olive-brown and without rays except in some very young specimens. The posterior slope is distinctly lighter than the remainder of the shell. Beaks are centrally placed, curved inward, and elevated well above the hinge line. Beak sculpture is fine and consists of 4-6 short, slightly sinuous bars. Hinge teeth are rather heavy and strong. The left valve has two thick, roughened, triangular pseudocardinal teeth and two short, strong, slightly curved lateral teeth. The right valve has one large, triangular serrated pseudocardinal tooth, usually with two small, compressed teeth on either side, and one short, thick, roughened lateral tooth, often with a secondary inner low, incomplete lateral tooth. The interdentum is narrow or absent. Adductor scars are deeply impressed. The nacre is

silvery white, with a tinge of blue or pink in some specimens. Sexual differences in the shell are obscure; in females, the posterior margin of the shell may be truncated. However, there is a distinct difference in size, with females being considerably smaller than males (Ortmann 1919). The species shows considerable ecophenotypic variation in shell inflation among specimens from large rivers, small rivers, and lakes.

The round hickorynut may grow up to 65 mm in length but seldom exceeds 60 mm in Tennessee (Parmalee and Bogan 1998) or 50 mm in New York (Strayer and Jirka 1997). According to Clarke (1981), *O. subrotunda* rarely exceeds 40 mm in Canada. However, the authors have observed shells (and one live individual) up to about 60 mm long in southern Ontario rivers, and live specimens up to 51 mm long in Lake St. Clair. Figure 1A shows the external features of the shell and internal features of the left valve (hinge teeth), and Figure 1B is a photograph of a live specimen collected from the Sydenham River near Alvinston, Ontario on 21 June 2001.

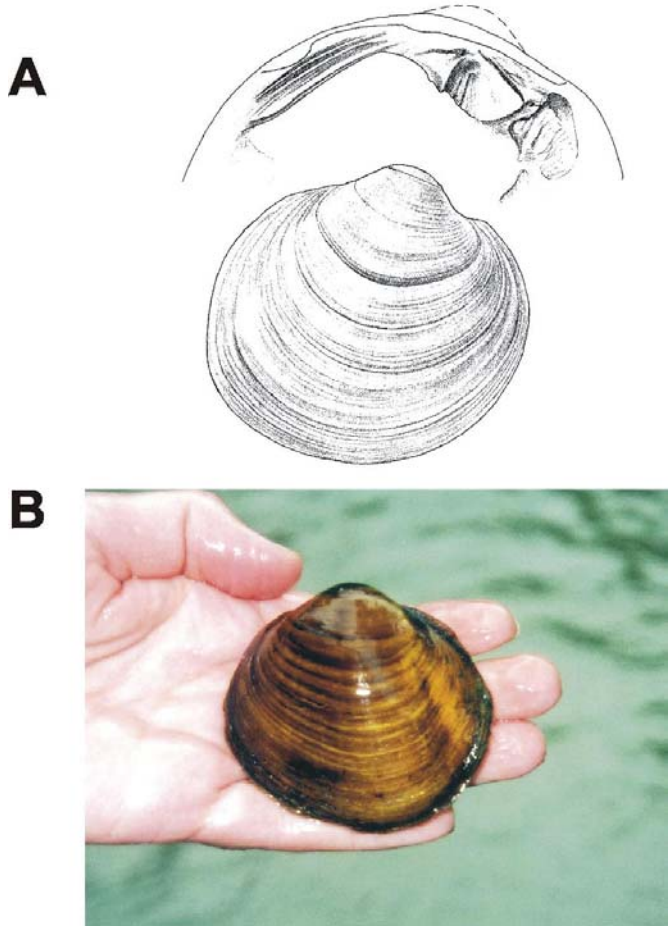

Figure 1. (A) Line drawings of the external features of the shell and internal features of the left valve (hinge teeth) of *Obovaria subrotunda*. Reproduced from Burch (1973). (B) Photograph of a live specimen from the Sydenham River, Ontario. Photo credit: D.T. Zanatta, NWRI.

DISTRIBUTION

Global range

The round hickorynut was found throughout the Tennessee and Cumberland river systems and in the Ohio River system from western Pennsylvania and peninsular Michigan west to eastern Illinois; it also occurred in Lake Erie and Lake St. Clair and their drainages in Canada and the United States (Parmalee and Bogan 1998). It was historically known from Alabama, Georgia, Illinois, Indiana, Kentucky, Michigan, Mississippi, New York, Ohio, Pennsylvania, Tennessee, West Virginia and Ontario (Figure 2).

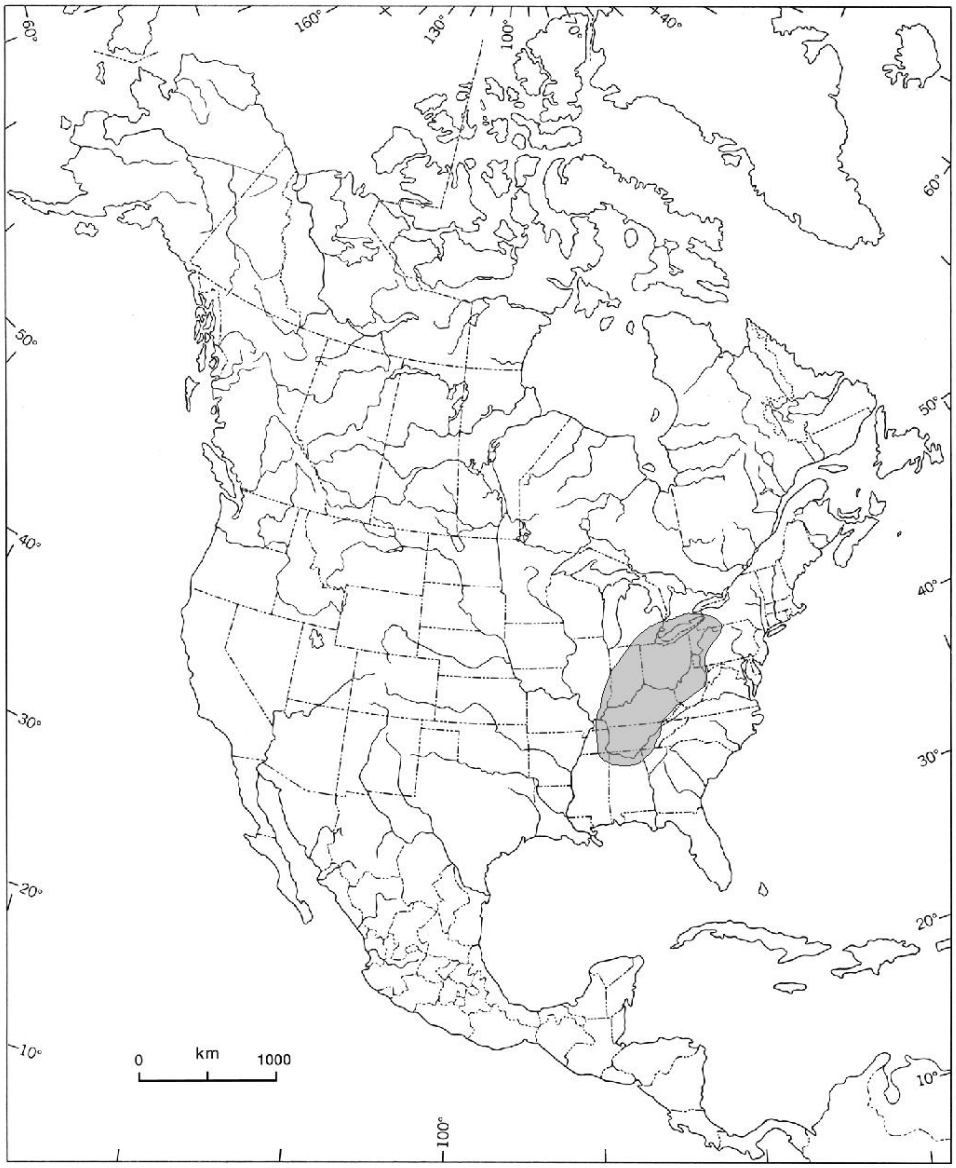

Figure 2. North American distribution of *Obovaria subrotunda* (based on information provided by jurisdictions).

Canadian range

In Canada, *O. subrotunda* is known only from southern Ontario. The National Water Research Institute's Lower Great Lakes Unionid Database was used to identify occurrence records for *O. subrotunda* in Ontario. At the time of writing, the database consisted of approximately 6000 records for 40 species collected from over 2000 sites in the lower Great Lakes drainage basin since 1860 (see Metcalfe-Smith et al. 1998a for a detailed description of the database and its data sources). The earliest record of the round hickorynut in Canada is two fresh whole shells collected in 1890 from Lake Erie at Kingsville by J.T. McQueen (specimens held by the Canadian Museum of Nature; cat. no. 002448). Since then it has been found in other locations in the western basin of Lake Erie (particularly around Pelee Island), Lake St. Clair, and the Welland, Grand, Detroit, Thames and Sydenham rivers. Figure 3 shows the historical distribution of the round hickorynut in Ontario, based on 44 records collected between 1890 and 1986, and the current distribution, based on 30 records (live animals and shells) collected over the past decade (1991 - 2001). Live specimens were most recently collected from the East Sydenham River and the St. Clair delta in Lake St. Clair in the summer of 2001. Appendix I contains detailed information for all known records of the round hickorynut in Canada.

Lake Erie, Lake St. Clair and the Detroit river (and presumably also the Welland River) are now infested with the exotic zebra mussel, *Dreissena polymorpha*, which has nearly destroyed native freshwater mussel populations in these waters — leaving only isolated pockets of surviving animals in some nearshore areas of the lakes (Zanatta et al. 2002). Approximately 64% of historical records for *O. subrotunda* are from waters now infested with zebra mussels. The round hickorynut has apparently been lost from the Grand and Thames rivers (Metcalfe-Smith et al. 1998b, 1999), and has declined dramatically in the Sydenham River (Metcalfe-Smith et al. 2001). However, 53 live specimens were collected in Canadian waters of the St. Clair delta in Lake St. Clair between 1999 and 2001 (Zanatta et al. 2002). The St. Clair population appears to be the only significant population of *O. subrotunda* left in Canada. Overall, the round hickorynut has been lost from over 90% of its historical range in Canada. It is now restricted to the East Sydenham River and a portion of the Lake St. Clair delta. The current extent of occurrence is approximately 1750 km^2 and the area of occupancy is 8 km^2.

HABITAT

Habitat requirements

The round hickorynut is typically found in medium-sized to large rivers (van der Schalie 1938; Strayer 1983; Parmalee and Bogan 1998), but also occurs in Lake Erie and Lake St. Clair (Clarke 1981; Strayer and Jirka 1997). During his study of the mussel fauna of the Huron River in southeastern Michigan, van der Schalie (1938) found *O. subrotunda* only near the mouth of the river and described it, as well as

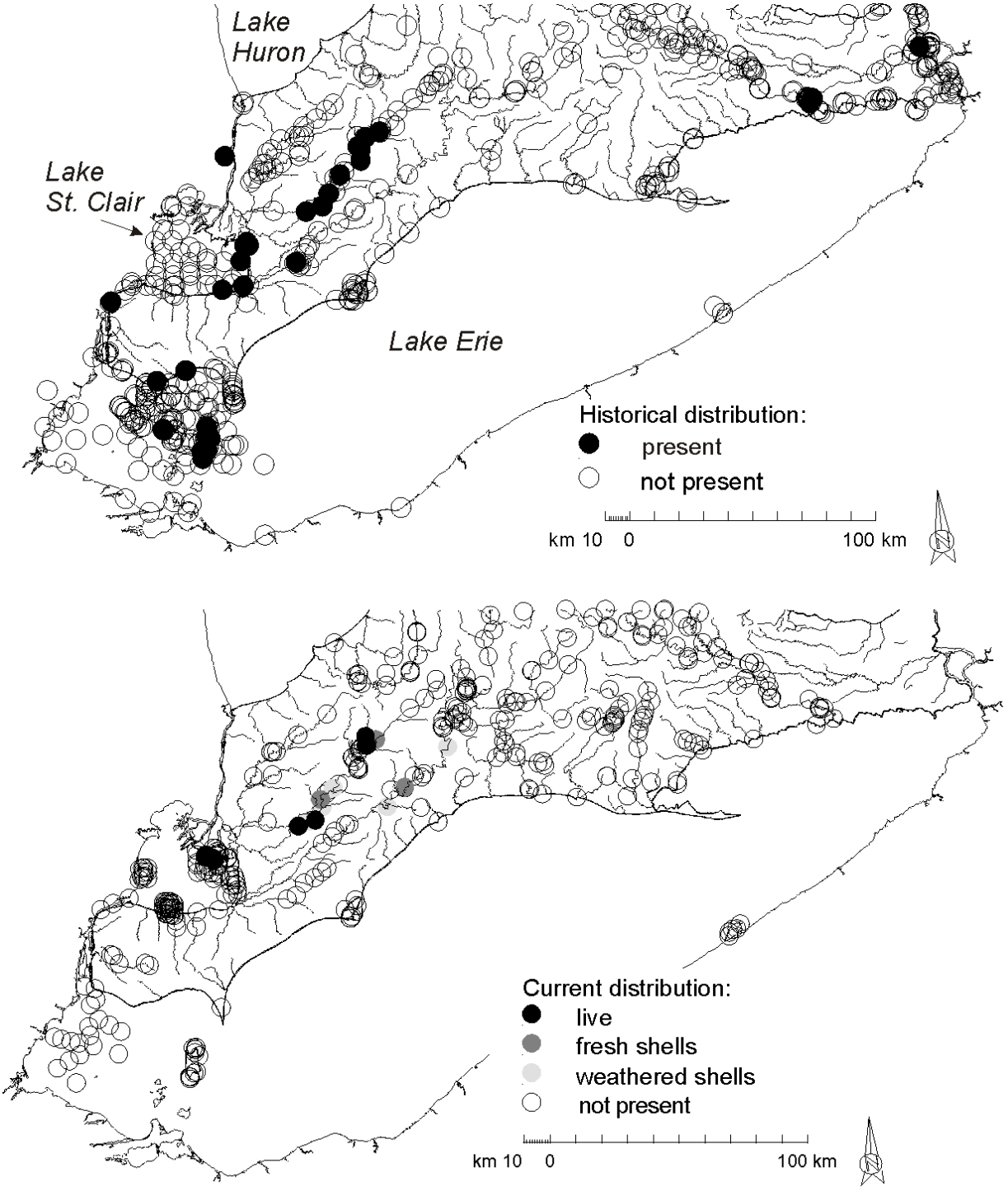

Figure 3. Historical (1890-1990) and current (1991-2001) distributions of *Obovaria subrotunda* in Ontario (based on records from the Lower Great Lakes Unionid Database).

Quadrula pustulosa and *Ligumia nasuta*, as “invaders from Lake Erie.” Ortmann (1919) reported collecting this species in “smaller branches” of the Ohio River. The preferred habitat of the round hickorynut is generally described as sand and gravel substrates with steady, moderate flows at depths of up to 2 m (Ortmann 1919; Gordon and Layzer 1989; Parmalee and Bogan 1998). In southeastern Michigan, however, it has mainly been found in turbid, low-gradient, hydrologically unstable rivers with clay/sand or clay/gravel substrates (van der Schalie 1938; Strayer 1983). In Lake St. Clair, *O. subrotunda* currently occupies shallow (<1 m) nearshore areas with firm, sandy substrates (Zanatta et al. 2002).

The habitat preferences of juvenile mussels are believed to be different from those of adults, but there have been few studies on this topic (Gordon and Layzer 1989). The juvenile life stage is certainly more vulnerable than the adult stage, because juveniles have no control over the habitat into which they are released by their host and may die quickly in unsuitable habitats. The glochidial (larval) stage is the most vulnerable and specialized life stage, because the glochidia must successfully attach to an appropriate host in order to complete their metamorphosis to the juvenile stage. The extent and quality of habitat in the Sydenham River is probably insufficient to maintain viable populations of O*. subrotunda*, and it is not known at present if the St. Clair “refuge” will persist (see section on Population Sizes and Trends).

Trends

Habitats for O*. subrotunda* and other unionids in Lake Erie and Lake St. Clair have been largely destroyed by the zebra mussel. Native mussel communities were virtually extirpated from the offshore waters of western Lake Erie by 1990 (Schloesser and Nalepa 1994) and the offshore waters of Lake St. Clair by 1994 (Nalepa et al. 1996). The mussel communities of Lake Erie were already in decline, probably due to a general decline in water quality over the past 40 years (Nalepa et al. 1991), but Lake St. Clair still supported an abundant and diverse mussel assemblage as recently as 1986 (Nalepa and Gauvin 1988). Unionids continue to survive in some nearshore areas with very shallow water, a high degree of connectivity to the lake (which ensures access to host fishes), and harsh conditions for zebra mussels (high water temperatures and considerable wave action in summer; ice scour in winter). However, such “refugia” are rare, and most of the unionid habitat in the Great Lakes has been permanently lost.

The round hickorynut has apparently been lost from the Thames and Grand rivers, and has declined significantly in the Sydenham River. It has also declined throughout most of its range in the United States, particularly in the Tennessee River system (Parmalee and Bogan 1998). Agriculture is believed to be the main cause of the destruction of mussel habitat across North America (Strayer and Fetterman 1999). Since agriculture accounts for 75-85% of land use in the Grand, Thames and Sydenham River basins, it is likely that agricultural impacts (e.g., runoff of sediment, nutrients and pesticides, increased water temperatures due to loss of riparian vegetation, destruction of habitat by tractor crossings and cattle) are primarily responsible for the loss of mussel habitat in these rivers.

Protection/ownership

Most land along the reach of the East Sydenham River where a few live specimens of *O. subrotunda* have been found in recent years is privately owned and in agricultural use. Only two small properties, the 7 ha Shetland Conservation Area and the 20 ha Mosa Township forest, are publicly owned and thus somewhat protected. It should be noted, however, that a recovery strategy has been developed for the aquatic ecosystem of the Sydenham River, and a number of landowners are participating in riparian rehabilitation projects and improved land use practices that will benefit *O. subrotunda* and other aquatic species at risk in the Sydenham River (Staton et al. 2002).

The most significant population of *O. subrotunda* left in Canada is located in the Canadian waters of the St. Clair delta, within the territory of the Walpole Island First Nation. The area is largely undisturbed and is likely to remain so in the future. The Walpole Island Heritage Centre is aware of the presence of *O. subrotunda* within their territory, and of the national significance of the population.

BIOLOGY

General

The basic life history of the freshwater mussel is applicable to the round hickorynut, and is described briefly as follows (adapted from Kat 1984, Watters 1999, and Nedeau et al. 2000): during spawning, males release sperm into the water and females living downstream filter the sperm out of the water with their gills. Ova are fertilized in a specialized region of the female gills, called marsupia, where they are held until they reach an intermediate larval stage termed the glochidium. The female mussel then releases the glochidia, which must attach to an appropriate host and become encapsulated. The glochidia remain attached and are nourished by the host's body fluids until they metamorphose into juveniles. The juveniles then break free of the capsule and fall to the substrate to begin life as free-living mussels. The proportion of glochidia surviving to the juvenile stage is estimated to be as low as 0.000001%. Mussels overcome the extremely high mortality associated with this life cycle by producing large numbers of glochidia.

Reproduction

The round hickorynut, like most freshwater mussels, is considered to be dioecious. Hermaphroditism has not been observed in this species. The lifespan of *O. subrotunda* is not known, but members of the subfamily Lampsilinae generally grow more rapidly and have shorter life spans than members of the Ambleminae, which can live for over 40 years (Stansbery 1967). For comparison, life spans of three other COSEWIC-listed lampsilines are: 10-20 years for *L. fasciola* (Metcalfe-Smith et al. 2000c), more than 15 years for *Epioblasma torulosa rangiana* (Staton et al. 2000), and up to 11 years for *V. fabalis* (Woolnough and Mackie 2002).

Obovaria subrotunda is a long-term brooder (bradytictic). Gravid females have been observed in every month except July in the Huron River, Michigan (van der Schalie 1938), and in all months of the year in the Cumberland River system of Tennessee and Kentucky (Gordon and Layzer 1989). According to Clarke (1981), the gravid period extends from about September to June in Canada. Clarke (1981) describes the glochidia as ovate in shape with a nearly straight hinge line, without hooks, and measuring 180 μm long and 200 μm high (200 μm long and 230 μm high, according to Hoggarth 1993). The lack of hooks suggests that they are gill parasites. The host fish is unknown; however, Clark (1977) noticed an association between the eastern sand darter (*Ammocrypta pellucida*) and the round hickorynut in the St. Joseph River system, a tributary to the Maumee River in the Lake Erie drainage. The eastern sand darter was designated as threatened in Canada in 1994, and many Canadian populations have declined or been extirpated. However, it still occurs in the East Sydenham River and Canadian waters of the St. Clair delta (Holm and Mandrak 1996), providing additional support for a possible host/parasite relationship with *O. subrotunda*. Furthermore, two other darter species, the naked sand darter (*Ammocrypta beani*) and southern sand darter (*Ammocrypta meridiana*), are known hosts of the Alabama hickorynut, *Obovaria unicolor* (Haag and Warren 2001).

Movements/dispersal

In the adult form, freshwater mussels are basically sessile; movement is limited to a few metres of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations (Nedeau et al. 2000). The Sydenham River population of the round hickorynut is isolated and may be close to extirpation. The remaining population in Lake St. Clair is located entirely within Canadian waters. Thus, there is no natural means by which individuals from American populations could bolster the Canadian populations or repopulate the Canadian range if the Canadian populations should disappear.

Nutrition and interspecific interactions

Round hickorynuts, like all species of freshwater mussels, are filter feeders as adults. Their primary food sources are bacteria, algae, particles of organic detritus, and some protozoans (Nedeau et al. 2000). Food availability may be a limiting factor for the Lake St. Clair population due to the presence of high densities of zebra mussels, which are extremely efficient filter feeders. During the parasitic larval stage, glochidia feed on the body fluids of the host.

POPULATION SIZES AND TRENDS

United States

Obovaria subrotunda is a very uncommon species that is clearly declining throughout much of its range in the U.S. It is extremely rare in the southeastern states. The only extant population in Alabama is in the Paint Rock River (J. Garner, Alabama Division of Wildlife and Freshwater Fisheries, pers. comm. October 2001), where Ahlstedt (1995-96) found only 9 live specimens during surveys in 1991. In Georgia, it may occur over an extremely limited range in the northern parts of the state in the Tennessee River drainage (P. Hartfield, U.S. Fish and Wildlife, pers. comm. July 2001). In Mississippi, it occurs only in the Big Black and Big Sunflower rivers (B. Jones, Mississippi Museum of Natural Science, pers. comm. October 2001). According to Parmalee and Bogan (1998), *O. subrotunda* was historically found throughout the Tennessee and Cumberland River systems, but "has disappeared, or nearly so, from most of these rivers." In the Cumberland system, it occurs in the Obey, Stones, Harpeth and Red rivers and in the mainstem Cumberland. In the Tennessee system, it was found in the main channel of the Tennessee River and in the Clinch, Pigeon, Little Tennessee, Sequatchie, Powell, Holston, Buffalo, Duck and Elk rivers. Ahlstedt (1983, 1991) conducted extensive surveys in the latter five rivers, plus the Nolichucky River, in 1979-80 and found a significant population of round hickorynuts in the Duck River and just a few live specimens in the Elk River. The Duck River population had also been noted in 1933 (van der Schalie 1938). *Obovaria subrotunda* is one of 103 species of mussels known from Kentucky. Based on a compilation of unionid records dating back to 1818, Cicerello et al. (1991) determined that *O. subrotunda* occurred in 12 of the 19 major river systems in the state. It is presently described as occasional in the upper Cumberland and Big Sandy rivers, sporadic in the upper Green, Kentucky and Licking rivers and Tygarts Creek, and rare in the Ohio River, lower Cumberland River and Little Sandy River.

The round hickorynut once occurred in four of the 25 drainages in Illinois, i.e., the Embarras River and Wabash River tributaries, the Vermilion and Little Vermilion River drainages, the Ohio River, and the Wabash River. It may have been fairly abundant in the past; for example, 131 live *O. subrotunda* were collected from the Embarras River by M.R. Matteson in 1956 (K. Cummings, Illinois Natural History Survey, pers. comm. August 2001). Since 1969, it has only been found alive in the Vermilon system (Cummings and Mayer 1997). In Indiana, *O. subrotunda* was most common in streams flowing to the Ohio River such as the Wabash and White rivers, and was rare in the Maumee system (Goodrich and van der Schalie 1944). Watters (1996) observed the species in Fish Creek, a tributary of the St. Joseph River in the Maumee system, in both 1988 and 1996. Although 17 live specimens were collected during surveys of the Tippecanoe River in 1987, the round hickorynut is generally quite rare in the state (K. Cummings, Illinois Natural History Survey, pers. comm. August 2001). *Obovaria subrotunda* is found throughout the state of Ohio, but rarely in any numbers (G.T. Watters, Ohio Biological Survey, pers. comm. July 2001). In the St. Joseph River, which seems to have received the most attention, Clark and Wilson (1912, in Clark

1977) found it to be "…fairly common in the feeder canal where 16 live specimens were secured, and in the St. Joseph River near its mouth, where we obtained 10." Clark (1977) reported finding it at seven sites in the mainstem or tributaries during collecting trips between 1938 and 1975. Way and Shelton (1997) recorded the round hickorynut from a site in the Ohio River in 1995, and Watters (1993-94) found it alive in the Muskingham River in 1992. In West Virginia, *O. subrotunda* is found throughout the interior basin of the state, though never in large numbers (J. Clayton, West Virginia Department of Natural Resources, pers. comm. August 2001).

Van der Schalie (1938) studied the mussel fauna of the Huron River in southeastern Michigan in the early 1930s. He only found shells of *O. subrotunda*, and these were at a site near the mouth. Strayer (1980) compared the historical distribution of mussels in the Clinton River (1870-1933), a tributary to the St. Clair River just north of Detroit, with the results of his own surveys of 76 sites in 1977-78. The round hickorynut had been reported from two sites in the lower reaches of the river prior to 1935, but he did not find it during his surveys and declared it "extinct" in the Clinton. He also stated that the species has been eliminated from most of its former range in the Erie-St. Clair system. Hoeh and Trdan (1985) surveyed 27 sites in the Black, Pine and Belle rivers (also Michigan tributaries to the St. Clair River), in 1982-83 and found the round hickorynut at one site in the Pine River where it was described as "rare" (<1 mussel found per man-hour of search effort). Strayer et al. (1991) surveyed 52 sites in rivers and streams of western New York in 1987-90, and found a single subfossil shell of *O. subrotunda* in Conewango Creek in the Allegheny River system. According to Strayer and Jirka (1997), the species is likely extirpated from the state of New York "although it may turn up in the Allegheny or Erie-Niagara basins." In Pennsylvania, it historically occurred in the Ohio, Beaver and Monongahela River drainages (Ortmann 1919); however, it has severely declined in recent years (A. Shiels, Pennsylvania Nongame and Endangered Species Unit, pers. comm. Sept. 2001).

Great Lakes waters

Lake Erie

There is evidence that O*. subrotunda* may have been extirpated from Lake Erie by as early as 1950. The species was reported from all but one of seven surveys conducted between 1910 and 1942 but not in 1960 or 1993, nor was it found during surveys of 33 sites along the southwest shore and around the Bass Islands in 1998 (Ecological Specialists 1999). Sixteen species of unionids were collected from the western basin of Lake Erie between 1930 and 1982 (Nalepa et al. 1991). *Obovaria subrotunda* was present in 1930 and 1951-52, but not in 1961, 1972, 1973-74, or 1982. By 1991, the community had been virtually eliminated by the zebra mussel (*Dreissena polymorpha*) — only four specimens of two species were found alive (Schloesser and Nalepa 1994). Schloesser et al. (1997) sampled 15 sites along the Michigan shoreline both before (1983) and after (1990 and 1993) the zebra mussel invasion, but did not find *O. subrotunda* on either occasion. The round hickorynut was also absent from the collections of Ortmann (1919) and Masteller et al. (1993) from Presque Isle Bay,

Erie, PA, and was not among 20 species found alive in Metzger Marsh, near Toledo, Ohio in 1996 (Nichols and Amberg 1999). Surveys of seven other marshes near Metzger in 2000 produced few live mussels, and none were *O. subrotunda* (Ecological Specialists 2001).

Lake St. Clair and the Detroit River

The round hickorynut still persists in Lake St. Clair. Nalepa and Gauvin (1988) surveyed 29 sites throughout the lake in 1986 and collected 281 live unionids of 18 species, including one live specimen of *O. subrotunda*. Nalepa et al. (1996) re-surveyed these sites in 1990, 1992 and 1994, and reported finding two live round hickorynuts in 1990. By 1994, unionids had been virtually extirpated from the offshore waters of the lake by the zebra mussel. Similarly, Schloesser et al. (1998) sampled 17 sites in the Detroit River before (1982-83) and after (1992 and 1994) the zebra mussel invasion, and found two live *O. subrotunda* in 1982-83, three in 1992 and none in 1994. Near total mortality of the unionid community in the river had occurred by 1994. Gillis and Mackie (1994) sampled several nearshore sites in the southwestern portion of Lake St. Clair near Puce, Ontario, and Grosse Pointe, Michigan, between 1990 and 1992, and did not find any *O. subrotunda*. Richness and abundance of unionids had declined dramatically over the sampling period, due to impacts of the zebra mussel. In contrast, Zanatta et al. (2002) discovered a significant unionid community of 22 species surviving in shallow (<1 m) nearshore waters of the St. Clair delta in 1999. A total of 53 live *O. subrotunda* were collected from five of the 31 sites sampled between 1999 and 2001; all five sites were in Canadian waters.

Two good indicators of the overall health or "strength" of a mussel population are: (a) density, which can be compared with the densities of known healthy populations; and (b) size class frequencies of live animals, which provide a record of reproductive success. Density estimates for *O. subrotunda* in the St. Clair delta were found to be $0.014/m^2$, $0.005/m^2$ and $0.002/m^2$ at three sites sampled quantitatively in 2001 (Zanatta et al. 2002). These densities are one to two orders of magnitude lower than the densities of $0.10/m^2$ to $0.20/m^2$ reported in 1979 for the Duck River in Tennessee (Ahlstedt 1991), which may harbour the healthiest remaining populations of the round hickorynut in North America. Although current densities in Lake St. Clair are low, the area of occupancy is large (approximately 8 km^2). Assuming that densities are consistent throughout the area of occupancy, an optimistic estimate of population size is 55,000 individuals. Size frequency distributions for the 53 live specimens collected from the St. Clair delta between 1999 and 2001 are presented in Figure 4. The population is dominated by animals from a few size classes, which may indicate frequent year-class failure. Mean shell length was 31.3 mm ($\pm$ 3.6 mm SE), which is probably typical for adult specimens in the Great Lakes. Various authors have noted that the "lake form" of *O. subrotunda* attains a much smaller size than the river form. For example, Ortmann (1919) reported that the largest specimen he had seen from Lake Erie was only 42 mm long.

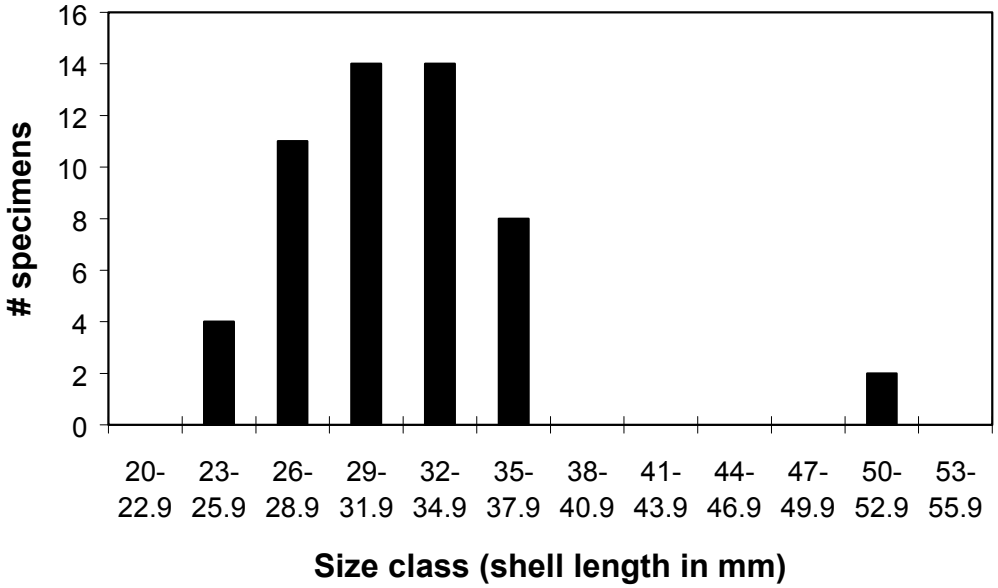

Figure 4. Size frequency distribution for live specimens of *Obovaria subrotunda* found in Lake St. Clair between 1999 and 2001 (n = 53).

Table 1 summarizes the available information on frequency of occurrence and relative abundance of *O. subrotunda* in various locations in Alabama, Kentucky, Michigan, Ohio, Tennessee and Ontario, including the Great Lakes. The round hickorynut was found at about 10% of sites surveyed (range 3-24%), representing 0.7% on average (range 0.2-8.0%) of the total number of mussels collected. It appears that the healthiest remaining populations in North America are in the Duck River, Tennessee, and the Ontario waters of the St. Clair delta in Lake St. Clair. The Paint Rock River population was significant in 1980, but has since declined rather dramatically.

Canadian rivers

Obovaria subrotunda has been reported from the Grand, Thames, Sydenham and Welland rivers in Ontario. There is only one record for the Welland River — from 1931. To our knowledge, this river has not been surveyed for mussels in recent years. Metcalfe-Smith et al. (1998b, 1999) surveyed 66 sites on the Grand, Thames, Sydenham, Ausable and Maitland rivers in 1997-98 to determine the conservation status of rare species of freshwater mussels in southwestern Ontario. They used the timed-search technique, which they have shown to be the most efficient method for detecting rare species (Metcalfe-Smith et al. 2000a), and an intensive sampling effort of 4.5 person-hours (p-h)/site. Sites that were known to support rare species (including *O. subrotunda*) in the past were targeted. Results of these and other recent surveys were compared with the historical data to determine population trends for the round hickorynut. This species was not found in the Ausable or Maitland rivers in the lower Lake Huron drainage, nor did it occur there historically.

Table 1. Frequency of occurrence and relative abundance of *Obovaria subrotunda* in various locations in the United States and Ontario.

River/Lake	State/Province	Frequency of occurrence, as % of sites surveyed (# sites)	Relative abundance, as % of community	Year of survey
Paint Rock River	AL	24% (25)	3.0%	1980 [a]
Paint Rock River	AL	12% (25)	0.7%	1991 [b]
Duck River	TN	18% (99)	1.4%	1979 [a]
Elk River	TN	3.7% (108)	0.2%	1980 [c]
Cumberland River	TN, KY	3.4% (29)	0.3%	1984-86 [d]
Green River	KY	-	0.1%	1990-91 [e]
St. Joseph River	OH	18% (40)	-	1938-75 [f]
Muskingham River	OH	-	0.3%; 0.5%	1992 [g]
Black, Pine and Belle rivers	MI	3.7% (27)	-	1982-83 [h]
Western basin Lake Erie	OH, MI, ON	-	0.3%	1951-52 [i]
Detroit River	MI, ON	-	0.2%	1982-83 [j]
Detroit River	MI, ON	-	0.1%	1992 [j]
Lake St. Clair	MI, ON	3% (29)	0.4%	1986 [k]
Lake St. Clair	MI, ON	16% (31)	2.2%	1999-2001 [l]

[a]Ahlstedt (1991), [b]Ahlstedt (1995-96), [c]Ahlstedt (1983), [d]Ahlstedt and Saylor (1995-96), [e]Cochran and Layzer (1993); [f]Clark (1977), [g]Watters (1993-94), [h]Hoeh and Trdan (1985), [i]Nalepa et al. (1991), [j]Schloesser et al. (1998), [k]Nalepa and Gauvin (1988), [l]Zanatta et al. (2002).

Small numbers of shells of the round hickorynut have appeared in several museum collections from the Grand and Thames rivers, dating back to the late 1800s. A fresh whole shell collected from the Thames River at Chatham in 1894 was most likely taken from a live animal, but the condition of another shell collected in 1930 is unknown. Metcalfe-Smith et al. (1998b and unpublished data) found a total of 13 weathered (subfossil) half shells at three sites in the middle reaches of the Thames River in 1997-98. Shells of the round hickorynut were collected from the lower Grand River in 1966 by John Oughton and in 1972 by Brian Kidd. After conducting an exhaustive search of the literature and examining many museum collections, Kidd (1973) concluded that the species had not been collected alive from the Grand River as far back as 1885. Metcalfe-Smith et al. (2000b) surveyed 95 sites throughout the Grand River and its tributaries between 1995 and 1998, and did not find a single shell of *O. subrotunda*. These results suggest that the Round Hickorynut may have already been extirpated from the Grand and Thames rivers by the turn of the century.

The round hickorynut has declined dramatically over time in the Sydenham River. Only three live individuals were collected over the past five years, despite at least 200 person-hours of survey effort, whereas 32 live specimens had been found at 11 different sites in the East Sydenham River between 1965 and 1991. The presence of *O. subrotunda* in the Sydenham River was first documented by Carol Stein and Joanne Stillwater (Ohio State University), who collected five live animals from a site

near Florence in 1965. Stein and Karen Heffelfinger also collected one live specimen from a site near Alvinston in 1967. Stein revisited the Florence site in 1973, and found only two fresh whole shells; however, she also visited a site near Dawn Mills, where she found 18 live animals. Clarke (1973) surveyed 11 sites in the river in 1971 using an average sampling effort of 1.1 p-h/site and found 26 live species. He found one live Round Hickorynut at each of three sites. Mackie and Topping (1988) surveyed 22 sites in the system in 1985 using a sampling effort of 1.0 p-h/site and found only 13 species alive, not including *O. subrotunda*. Clarke (1992) surveyed 16 sites in 1991, using a greater sampling effort than in 1971 (mean = 2.4 p-h/site) and found five live Round Hickorynuts at four sites. Metcalfe-Smith et al. (1998b, 1999) surveyed 17 sites on the Sydenham River in 1997-98, with good coverage of the reach where *O. subrotunda* previously occurred, and found only 24 shells — 70% of which were weathered, broken valves. Quantitative sampling was subsequently conducted at four of these sites (10-12 p-h search effort/site), and one live *O. subrotunda* was found at a site near Dawn Mills. Another live specimen was found at this site during other sampling in 2001 (Daelyn Woolnough, University of Guelph, pers. Comm..), and a third live specimen was found by the authors at a site near Alvinston in 2001 after 6.25 p-h of search effort. Since all live specimens and fresh whole shells collected in recent years were large, i.e., 48-61 mm (D.L. Strayer, Institute of Ecosystem Studies, Millbrook, NY, described the 61 mm shell as “huge” for this species), this leads us to believe that they may be old, non-reproducing, remnants of the original population.

LIMITING FACTORS AND THREATS

The introduction and spread of the exotic zebra mussel (*Dreissena polymorpha*) throughout the Great Lakes has destroyed native freshwater mussel populations in infested areas (Schloesser et al. 1996). Zebra mussels attach to a unionid’s shell, where they interfere with activities such as feeding, respiration, excretion and locomotion — effectively starving it to death (Haag et al. 1993; Baker and Hornbach 1997). Approximately 64% of the sites where *O. subrotunda* was historically collected in Ontario are in Great Lakes waters that are now heavily colonized by zebra mussels. It is not known at present why *O. subrotunda* and other species of unionids living in the shallow waters of the St. Clair delta have thus far survived the zebra mussel invasion. We speculate that the numbers of veligers reaching and/or settling in the area may vary from year to year depending on wind direction, currents and water levels (Zanatta et al. 2002). Several studies have shown that temporal variation in densities and colonization rates of zebra mussels can influence zebra mussel-induced mortality of unionids (Schloesser et al. 1997). We must caution, however, that there is no guarantee that the St. Clair “refuge” will persist. In fact, several of the species known to be most susceptible to the zebra mussel have declined, and overall infestation rates are higher than in other refuge sites in Lake Erie. If the Lake St. Clair population of *O. subrotunda* eventually succumbs to the zebra mussel, this will likely mean that the species has been extirpated from Canada.

Obovaria subrotunda has severely declined throughout the Tennessee River drainage (see Population Sizes and Trends), along with many other mussel species. Threats known to have caused the decline of mussels in this system include: dams (which cause altered temperature regimes, fluctuating water levels, seasonal oxygen deficits, and separate mussels from their hosts); channelization (for flood control); municipal sewage; silts and coal fines from strip-mining and coal washing facilities; silt from mica and feldspar mining; and runoff of silt from agricultural lands, as well as chemicals used on cotton and bean crops (Ahlstedt 1991). According to Strayer and Fetterman (1999), the main threats to mussels today are high loads of sediment, nutrients, and toxic chemicals from non-point sources, especially agriculture. Agriculture is the primary land use in the Sydenham River basin, with 85% of the land in agricultural use (mainly row crops) and 60% of the watershed in tile drainage (Staton et al. 2002). Only 17% of the original forest cover remains, and there are long reaches of the river with little or no riparian vegetation. Sediment loadings from overland runoff and tile drainage are high. Sediments originating from tile drainage tend to be fine-grained (Grass et al. 1979). Fine sediments are known to adversely affect mussels in many ways, e.g., they can clog the gills, thereby reducing respiration rates, feeding efficiency, and growth; they can affect their food source by reducing the amount of light available for photosynthesis; and they can affect mussels indirectly by impacting on their host fishes (see Brim-Box and Mossa 1999 for a review). Nutrient loadings are also high in the Sydenham River, and total phosphorus levels have consistently exceeded the provincial water quality objective over the past 30 years; chloride levels are slowly rising due to the increased use of road salt (Staton et al. 2002). Despite these threats, the unionid fauna of the Sydenham River remains remarkably intact — 30 of the 34 species still survive in the system. However, *O. subrotunda* is one of three species that have shown a statistically significant decline in frequency of occurrence over time (Metcalfe-Smith et al. 2001).

The most significant natural controls on the size and distribution of mussel populations are the distribution and abundance of their host fishes, and predation. Unionids cannot complete their life cycle without access to their proper glochidial host. If host fish populations disappear, or decline in abundance to levels below that which can sustain a mussel population, recruitment will no longer occur and the mussel species may become functionally extinct (Bogan 1993). The host fish for O. subrotunda is unknown, although the eastern sand darter has been suggested as a possibility (see Biology). The eastern sand darter was designated as threatened in Canada in 1994, and many Canadian populations have declined or been extirpated (Holm and Mandrak 1996). Determination of the host(s) of the round hickorynut in the Sydenham Rivers and Lake St. Clair is crucial to understanding its chances for survival in these systems. There have been significant advances in the methodology for laboratory identification of glochidial hosts of freshwater mussels in recent years (e.g., Hove et al. 2000), and a testing facility has now been established at the University of Guelph, Guelph, Ontario (Woolnough and Mackie 2002).

Freshwater mussels are known to be food sources for a variety of mammals and fish (Fuller 1974). Predation by muskrats (*Ondatra zibenthicus*), in particular, may be a

limiting factor for some mussel species. Tyrrell and Hornbach (1998) and others have shown that muskrats are both size- and species-selective in their foraging, and can significantly affect both the size structure and species composition of mussel communities. We are aware of only one study on the effects of muskrat predation on mussels that reported data for *O. subrotunda*. Watters (1993-94) compared the composition of the mussel community at two sites in the lower Muskingham River in Ohio with the composition of shells in nearby muskrat middens. He found that muskrats neither favoured nor avoided the round hickorynut, which represented 0.28-0.53% of the mussel community and 0.07-2.53% of the shells in middens. The authors of the present report found several fresh *O. subrotunda* shells in muskrat (or raccoon) middens along the banks of the East Sydenham River, even though only three live specimens were observed during mussel surveys. Although predation is a natural control on mussel populations, we must recognize that land use practices can significantly influence the distribution and density of predators. We are not aware of any studies on raccoon predation; however, we have observed raccoons feeding on mussels in the field, and there is anecdotal information from the farming community in the Sydenham River watershed that the recent adoption of conservation tillage practices has led to an explosion in the raccoon population. It is therefore possible that predation represents a significant threat to the population of *O. subrotunda* in this river.

SPECIAL SIGNIFICANCE OF THE SPECIES

There are six recognized species in the genus *Obovaria*; only the hickorynut (*O. olivaria*) and round hickorynut (*O. subrotunda*) have ranges extending into Canada. One of the six species, the ring pink (*O. retusa*), is listed as federally endangered in the United States (U.S. Fish and Wildlife Service 2002). The American Fisheries Society (AFS) also recognizes the round ebonyshell (*O. rotulata*) as endangered (Williams et al. 1993). Three other species, the southern hickorynut (*O. jacksoniana*), Alabama hickorynut (*O. unicolor*) and round hickorynut (*O. subrotunda*) are listed as special concern (a species or subspecies that may become endangered or threatened by relatively minor disturbances to its habitat, and deserves careful monitoring of its abundance and distribution) by the AFS; only the hickorynut (*O. olivaria*) is considered to be stable.

EXISTING PROTECTION OR OTHER STATUS

Obovaria subrotunda is currently listed as endangered in Illinois, Michigan, and Alabama (and proposed for endangered status in Pennsylvania), threatened in Tennessee, and special concern in Indiana, and is therefore afforded some protection in these states. In Illinois, for example, “it is unlawful for any person to possess, take, transport, sell, offer for sale, give or otherwise dispose of any animal or the product thereof of any animal species which occurs on the Illinois List…”. Species on the list include all species listed as endangered under the Federal Endangered Species Act, plus other species in danger of extinction in the wild in Illinois (Illinois DNR 2002). Endangered status is also proposed for this species in Pennsylvania. The round

hickorynut is not currently listed or proposed for listing under the U.S. Endangered Species Act, nor is it listed in the IUCN Red Book. The Nature Conservancy has assigned the round hickorynut a global rank of G4. Sub-jurisdictional (state and provincial) ranks for the species are shown in Figure 5 (for information sources, see Authorities Consulted). The round hickorynut is currently ranked as S4S5 in Kentucky, S3 in Tennessee and West Virginia, S2 in Mississippi, Alabama, Indiana and Ohio, and S1 in Illinois, Pennsylvania, Michigan and Ontario. It is believed to be extirpated (SX) from New York, and has not been assigned a rank in Georgia.

Canada does not have federal endangered species legislation at this time, but Ontario is one of six provinces that have stand-alone Endangered Species Acts (B.T. Fowler, Co-Chair, Lepidopterans and Molluscs Specialist Subcommittee, COSEWIC, pers. comm. August 2002). Ontario's Act prohibits the willful destruction of, or interference with, a regulated endangered species or its habitat. Five species of freshwater mussels that are currently listed as endangered by COSEWIC are found only in the Province of Ontario; these species are the northern riffleshell (*Epioblasma torulosa rangiana*), rayed bean (*Villosa fabalis*), wavy-rayed lampmussel (*Lampsilis fasciola*), snuffbox (*Epioblasma triquetra*) and Mudpuppy mussel (*Simpsonaias ambigua*). Since Ontario has not yet proceeded with regulating any of these species under the Act (A. Dextrase, Species at Risk Section, Ontario Parks, Ontario Ministry of Natural Resources, pers. comm. November 2001), freshwater mussels currently do not benefit from this legislation.

The Federal Fisheries Act may represent the most significant legislation protecting freshwater mussels and their habitat in Canada at the present time. Fish are broadly defined under the Act to include shellfish, although the intent was to protect marine shellfish harvested for human consumption. The protection of fish and fish habitat may indirectly protect the habitat of *O. subrotunda* and other species of freshwater mussels. The collection of live mussels is theoretically "fishing" and would fall under the Ontario Fishery Regulations that are made under the Federal Fisheries Act. No permits have been issued for the collection of live mussels in Ontario (J. Maffei, Lake Erie Management Unit, pers. comm. May 2001). The Provincial Policy Statement under Section 3 of the Planning Act provides for protection from development and site alteration in significant portions of the habitats of threatened and endangered species. Other mechanisms for protecting mussels and their habitat in Ontario include the Ontario Lakes and Streams Improvement Act, which prohibits the impoundment or diversion of a watercourse if it would lead to siltation; and the voluntary Land Stewardship II program of the Ontario Ministry of Agriculture, Food, and Rural Affairs, which is designed to reduce erosion on agricultural lands. Stream-side development in Ontario is managed through flood plain regulations enforced by local Conservation Authorities. In the East Sydenham River, where three live *O. subrotunda* have been found in recent years, 85% of the land is privately owned and in agricultural use (Staton et al. 2002).

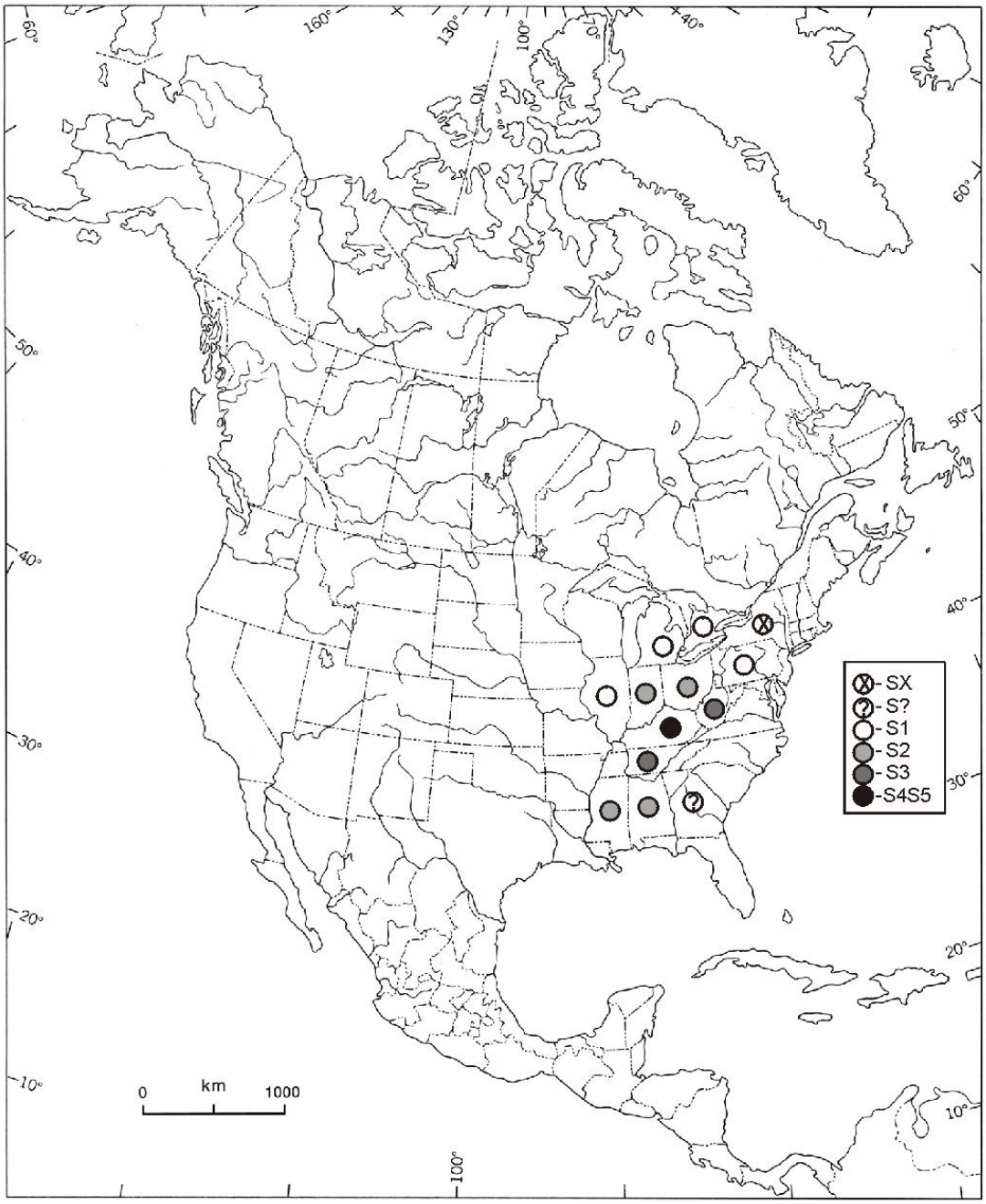

Figure 5. State and Provincial conservation priority ranks (S-ranks) for *Obovaria subrotunda*.

The only significant population of *O. subrotunda* left in Canada is located in the waters of the St. Clair delta, within the territory of the Walpole Island First Nation. The shoreline consists of natural marshland, and is completely undeveloped. Special permission from the band council is required in order to access the area, so it is largely undisturbed. The Walpole Island First Nation is committed to preserving their natural heritage, and have adopted the following philosophy statement (in part) concerning the environment: “To preserve, enhance and maintain a mutual respect and to continue our

beneficial dependency upon the environment, we shall endeavor to co-exist with Mother Nature and protect this relationship" (C. Jacobs, Walpole Island Heritage Centre, pers. comm. Oct. 2001). The Walpole Island Heritage Centre is aware of the presence of *O. subrotunda* within their territory, and of the national significance of the population.

SUMMARY OF STATUS REPORT

Obovaria subrotunda historically occurred in 12 states and the province of Ontario. In the United States, it was found throughout the Tennessee and Cumberland river systems and in the Ohio River system from western Pennsylvania and peninsular Michigan west to eastern Illinois. It also occurred in Lake Erie and Lake St. Clair and their drainages. Almost every jurisdiction has reported declines, and some of these are quite severe — especially in the Tennessee River system. In Canada, the round hickorynut was historically found in the western basin of Lake Erie (particularly around Pelee Island), Lake St. Clair, and the Welland, Grand, Detroit, Thames and Sydenham rivers. It has been lost from Lake Erie, the Detroit River, and the offshore waters of Lake St. Clair due to impacts of the zebra mussel. A significant population was discovered in shallow waters of the St. Clair delta in Lake St. Clair in 1999, but most specimens were large and it is not certain that recruitment is still occurring. The round hickorynut has apparently been lost from the Grand and Thames rivers, and has significantly declined in the Sydenham River where only three live specimens have been found in recent years.

Obovaria subrotunda may be very sensitive to human disturbance, since there is evidence that it was lost decades ago from many systems. For example, it has been found in only one river in Illinois since 1969; and it was last seen alive in Lake Erie in 1950, in the Clinton River, Michigan in 1935, and in the Grand River, Ontario at the turn of the century. Only a few subfossil shells have been found in New York and in the Thames River, Ontario in recent years. The round hickorynut was not among the 16 species of unionids that have recolonized the lower Grand River over the past 25 years as a result of significant improvements in water quality. Furthermore, *O. subrotunda* has significantly declined in the Sydenham River, where the endangered northern riffleshell (*Epioblasma torulosa rangiana*), snuffbox (*Epioblasma triquetra*), rayed bean (*Villosa fabalis*), and mudpuppy mussel (*Simpsonaias ambigua*) still persist and are reproducing.

The round hickorynut is currently listed as endangered in Illinois, Michigan, and Alabama, threatened in Tennessee, and special concern in Indiana, and is therefore afforded some protection in these states (it is not federally listed in the U.S.). Most land along the reach of the East Sydenham River where a few live specimens of *O. subrotunda* were found in recent years is privately owned and in agricultural use. The only significant population of *O. subrotunda* left in Canada is located in the waters of the St. Clair delta, within the territory of the Walpole Island First Nation. The area is undeveloped and is under the control of the First Nation, which means there is excellent potential for protecting the population from human disturbance. However, it may not be possible to protect it indefinitely from the zebra mussel. The most significant threats to the continued existence of the round hickorynut in Canada are zebra mussels and agricultural impacts.

TECHNICAL SUMMARY

Obovaria subrotunda
Round Hickorynut Obovarie ronde
Southwestern Ontario

Extent and Area information	
• *extent of occurrence (EO)(km²)*	East Sydenham River and portion of the Lake St. Clair delta ~1750 km^2
• *specify trend (decline, stable, increasing, unknown)*	Decline, estimate 90% (likely extirpated from offshore waters of Lake St. Clair, Lake Erie, Detroit River, Thames River, and Grand River)
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	No
• *area of occupancy (AO) (km²)*	Scattered specimens in the East Sydenham River (no area estimate possible); 8 km^2 in a portion of the Lake St. Clair delta
• *specify trend (decline, stable, increasing, unknown)*	Decline
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	No
• *number of extant locations*	2
• *specify trend in # locations (decline, stable, increasing, unknown)*	Decline
• *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*	Declining
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	Unknown (estimate 10 years)
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	Unknown (estimate 55 000)
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Declining
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	90% over last 10 years due to zebra mussel infestation of Lake Erie, Lake St. Clair, Detroit River
• *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)?*	Yes, only 2 isolated populations
• *list each population and the number of mature individuals in each*	
• Lake St. Clair	Estimate 55 000
• *Sydenham River*	Unknown (very few)
• *specify trend in number of populations(decline, stable, increasing, unknown)*	Decline
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	No

Threats (actual or imminent threats to populations or habitats)	
– Zebra mussels (invasive species)	

– Habitat loss and degradation:
  – Siltation
  – Nutrient loading
  – Loss of riparian vegetation	

– Potentially declining host fish species	
– Predation by muskrats and raccoons	
Rescue Effect (immigration from an outside source)	
• *does species exist elsewhere (in Canada or outside)?*	Yes (United States)
• *status of the outside population(s)?*	Declining
• *is immigration known or possible?*	No
• *would immigrants be adapted to survive here?*	Likely (genetic testing required)
• *is there sufficient habitat for immigrants here?*	No
Quantitative Analysis	

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David T. Zanatta received a B.Sc. (Hons.) in Biology from Laurentian University (1998) and a M.Sc. (Zoology) from the University of Guelph (2000). His M.Sc. supervisor, Dr. Gerald L. Mackie, is currently chair of the Mollusc Species Subgroup Group of the Lepidoptera and Mollusca Subcommittee of COSEWIC. Mr. Zanatta's thesis was entitled "Biotic and abiotic factors relating to distribution of unionid mussel species in Lake St. Clair." Part of his thesis research, which documented the discovery of native mussel refuge sites in Lake St. Clair, will be published shortly in the Journal of Great Lakes Research. He has also studied Lake Trout populations in Northwestern Ontario lakes and analyzed Walleye index netting data for the Ontario Ministry of Natural Resources. He is a member of the North American Benthological Society and the Freshwater Mollusk Conservation Society. David is currently a research technologist with the National Water Research Institute of Environment Canada in Burlington, Ontario.

Janice L. Metcalfe-Smith is an aquatic research biologist with the National Water Research Institute of Environment Canada in Burlington, Ontario. She has a B.Sc. (Hons.) in Zoology from the University of Manitoba (1973), and 29 years of experience as a technologist (1973-1978) and biologist (1978-present) with the departments of Fisheries and Oceans (Winnipeg, Manitoba and St. Andrews, New Brunswick) and Environment (Burlington, Ontario). She has conducted research in several areas, including the effects of forestry practices and acid rain on Atlantic salmon, the use of benthic macroinvertebrate communities in water quality assessment, and the development of biological monitoring techniques for measuring contaminant trends in freshwater ecosystems. Since 1995, her research has focused on the assessment and conservation of freshwater mussels in Ontario. She has authored or co-authored over 60 scientific papers and reports, including 15 on biodiversity issues. She is a member of the North American Benthological Society, the Freshwater Mollusk Conservation Society, and the Mollusc working group of the Lepidopterans and Molluscs Specialist Subcommittee of COSEWIC. She co-authored five previous status reports on mussel species at risk for COSEWIC.

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COLLECTIONS EXAMINED

In 1996, all available historical and recent data on the occurrences of freshwater mussel species throughout the lower Great Lakes drainage basin were compiled into a

computerized, GIS-linked database referred to as the Lower Great Lakes Unionid Database. Data sources included the primary literature, natural history museums, federal, provincial, and municipal government agencies (and some American agencies), conservation authorities, Remedial Action Plans for the Great Lakes Areas of Concern, university theses, and environmental consulting firms. Mussel collections held by six natural history museums in the Great Lakes region (Canadian Museum of Nature, Ohio State University Museum of Zoology, Royal Ontario Museum, University of Michigan Museum of Zoology, Rochester Museum and Science Center, and Buffalo Museum of Science) were the primary sources of information, accounting for over two-thirds of the data acquired. The database continues to be updated and now has over 6000 records of unionids from the lower Great Lakes drainage. One of us (J.L. Metcalfe-Smith) personally examined the collections held by the Royal Ontario Museum, University of Michigan Museum of Zoology and Buffalo Museum of Science, as well as smaller collections held by the Ontario Ministry of Natural Resources.