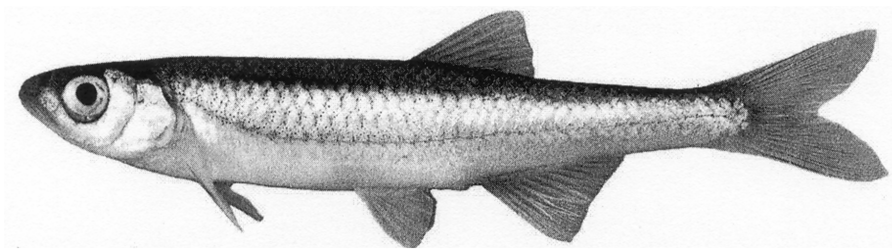
COSEWIC
Assessment and Update Status Report

on the

Carmine Shiner
Notropis percobromus

in Canada



THREATENED
2006

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 2006. COSEWIC assessment and update status report on the carmine shiner *Notropis percobromus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 29 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Previous reports

COSEWIC 2001. COSEWIC assessment and status report on the carmine shiner *Notropis percobromus* and rosyface shiner *Notropis rubellus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. v + 17 pp.

Houston, J. 1994. COSEWIC status report on the rosyface shiner *Notropis rubellus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-17 pp.

Production note:

COSEWIC would like to acknowledge D.B. Stewart for writing the update status report on the carmine shiner *Notropis percobromus* in Canada, prepared under contract with Environment Canada, overseen and edited by Robert Campbell, Co-chair, COSEWIC Freshwater Fishes Species Specialist Subcommittee.

In 1994 and again in 2001, COSEWIC assessed minnows belonging to the rosyface shiner species complex, including those in Manitoba, as rosyface shiner (*Notropis rubellus*).

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur la tête carminée (*Notropis percobromus*) au Canada – Mise à jour.

Cover illustration:
Carmine shiner — Carmine shiner from the Whitemouth River watershed in Manitoba (Photo courtesy of D. Watkinson, DFO, Winnipeg).

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COSEWIC
Assessment Summary

Assessment Summary – April 2006

Common name
Carmine shiner

Scientific name
Notropis percobromus

Status
Threatened

Reason for designation
This freshwater fish species occurs in an extremely restricted area of Manitoba. The major threat to the species is the alteration in water flow as a result of stream regulation.

Occurrence
Manitoba

Status history
Designated Special Concern in April 1994. Status re-examined and designated Threatened in November 2001 and in April 2006. Last assessment based on an update status report.

COSEWIC
Executive Summary

Carmine Shiner
Notropis percobromus

Species information

In 1994 and again in 2001, COSEWIC assessed minnows belonging to the rosyface shiner species complex, including those in Manitoba, as rosyface shiner (*Notropis rubellus*). In 2001, the Manitoba population was designated as “Threatened”, based on its disjunct distribution in relation to other populations of the species, its restricted range, and the species’ sensitivity to changes in water temperature and quality. Recent studies have shown that the fish found in Manitoba are not rosyface shiners but carmine shiners (*N. percobromus*), a species that has not been reported elsewhere in Canada. The name comes from the “carmine” colour developed in breeding individuals.

Distribution

This Manitoba population is disjunct from carmine shiner populations in northwestern Minnesota but, since 2001, its known distribution has been broadened from the Whitemouth River watershed to include the Bird River and Pinawa Channel of the Winnipeg River watershed downstream.

Habitat

In summer, carmine shiners in Manitoba are found mostly at midwater depths of clear, brown-coloured, fast flowing creeks and small rivers with clean gravel or rubble substrates, usually at the foot of riffles. Otherwise, their habitat requirements are unknown.

Biology

These slender, elongate minnows are omnivorous lower to mid-level consumers that spawn in early summer. Little else is known of their biology, life history, distribution, or abundance. Consequently, critical habitat cannot be identified, and too little is known of the species’ physiology or ability to adapt to different conditions to identify factors that might limit its recovery. Genetic (DNA) and morphological studies are underway to improve the ability to distinguish carmine shiners from other members of the rosyface shiner species complex.

Population sizes and trends/ limiting factors and threats

There is no evidence that the Manitoba population has declined over time, but because of its apparently limited distribution and abundance, the species may be sensitive to future anthropogenic disturbances. Threats to the species include: habitat loss/degradation, overexploitation, species introductions, and pollution. However, too little is known of the species' life history requirements and habitat use to assess the actual threats each may pose. Habitat loss and/or degradation associated with flow regulation, shoreline development, landscape changes and climate change is likely in some reaches of the rivers inhabited by carmine shiners and, at present, is probably the most significant threat to survival of these fish. Overexploitation probably is not a serious threat to the species as baitfish harvesters do not target it, and baitfishes are rarely harvested from habitats where carmine shiners have been found.

Special significance of the species

The species has no direct economic importance and limited importance as a forage species, but is of biological significance and scientific interest.

Existing protection

Carmine shiner critical habitat, once identified, would be afforded protection under the *Species at Risk Act* and under general provisions of the *Fisheries Act*, but it is not otherwise protected in Manitoba

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 5th 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 (2006)

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

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Canada

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

Update
COSEWIC Status Report

on the

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2006

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SPECIES INFORMATION

The taxon was first reviewed by COSEWIC as rosyface shiner (*Notropis rubellus*) (Houston 1996), but the Manitoba populations are now believed to be the carmine shiner (*N. percobromus*) (Wood *et al*. 2002; Stewart and Watkinson 2004; Nelson *et al*. 2004). The initial review by Houston (1996) summarized knowledge of both shiners, without differentiating between them. This update addresses only the carmine shiner.

Name and classification

Class:	Actinopterygii
Order:	Cypriniformes
Family	Cyprinidae
Genus	*Notropis*
Species*:	*Notropis percobromus* (Cope, 1871)
Common name:	English* carmine shiner
	French *tête carminée*

*Nelson *et al*. (2004)

The carmine shiner is a small minnow (F. Cyprinidae) of the genus *Notropis*, the second largest genus of freshwater fishes in North America. Many species in this genus are difficult to distinguish from one another and **phylogenetic relationships**[1] among them are largely unresolved (Dowling and Brown 1989). Recent **allozyme** studies support the existence of at least five species that had hitherto been recognized only as "rosyface shiners", including the rosyface shiner, highland shiner (*N. micropteryx*), rocky shiner (*N. suttkusi*), carmine shiner, and a species that has not yet been described (Wood *et al*. 2002).

Stewart and Watkinson (2004) accepted the carmine shiner as the identity of the Manitoba population(s) on the basis of the biogeographic information in Wood *et al*. (2002) and in conformity with Nelson *et al*. (2004). Ongoing morphometric (K.W. Stewart and D. Watkinson) and genetic studies (DNA; C. Wilson) have confirmed that Manitoba representatives of this "species complex" are carmine shiners, and that rosyface and carmine shiners are distinct species (W. Franzin, pers. comm. 2005).

Morphological description

Carmine shiners are slender, elongate minnows that can be distinguished from other minnows in Manitoba by the following features: 1) the origin of the dorsal fin is located behind a line drawn vertically from the insertion of the pelvic fins, 2) absence of a fleshy keel on the abdomen and of a strongly decurved lateral line, and 3) a narrowly conical snout that is equal in length, or nearly so, to their eye diameter, 4) 5-7 short gill rakers on the lower limb of the first gill arch, 5) the longest being about as long as the width of its base, and 6) 4 slender, hooked, main row pharyngeal teeth (Stewart and Watkinson 2004; K.W. Stewart, pers. comm. 2005) (Figure 1). The last four characters distinguish the

[1] Bold text defined in the glossary.

carmine shiner from the emerald shiner (*N. atherinoides*), with which it is often confused. The emerald shiner has a more blunt, rounded snout, usually only about 3/4 the length of the eye diameter; 8-12 gill rakers on the lower limb of the first arch, the length of longest being twice the width of its base; and four stouter, and only slightly hooked, pharyngeal teeth in the main row on each side (K.W. Stewart, pers. comm. 2005).

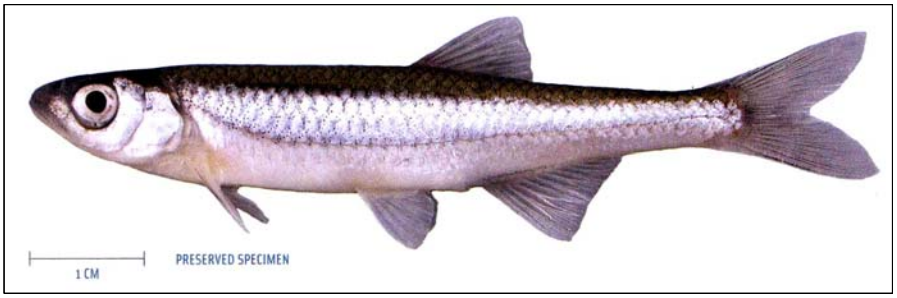

Figure 1. Carmine shiner from the Whitemouth River watershed in Manitoba (Photo courtesy of D. Watkinson, DFO, Winnipeg)

Outside of the breeding season, carmine shiners are olive green dorsally, silvery on the sides and silvery white on the belly (Scott and Crossman 1973). They have black pigment outlining the scale pockets dorsally, and freshly caught adult specimens often retain pinkish or rosy pigment on the opercula and cheek, which becomes more vivid and extensive during spawning. Fins are transparent. Breeding males develop fine, sandpaper-like nuptial tubercles on the head, on some predorsal scales, and on the upper surface of the pectoral fin rays.

Full development of spawning colour in the carmine shiner is ephemeral, and the colours also fade quickly after death and preservation. Males and females are both brilliantly marked when they are actively spawning. The following description is based on the spawning female in the photograph of Figure 2. Spawning fish of both sexes are olive dorsally and silvery laterally, with reddish colour on the snout, brilliant crimson on the upper portions of the operculum and the cheek, along all of the pectoral girdle and sides around the base of the pectoral fins, the lateral line back to the anal fin, and the bases of the pectoral, pelvic and caudal fins.

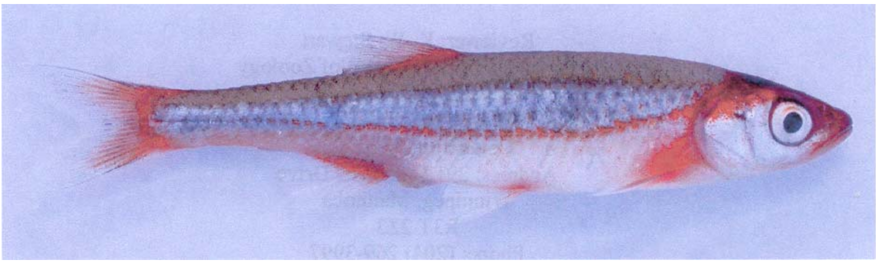

Figure 2. Spawning female carmine shiner collected 7 July 2005 from below Old Pinawa Dam, Pinawa Channel, Winnipeg River, Manitoba. Collection and photo by D.A. Watkinson.

Genetic description

The phylogeny of the rosyface shiner species complex, which includes the carmine shiner, is unresolved. Mayden and Matson (1988) and Dowling and Brown (1989) argued, on the basis of allozyme and mitochondrial DNA variation, respectively, for monophyly of the *N. rubellus* species group. Woods *et al*. (2002), who studied the population genetics and phylogenetics of 37 presumptive gene loci in 33 populations throughout the range of the *N. rubellus* species complex, disagreed. They still recognized a monophyletic *N. rubellus* species complex but analysis of their data suggested that the taxonomy then employed for *N. rubellus* did not reflect the patterns of genetic divergence, cladogenesis and phylogenetic affinity within the species group, or between members of this group and other closely related species. Instead, it supported the existence of at least five species that had hitherto been recognized under *N. rubellus*, including a species that has not yet been described, recently described *N. suttkusi* (rocky shiner), and three allopatrically distributed species. The latter include *N. rubellus* (rosyface shiner), *N. micropteryx* (highland shiner), and *N. percobromus* (carmine shiner).

Ongoing studies have confirmed that the carmine and rosyface shiners are separate taxa, as is the emerald shiner, based on both mitochondrial (ATPase 6 and 8 genes) and nuclear (rRNA ITS-1) DNA sequences (C. Wilson, pers. comm. 2005). Research is continuing to identify sequence differences that can be easily detected with restriction enzymes. These studies show that the fish in Manitoba are carmine shiners, like those to the south, and not rosyface shiners like those in eastern Canada.

Designatable units

Populations of carmine shiner described herein represent the only known occurrence of this taxon in Canada, they occupy a single ecoregion as recognized by COSEWIC, and there is no evidence of relevant differentiation below the species level. Thus, there are no designatable units within this species in Canada.

DISTRIBUTION

Global range

The rosyface shiner species complex is distributed widely throughout highland and glaciated regions of eastern North America (Wood *et al*. 2002). The distributions of species that comprise the complex are shown in Figure 3. It was suggested that only one species of the complex, *N. percobromus*, occurs west of Lake Michigan and south of Lake Superior, contrary to Wood *et al*. (2002), who suggested some *N. rubellus* occur west of Lake Michigan (W. Franzin, pers. comm. 2005). Recent genetic results (C. Wilson, pers. comm. 2005) show that *N. rubellus* is present in the Lake Michigan watershed in Wisconsin, as is *N. percobromus* (Little Wolf River). *N. rubellus* is also present in the Fox River basin – Mississippi River drainage location.

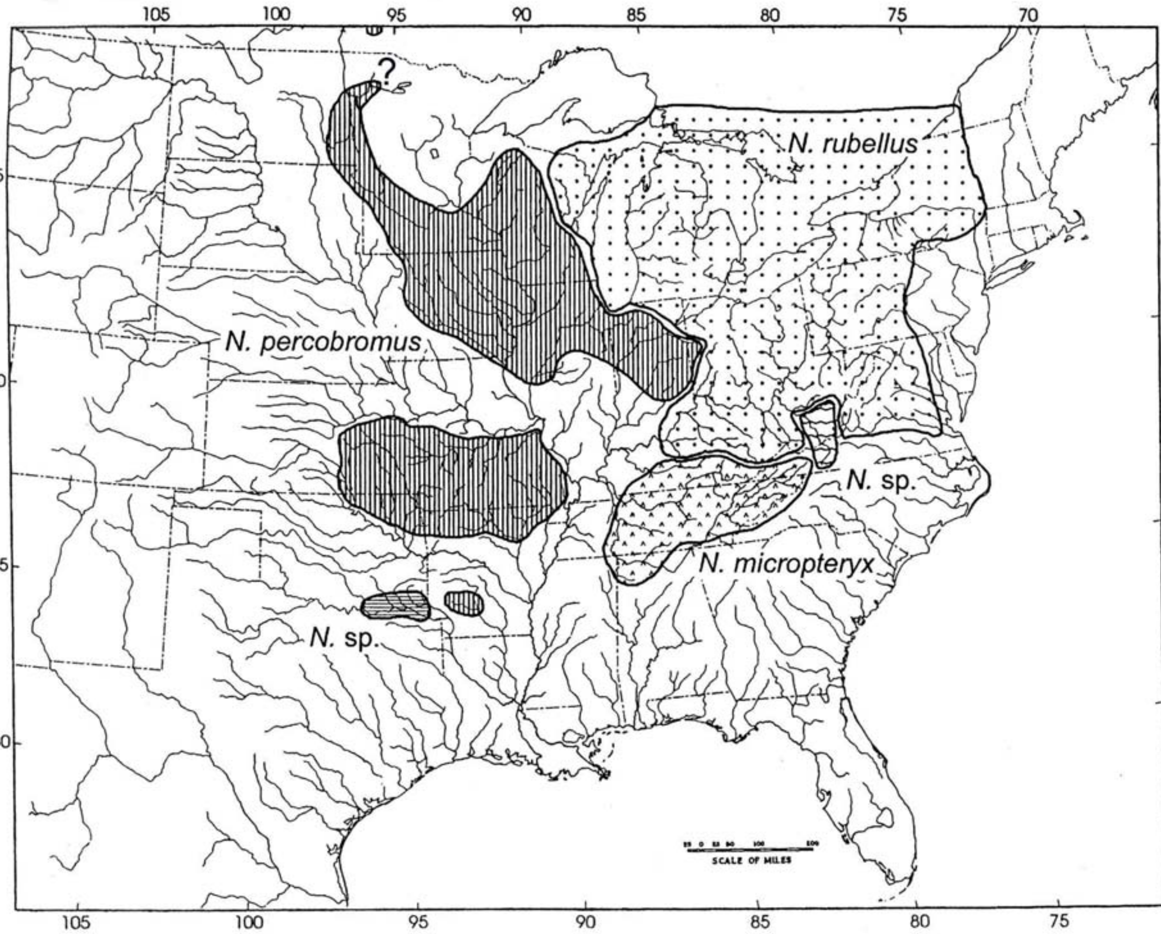

Figure 3. Hypothesized geographical distributions of species in the *Notropis rubellus* species complex based on geographical variation of allozyme products (modified from Wood *et al*. 2002).

The existence of various distinct forms within *N. percobromus* supported by morphological and allozyme characters and phylogenetic analyses of allozyme data may eventually warrant taxonomic recognition (Wood *et al*. 2002). Since populations in the Whitemouth and Winnipeg rivers are apparently disjunct from those in the Red River and elsewhere, and were likely isolated there by isostatic rebound elevations, thereby breaching drainage connections with the Whitemouth watershed and the Red lakes watershed in Minnesota, taxonomic revision could affect Manitoba populations.

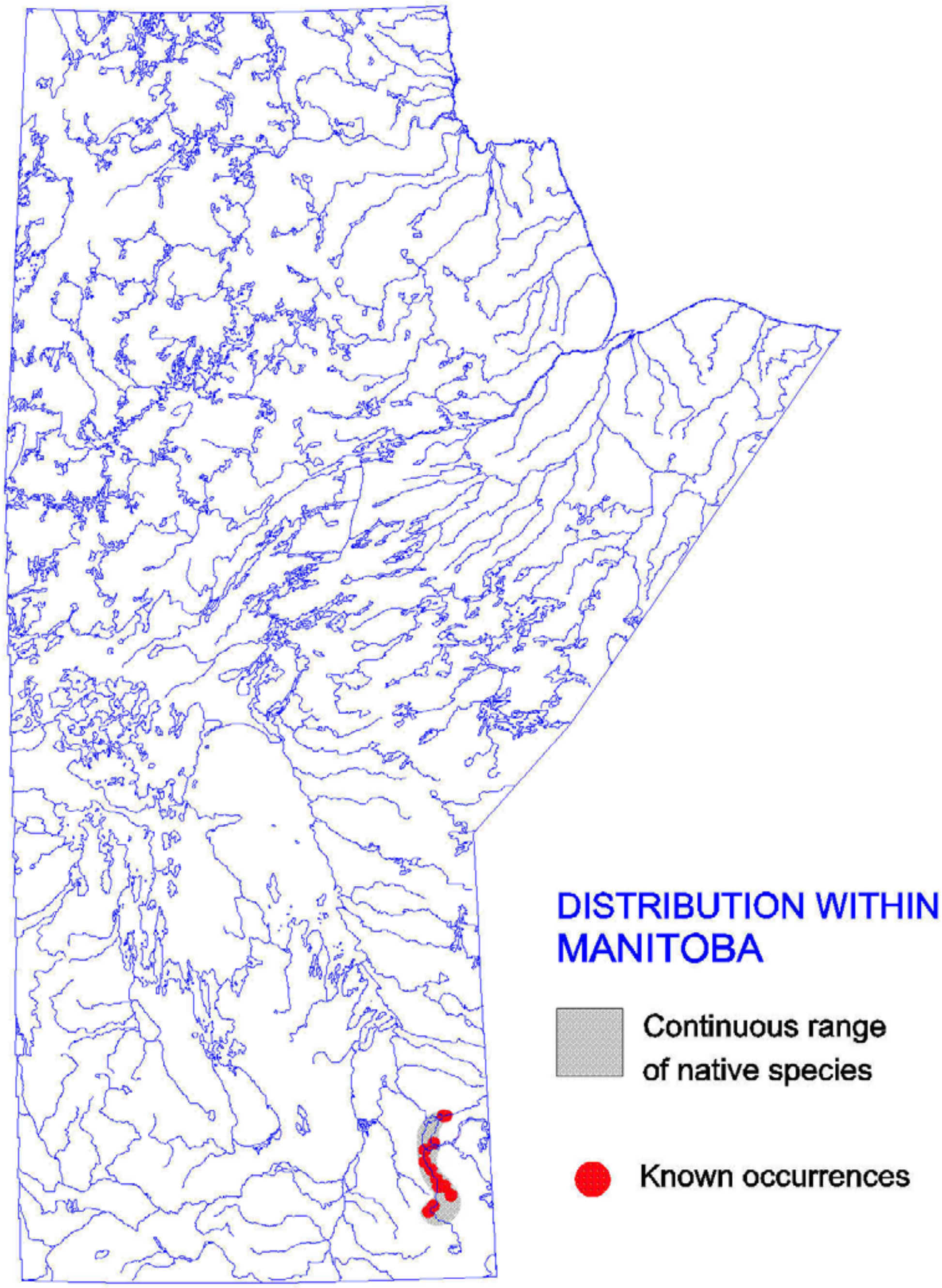

Figure 4. Distribution of the carmine shiner in Manitoba (courtesy of D. Watkinson, DFO, Winnipeg).

When the rosyface shiner was first reviewed for COSEWIC, Canadian representatives of this complex were identified as *N. rubellus*, and the Manitoba population was thought to be isolated in the Whitemouth River system (Houston 1996). New information suggests that neither of these assessments is valid. Genetic studies have identified the Manitoba fish as *N. percobromus*, and those to the east of Lake Superior in southwestern Ontario as *N. rubellus* (Wood *et al*. 2002; W. Franzin, pers. comm. 2005). Recent collecting efforts have also extended the known distribution of the Manitoba population to include the Old Pinawa Channel, a branch of the Winnipeg River, and the Bird River, a tributary to the Winnipeg River. Both of these, like the Whitemouth River, join the Winnipeg River in the reach bounded by Seven Sisters Falls upstream and MacArthur Falls downstream (Stewart and Watkinson 2004; K. Stewart pers. comm. 2006).

Canadian range

Within Canada, the carmine shiner has only recently been reported from the Province of Manitoba, where it is at the northwestern limit of the species' range (Figure 4). The species' presence in the Winnipeg River upstream of insurmountable barriers, and its apparent absence from the lower Red River and Lake Winnipeg, suggest that colonization may have been via a post-glacial connection with the headwaters of the Red Lake River in Minnesota, a dispersal track that is shared with the hornyhead chub (*Nocomis biguttatus*) and the fluted shell mussel (*Lasmigona costata*) (Clarke 1981; K.W. Stewart, pers. comm. 2004). Alternatively, colonization may have been via dispersal into the Rainy River watershed from Upper Mississippi headwaters in northwestern Minnesota, a dispersal track shared by five other fish species in southern Manitoba.

Houston (1996) reported the distribution of the carmine shiner only from the Whitemouth River and its tributary the Birch River (J.J. Keleher ROM 17539; Smart 1979; Houston 1996). More recent sampling (Figure 5) has extended that range with additional specimens collected from the Whitemouth River, from its tributaries the Birch and Little Birch rivers, and from the Winnipeg River immediately below Whitemouth Falls (Clarke 1998; Stewart and Watkinson 2004; D. Watkinson, pers. comm. 2004). Specimens were also collected from the Winnipeg River in the Pinawa Channel immediately below the Old Pinawa Dam, from the Bird River at the first set of rapids upstream from Lac du Bonnet (Winnipeg River mainstem lake) and at the mouth of Peterson Creek, a Bird River tributary. All of these new reports are from reaches of the Winnipeg River system downstream of the Whitemouth River outlet. An historical report of carmine shiners further upstream on the Winnipeg River system, in Lake of the Woods (Evermann and Goldsborough 1907), has not been verified. The nearest known *Notropis percobromus* population to the Whitemouth River watershed in Manitoba is found in the Lost River tributary of the Red Lakes River watershed (Red River drainage) in northwestern Minnesota.

Stewart and Watkinson (2004) reported carmine shiners from Forbes Creek, a tributary of George Lake, and from Tie Creek, the outlet to George Lake, which discharges into the Winnipeg River upstream from the confluence of the Whitemouth and Winnipeg rivers. On re-examination, these fish proved to be emerald shiners (K.W. Stewart, pers. comm. 2005).

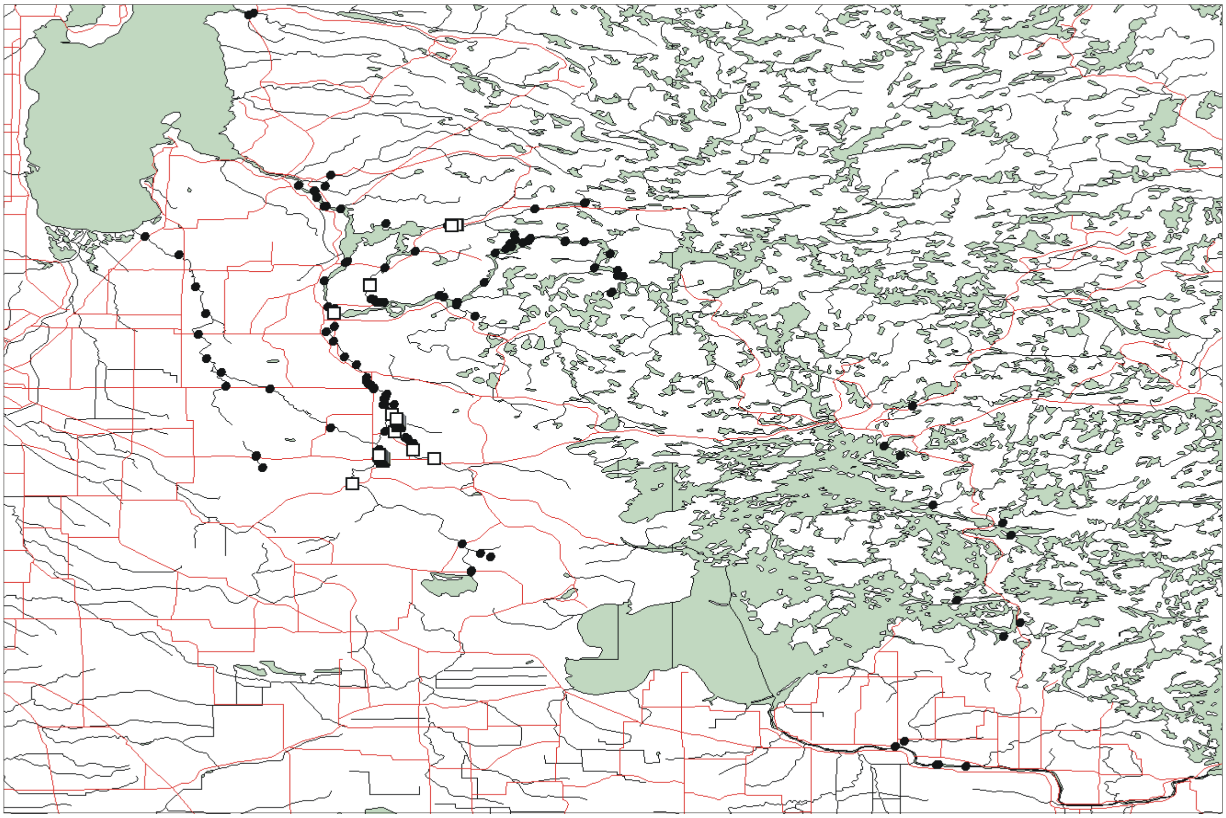

Figure 5. The distribution of fish collection sites (●) and sites where carmine shiners were captured (□) in 2002-2005 in the Whitemouth and Winnipeg river watersheds within Manitoba and northwestern Ontario. Over 326 locations in the Winnipeg River and Lake of the Woods watersheds have been sampled, not including repeat sampling in the same location at different dates from 2002-2005. A further 36 locations that are Lake Winnipeg watersheds separate from the Winnipeg River have been sampled in an attempt to expand their known distribution with no success (2002-2004). The majority of this sampling has been conducted with boat electroshocker equipment.

The extent of occurrence and area of occupancy of the carmine shiner in Canada are estimated at 120 km² and 3.4 km², respectively (Table 1). These area estimates are for the surface of the waterbodies, and are rough approximations since there has been very little directed sampling for these fish, and they are difficult to differentiate from emerald shiners.

HABITAT

Habitat requirements

The habitat requirements and life history of carmine shiner are not well known, as most work on the species complex has been conducted outside its range in areas inhabited by the rosyface shiner (Pfeiffer 1955; Reed 1957a, 1957b).

Table 1. Area of occupancy and extent of occurrence.

Area of Occupancy (based on data in Smart 1979 and Schneider Vieira and MacDonell 1993):

Length (m)	Width (m)	Area (sq km)	
21000	56	1.176	Whitemouth River (lower course)
74000	27	1.998	Whitemouth River (middle course)
19000	14	0.266	Birch River
	Total:	3.44	sq km

Extent of Occurrence (area integrated on http://geoapp2.gov.mb.ca/website/MAFRI/index3.html):

		Area (sq km)	
		3.44	Area of Occupancy
3691.5	acres =	14.94	Winnipeg River (Seven Sisters to PR 313)
25275.0	acres =	102.28	Lac du Bonnet (bounded by PR 313, McArthur Falls, Bird River, Rice Creek, Old Pinawa Dam)
	Total:	120.66	sq km

In Manitoba, during the summer, carmine shiners are typically found at midwater depths in clear, brown-coloured, fast flowing creeks and small rivers with clean gravel or rubble substrates, usually in or near riffles (Smart 1979; D. Watkinson, pers. comm. 2004). They are not known to migrate but may move into deeper pools and eddies in winter, and are sometimes present in lakes near stream mouths. The species' apparent absence from the lower Red River, between Grand Forks and Lake Winnipeg, suggests that turbidity and fine sediment substrates may limit dispersal. These minnows may be intolerant of sustained turbidity (Trautman 1957; Becker 1983), but can tolerate pulses of turbidity in the Whitemouth River watershed associated with natural flood events (Stewart and Watkinson 2004).

Smart (1979) captured carmine shiners at 15 of 18 midcourse sites sampled on the Whitemouth River, and at 2 of 12 sites sampled on the lower 19 km of the Birch River. The channel of the midcourse reach of the Whitemouth River is gently winding and ranges in width from 18 to 36 m with sand, pebble, and cobble bottom substrate and numerous riffles. The channel of the lower Birch River is similar, but relatively straight. Carmine shiners were not caught in the headwaters, lower course, or other tributaries of the Whitemouth where the bottom substrate was silt and there were fewer riffles. More recent sampling has found them in the lower reaches of the Whitemouth River, in flowing water less than 3 m deep over primary bottom substrates ranging from sand, gravel, and cobble to bedrock (D. Watkinson, pers. comm. 2004). Similar habitats are available in the Pinawa Channel at riffles above the Old Pinawa Dam.

During periods of heavy runoff, rosyface shiners in Ontario will retreat to the slower-flowing edges of flooded rivers and onto the floodplain (Baldwin 1983). While it has not been observed, carmine shiners in Manitoba may show similar behaviour. Where they are available, flooded habitats may offer additional food resources and better feeding opportunities during periods of high turbidity. Their use may also lead to mortality by stranding. Wintering habitats are not well known for either the rosyface or carmine shiners. In Ontario, rosyface shiners occupy deeper pools during the winter, where they are believed to remain inactive (Baldwin 1983).

Data are not available on the habitat preferences of young-of-the-year carmine shiners. However, Baldwin (1983) caught young-of-the-year rosyface shiners in pool habitats that were relatively turbid in summer and clearer in the autumn. These fish were concentrated in areas with less than 5% plant cover of the bottom substrates and partially forested shores.

The restricted distribution of carmine shiners in Manitoba, and the warm-water adaptation of all species of the *N. rubellus* complex, suggests that the carmine shiner is a relatively recent colonizer (Houston 1996) that reached the Hudson Bay Drainage from the Upper Mississippi watershed lake after glacial recession and the drainage of Lake Agassiz, possibly as recently as within the last thousand years. Dispersal into the headwaters of the Red River in northwestern Minnesota is demonstrated by the occurrence of the species there (Koel 1997). They may also have reached Rainy River headwaters adjacent to the Upper Mississippi watershed, as there is an early report of the species from Lake of the Woods (Evermann and Goldsborough 1907). These specimens should be re-examined, if available, to determine whether their identification is correct [they are probably *N. atherinoides* (K. Stewart, pers. comm. 2006)]. The absence of records of *N. rubellus* complex fish from the upper Mississippi watershed in northern Minnesota, however, suggests that the species may not occur upstream of the Whitemouth and Winnipeg rivers in the Hudson Bay Drainage.

Based on existing information, the Carmine Shiner Recovery Team (2005) was unable to reliably identify critical habitat necessary for the survival or recovery of the carmine shiner. Little is known of when or where spawning occurs; the location of nursery, rearing, feeding or food supply areas; and the timing or extent of migrations, should they occur. Adults do frequent shallow riffles with clear water and clean gravel or stone bottom in the Whitemouth River, but it is not known whether these habitats are critical to the species' continued existence. They have been collected in a wider range of habitats elsewhere in the Winnipeg River system.

Habitat trends and limitations

Without specific information on the habitat requirements of the carmine shiner it is not possible at present to assess trends in their habitat, and limitations to their habitat use.

Habitat protection/ownership

The *Species at Risk Act* (Ss.58.1) prohibits the destruction of any part of critical habitat identified for any listed endangered, threatened or extirpated wildlife species. As yet, critical habitat for the carmine shiner has not been identified, so specific legal protection for critical habitat cannot be afforded through SARA at this time (Carmine Shiner Recovery Team 2005). The *Manitoba Endangered Species Act* protects the habitat of species that are listed by Manitoba, but carmine shiner has not yet been listed. Other existing federal and provincial statutes and policies may provide protection to the fish habitat in general.

Federally, the *Fisheries Act* (R.S. 1985, c. F-14) prohibits the harmful alteration, disruption or destruction of fish habitat (S.35) except as authorized by the minister and similarly prohibits the deposit of deleterious substances into waters frequented by fish (i.e., fish habitat) (Ss.36.3). The *Canadian Environmental Assessment Act (CEAA)* ensures that all federal regulatory actions including authorizing the destruction of fish habitat are vetted through an appropriate environmental review with consideration of species at risk.

Provincially, a 130-ha headwater section of the Whitemouth River that was designated as Ecological Reserve in 1986 to protect river-bottom forest may also provide some incidental protection for carmine shiner habitat (Hamel 2003).

BIOLOGY

Information on the carmine shiner is limited and somewhat confused, since many studies of the rosyface shiner species complex were conducted on eastern populations before the western populations were recognized as a distinct species (i.e., carmine shiner). The COSEWIC review by Houston (1996) included information on both species, as did Becker (1983). To avoid this problem, surrogate information from the closely related rosyface shiner is presented only where there is no information for the carmine shiner.

Growth

The growth and age structure of carmine shiner populations in Manitoba is unknown, as is the species' longevity. In New York State, rosyface shiners live to age 3 years with fewer males than females attaining that age (Pfeiffer 1955). Whether carmine shiners at the northern fringe of their distribution are slower to mature and longer lived than the more southerly rosyface shiners in New York State is unknown. The spawning frequency of individuals in northern populations is also unknown.

Life cycle and reproduction

In Manitoba, carmine shiners have only been observed in spawning condition below the Old Pinawa Dam, where a single ripe and running female was captured on 7 July

2004 in water that was 19.3ºC (D. Watkinson, pers. comm. 2004). Little is known of the species' spawning habits and reproductive potential in Canada. Their habits are probably similar to those of the rosyface shiner. Spawning of carmine shiners in the southern part of their range and of rosyface shiners in Great Lakes watersheds typically occurs in riffles in May and June at temperatures of 20 to 28.9ºC (Starrett 1951; Pfeiffer 1955; Reed 1957a; Miller 1964; Pflieger 1975; Baldwin 1983; Becker 1983). The presence of adult rosyface shiners in spawning colours or with ripe gonads suggests that the actual spawning period in Ontario may extend from early May through mid-July (Baldwin 1983). Cold spring weather will delay the spawning of rosyface shiners (Reed 1957a), and in the Des Moines River, Iowa, populations of early spawning species—including carmine shiners—may be limited by normal high river stages in May and June (Starrett 1951). Further south, in Missouri, carmine shiners spawn from mid-April to early July, with the peak of activity in May and early June (Pflieger 1975). However, these observations of more southerly populations may not be directly applicable to Manitoba.

During spawning, schools of rosyface shiners break up into groups of 8 to 20 fish that spawn over depressions in the gravel (Pfeiffer 1955; Miller 1964). Often, these depressions are nests constructed by other cyprinids, such as the hornyhead chub and creek chub (*Semotilus atromaculatus*) (Miller 1964; Vives 1989), and some are also occupied by the common shiner (*Luxilus cornutus*) (Reed 1957a; Miller 1964; Baldwin 1983; Vives 1989). Spawning by rosyface shiner was described by Pfeiffer (1955) and Miller (1964). Hermaphroditism has been found among rosyface shiners in Pennsylvania (Reed 1954), and may also occur among carmine shiners in Manitoba (K.W. Stewart, pers. comm. 2005).

The number of eggs per female in rosyface shiner increases with size and age (Pfeiffer 1955). On average, a year-old female (age of maturation) contains 600 eggs (n=10, range 450-754), a 2-year old 1090 eggs (n=10, range 675-1460), and a 3-year old 1175 eggs (n=8, range 783-1482). Unfertilized eggs are spherical and dull grey (Reed 1958). They are 1.2 mm in diameter within the female and expand to 1.5 mm on contact with water. Fertilized eggs turn bright yellow and become water-hardened and adhesive. At 21.1ºC (70ºF) they hatch in 57 to 59 hours. Newly hatched larvae take cover in the interstices of bottom gravel (Pfeiffer 1955), presumably until yolk absorption is complete. Reed (1958) described the major stages of egg development and illustrated a newly hatched larva.

Hybridization of the carmine shiner with other species of *Notropis* has not been described but is likely given that the rosyface shiner hybridizes naturally with several species including common shiner (Raney 1940; Pfeiffer 1955; Miller 1964), mimic shiner (*N. volucellus*; Bailey and Gilbert 1960), and striped shiner (*Luxilus chrysocephalus*; Thoma and Rankin 1988).

Diet

Carmine shiners in Canada probably are omnivorous, lower to mid-level consumers like southern populations of the species in the Ozarks (Hoover 1989) and the rosyface shiner in New York (Pfeiffer 1955; Reed 1957b). Aquatic insects, particularly caddisfly larvae, constituted the bulk of the diet of these fishes, but they also consume terrestrial insects, fish eggs, algae, diatoms, and inorganic material. The young-of-the-year prefer algae and diatoms to insects. Competition for prey among minnow species in an Ozark stream led to greater dietary specialization by carmine shiners on midges (Chironomidae) (Hoover 1989). The breadth of their diet decreased in the presence of smallmouth bass (*Micropterus dolomieu*) and increased at higher light levels, which indicates that prey are located by sight. In the Whitemouth River, surface insects seem to be the dominant food type and carmine shiners have been observed rising to the surface, apparently to feed (K.W. Stewart, pers. comm. 2006).

Physiology

Little is known of the physiology of the carmine shiner. Rosyface shiners in southwest Virginia avoid chlorine in water and do not acclimate to continued exposure (Cherry *et al*. 1977). Their response threshold varies with water temperature and pH and is correlated with the hypochlorous fraction of the residual chlorine. If the carmine shiner responds similarly, it may also show continued avoidance of other pollutants. Rosyface shiners in Virginia (New River) may also avoid water temperatures that exceed 27.2ºC (Stauffer *et al*. 1975). The responses of the carmine shiner to temperature are unknown, but are presumed to similar to those of the rosyface shiner.

Dispersal/migration

Carmine shiners are not known to migrate, although they likely move into deeper water to winter. In the Whitemouth River, individuals may be dispersed downstream or into nearby ponds by flash floods caused by heavy rainfall. Their natural predisposition to disperse is unknown. The species’ apparent absence from the lower Red River, between Grand Forks and Lake Winnipeg, suggests that turbidity may limit dispersal. However, this does not mean they cannot use turbid rivers for dispersal. The detailed distribution of both carmine and rosyface shiners suggests that they disperse via large lakes and rivers, but colonize and establish in tributaries to these waters, occupying them to the first impassable obstacle upstream from the mouth. One means of dispersing via normally turbid rivers would be do so in the winter when reduction in flows resulting from surface freeze-up results in clearer water flowing beneath the ice (K.W. Stewart, pers. comm. 2006).

Interspecific interactions

Little is known of the predators, parasites, and diseases of the carmine shiner. Carmine shiners are likely preyed upon mostly by larger fishes and fish-eating birds. Their eggs may be eaten by darters, suckers, common carp (*Cyprinus carpio*), and minnows—similar to the rosyface shiner (Reed 1957a; Baldwin 1983).

Parasites and diseases of carmine shiners in Manitoba have not been studied. Hoffman (1970:358) listed six species of trematodes and one nematode (*Spiroxys* sp.)

that infest *N. rubellus* in North American waters. This short list likely reflects limited sampling effort rather than few parasite species, since many more species have been found in *L. cornutus* (see Hoffman 1970:356).

Adaptability

The species' ability to adapt to different conditions is unknown. It appears to occupy a relatively narrow ecological niche i.e., mid-water depths of brown coloured, fast flowing streams at the foot of ripples, which suggests limited adaptive ability.

POPULATION SIZES AND TRENDS

Abundance

Prior to its designation by COSEWIC, the carmine shiner had only been reported incidentally (e.g., Smart 1979). Since then, directed samplings have extended its known range (Stewart and Watkinson 2004). The species is present, but not abundant in the midcourse reach of the Whitemouth River (Smart 1979). The lack of information on its distribution and abundance may be an artifact of limited sampling, and of confusion with the emerald shiner.

Fluctuations and trends

Unknown.

Rescue effect

Rapids and falls, now largely replaced by hydroelectric dams, have partitioned fish habitat in the Winnipeg River mainstem, and falls at the mouth of the Whitemouth River prevent its re-colonization from the Winnipeg River. These barriers significantly reduce any natural rescue potential for the species. In addition, the original dispersal route, presumed to be from the Red Lakes area of Minnesota, may no longer be available (see Distribution above). The percentage of the global range of the carmine shiner in Canada remains uncertain pending additional sampling in the Winnipeg River and Lake Winnipeg watersheds and genetic studies to clarify the relationship between these fish and other members of the *Notropis rubellus* species complex.

LIMITING FACTORS AND THREATS

Limiting factors

Too little is known of the carmine shiner's physiology or ability to adapt to different conditions to identify factors that might limit its survival. The species appears to occupy a relatively narrow ecological niche, which suggests limited adaptive ability. If the carmine shiner's responses are similar to those of the closely related rosyface shiner, it may show long-term avoidance of pollutants (Cherry *et al*. 1977) and avoid water temperatures that exceed 27.2ºC (Stauffer *et al*. 1975). Some other factors that may be important include: the availability of key prey species, predation by other species, competition with other minnows for preferred habitat, diseases and parasites, and hybridization with other shiner species.

Manitoba Aquatic Ecosystem biologists, who are familiar with the carmine shiner, indicate that some or all of the limiting factors/threats listed below are occurring throughout the carmine shiner range (Whitemouth River, Bird River and Pinawa Channel, including the Birch River), and have been documented by Schneider-Vieira and MacDonell (1993) and Clarke (1998). Dams, weirs, and natural falls are also impacts found in the range. The actual severity of the impacts is hard to determine as specific studies have not been done, but the extent of occurrence of these impacts (in the carmine shiner range) is considered to be in the high to medium range (M. Erickson, Manitoba Water Stewardship, Winnipeg, Manitoba, pers. comm. 2006).

Threats

Carmine shiners spawn in relatively warm, clear water and frequent shallow flowing water with clean rocky substrates. They may be limited to habitats that offer these conditions, and threatened by activities that alter the turbidity or flow. The closely related rosyface shiner has a narrow range of habitat requirements and responds quickly to changes in habitat and water quality (Smith 1979; Trautman 1981; Humphries and Cashner 1994; Houston 1996). The carmine shiner may show a similar response. Flow impoundment, farmland drainage that increases sediment loads, streambed gravel removal, and stream channelization are examples of activities that have been implicated in the decline or disappearance of the rosyface shiner from streams. Increased bank erosion and consequent siltation probably have negative effects on their eggs, fry, and food supply.

The Carmine Shiner Recovery Team (2005) undertook a detailed threats assessment for each waterbody where the species is known to occur. Four primary categories of threat were identified: habitat loss/degradation, overexploitation, species introductions, and pollution.

<u>Habitat loss/degradation</u>

Habitat loss and/or degradation associated with flow regulation, shoreline development, landscape changes and climate change is likely in some reaches of the rivers inhabited by carmine shiners, and may pose a threat to the species. At present it is probably the most significant threat to survival of the carmine shiners, but is difficult to assess given the uncertainties in the species' distribution and life history requirements.

Because carmine shiners frequent shallow riffles with clear water in summer, flow alterations that affect these conditions may pose a threat to their existence.

Hydroelectric development has altered flow in the Winnipeg River. Development on the river mainstem began in 1909 at Pointe du bois, and ended in 1955 with the completion of the station at McArthur Falls (http://www.hydro.mb.ca). These stations are still in operation and are unlikely to be removed in the foreseeable future. Another station on the Pinawa Channel was completed in 1906. It was retired in 1951 and has been partially razed. These developments impounded reaches of the river creating forebays, flooding vegetation, and eliminating rapids. Whether these changes increased turbidity and decreased riffle habitat sufficiently to cause a decline in the abundance of carmine shiners in the system is unknown. Over time the turbidity will decrease as flooded shorelines naturalize.

Other activities such as land drainage for farming, highways, and peat extraction; the installation of weirs and river crossings; and removal of nearby vegetation for forestry or agriculture may also affect drainage and thereby flow patterns. The effects of many of these activities on shorelines and runoff can be mitigated. Water removal for domestic use, lawn or agricultural irrigation and for watering livestock can also reduce flow, particularly during dry years.

Peat moss mining occurs in reaches of the watershed upstream from the area known to have carmine shiners. The concern is what effect peat moss removal will have on the hydrography and turbidity of the river. How extensive can peat moss removal be before water storage capacity in the peat is sufficiently reduced so that the stream, or some of its tributaries, become at risk for flash-floods as a result of heavy rainfalls? Similarly, how much can the storage capacity be reduced before the stream is at risk from low flows during dry years? How important is winter water discharge from peatlands in maintaining sufficient flows to keep some open water in rapid or riffle sections, and hence, keep enough oxygen in the water for winter survival? The present operations may not constitute a threat to the biota of the Whitemouth River, but, as "the thin edge of the wedge", they do present a potential future threat, for which more information is needed to assess its importance.

In the past (up to the middle 1990s) water has been drawn from the Whitemouth and other southeastern Manitoba rivers during the winter for pressure testing of sections of newly constructed or repaired pipelines which transect them. The threat, in this case may arise from two areas. First is the abrupt, and large in relation to typical winter natural discharge, change in flows in the affected stream. Increased flow in a recipient stream may break up ice cover, scour the stream bottom, and erode banks, all of which would lead to large increases in turbidity that fish could not avoid under winter conditions. Decreased flow in a donor stream could be so great over the span of a week or more, that instream flow could be interrupted, or nearly so, resulting in shallow areas freezing to the bottom and pools in which fish might survive. Finally, since the water used in these tests is not treated or filtered, the recipient stream could be colonized by exotics, if any occur in the source area. There have been proposals that would involve transfer of water from the Great Lakes to the Brokenhead River; the risk of transfer of exotics is a real hazard (K.W. Stewart, pers. comm. 2006).

Development of the shoreline in areas that provide spawning habitat for carmine shiners, or immediately upstream, could adversely affect spawning habitats by causing physical disturbances or changes in water quality. Clearing of riparian forest to the water's edge for cottage or agricultural development, for example, can destabilize banks and increase erosion. Allowing livestock access to the river's edge can also disturb habitats and increase silt and nutrient loading, as can ditching and drainage for local highways. Indeed, most of these effects have been documented along the lower Birch River (Schneider-Vieira and MacDonell 1993; Clarke 1998).

Forestry, agriculture, peat extraction, and highway development all have the potential to change landscapes in ways that alter the patterns and quality of runoff entering waters that support carmine shiners. These changes include, in particular, the removal of vegetation, grading of overburden, drainage of wetlands, and the construction of barriers (e.g., roads) and ditches.

The effects of climate change on carmine shiners are unpredictable. These effects may be positive or negative depending on the direction, extent, and timing of any changes in water temperature and hydrology that affect the species' habitats. Areas like the Birch River, where low flow and low oxygen conditions already occur in summer and winter (Clarke 1998), may be the most vulnerable to any changes.

Overexploitation

Bait fishing operations may harvest some carmine shiners, but currently the degree of threat to this species is not known. Commercial bait fishing operations are regulated and require a licence. To prevent the spread of undesirable aquatic species, Manitoba Water Stewardship must approve waters for live bait harvest. There are commercial bait fishing allocations in most areas where carmine shiners have been found, but the harvest from specific waters is unknown (B. Scaife, pers. comm. 2004). Licensed commercial bait fishermen may harvest fish for dead bait use from any Crown water on their allocation. Licensed anglers may harvest baitfish for their own use from any Crown water, although live baitfish may be harvested only where live bait use is permitted. Anglers may not transport live baitfish away from the waters in which they were caught.

Most of the commercial baitfish harvest in southeastern Manitoba is directed at collecting fish for sale as live bait (B. Scaife, pers. comm. 2004). The Whitemouth and Bird rivers are both approved for live baitfish harvest. However, most live bait harvest is directed at non-shiner species, which are hardier, have a higher survival rate, and frequent different habitat from shiners. While the use of live traps allows for sorting and release, carmine shiners are difficult for fishermen to identify and easily damaged by handling. Bait fishermen with allocations in the Whitemouth and Bird rivers have not indicated any frozen production on their annual production report forms.

Bait harvesting is of greater concern in areas where baitfish can be harvested only for use as dead bait (e.g., Winnipeg River), since shiners are generally the targeted species. The gear used for these harvests (e.g., seines) is more likely to kill or harm the bait fish than that used for live-capture, but these methods are seldom used in the medium to small stream habitats where carmine shiners are found (K.W. Stewart, pers. comm. 2004).

Despite the regulations, carmine shiners may be inadvertently collected along with other species for bait. Even in cases where the collector is able to identify the species, released individuals are not liable to survive. However, the extent of such collecting is not currently known.

Species introductions

Species introductions could pose a threat to carmine shiner populations through predation, competition and food chain disruption. They might also carry diseases and parasites that are new to carmine shiner populations and could adversely affect them.

Possible sources of introductions are in water released from the hydrostatic testing of pipelines in the Whitemouth watershed, as live-bait used by anglers, and through the introduction of game fish. The import of live bait into Canada is illegal and should be strictly enforced by Canada Customs. Walleye (*Sander vitreus*) have been stocked in Whitemouth Lake since 1960, and brook trout (*Salvelinus fontinalis*) were stocked there in 1961-62 (D. Leroux, pers. comm. 2005; see also http://www.gov.mb.ca/conservation/fish/). The Birch River has been stocked with rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), and walleye with poor survival (Clarke 1998). Brown trout have been stocked in the Pinawa Channel. Smallmouth bass and rainbow smelt (*Osmerus mordax*) have been introduced to the Winnipeg River system. The effects of these piscivores on carmine shiner populations are unknown, although elsewhere smallmouth bass and carmine shiners do coexist. The potential for transfer of species from the Lake of the Woods watershed via overland drainage exists but is limited at present by beaver dams and bogs.

Pollution

Some pollutants that could affect the species include farm fertilizers, herbicides, and pesticides. Nutrient enrichment by runoff from barnyards or intensive livestock operations is an ongoing problem that is being addressed by the Province of Manitoba and the Prairie Farm Rehabilitation Administration. Clarke (1998) found elevated levels of phosphorus ($0.2\ mg\cdot L^{-1}$ TDP) and nitrogen ($0.99\ mg\cdot L^{-1}$ nitrate/nitrite) in the lower Birch River in April 1996, but not at other times of the year. These levels are probably elevated through mobilization of agricultural chemicals by spring runoff. Before leaks were repaired, the Birch River also received chlorinated water leaking from the Winnipeg Aqueduct (Clarke 1998).

Other threats

Scientific sampling may also pose a threat to the carmine shiner. However, there has been no evidence of reduction in range or abundance of carmine shiners in

Manitoba over the past twenty years, during which there has been regular sampling of the Whitemouth River populations.

Natural hybridization may occur between carmine shiners and other shiners in Manitoba. A substantial decline in the proportion of carmine shiners on the spawning grounds might lead to decreases in reproductive success or complete assimilation of the carmine shiner populations. Given the genetic separation now demonstrated between the *Notropis rubellus* species complex and other cyprinids this is unlikely (K.W. Stewart, pers. comm. 2006).

SPECIAL SIGNIFICANCE OF THE SPECIES

The carmine shiner has no direct economic importance and limited importance as a forage species, but is of scientific interest (Scott and Crossman 1973; Houston 1996; Stewart and Watkinson 2004). It does have intrinsic value as a contributor to Canada's biodiversity and as a potential colonizing species. As peripheral populations, at the northwestern limit of the distribution of the species, and the *N. rubellus* complex, which are geographically isolated from their nearest neighbours in Minnesota, those in Manitoba may be unique and provide evidence of local adaptation to their habitat and genetic differentiation from other populations of the species (Stewart and Watkinson 2004). They may constitute a significant component of the genetic diversity of the species. Scientific studies of these populations might improve our understanding of the timing and routes of post-glacial re-colonization of Manitoba by fishes (Houston 1996). They may also provide evidence of genetic adaptation near the limit of a species' distribution.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

When the Manitoba population of carmine shiner, formerly called rosyface shiner, was first assessed by COSEWIC in 1994, the species had only been reported from the Whitemouth River (Houston 1996). Given its limited distribution and an apparent geographical separation of about 900 km from the nearest other Canadian populations in Ontario and Quebec, COSEWIC designated the Manitoba population as "vulnerable", now "special concern". In 2001, COSEWIC used the existing report to reassess the population, and uplisted its status to "Threatened". The Manitoba population was subsequently listed as such under Schedule I of the *Species at Risk Act* (*SARA*) on 5 June 2003.

Listing under *SARA* confers protection on the Manitoba population of carmine shiners by prohibiting their harvest and sale. The carmine shiner is not otherwise protected in Manitoba except by general provisions in the habitat sections of the *Fisheries Act*, and incidentally by several provincial reserves and parks discussed above. The Manitoba Conservation Data Centre has assigned it a provincial rank of S2, on the basis that the species is rare in the province (6 to 20 occurrences) and may be vulnerable to extirpation, with a global rank of G5 that indicates the species is widespread, abundant, and secure elsewhere. The Manitoba Endangered Species Advisory Committee, as of February 2003, listed the carmine shiner as threatened (Stewart and Watkinson 2004). The *Manitoba Endangered Species Act* does not mandate habitat protection for listed species, so protection of carmine shiner habitat is at the government's discretion.

TECHNICAL SUMMARY

Notropis percobromus **(Cope, 1871)**
carmine shiner — tête carminée
Range of Occurrence in Canada: Manitoba, Whitemouth River watershed and other nearby areas of the Winnipeg River watershed in Manitoba

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* See Table 1	~120
• *Specify trend in EO*	unknown
• *Are there extreme fluctuations in EO?*	unknown
• *Area of occupancy (AO) (km²)* See Table 1	~3.4
• *Specify trend in AO*	unknown
• *Are there extreme fluctuations in AO?*	unknown
• *Number of known or inferred current locations*	Whitemouth, Birch, Bird, and Winnipeg rivers, and the Pinawa Channel.
• *Specify trend in #*	Unknown
• *Are there extreme fluctuations in number of locations?*	no
• *Specify trend in area, extent or quality of habitat*	Unknown
Population Information	
• *Generation time (average age of parents in the population)*	2-3 years
• *Number of mature individuals*	Unknown
• *Total population trend:*	Unknown
• *% decline over the last/next 10 years or 3 generations.*	
• *Are there extreme fluctuations in number of mature individuals?*	Unknown
• *Is the total population severely fragmented?*	No
• *Specify trend in number of populations*	Unknown
• *Are there extreme fluctuations in number of populations?*	Unknown
• List populations with number of mature individuals in each:	Unknown
Threats (actual or imminent threats to populations or habitats)	
Overexploitation, species introductions, and pollution have the potential to threaten carmine shiner habitats or populations. However, too little is known of the species' life history requirements and habitat use to assess the actual threats each may pose. Habitat degradation is likely in some reaches of rivers inhabited by the carmine shiner, particularly related to stream regulation, and poses the most significant threat to survival of the species.	
Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA: not at risk**	
• *Is immigration known or possible?*	Unknown, but unlikely due to drainage patterns and intervening unsuitable habitat
• *Would immigrants be adapted to survive in Canada?*	Likely
• *Is there sufficient habitat for immigrants in Canada?*	Unknown
• *Is rescue from outside populations likely?*	Unlikely
Quantitative Analysis	Insufficient data

Existing Status

Nature Conservancy Ranks (NatureServe 2006)
Global – G5
National
US – N5
Canada N2

Regional
US: AR – S4, IL – S3, IN – SNR, IA – S5, KS – S4, MI – SNR, MN – SNR, MO – SNR, ND – S3, OH – SNR, OK – S4, SD – S2, WI – SNR

Canada: MB – S2

Wild Species 2000 (Canadian Endangered Species Council 2001)
Canada - NA
MB - 2

COSEWIC
Designated Special Concern in April 1994. Status re-examined and designated Threatened in November 2001 and in April 2006.

Eligibility for assessment by COSEWIC: Carmine shiner is a named and recognized species. *Notropis percobromus* (Cope 1871) was a synonymized but available name that was recently resurrected by Wood *et al*. (2002) for some US populations of what was then called *Notropis rubellus*, the rosyface shiner. Unpublished morphometric studies by Stewart and Watkinson and genetic studies by Wilson have determined that the Manitoba population is refer able to *N. percobromus*. The 6th edition of the American Fisheries Society's Common and Scientific names of fishes from the United States, Canada, and Mexico (Nelson *et al*. 2004) has accepted this evidence and recognizes the Manitoba population as referable to *N. percobromus*.

Status and Reasons for Designation

Status: Threatened	**Alpha-numeric code**: D2
Reasons for Designation: This freshwater fish species occurs in an extremely restricted area of Manitoba. The major threat to the species is the alteration in water flow as a result of stream regulation.	
Applicability of Criteria	
Criterion A: (Declining Total Population): Not Applicable - Criterion thresholds not met because not known. **Criterion B**: (Small Distribution, and Decline or Fluctuation): Meets criteria B1 + 2a (5 locations) but neither b nor c are met. **Criterion C**: (Small Total Population Size and Decline): Not Applicable - Criterion thresholds not met because not known. **Criterion D**: (Very Small Population or Restricted Distribution): Meets D2 for Threatened (AO about 3.4 <20 sq. km.) and five locations. **Criterion E**: (Quantitative Analysis): Not Applicable	

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GLOSSARY

Allozymes are forms of an enzyme that differ in their chemistry.
Phylogenetic relationships describe the evolutionary or genealogical history of species relative to one another.
Sympatric species occur in the same or overlapping areas. They coexist.

BIOGRAPHICAL SUMMARY OF REPORT WRITER

D. Bruce Stewart, M.Sc., is a zoologist with training in ecology and physiology. From 1977-86, he planned and conducted baseline research on aquatic resources throughout the NWT and Nunavut for the Northern Land Use Information Series (NLUIS) Mapping Program. He has worked with Inuit on the land to study anadromous Arctic charr populations and in the communities to compile traditional knowledge of the distribution and biology of narwhals and belugas in the Canadian eastern Arctic. As

Head of Arctic Biological Consultants, Bruce has provided expert advice on aquatic resources, parks initiatives, and resource developments to government, industry, and native organizations. This work has included preparation of a comprehensive fishery development strategy for the Canadian Beaufort Sea/Amundsen Gulf area for the Inuvialuit; reviews of information on fish populations and harvests in the Nunavut, Sahtu Dene and Metis, Gwich'in, North Slave, South Slave and Deh Cho settlement areas for the Department of Fisheries and Oceans (DFO); and studies that recommend areas for consideration as new National Marine Parks in Hudson Bay and James Bay. In 1991-93, the Ministers of the Environment for Canada and Manitoba appointed Bruce to a six-member panel charged with conducting a public review of the potential environmental effects of the $5.7 billion Conawapa hydroelectric development proposed by Manitoba Hydro. He has also assessed the potential impacts of the Nanisivik Mine, the Diavik and Jericho diamond projects, and Meadowbank Gold project on the aquatic environment, and recently completed a comprehensive overview of the Hudson Bay marine ecosystem for DFO. Bruce has also prepared the narwhal, walrus, and darktail lamprey updates for COSEWIC. He has written over 70 scientific publications and reports, published popular articles and photographs in *Canadian Geographic* and *The Beaver*, and lectured on the Arctic to a wide variety of audiences.

COLLECTIONS EXAMINED

Collections were not examined as part of this work. However, K.W. Stewart and D.A. Watkinson have examined Manitoba carmine shiner specimens and shiner specimens from other areas, including Wisconsin, Minnesota, and Ontario as part of supporting studies for the Carmine Shiner Recovery Strategy (2005). The results of these examinations are reflected in the text.