The Status of Pygmy Whitefish, *Prosopium coulteri*, in Alberta

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ABSTRACT

Pygmy whitefish, *Prosopium coulteri*, are small slender fish with a wide, disjunct distribution in Canada. The significant morphological differences which exist between populations are thought to originate from fish which occupied different glacial refugia during the last ice age. They are known from two locations in Alberta, Waterton Lake and the upper Athabasca River as far downstream as Whitecourt. Little is known of the biology of pygmy whitefish in running water except that they are found in relatively cold, fast montane streams. Their rarity in the upper Athabasca River make this population susceptible to ecological perturbations. For these reasons the pygmy whitefish should be considered Vulnerable in Alberta.

Key Words: coregoninae, coregonid, whitefish, pygmy whitefish, *Prosopium coulteri*, Alberta, rare fish, endangered species

The Status of Pygmy Whitefish, *Prosopium coulteri* (Eigenmann and Eigenmann), in Alberta

Pygmy whitefish, *Prosopium coulteri* (Eigenmann and Eigenmann) are small, slim whitefish with relatively large scales, a blunt snout and almost cylindrical bodies. They are found in deep water in cold, deep lakes and in some montane streams. In Canada they are widely distributed in British Columbia, and have been reported from the Yukon, western Northwest Territories, the Saskatchewan portion of Lake Athabasca a few locations in Alberta and Lake Superior. The Alberta locations are disjunct and include Waterton Lake and parts of the upper Athabasca River drainage.

This summary was prepared in response to a request from Fisheries Management Division of Alberta Environmental Protection to have the species considered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Description

Pygmy whitefish are small and slim with relatively large scales, a blunt snout and almost cylindrical bodies (Figure 1). In cross section the depth of the body is less than twice its width. The head is longer than the body depth and the diameter of the eye is larger than the snout length. They have 50-70 pored scales along the lateral line and 14-33 pyloric caeca. The maximum length reported is 26.2 cm fork length in McLure Lake, British Columbia (McCart 1963) but in most waters they only reach 10 to 14 cm total length. Individuals which are less than 10-12 cm total length have 7 - 14 distinct round to oval 'parr marks' along the lateral line as well as 12-14 similar spots along the middle back. During spawning season both sexes develop nuptial tubercles on the head, back, sides and pectoral fins (Weisel and Dillon 1954).

The lack of records of pygmy whitefish in Alberta is likely due in part to the ease with which they can be confused with other whitefish in the field. The feature which distinguishes *Prosopium* species from ciscos is the position of the mouth which is posterior to the tip of the snout. *Prosopium* species can be distinguished from *Coregonus* species by the single flap between the nostrils (Figure 2a) and the ventral notch in the adipose eyelid (Figure 2b).

Pygmy whitefish are most likely to be confused with the mountain whitefish (*Prosopium williamsoni* (Girard)) in western Alberta and with the round whitefish (*Prosopium cylindraceum*

The Status of Pygmy Wildlife Populations in Alberta (Eligibility and Management)

Pygmy wildlife populations in Alberta are generally small and scattered. They are often found in remote areas, such as the Rocky Mountains and the Canadian Rockies. The status of these populations is uncertain, and they are often threatened by habitat loss and hunting. The Alberta Wildlife Act provides for the protection of wildlife, but it is often difficult to enforce these laws in remote areas. The status of pygmy wildlife populations in Alberta is therefore uncertain, and they are often threatened by habitat loss and hunting.

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PYGMY WHITEFISH (*Prosopium coulteri*)

a

b

c

Figure 1. Drawings of pygmy whitefish from a) Nelson & Paetz, 1992 b) Scott & Crossman, 1973 c) McPhail & Lindsay, 1970.

Pygmy Killifish (Poecilia reticulata)

Figure 1. Illustration of Poecilia reticulata (Pygmy Killifish) in lateral view. (A) Male, (B) Female, (C) Juvenile.

PYGMY WHITEFISH (*Prosopium coulteri*)

Figure 2. External anatomical features which help distinguish pygmy whitefish from other coregonids. (a) single nasal flap between nostrils of *Prosopium* species (left) and two nasal flaps found in other coregonids (from McPhail & Lindsey, 1970); (b) ventral notch in adipose eyelid of *Prosopium* species (from McPhail & Lindsey, 1970); (c) profile of head of a mountain whitefish (left) and pygmy whitefish (right) (from Nelson & Paetz, 1992).

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(Pallas)) in the Lake Athabasca region of northeastern Alberta. The main external features which distinguishes pygmy whitefish from these other *Prosopium* species are its rather elongate head, relatively large eye (Figure 2c), relatively small adipose fin (Figure 3), and relatively blunt snout (Figure 2c). The main meristic features which distinguish pygmy whitefish from other *Prosopium* species are 50-70 pored scales along the lateral line and 14-33 pyloric caeca (Table 1). The key identification features which are most useful in the field to distinguish pygmy whitefish from mountain whitefish are the blunt nose, small adipose fin and dark markings on the sides and back of the pygmy whitefish.

Distribution

Pygmy whitefish have a wide, but disjunct distribution in northern North America extending from the Columbia basin in the northwestern United States through western and northwestern Canada and Alaska and also in Lake Superior (Figure 4). They have also been reported from the Chukchi Peninsula in Russia where they were found in the Amguehma River basin (Chereshnev and Skopets 1992) which drains into the Chukchi Sea. They likely had a continuous distribution during the late Pleistocene but became disjunct after the retreat of the Wisconsin glaciation (Eschmeyer & Bailey 1955).

In Canada, pygmy whitefish are wide spread in British Columbia (Figure 5) and have been reported from the Yukon, Great Bear Lake (Nelson and Paetz, 1992) in the Northwest Territories, Lake Superior, the eastern portion of Lake Athabasca in Saskatchewan, and Alberta (Figure 4).

There are only a small number of deep, cold lakes in Alberta in which one would expect to find pygmy whitefish. These are Waterton Lake, in which they have been described, as well as Cold Lake and Lake Athabasca. There is no record of them in Cold Lake in spite of considerable fishing effort over several years in deep water with fine mesh nets (Wayne Roberts, personal communication January 1998). They have been reported in the deep, eastern end of Lake Athabasca in Saskatchewan (Peter McCart and Derrick Trip, personal communication January 1998).

In the upper Athabasca River drainage they have been found in Solomon Creek, where it drains into the Athabasca River northwest of Hinton, and in the Snake Indian River, near where it drains into the Athabasca River in Jasper National Park (D. Mayhood 1980, 1992). Most recently they have been collected in the Athabasca River at Whitecourt (Bob Schelast personal communication, September 1997). Pygmy whitefish have been collected in the deep

Figure 3. (a) Profiles of pygmy whitefish and other *Prosopium* species (from Nelson & Paetz, 1992). Note large adipose fin on mountain whitefish and relatively slimmer body of pygmy whitefish; (b) profiles of two 'sibling species' of pygmy whitefish from Alaska (from McCart, 1970).

Table 1. Comparison of some morphological characteristics of three species of the genus *Prosopium*

Character	Pygmy whitefish <i>Prosopium coulteri</i>	Mountain whitefish <i>Prosopium williamsoni</i>	Round whitefish <i>Prosopium cylindraceum</i>
Total # rakers on gill arch	11-21	19-26	14-21
# of rakers on lower arm of gill arch	8-13	8-10	9-13
# of rakers on upper arm of gill arch	3-7	11-15	5-8
Teeth on gill rakers	none	present	present at base
# of branchiostegal rays	6-9 + 6-9	7-10 + 7-10	6-9 + 7-9
# of dorsal fin rays	10-12	11-15	11-15
# of pectoral fin rays	13-18	14-18	14-17
# of anal fin rays	10-14	10-13	10-13
# of lateral line scales	50-70	74-90	74-106
# of pyloric caecae	13-33	50-146	50-130
# of vertebrae	50-55	53-61	62-64
nuptial tubercles	Both ♂ & ♀ on head, back sides and paired fins	♂ only on sides, not on head	On sides of ♂ & ♀. More on ♂
Nostril flap	single	single	single

Figure 4. North American Distribution of pygmy whitefish

Figure 5. Distribution of pygmy whitefish in British Columbia (from McCart, 1965).

Saskatchewan portion of Lake Athabasca (Derrick Tripp, personal communication, January 1998; Nelson and Paetz 1992). Thus there is a reasonable expectation that they also occur in the Alberta portion of Lake Athabasca. Pygmy whitefish have also been reported from the Peace River in British Columbia downstream of the present location of the Bennett Dam (McCart 1965) but none have been reported in the Peace River in Alberta.

Protection

Pygmy whitefish are listed as a species of special concern in Wisconsin and Washington state (Johnson 1987). They do not appear to have any special protection in Canada other than the general protection provided by the Fisheries Act. They are considered to be rare in Jasper National Park (Mayhood 1992). The small portion of the Athabasca River population which resides in Jasper National Park and the Waterton Lake population have the protection provided by a national park.

Population Sizes and Trends

The population of pygmy whitefish in Alberta appears to be small and scattered. A total of 7 fish have been collected from four locations in Alberta (Figure 6). The four records of pygmy whitefish from Alberta consist of two fish collected from Waterton Lake (Lindsey & Franzin 1972) and five fish collected from the upper Athabasca River: two from Snake Indian River at its confluence with the Athabasca River in Jasper National Park (Mayhood 1980); one from Solomon Creek near its confluence with the Athabasca River northwest of Hinton (University of Alberta Museum of Zoology #5277) and two from the Athabasca River near Whitecourt (Bob Schelast, personal communication, August 1997). In all records from the Athabasca River drainage pygmy whitefish have been collected along with a relatively large number of mountain whitefish.

Too few pygmy whitefish have been collected in Alberta to establish any firm data on population size or population trends for the province. Their widespread occurrence along the upper Athabasca indicates that a viable population exists there. The low numbers of individuals collected in the Athabasca River reflects a very small number of pygmy whitefish relative to the number of mountain whitefish of similar size collected at the same sites (Mayhood 1980; Schelast, personal communication, August 1997). Mayhood (1992) collected 420 mountain whitefish in the same area as the two pygmy whitefish and 38 juvenile mountain whitefish in the same reach as the two pygmy whitefish. This provides additional evidence for their rarity in the

Figure 8. Distribution of pygmy whitefish in Alberta

Athabasca River.

Pygmy whitefish occur in two lakes which overlap Alberta's boundaries; Waterton Lake on the southwest boarder and Lake Athabasca on the northeast. Although the number of pygmy whitefish recorded from these two lakes is sparse, the sampling effort has been equally sparse. No pygmy whitefish have been reported from the Alberta portion of Lake Athabasca probably because little or no effort has been devoted to collect them there. The lake is also not as deep on the Alberta side. The populations in Waterton Lake and Lake Athabasca may not be large but they are well buffered from human disturbance.

Habitat

Pygmy whitefish occur in deep lakes and montane streams. They appear to be a glacial relic species which is now found mainly in the deep water of deep cold lakes where they are spatially separated from lake whitefish and cisco which appear to occupy a similar niche in shallower water (McCart 1963). In Alberta and British Columbia pygmy whitefish are also found in cold, fast moving rivers where they are much less abundant than their closest relative, the mountain whitefish, *Prosopium williamsoni*. Little is known of the biology of pygmy whitefish in running water.

In lakes pygmy whitefish are usually found in cold deep (> 6 m) water. The fish collected in Waterton Lake were caught on the bottom at a depth of about 50 m (Lindsey and Franzin 1972). Similarly the pygmy whitefish collected in the eastern (Saskatchewan) portion of Lake Athabasca were also from deep water (Derrick Tripp, personal communication, January 1998). The most successful method of sampling pygmy whitefish in deep lakes in the southern part of their range is with small mesh gill nets set at the bottom in deep water. Even then they are very difficult to collect early in the summer (Peter McCart, personal communication January 1998) presumably because they are inactive at this time. However in the Naknek River system of southwestern Alaska they are found at all depths from shallow littoral to 168 m (Heard and Hartman 1966) although they were most common in shallow water.

Pygmy whitefish also occur in fast moving montane rivers and streams, which can be clear or silted (McPhail & Lindsey 1970, Mayhood 1992). In Alberta they have been found in the Athabasca River and tributaries as far downstream as Whitecourt (Bob Schelast, personal communication August 1997).

General Biology

Little is known of the general biology of pygmy whitefish in Alberta except the location of collection of the four records from the province and the fact that one was a sexually mature male. There is no information in the literature concerning the biology of riverine populations of pygmy whitefish. The information below has been drawn from existing literature on lake populations.

Reproduction

Like other members of their genus pygmy whitefish are fall spawners. Spawning has been reported in November or December for populations in Glacier National Park, Montana, (Schultz 1941, Weisel and Dillon 1954), Lake Superior (Eschmeyer and Bailey 1955), four lakes in British Columbia (McCart 1965) and in southwestern Alaska (Heard and Hartman 1966). Previous reports of earlier spawning are likely in error (Heard and Hartman 1966).

Pygmy whitefish mature early and at a small size. Males mature at age 1 or 2 and from 60 to 80 mm and females at age 1 to 3 and from 70 to 228 mm. The northern populations and populations from cold waters mature at a smaller size and younger age than southern populations. In Brooks Lake, Alaska both males and females matured at age 1 or 2 with virtually all age 2 fish being sexually mature (Heard and Hartman 1965). Males matured as small as 58 mm and females as small as 61 mm. All males were mature at 65 mm and all females at 68 mm. In Lake Superior some males were sexually mature at 81 mm total length and all males were sexually mature at age 2 and 91 mm TL; some females were sexually mature at 97 mm total length, all females were mature at age 3 and 228 mm (Eschmeyer and Bailey 1955). In Montana females matured by age 2 at 120 to 139 mm standard length and males were mature at ages 1 and 2 at standard lengths of 81 to 130 mm (Weisel and Dillon 1954, Weisel et al. 1973). The single sexually mature male from Alberta was 86 mm fork length (Mayhood 1995).

During spawning season both sexes develop nuptial tubercles on the head, back, sides and pectoral fins. In addition the ventral fins of both sexes become orange (Heard and Hartman 1966).

The only published records of pygmy whitefish in rivers come from the Brooks River, part of the Naknek River system in Alaska. Pygmy whitefish from Brooks Lake moved into the Brooks River and spawned there at night (Heard and Hartman 1966). Fecundity ranged from 200 for a 90 cm (FL) to 1000 for a 15 cm fish (Heard and Hartman 1966). The diameter of mature

eggs was 2 mm in Lake Superior (Eshmeyer and Bailey 1955) and 2.4 mm in Alaska (Heard and Hartman 1966).

In Alberta, one of two males collected in October in the lower Snake Indian River was ripe (Mayhood, personal communication January 1998).

Growth

Pygmy whitefish live from three to nine years and reach a maximum size of 65 to 260 mm (Figure 7). Maximum size at MacLure Lake, British Columbia was over 260 mm FL at age nine (McCart 1965) while those from Brooks Lake, Alaska reached a maximum size of about 65 mm at age 3 (Heard and Hartman 1966).

Species Movement

The only data available on movement of pygmy whitefish comes from southwestern Alaska. There young of the year moved from benthic locations in the littoral zone to limnetic areas in late summer (Heard and Hartman 1966). They also moved out of their usual lake habitats into an inlet river to spawn (Heard and Hartman 1966).

Behaviour

The only behavioural information on pygmy whitefish comes from SCUBA observations in the Brooks River, Alaska. There pygmy whitefish formed large schools which were evenly spread over a relatively large area (Herd & Hartman 1965). When disturbed they formed dense schools which moved slowly over the stream bottom (Herd & Hartman 1965).

Diet

Pygmy whitefish appear to be quite flexible in their diet which is best known from lacustrine populations where they feed on planktonic and benthic invertebrates. In four British Columbia lakes the most important food items were small cladocerans, the larvae and pupae of midges and *Chaoborus* larvae (McCart 1965). In Alaska the major food organisms were crustacean zooplankton and insects. The crustaceans included several cladocerans (*Daphnia*, *Bosmina* and *Holopedium*) and copepods (*Cyclops* and *Diaptomus*). The major insects eaten were all life history stages of several dipterans (mainly Chironomidae) and plecopteran nymphs

Figure 7. Growth curves for ten populations of female pygmy whitefish (from Heard & Hartman, 1966). Bull Lake and Lake McDonald are in Montana, McLeese Lake, MacLure Lake, Cluculz Lake and Tacheena Lake are in British Columbia while Brooks Lake, South Bay, Naknek are in Alaska.

(Heard and Hartman 1966). In western Montana they fed on cladocera as well as chironomid larvae and pupae (Weisel et al. 1973). The major food organisms in Lake Superior were *Pontoporeia*, a benthic crustacean as well as ostracods (Eshmeyer and Bailey 1955).

Parasites

Little is known concerning the parasites of pygmy whitefish. The only record of parasites are from populations in western Montana which harboured cysts of the Myxobolid parasite *Henneguya zschokkei* Gurley, 1893 in their muscles (Mitchell 1989).

Limiting Factors

Little is known about the biology of riverine stocks of pygmy whitefish in Alberta or elsewhere. Pygmy whitefish are best known from deep water of cold, deep lakes. Their deep water locations in lakes appears to be due to their requirement for relatively low water temperatures and the result of spatial segregation from competing, sympatric coregonids (McCart 1963). No similar observations have been made in riverine populations but it is likely that mountain whitefish are formidable competitors with pygmy whitefish in rivers. The riverine stocks of pygmy whitefish in the upper reaches of the Athabasca River basin are sympatric with mountain whitefish (Mayhood 1992). One of the limiting factors for pygmy whitefish in the Athabasca river may be their ability to compete with mountain whitefish. When pygmy whitefish have been collected in the upper Athabasca River they have been out numbered by one or two orders of magnitude by mountain whitefish. This indicates that they occupy spatially overlapping habitats and that pygmy whitefish are less successful in these habitats than mountain whitefish. Any additional environmental stresses such as increases in water temperature may result in decreased competitive ability.

Special Significance of Species

Pygmy whitefish appear to be glacial relics being well adapted to cold habitats with short growing seasons. It is likely that there were several refugia for pygmy whitefish during the last glacial period and that some of the various disjunct, existing populations have descended from different ice age stocks. Pygmy whitefish are scientifically significant in that the various disjunct populations can be distinguished morphologically and hence used to distinguish refugia from the Pleistocene glaciations. They have been most extensively studied from this perspective (Bird & Roberson 1979, Weisel et al. 1973, McCart 1970, Lindsey & Franzin 1972, Mayhood 1992).

Further study of these populations may reveal locations of glacial refugia as well as patterns of post glacial dispersal.

The stocks of pygmy whitefish in Alberta may be quite distinct genetically from those in British Columbia and Lake Superior. The fish from Waterton appear to be quite distinct from the two major known stocks (Lindsey & Franzin 1972). The pygmy whitefish from the lower Snake Indian River may differ from other stocks as well (D. Mayhood personal communication, January 1998 and Mayhood 1992). Further investigation of these stocks is definitely merited.

Evaluation

The two populations of pygmy whitefish which are known to occur within Alberta are isolated from one another and appear to be small. The Waterton Lake population is in a National Park and relatively isolated from human disturbances. Thus the risk of extirpation of pygmy whitefish from Waterton Lake are small. The Athabasca River population outside of Jasper National Park appears to be small and widely scattered. The watershed is subjected to the impact of industrial development (logging, oil and gas, mining, etc.). While it is not known how sensitive they are to habitat degradation Mayhood (1998) believes that damage to rearing habitat has affected their numbers in the Snake Indian River. Thus the risks of extirpation in the upper Athabasca River are considerably greater than in Waterton Lake.

The Athabasca River stock of pygmy whitefish may be biologically distinct from other stocks (Mayhood, 1992). Little is known concerning the size of this population or their biology. This reach of the Athabasca has been extensively sampled by competent biologists over the last few decades and a total of only 5 fish have been reported from three different locations. This suggests that the population of pygmy whitefish in the Athabasca is relatively small and requires some measure of protection.

Author's Recommendation of Status

Two distinct stocks of pygmy whitefish which have been shown to exist in Alberta appear to be small. The Waterton Lake stock is reasonably well protected as a result of being located in a National Park. Only a small portion of the Athabasca River stock has the protection of Jasper National Park. Given the restricted range of pygmy whitefish in Alberta, their apparently small numbers, and the potential for habitat disturbance in the upper Athabasca River basin the pygmy whitefish should be considered Vulnerable in Alberta.

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