

The Freshwater Fishes of British Columbia

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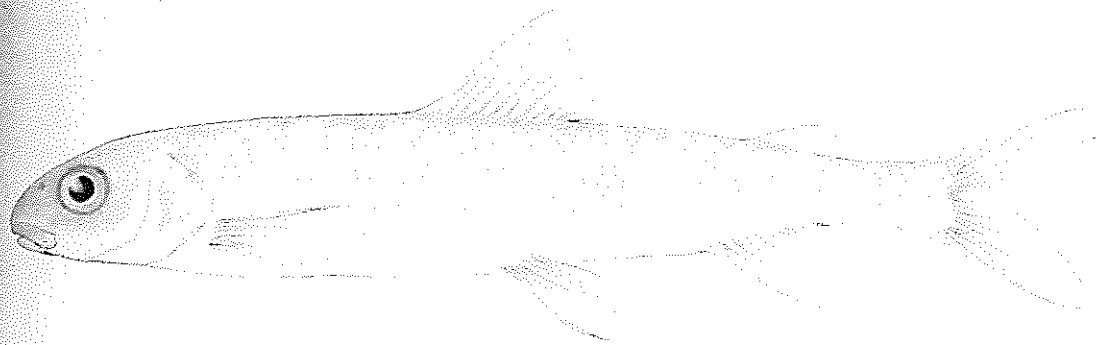
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Prosopium coulterii (EIGENMANN & EIGENMANN)

PYGMY WHITEFISH



Distinguishing Characters This large-scaled (in our area 62–67 scales along the lateral line) whitefish has a small adipose fin (its base is about equal to the eye diameter) and 9 or 10 dorsal rays. The body is round in cross section, and the snout usually is blunt and rounded when viewed from above. In the field, adult pygmy whitefish are easily confused with juvenile mountain whitefish (*Prosopium williamsoni*) and juvenile round whitefish (*Prosopium cylindraceum*). Usually, dorsal fin ray number will separate these species: 9 or 10 in pygmy whitefish and 11–15 rays in mountain and round whitefish. Under the microscope or with a hand lens, a good character is the size of the scales on the anterior portion of the lateral line: in adult pygmy whitefish, the anterior lateral line scales are about the same size as the scales immediately above and below the lateral line. In contrast, in juvenile mountain and round whitefishes the anterior lateral line scales are noticeably smaller than the scales immediately above and below the lateral line. Lateral parr marks are absent in young-of-the-year (≤ 30 mm) pygmy whitefish; however, juveniles and most adults have well-developed parr marks.

Taxonomy There are no major taxonomic problems associated with pygmy whitefish. Like a number of other species, pygmy whitefish in British Columbia probably are derived from more than one glacial refugium. Consequently, there may be genetic differences among populations in different parts of the province, and it is possible that the upper Peace populations are a mixture of fish derived from the Bering and Pacific refugia. “Giant” pygmy whitefish are known from two lakes (McLease Lake in the Fraser system, and Tyhee Lake in the Skeena system). These populations grow faster and reach a greater size than most pygmy whitefish (McCart 1965); however, there are no mitochondrial DNA differences between them and adjacent normal populations (Rankin 1999).

The pygmy whitefish in Crescent Lake on the Olympic Peninsula, Washington, were originally described (Myers 1932) as a separate species, *Prosopium snyderi*. At that time, very few pygmy whitefish were available for comparison. Later, the locality (which was well outside the known range) was questioned (Eschmeyer and Bailey 1955), and it was suggested that the specimen probably came from Crescent Lake in northeastern Washington. Recently, however, the presence of a pygmy whitefish in Crescent Lake on the Olympic Peninsula has been confirmed (P. Mongillo, Washington Department of Fish and Game, personal communication). Since there is evidence of endemism in other freshwater fish in this region (McPhail 1967; McPhail and Taylor 1999; Schultz 1929), the status of *P. snyderi* should be re-examined.

Sexual Dimorphism Except at spawning time, the sexes are difficult to distinguish. In spawning populations, females are, on average, larger than males, and breeding fish of both sexes develop spawning tubercles on some of the scales above the lateral line, on the paired fins, and on the top of the head (Weisel and Dillon 1954). These nuptial tubercles are more pronounced on males than on females. In the upper Peace system (Dina #1 Lake), fish captured in late October had tubercles on the paired fins, the dorsal and anal fins, and the lower lobe of the caudal fin but none on the flanks.

Hybridization In the upper Peace system (e.g., Nation River), occasional individuals are encountered that are morphologically intermediate between mountain and pygmy whitefish. These may be hybrids.

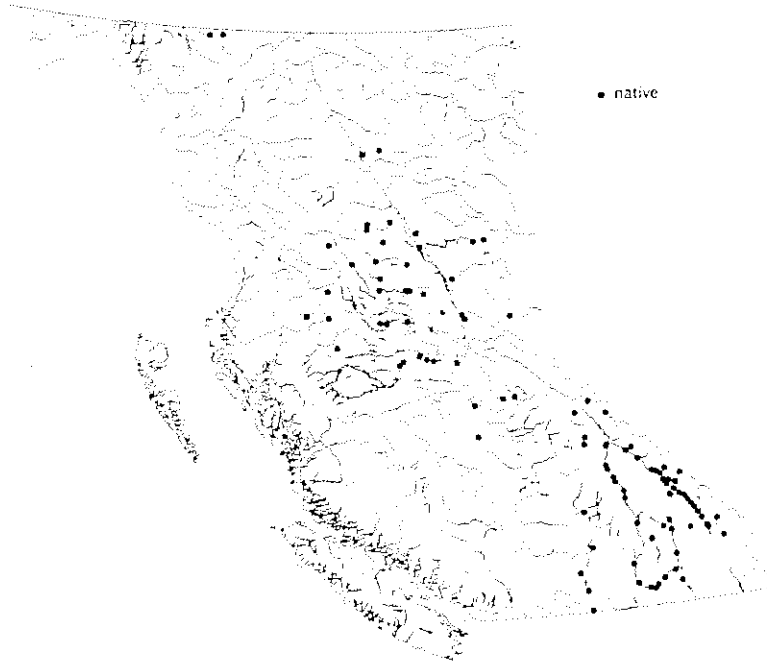
Distribution NATIVE DISTRIBUTION

Until recently, the pygmy whitefish was thought to be a North American endemic; however, pygmy whitefish were discovered recently in three lakes in the Anguem River system on the Chukotsk Peninsula, Siberia (Chereshnev and Skopets 1992). In North America, pygmy whitefish are widely distributed west of the Continental Divide. Here, they occur from the Columbia River system (northern Washington, Idaho, and inter-mountain Montana) to the Bristol Bay region of Alaska. Pygmy whitefish also are found east of the Continental Divide, but here they are uncommon and noteworthy for their widely scattered distribution: Lake Superior, Lake Athabasca, Great Bear Lake, Waterton Lakes, and tributaries to the Athabasca River near Hinton, Alberta (Eschmeyer and Bailey 1955; Lindsey and Franzin 1972; Nelson and Paetz 1992).

BRITISH COLUMBIA DISTRIBUTION

Pygmy whitefish populations are scattered throughout the interior of the province but are noticeably absent from coastal lakes and rivers (Map 59). In western Washington, however, this species occurs west of the Cascade Mountains on the Olympic Peninsula (Crescent Lake) and in Chester Morse Reservoir near Seattle (Wydoski and Whitney 2003).

Map 5. The B.C. distribution of pygmy whitefish, *Prosopium coulterii*



Life History Throughout its geographic range, information on the life history of pygmy whitefish is meagre, and only two published papers involve B.C. populations (McCart 1965; Zemplak and McPhail 2006). Age, growth, diet, and habitat use in four populations are described in McCart (1965), and similar data are presented on one other population (McPhail and Zemplak 2001). These papers (McCart 1965; McPhail and Zemplak 2001) form the basis of the following account, supplemented with observations from western Montana (Weisel et al. 1973), western Washington (R2 Resource Consultants 1995), and the upper Peace River system (Stamford 2001a). So far, all the published information on pygmy whitefish is derived from lacustrine populations, and the life history and ecology of fluvial pygmy whitefish remains unknown.

REPRODUCTION

Pygmy whitefish spawn in late autumn or early winter. The exact time of spawning varies among populations, and fish in reproductive condition have been observed from early September to mid-January (Hallock and Mongillo 1998; McCart 1965; McPhail and Zemplak 2001; Weisel et al. 1973). Although all known spawning sites are in inlet streams, circumstantial evidence indicates that some populations spawn in lakes (Hallock and Mongillo 1998; McPhail and Zemplak 2001). Curiously, most accounts of pygmy whitefish spawning do not mention water temperature, but given the spawning times, the spawning temperature probably is usually $< 5^{\circ}\text{C}$. There is no detailed description of either spawning sites or

spawning behaviour; however, in lakes, schools of pygmy whitefish have been observed holding near the mouths of inlet streams and, in rivers, holding in pools just below riffles. If their spawning behaviour is similar to that of mountain whitefish, they probably spawn at night on riffles over coarse gravel. Presumably, there is no site preparation, and the demersal eggs lodge in interstices of the gravel and rubble on the bottom. If, as circumstantial evidence suggests, pygmy whitefish also spawn in lakes, the lacustrine spawning sites may be associated with upwelling groundwater.

Fecundity increases with body size and ranges from as low as 93 to over 1,100 eggs (Eschmeyer and Bailey 1955; Weisel et al. 1973). Pygmy whitefish eggs are smaller than those of other whitefish, and the diameter of water-hardened eggs ranges from 2.4 to 2.6 mm (Weisel et al. 1973). The incubation time is unknown; however, they presumably incubate over winter, and depending on latitude and altitude, the fry emerge in the spring or early summer (late March to early June).

AGE, GROWTH, AND MATURITY

Most pygmy whitefish are collected with gill nets. Hence, young-of-the-year are rare in samples, and descriptions of growth usually begin with fish in their second growing season (1⁺). In Dease Lake, however, two collections separated by 40 years show a remarkable consistency in the growth of young-of-the-year. By late July or early August in both collections, young-of-the-year ranged from 28 to 40 mm (with both means at 34 mm). In the same collections, 1⁺ pygmy whitefish ranged from 48 to 58 mm FL and averaged 53.5 mm. These fish probably had another month of growth left before winter. In Dina #1 Lake by the end of August, young-of-the-year pygmy whitefish ranged from 30 to 48 mm. By the end of the second growing season, average size varies dramatically among lakes: from about 60 mm (Heard and Hartman 1966) to about 150 mm (Rogers 1964). Although growth rate slows at maturity in all populations, interpopulation differences in size usually are maintained throughout life. The smallest recorded adults are about 65 mm FL from Brooks Lake, Alaska (Heard and Hartman 1966), and the largest known adults average about 250 mm (Tyhee Lake, B.C.). In most populations, males and females grow at the same rate until maturity; however, since females usually mature at least a year later than males and live longer, they achieve a larger adult body size than males (McCart 1965; McPhail and Zemplak 2001; Weisel et al. 1973). Typically, about 50–70% of males mature near the end of their second growing season (1⁺), whereas most females do not mature until the end of their third growing season (2⁺). Relatively few males survive beyond their third year, but females can reach ages of 7 or 8 years. The oldest pygmy whitefish recorded in British Columbia was 16⁺ (Rankin 1999), but fish older than 9⁺ are rare in most populations.

FOOD HABITS

Most studies indicate that pygmy whitefish are benthic foragers and most lake-dwelling populations feed on chironomid larvae and pupae, *Chaoborus*, cladocerans, small molluscs, ostracods, and amphipods (McCart 1965; Weisel et al. 1973). In some cases, however, they also forage on zooplankton in the pelagic zone (R2 Resource Consultants 1995) and copepods and *Daphnia* were the primary prey in Dina #1 Lake (Stamford 2001). Fluvial populations also feed heavily on chironomid larvae and pupae but include nymphs of other aquatic insects in their diet. During the breeding season, fish eggs are frequent in stomachs and what were probably salmon eggs were present in some stomachs in the fall (Heard and Hartman 1966). These same authors observed pygmy whitefish feeding during daylight hours. Most of the feeding movements were directed at the substrate, but occasionally, the fish moved up into the current and struck at drifting prey. In contrast, in Chester Morse Reservoir, peak pygmy whitefish activity occurred at night, and very few fish were active during the day (R2 Resource Consultants 1995).

Habitat Relatively little is known about habitat use by pygmy whitefish in British Columbia. The same sources as for their life history (McCart 1965; McPhail and Zemplak 2001; R2 Resource Consultants 1995; Weisel et al. 1973; Zemplak and McPhail, 2006) provide most of the available information.

ADULTS

In British Columbia, pygmy whitefish are a cold-water species (usually found in water $< 10^{\circ}\text{C}$) that occur in both lakes and rivers. In the southern and central parts of the province, they are restricted to relatively deep lakes, and there is probably little gene flow among populations. However, the glacial rivers of the southeastern portion of the province contain strong fluvial populations (the species was first described from the Kicking Horse River). In the northern parts of the province, both lacustrine and fluvial populations are relatively common.

Most information on habitat use by adult pygmy whitefish comes from overnight gill nets sets. Generally, they suggest pygmy whitefish are a deep-water species; however, sometimes they are taken in shallow water (Rankin 1999; Zemplak and McPhail 2006), and a number of factors may affect their intra-lacustrine distribution. For example, they have different depth distributions in lakes with, and without, other whitefish species (McCart 1965). In the summer, adult pygmy whitefish sympatric with mountain and lake whitefish (*Coregonus clupeaformis*) were restricted to depths below 10 m. In contrast, in lakes without other whitefish species, pygmy whitefish used water as shallow as 5 m. In Chester Morse Reservoir, Washington, adult pygmy whitefish were most abundant near the bottom at depths of between 30 and 40 m, but some individuals were observed in both the littoral and pelagic zones of the reservoir (R2 Resource Consultants 1995). Thus, the use of deep water in lakes

is not obligatory but depends on what other fish species (predators or competitors) are present. In some northwestern lakes, there is also a seasonal component to depth use. In Priest Lake, Idaho, in the fall, there is a diel movement of adults onshore in late afternoon or early evening and back into deep water at dawn (Simpson and Wallace 1978). Since these observations were made in the autumn, the authors suggested that the onshore movements may have been associated with spawning activity. In Dina #1 Lake, however, both trapnet and gill-net sets indicate that adults aggregate close to the bottom and move into shallow water at dusk (up to, but not above, 2.5 m) and return to deep water at dawn. This onshore-offshore movement pattern was observed throughout the summer and is not confined to either adults or the spawning season.

In rivers, pygmy whitefish are found in both turbid and clear waters with moderate to swift current and, usually, over gravel or cobble substrates. In fluvial populations, there are no observations on the habitats used by either young-of-the-year or juvenile pygmy whitefish.

JUVENILES

In Dina #1 Lake, yearling (1+) pygmy whitefish were rarely captured in gill nets (bottom sets), but relatively large numbers were taken on the occasions when they were caught. This suggests that juveniles may school. Juveniles were collected more commonly in trap nets and, again, displayed the same pattern of captures as adults: they were only captured occasionally but, when they were captured, were present in large numbers. In Dease Lake (Liard system) in late summer, large schools of young-of-the-year and juvenile (1+) *Prosopium* congregate in shallow (<1 m) water along the lake margins. Some schools consist mainly of pygmy whitefish and a few round whitefish and, rarely, a mountain whitefish. Other schools contain mainly round whitefish with a few pygmy whitefish. So far, the meagre evidence suggests that, in northern British Columbia, juvenile pygmy whitefish occur in schools.

YOUNG-OF-THE-YEAR

Most habitat observations on pygmy whitefish are based on adults, and the habitat requirements of the young-of-the-year are, as yet, undocumented. However, late in their first growing season in Dina #1 Lake, 43 young-of-the-year were taken in one overnight trap-net set in shallow water (5–7 m). This suggests that, like adults, young-of-the-year are benthic oriented, school, and move inshore at night.

Conservation Comments

In the southern part of their B.C. distribution, most pygmy whitefish occur as isolated populations in large, deep lakes. Consequently, there may be minor genetic differences among the southern lake populations. In addition, B.C. pygmy whitefish probably colonized our province from multiple refugia: Beringia, the unglaciated portion of the Columbia River system, and perhaps, the Great Plains. Like other species that dispersed into British Columbia from more than one refugium, there may

be genetic and biological differences associated with fish from these different ice-free areas. Although we are ignorant of the status of most of our pygmy whitefish populations, some southern populations (especially in the Okanagan system) appear to be in decline. This species is not listed by COSEWIC, but the BCCDC lists the two "giant" pygmy whitefish populations—the McLeese and Tyhee (Maclure) lakes populations—as critically imperiled (S1).