Range Extension for Pygmy Whitefish (*Prosopium coulterii*) in the Northwest Territories, Canada

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We document the first occurrence of Pygmy Whitefish (*Prosopium coulterii*) in the Northwest Territories outside of Great Bear Lake. Six specimens were captured in Bluefish Lake in September 2012. Bluefish Lake is on the Yellowknife River, approximately 25 km upstream from Great Slave Lake.

Key Words: Range extension; Pygmy Whitefish; *Prosopium coulterii*; Northwest Territories; Coregoninae; distribution; Bluefish Lake; Yellowknife Lake; Great Slave Lake

Introduction

The Pygmy Whitefish (*Prosopium coulterii*) is the smallest member of the subfamily Coregoninae. It has large scales, large eyes, a blunt snout with a subterminal mouth, and a cylindrical body. Its gill rakers are short and number between 13 and 20. Scales along the lateral line range between 54 and 70 (Eschmeyer and Bailey 1955). The Pygmy Whitefish is typical of fishes in the genus *Prosopium* in having a single internarial flap (McPhail and Lindsey 1970). Colouration is typically brownish along the dorsum with dark parr marks even in adults (Scott and Crossman 1973; Nelson and Paetz 1992; Mecklenburg *et al*. 2002). Ventral fins of both sexes become dark yellow or orange during spawning (Heard and Hartman 1965). Fecundity is lower than other coregonids, with egg production ranging from 97 to approximately 1000 (Weisel *et al*. 1973). Mean egg size in Alaska was 2.4 mm (Heard and Hartman 1965). Although the largest recorded egg size is 262 mm (McCart 1963), the maximum size rarely exceeds 140 mm (Eschmeyer and Bailey 1955; Mackay 2000*).

The Pygmy Whitefish has a wide discontinuous distribution in North America (Scott and Crossman 1973; Hallock and Mongillo 1998*; McPhail 2007* Sullivan 2011*) that includes Lake Superior (Ontario, Michigan, and Wisconsin); Yukon River drainage (northern British Columbia, Yukon, and Alaska); southwestern Alaska (Chignik, Naknek, and Wood River drainages); and the Columbia River drainage (western Montana, Washington, and British Columbia).

The Pygmy Whitefish has also been reported from Great Bear Lake, Northwest Territories, and Lake Athabaska, Saskatchewan (Nelson and Paetz 1992; Dr. Michael Sullivan, Provincial Fisheries Science Specialist, Sustainable Resource Development, Fish and Wildlife Division, Government of Alberta, personal communication, 2013) and from the Chukotski Peninsula in Russia (Chereshnev and Skopets 1992). The Pygmy Whitefish likely had a more continuous distribution during the late Pleistocene, but was isolated during the retreat of the Wisconsin glaciation (Eschmeyer and Bailey 1955).

In lakes, the Pygmy Whitefish ranges from shoreline habitat to waters as deep as 168 m (Heard and Hartman 1965; Lindsey and Franzin 1972). At northern latitudes, the species is most common in shallow water. Although the Pygmy Whitefish is typically lake dwelling, it also occurs in fast-moving montane rivers and streams that are clear or silted (McPhail and Lindsey 1970; Mayhood 1992*).

Spawning typically occurs in the late fall from November to December (Schultz 1941*; Weisel and Dillon 1954; Eschmeyer and Bailey 1955; McCart 1963; Heard and Hartman 1965; Hallock and Mongillo 1998*). Males mature at age 1 year and females at about 2 years (Wiesel *et al*. 1973). Maximum reported ages are typically 5–7 years (Eschmeyer and Bailey 1955).

Methods

We conducted a fish survey in Bluefish Lake from September 26 to October 1, 2012. Bluefish Lake is a natural widening of the Yellowknife River upstream from Prosperous Lake (Figure 1), and approximately 25 km upstream from Yellowknife Bay in Great Slave Lake.

Fish were collected using bottom-set, graded-mesh gillnets. Nets were 75 m long by 1.8 m high and composed of five, 15-m panels of 21.5-, 45.8-, 70.1-, 97.5-, and 120.4-mm stretched mesh. Nets were deployed overnight for more than 12 h at a depth of 25–33 m.

The entire catch was sorted and coregonids were processed as soon as possible after capture. A digital image of the left side of each individual was made using a Nikon D700 camera (Nikon Canada, Mississauga, Ontario, Canada). Fish were displayed on a flat pale pink surface with their fins pinned in the open position and a ruler added for scale (Figure 2). Dorsal views were also taken to illustrate spotting along the dorsal surface and flank. Each fish was individually bagged, labeled, and transferred to a freezer before processing in the laboratory.

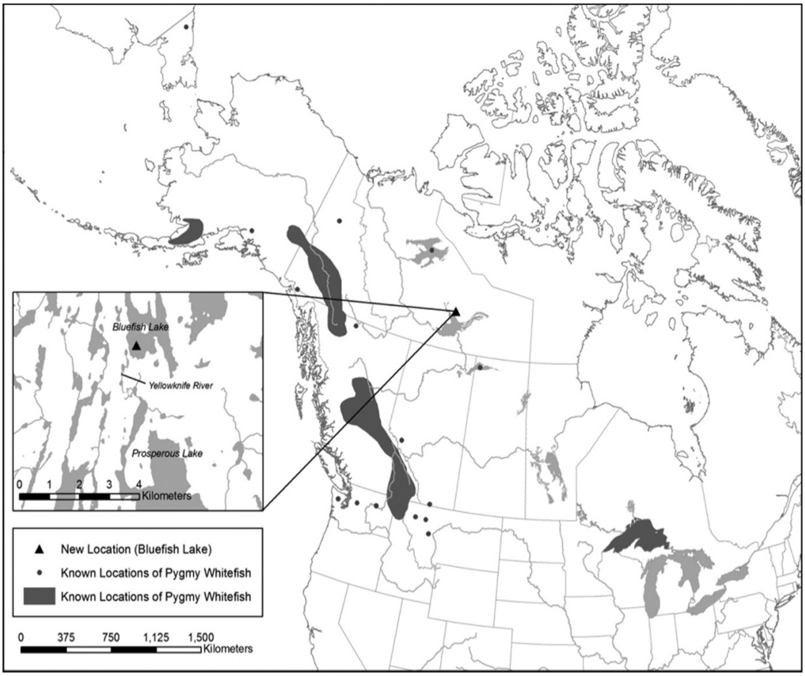

FIGURE 1. Distribution of the Pygmy Whitefish (*Prosopium coulterii*). Shaded areas and circles indicate known locations; the triangle shows the new location at Bluefish Lake, Northwest Territories.

Twenty-three linear morphometric and seven meristic characteristics were quantified following Vuorinen *et al*. (1993). All linear measurements were made point-to-point on the left side of the fish using digital calipers (± 0.01 mm). After measurements were made, the first left gill arch was extracted. Gill raker enumeration was done under a Leica ES2 dissection scope (Leica Microsystems Inc., Concord, Ontario, Canada) with reflected light at a magnification between 10× and 30×. All rakers were counted, including rudimentary rakers at the base of the arch. Scales in the lateral line were enumerated to the end of the hypural complex; where scales were missing because of damage during handling, scale pockets were counted. For fin ray enumeration, the anterior rays were excluded unless they were at least two-thirds the length of the longest ray. When

FIGURE 2. Pygmy Whitefish (*Prosopium coulterii*) captured in Bluefish Lake, Northwest Territories, 2012.

the shortest ray was split at the base, it was counted as a single ray.

After morphometric and meristic measurements were completed, specimens were cut ventrally, and the body cavity was examined for sex determination. When ovaries were found intact, they were removed. Fecundity was determined by counting eggs under a Leica ES2 dissection scope. Six eggs from each of three females were measured. All fish were subsequently re-frozen and archived.

We compared our morphological and biological characteristics to Coregonidae descriptions (McPhail and Lindsey 1970; Scott and Crossman 1973; McPhail 2007*), paying closest attention to features unique to Pygmy Whitefish and to *Prosopium* species. The Pygmy Whitefish is often confused with juvenile Mountain Whitefish (*Prosopium williamsoni*) or Round Whitefish (*Prosopium cylindraceum*).

Water temperature (° C), dissolved oxygen (mg/L), conductivity (µS/cm) and pH were recorded at the location and depth of the gillnet. An Ekman model E411196B12 bottom substrate retriever (Wildco, Yulee, Florida) was used to obtain bottom sediment at the sampling location. The bottom sediment sample was obtained from a single grab, described, and archived.

Results

Six individual Pygmy Whitefish, five females and one of unknown gender, with distinct stages of maturity were captured and examined. For general overall appearance, see Figure 2.

Description

Body small, fusiform, and streamlined; to 118 mm FL. Lumbar region moderate (15–19.5% of standard total length (STL). Caudal peduncle elongate (15.2–18.2% of STL) and narrow (6.3–7.1% of STL), body shallow, but variable (18.5–22.9% of STL). Dorsal aspect of head moderately to highly convex in profile (i.e., straight line from the premaxilla to the occipital bone). Head depth shallow (37.6–47.2% of head length [HLL]). Mouth slightly subterminal; maxillary short in length (24.5–31.2% of HLL) to near middle of eye and narrow (6.9–10% HLL). Eyes mid-set (preorbital length 20–22.6% of HLL), typically centred on the head along or slightly above midline of body. Eye diameter moderate (27.3–31.1% of HLL). Interorbital distance moderate (19.5–24.7% HLL). Gill raker number low, 16–18: 6–7 on upper arch and 10–11 on lower arch. Gill raker length short (3.2–4.7% of HLL), a distinguishing feature for this species. Dorsal fin moderate in length (10–11.8% of STL) and height (15.5–18.3% of STL); outer margin of dorsal fin angular; rays 9–10. Anal fin short at base; rays 9–11. Caudal fin forked and tips angular. Pectoral fins short and outer margin slightly concave; rays variable, 14–16. Pelvic fins short; origin below the second or third branched dorsal rays; rays 10–11; pelvic axillary process present. Adipose small. Lateral line complete, 54–60 scales. See Tables 1 and 2 for mean morphometric measurements and meristic counts.

Colouration

Live specimens generally silver with brownish dorsal colouration extending ventrally to two or three scale rows above the lateral line. Numerous parr marks present along lateral line and smaller blotches visible along dorsal surface. Anteriorly pigmented mandible and maxilla; paired fins immaculate or yellowish. Caudal fin lightly pigmented. Anal fin immaculate.

TABLE 2. Meristic counts for six Pygmy Whitefish (*Prosopium coulterii*), five females and one unknown gender, at Bluefish Lake, Northwest Territories.

Meristic count	Mean number
Dorsal rays	10.00
Anal rays	10.83
Pectoral rays	15.00
Ventral rays	10.20
Upper gill rakers	6.67
Lower gill rakers	10.17
Lateral line scales	56.17

TABLE 1. Morphometric measurements of six Pygmy Whitefish (*Prosopium coulterii*), five females and one unknown gender, at Bluefish Lake, Northwest Territories.

Measurement	Mean, mm	Measurement	Mean, mm
Trunk length	114.17	Caudal peduncle depth	6.55
Fork length	105.33	Interorbital length	5.03
Standard length	98.83	Maxillary length	6.01
Preorbital length	4.84	Maxillary width	1.99
Orbital length	6.91	Pectoral fin length	16.35
Post orbital length	11.26	Pelvic fin length	15.51
Trunk length	22.91	Adipose length	8.15
Dorsal fin length	10.56	Middle gill raker length	0.89
Dorsal fin height	16.18	Lower arch length	9.26
Caudal peduncle length	16.62	Anal fin length	9.30
Head depth	9.65	Lumbar length	17.50
Body depth	20.69		

Reproductive state

Five of the specimens were females with developed gonads indicating that they were close to spawning. One was in the resting phase and gender could not be determined. Fecundity, measured as total egg number, was determined for three of the five females as 209, 211, and 217 eggs. Egg size ranged from 2.08 to 2.79 mm.

Taxonomic assessment

Based on scale size, low lateral line scale count, adult parr marks, low gill raker counts, snout proportions, size at maturity, low fecundity, and large egg size, the six specimens collected in Bluefish Lake during our 2012 survey were determined to be Pygmy Whitefish. Specimens are archived at Fisheries and Oceans Canada, Yellowknife.

Habitat data

The bottom substrate at the sampling station consisted of clay and organic debris. At the depth where the six Pygmy Whitefish were captured, water temperature was 5.3° C, dissolved oxygen 3.5 mg/L, conductivity 63 µS/cm, and pH 6.3.

Discussion

The capture of Pygmy Whitefish in Bluefish Lake represents only the second observation of this species in the Northwest Territories and the first report of their presence in the Great Slave Lake Basin. It is unclear which glacial refugium was used to recolonize Bluefish Lake. However, the Athabasca population is thought to originate from the Cascadia refugium; thus, it is possible that the Pygmy Whitefish of Bluefish Lake are most closely related to the Columbia River drainage group. (see Appendix I for meristic means of North American Pygmy Whitefish populations studied thus far.) Isolated and small populations of coregonids, such as the Bluefish Lake Pygmy Whitefish, are important from a conservation standpoint because populations are often small and are, therefore, more susceptible to extirpation by stochastic events. It is likely that the distribution data for Pygmy Whitefish are incomplete, possibly because collectors fail to collect this species (Eschmeyer and Bailey 1955), due to their small size and relatively deep depth of capture. They may also be misidentified as juvenile Mountain Whitefish or Round Whitefish where these species co-occur.

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APPENDIX I. Meristic counts for Pygmy Whitefish (*Prosopium coulteri*) from all study areas in North America.

	Mean number									
Drainage	Locality	Source	Latitude, ° N	Longitude, ° W	Gill rakers	Lateral line scales	Caudal peduncle scales	Dorsal fin rays	Anal fin rays	Pectoral fin rays
Chignik	Black Lake	McCart (1970)	56.456	158.991	14.06	61.54	17.54	11.25	11.81	15.19
Chignik	Chignik Lake (slr)	McCart (1970)	56.259	158.824	14.16	63.95	18.02	11.36	12.44	15.40
Chignik	Chignik Lake (dlr)	McCart (1970)	56.259	158.824	14.50	62.94	17.93	11.55	11.95	15.05
Chignik	Chignik Lake (hr)	McCart (1970)	56.259	158.824	19.21	61.44	16.00	10.15	12.21	15.07
Columbia	Blaeberry River	McCart (1970)	51.519	117.373	14.15	62.90	19.31	11.70	11.95	15.30
Columbia	Bull Lake	Eschmeyer and Bailey (1955)	48.251	115.857	16.71	60.70	18.50	11.83	12.57	15.89
Columbia	Kicking Horse River	McCart (1970)	51.259	116.723	14.66	61.75	18.75	11.58	12.00	14.33
Columbia	Kinbasket Lake	McCart (1970)	52.132	118.436	13.60	60.15	18.07	12.05	12.65	15.40
Columbia	Laird Creek	McCart (1970)	49.621	117.004	15.70	57.80	18.23	11.45	13.15	16.85
Columbia	Lake McDonald	Eschmeyer and Bailey (1955)	48.583	113.920	17.20	59.20	18.35	11.40	12.45	16.00
Copper River	Klutina Lake	Bird and Roberson (1979)	61.691	145.966	17.50	55.50	16.00	11.40	11.90	13.90
Copper River	Tazlina Lake	Bird and Roberson (1979)	61.858	146.490	15.30	56.60	16.30	11.00	11.40	13.90
Copper River	Tonsina Lake	Bird and Roberson (1979)	61.500	145.527	15.30	57.00	16.00	11.30	11.50	14.50
Fraser	Cluculz Lake	McCart (1970)	53.884	123.585	13.70	58.59	18.88	11.15	12.55	15.26
Fraser	McLeese Lake	McCart (1970)	52.407	122.296	15.80	54.95	18.63	11.75	11.90	14.70
Fraser	Moose Lake	McCart (1970)	52.962	118.936	13.75	61.60	18.48	11.80	12.70	15.20
Fraser	Yellowhead Lake	McCart (1970)	52.867	118.533	13.90	57.09	18.11	11.64	12.54	15.73
Knik	Lake George	Wiedmer *et al.* (2010)	61.280	148.480	17.67	58.17	15.83	10.33	10.50	15.17
Mackenzie	Dease Lake	McCart (1970)	58.633	130.038	17.50	56.10	16.15	10.85	11.25	13.60
Mackenzie	Finlay River	McCart (1970)	56.879	126.972	14.60	60.50	19.30	12.10	12.90	15.20
Mackenzie	Tacheeda Lake	McCart (1970)	54.719	122.511	14.47	56.57	19.00	11.60	12.20	15.80
Naknek	Brooks Lake	McCart (1970)	58.513	155.901	16.32	54.85	15.90	11.00	12.10	15.20
Naknek	Grosvenor Lake	McCart (1970)	58.684	155.222	17.10	55.70	15.33	10.44	12.30	14.70
Naknek	Naknek Lake (lr)	McCart (1970)	58.649	156.210	14.54	62.77	17.85	12.00	12.33	15.48
Naknek	Naknek Lake (hr)	McCart (1970)	58.649	156.210	17.33	55.37	15.62	10.77	11.80	15.40
Nushagak	Lake Aleknagik (lr)	McCart (1970)	59.367	158.893	13.46	71.57	19.91	12.11	12.80	14.51
Nushagak	Lake Aleknagik (hr)	McCart (1970)	59.367	158.893	15.82	56.88	16.18	10.43	11.72	15.63
Saint Lawrence	Lake Superior	Eschmeyer and Bailey (1955)	47.097	87.007	18.28	57.14	19.46	10.90	13.20	14.62
Skeena	Morice Lake	McCart (1970)	54.005	127.606	15.20	62.20	19.20	11.70	12.65	15.90
Skeena	Nilkitkwa Lake	McCart (1970)	55.241	126.374	13.70	61.15	18.85	11.80	12.40	15.95
Skeena	Tyhee Lake	McCart (1970)	54.657	126.925	14.30	61.90	19.20	11.10	11.70	15.25
Yukon	Chadburn Lake	McCart (1970)	60.643	134.947	19.00	54.29	17.00	11.00	11.43	15.14
Mackenzie	Bluefish Lake	This study	62.684	114.262	16.84	56.17	n/a	10.00	10.83	15.00

Source: Wiedmer *et al*. 2010; McCart 1970.
Note: Water bodies have one or several morphotypes with high or low numbers of gill rakers and sometimes associated with deep or shallow water habitat: dlr = deep water low rakered, hr = high rakered, lr = low rakered, slr = shallow water low rakered.