Occurrence of Lake Chub, *Couesius plumbeus*, in Northern Labrador

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Lake Chub (*Couesius plumbeus*) were recently found in seven previously undocumented locations in northern Labrador. These populations represent the first recorded accounts of this species in the Labrador region north of the Churchill River drainage and east of the George River. Lake Chub likely invaded this region via dispersal routes provided by eastern spillways of glacial Lake Naskaupi.

Key Words: Lake Chub, *Couesius plumbeus*, species distribution, post-glacial dispersal, Labrador.

The distribution of freshwater species in the Labrador region of the province of Newfoundland and Labrador, like many other areas in northern Canada, remains poorly documented (Black et al. 1986). This is perhaps due to the lack of human intrusion into the region, which is largely unpopulated and undeveloped. The distribution of many species in the Labrador region has been compiled from surveys conducted in coastal areas or in the Churchill River basin (e.g., Backus 1957; Ryan 1980), with lakes and rivers in other inland areas remaining largely unexplored.

Lake Chub, *Couesius plumbeus* (Agassiz), has the most widespread northern distribution of any cyprinid species in North America, where it is found in lakes and rivers throughout continental Canada and the northern United States (Scott and Crossman 1973). However, there are relatively few documented occurrences of the species from the Labrador region. As part of an early ichthyofaunal survey, Backus (1951, 1957) reported finding Lake Chub in Lake Melville and what was then called the Hamilton River basin (now the Churchill River). Black et al. (1986) published the most recent compilation of distributional records for Lake Chub in Labrador, with observations reported primarily from the Churchill River basin (Figure 1). Several reports do note the presence of Lake Chub in major drainages of eastern Ungava Bay, including the George River, Koksoak River, and Whale River (e.g., McAllister and Bleakney 1960; Power and Oliver 1961; Harper 1961; Power et al. 2009), as well as some of the minor drainages (e.g., the Nepihgee River: Power et al. 2002). To our knowledge, however, the occurrence of Lake Chub has not been previously documented in the area of Labrador east of the George River and north of the Churchill River basin. This likely does not represent the actual distribution of the species, but is reflective of the extensive survey work that has been conducted in the Churchill River drainage relative to more northerly parts of the region. As Lake Chub are not a popular game species or widely utilized as fishing bait, they would also go largely unnoticed by anglers and would therefore likely be documented only if lakes were being surveyed specifically for the purposes of describing the fish fauna.

Materials and Methods

Sites

During the period 2002 through 2008, Lake Chub were captured in seven lakes in northern Labrador (Table 1, Figure 1). These lakes are all situated on a plateau that falls within the Kingurutik–Fraser River ecoregion, extending from the Adlatok River in the south (54.25°N) to Okak Bay in the north (57.75°N) (Bell 2002a) (Figure 1). Elevations of the seven lakes range from approximately 136 m (Konrad Lake) to 519 m (Coady's Pond #2). The area is classified as high subarctic tundra and has little vegetation (Bell 2002a). The regional climate is characterized by short, cool summers and long, cold winters (Lopoukhine et al. 1978), with a mean annual temperature of approximately −5°C and ponds on the plateau remaining ice covered as late as July (Peach 1975). Mean annual precipitation varies from 700 mm in the east to 1000 mm in the west (Peach 1975; Bell 2002a*). Geologically, the area is composed primarily of granite, anorthosite, and gneiss (Sutton 1972). Glacial action occurred from west to east in this region, forming steep valleys. Two types of oligotrophic lakes are common here: small, shallow, irregular ponds which occupy hollows eroded in the bedrock; and larger, rock-basin lakes created by damming that resulted from natural accumulations of glacial and fluvial deposits (Anderson 1985).

TABLE 1. Location of the seven lakes where Lake Chub were recently found. Drainage rivers, surface area, and perimeter of each lake are also reported.

Location	Latitude	Longitude	Drainage	Surface area (km^2)	Perimeter (km)
Coady's Pond #2	56.6435°N	63.6271°W	Fraser River	1	9
Coady's Pond #1	56.5217°N	63.8931°W	Kogaluk River	6	40
Ikadlivak Lake	56.3288°N	63.3420°W	Ikadlivak Brook	7	18
Walkabout Lake	56.3277°N	63.1565°W	Ikadlivak Brook	4	26
Konrad Lake	56.2224°N	62.7156°W	Konrad Brook	8	24
Esker Lake	56.4171°N	63.6394°W	Kogaluk River	60	194
Strange Lake	56.2853°N	63.9475°W	Kogaluk River	2	10

[1] Coady's Pond #1 and #2 are location names given to lakes sampled based on maps from Larry Coady, showing rough locations at which his group angled while exploring this section of Labrador (Coady 2008).

TABLE 2. Number of individuals of each species caught in the seven sampled lakes.

Location	*Couesius plumbeus*	*Salvelinus namaycush*	*Salvelinus fontinalis*	*Salvelinus alpinus*	*Catostomus catostomus*	*Prosopium cylindraceum*
Coady's Pond #2	7	25	–	33	–	–
Coady's Pond #1	6	14	1	–	12	–
Ikadlivak Lake	6	78	–	3	51	20
Walkabout Lake	70	86	18	6	95	19
Konrad Lake	9	120	3	8	45	–
Esker Lake	50	96	1	6	213	7
Strange Lake	76	138	–	9	178	42

Lakes containing Lake Chub were fairly shallow, with exposed boulders around much of the shoreline. Some of the largest lakes in the region could have areas of deep water (in the range of 50 to 100 m based on the height of the surrounding land), but lake depth was not measured in these surveys. Lake substrates were mainly mud and sand mixed with larger rocks and boulders, and little or no vegetation observed in the littoral areas. Like many lakes on the plateau, the surveyed lakes tended to be separated from nearby lakes by shallow, boulder-filled streams that may facilitate fish migration between ponds.

Sampling

Two unofficially named lakes, which we will refer to as Coady's Pond #1 and #2 (see Table 1), were fished as part of a sampling program targeting Arctic Charr (*Salvelinus alpinus*) in Labrador. These lakes were sampled in early fall using multimesh Lundgren® gillnets (similar to those described by Hammar and Filipsson (1985)). Gillnets were set perpendicular to the shoreline, with the smallest mesh size oriented closest to shore, and allowed to soak overnight. The five other lakes were sampled as part of a larger climate change study being conducted by the Government of Newfoundland and Labrador. As before, standardized monofilament gillnets with mesh size increasing from 12.7 to 127 mm (bar) by 12.7 mm increments, attached in a series of 15.2 m net panels, were used to sample the lakes. Three nets were set perpendicular to the shore at random locations in each lake and allowed to soak for an average of 4 hours. Length, weight, and sex, as well as date and location of capture, were recorded for all sampled fish (with the exception of Esker Lake). In addition to Lake Chub, Lake Trout (*Salvelinus namaycush*), Longnose Sucker (*Catostomus catostomus*), Arctic Charr, Brook Trout (*Salvelinus fontinalis*), and Round Whitefish (*Prosopium cylindraceum*) were captured in the seven lakes (Table 2).

Results and Discussion

Species Description

Lake Chub were identified using descriptions of the species provided by Scott and Crossman (1973), McPhail and Lindsey (1970), and Stewart and Watkinson (2004). Some of the key distinguishing features of Lake Chub from Labrador included a greenish-brown back, a dark mid-lateral band on the smaller specimens, cycloid scales, threadlike terminal maxillary barbels, and a continuous groove separating the upper lip from the snout. No tubercles were noted on any specimens; however, fish were caught in late summer, presumably after spawning had occurred.

According to Scott and Crossman (1973) and McPhail and Lindsey (1970), Lake Chub consume primarily aquatic insect larvae throughout their range, including chironomid and caddis (*Trichoptera*) species as well as cladocerans, zooplankton, and algae. Stomach contents of the fish from Coady's Pond #1 and Coady's Pond #2 were consistent with this description, including chironomid larvae and insect remains.

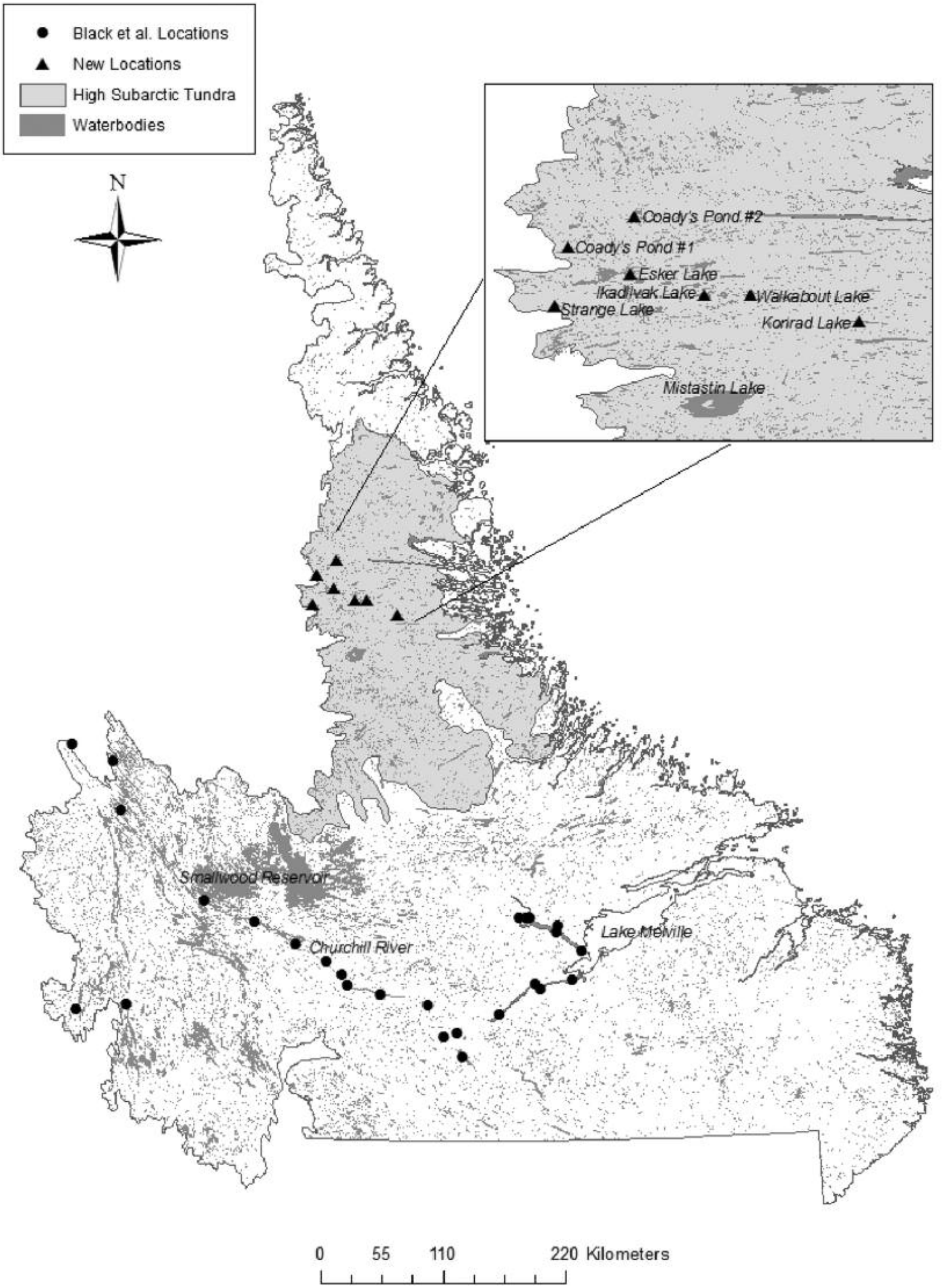

FIGURE 1. Map of Labrador illustrating previously recorded locations for Lake Chub as described by Black et al. (1986) and the seven new locations identified in this study. The Kingurutik–Fraser River ecoregion (high subarctic tundra) is also marked (Bell 2002a*).

TABLE 3. Length (measured as forklength) and weight range of Lake Chub sampled from each lake. This information was not taken for Esker Lake.

Location	Length range (mm)	Weight range (g)
Coady's Pond #2	105–141	14–33
Coady's Pond #1	85–109	7–17
Ikadlivak Lake	102–129	11–23
Walkabout Lake	68–140	3–29
Konrad Lake	90–107	7–11
Esker Lake	–	–
Strange Lake	59–124	1–20

However, small gastropods were also found in the stomachs of two fish from Coady's Pond #2. Carbon and nitrogen stable isotope signatures were obtained for dorsal muscle tissue samples from two individuals from Coady's Pond #2 and from seven individuals from Coady's Pond #1 to further characterize the diet of these populations. All tissue samples were processed according to the methods described in Guiguer et al. (2002). Nitrogen signatures (mean ± SD, Coady's Pond #2: $\delta^{15}N = 7.68 \pm 0.16$; Coady's Pond #1: $\delta^{15}N = 7.04 \pm 0.61$) indicate these fish are secondary consumers (assuming a mean trophic enrichment of approximately 3.4% with each trophic level as reported by Post (2002)), which is consistent with the macroinvertebrate prey items found in stomach contents. Carbon signatures (mean ± SD, Coady's Pond #2: $\delta^{13}C = -21.23 \pm 0.82$; Coady's Pond #1: $\delta^{13}C = -21.33 \pm 0.85$) are consistent with a diet obtained from the littoral food web. Diet information was not available for the five other populations.

Post-glacial Dispersal

As suggested by Black et al. (1986), Lake Chub likely colonized Labrador following the last period of glaciation via an overland route across Quebec. An overland invasion route is more probable than a marine one, given that Lake Chub are a stenohaline species and would therefore not have been able to travel through even brackish water over long distances. It is also unlikely these populations were established as a result of introductions, as there is relatively little human presence, including recreational fishing, in the area. Crossman and McAllister (1986) and Underhill (1986) suggest multiple glacial refugia for Lake Chub in central and eastern North America, including the Atlantic, Mississippian and Missourian refugia. It is therefore likely that Lake Chub dispersed from one or more of these inland refugia and followed various drainages east through the central glacial lakes of the Ungava region. Such a dispersal route could have ultimately led to glacial lakes McLean and Naskaupi, which were formed by the flooding of what is now the George River basin (Jansson 2003). Glacial lake Naskaupi established spillways through cols in the Torngat Mountains watershed, which included an outlet through the Kogaluk River (Ives 1960; Barnett and Peterson 1964; Jansson 2003). Fish following this dispersal route could thus have been able to colonize lakes in the Kogaluk River basin and would have become trapped in lakes on the plateau as Naskaupi and its eastern spillways dried up. Such a colonization route may also explain the apparent absence of Lake Chub between the Kogaluk River and the Churchill River drainages, where there were no known major easterly drainages from Lake Naskaupi during the immediate post-glacial period. However, the presence of fish species within this region is not well documented and further exploration is needed to develop a full understanding of existing distributional patterns and post-glacial colonization routes of freshwater fish species in northern Labrador.

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