RESOURCE NOTES

NO. 21 DATE 06/27/00

A Newly Discovered Population of Arctic Char of the Kigluaik Mountains of Alaska[1]

Joseph F. Webb, Retired
BLM Fairbanks, Alaska

Background

Arctic char, *Salvelinus alpinus*, have a holarctic distribution and exist as anadromous, stream resident and lake resident populations. In Alaska, the preponderance of evidence suggests that only lake resident populations occur (Morrow, 1980 and Reist, et al. 1997). Until 1987, Arctic char populations in Alaska were known only from certain lakes in the Brooks Range and its northern foothills area, southwestern Alaska in the Bristol Bay drainage area, and from south-central Alaska, the Kenai Peninsula and Kodiak Island. In 1987, biologists with the BLM conducted the first fishery inventories of lakes and streams in the Kigluaik Mountains, Alaska, and documented the presence of char, *Salvelinus sp*. in several area lakes. Early objectives of this project were to document fish presence in Kigluaik Mountain lakes and to determine whether char were *S. alpinus* or *S. malma.* Later efforts sought to determine to which subspecies did the char belong.

The Kigluaik Mountains are on the Seward Peninsula, approximately 60 kilometers north of Nome, Alaska, at 66 degrees north latitude and 165 degrees west longitude. The mountain range extends for about 72 kilometers east to west and 20 kilometers north and south. Peaks and ridge lines rise sharply from near sea level to elevations of 1433 meters. Tundra dominates the vegetation. The Kigluaik Mountains are treeless except for small willows (*Salix sp.*). Within the mountains are approximately 50 glacially formed lakes and ponds ranging in size from a few hectares to several hundred hectares. Many of these lakes have barriers to fish entry because of avalanche dikes or waterfalls. The largest recorded lake containing char is approximately 115 hectares.

Methods

The first fish population sampling of the Kigluaik lakes was conducted in 1987. Since that point, fish populations have been investigated in 1992, 1995, 1996, and 1997. In 1987, 21 of approximately 50 lakes in the area were visually examined by use of aircraft to determine their likelihood of supporting fish. Those lakes believed likely to contain fish were sampled with variable mesh monofilament gill nets or hook and line. The following data was usually recorded from each specimen at the time of capture: total and fork length, weight, sex, and state of maturity. Pyloric caeca and gill rakers were removed for future analysis.

The number of pyloric caeca and gill rakers are widely used characteristics for distinguishing between *S. alpinus* and the more common *S. malma*. Although it must be stated that these characteristics are not absolute but rather a range of values (Morrow 1980, Scott and Crossman 1973, and McPhail 1961).

Discussion

Six lakes of 21 observed by air in 1987 were thought likely to support fish. The six lakes were fished with monofilament gill nets. Char, *Salvelinus sp*. were the only species found. Gill raker counts for these fish fit into the range given by Morrow (1980) for both *S. alpinus* and *S. malma* and so were of no value for precise classification. Mean pyloric caeca number was within Morrow's range of values for *S. alpinus* only. In 1996, samples, gill rakers, and pyloric caeca numbers were within the ranges for both *S. alpinus* and *S. malma*. However, pyloric caeca counts were in the extreme upper range given by Morrow. At this point, it seems that gill raker counts may be of little value as a diagnostic feature for determining speciation in Kigluaik Mountain char while pyloric caeca counts may be of some value in helping to separate *S. malma* from *S. alpinus.*

Comparative observations of caudal fin shape between stream and lake resident char revealed that lake char had fins that were distinctly forked at the posterior margins with rather pointed tips, whereas the fins of stream char were only slightly indented and had rounded tips.

Observations of color patterns, markings, and body shape revealed some quite interesting findings. Crater Lake was the only lake in which adult fish exhibited a typical, non-neotenic adult color pattern: a pale silvery gray on the dorsal surface and on the sides above the lateral line with distinct orange to pink ventral coloring and with prominent pink spots on the side primarily below the lateral line. The Falls Creek Lake specimens and those from other lakes collected during the initial 1987 inventories, and in subsequent years, exhibited a high degree of neoteny. Neoteny is a fairly common phenomenon among different populations of *S. alpinus* and *S. malma*, especially showing up in populations where sexual maturity is reached at a comparatively small size but at an old age. Thirty-seven char collected from five lakes in 1987 ranged from 183 to 574 mm fork length and were from 7 to 12 years old. Crater Lake was the only lake where char longer than 400 mm were found.

Inventories of lakes since 1987 have primarily collected specimens

[1]adopted from **Webb, Joseph F. 1999. Article Char of the Kigluaik Mountains of Alaska,** in the Proceedings of the Eighth and Ninth International Society of Arctic Char Fanatics (ISACF) Workshop on Arctic Char 1996 and 1998. Frederick W. Kircheis, ed. Information Series Number 7.

for genetic studies currently in progress. In 1992 five specimens were taken from Falls Creek Lake for potential DNA genetic analysis. In 1995 another visit was made where nine specimens were taken for genetic study. The nine specimens collected in 1995 had been feeding heavily on chironomid and trichopteran larvae. Two individuals had fed on two other fish: one appeared to be a small char and the other char had eaten a slimy sculpin, *Cottus cognatus*. This discovery was the first finding of a non- char species from Fall Creek Lake. Specimens for genetic testing were again collected in both 1996 and 1997.

Initial results indicate these fish appear to be genetically distinct from other populations of *S. alpinus* and were the first Arctic char collected from this area of Alaska. Preliminary genetic analysis using ribosomal DNA first internal spacer region was different from other *S. alpinus* populations that were available for comparison. Further genetic analysis indicated that the populations from the two lakes (Crater and Fall Creek) are also different from each other.

Conclusion

The discoveries made thus far include the following: heretofore unknown populations of *Salvelinus alpinus* and *S. malma* have been discovered; some of these populations appear presently to be reproductively isolated from other populations outside the Kigluaik Mountains and from each other; the char from Falls Creek Lake retain juvenile parr marks at an unusually large size; the char from Crater Lake are the only populations having adults with normal adult markings and coloration, and the pink spots on these adult char are confined primarily below the lateral line; all lakes in the Kigluaik Mountains that appear to be deep enough to contain fish apparently do not contain fish (i.e., some of those lakes that have avalanche dikes or waterfalls near their outlets contain fish and some apparently do not).

To understand what may have happened to isolate fish in these lakes, one must go back in time approximately 18,000 years to the last emergence of Beringia, the lowland mass between Asia and North America which has been periodically exposed and flooded depending on the extent of continental glaciation. The drainage patterns of rivers that crossed Beringia have been discovered by marine geologists. Some modern Alaskan rivers that now empty into the sea were once joined to other rivers that were connected as headwaters common to the Beringia river system, so that direct freshwater access was available to the opposite side of the Bering Strait. Throughout the Pleistocene, the ability of freshwater fish to traverse Beringia has been limited by barriers of sea water or glacial mass. However, with species having the ability to become anadromous, sea water did not represent a significant barrier to distribution. There must have been a "window of time" when an Atlantic/Arctic Basin endemic (*S. alpinus*) could invade areas on the Seward Peninsula before Pacific endemic species (*S. malma*) could invade.

In addition to the Beringian phenomenon, the glaciation of the Kigluaik Mountains was a simultaneous phenomenon that existed separately from the great continental glaciers. Kigluaik Mountain glacial systems existed in varied size and location due to factors of slope, elevation, and aspect. The lake basins that resulted from glaciation and that filled with water at the glaciers' retreat were created during different times because of these varying topographic and microclimate conditions. It is likely that *S. alpinus* and not *S. malma* (a stream inhabitant) would have been the species successful in establishing populations in the newly created lake habitat left by the retreating mountain glaciers. Later, as the continental glaciers retreated, Arctic char populations remained only in the highland lakes where they had established themselves and remain today as remnant populations isolated by avalanche dike or waterfall barriers.

For more detailed information, see the original articles published as:

Webb, Joseph F. 1999. Arctic Char of the Kigluaik Mountains of Alaska, in the Proceedings of the Eighth and Ninth International Society of Arctic Char Fanatics (ISACF) Workshop on Arctic Char 1996 and 1998. Frederick W. Kircheis, ed. Information Series Number 7.

For information on how to reach Mr. Webb, contact:

Bruce M. Durtsche,
Wildlife Biologist, NSTC
Building 50, Denver Federal Center, PO Box 25047
Denver, CO, 80225-0047
phone (303) 236-6310
fax (303) 236-3508
email bdurtsch@blm.gov

National Science & Technology Center
Bureau of Land Management