Phillips

UNIVERSITY OF WISCONSIN MILWAUKEE

Department of Biologial Sciences
PO Box 413
Milwaukee, WI 53201

UWM

Dr Robert Behnke
Dept of Fishery & Wildlife Biology
Fort Collins, Colorado
80523-1474

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UNIVERSITY OF WISCONSIN MILWAUKEE

To: Bob Rehnke
From: Ruth Phillips
Date: May 23, 1996
Subject:

Here is information from Joe Webb.

We found that the % sequence divergence in ITS1 was:

	S. a. erythrinus	S. a. tarnetzi	S. m. malma
Kiyi/Lake fish	5%	5%	6%
S. a. erythrinus	—	1.4%	2.8%

All of the other sequences were 7-8% different from lake trout.

Department of Biological Sciences
College of Letters and Science

414 229-4214
FAX 414 229-3926

Carl

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Kobuk District Office
1150 University Avenue
Fairbanks, Alaska 99709-3844

IN REPLY REFER TO:

JUN 2 6 1995

June 26, 1995

Dr. Ruth Phillips
University of Wisconsin, Milwaukee
Department of Biological Science
P.O. Box 413
Milwaukee, WI 53201

Dear Dr. Phillips:

I am a fishery biologist with the U. S. Bureau of Land Management in Fairbanks, Alaska. While reviewing the recent literature covering the genetics of Salvelinus alpinus I came across a number of articles that you have recently authored and I was attracted to the fact that some of your work may be shedding new light on the systematics of the arctic char complex. And although I am not a geneticist it seems to me that it may have real potential for unraveling some of the mysteries surrounding the alpinus/malma complex, including geographical origins and distribution. While discussing some of your work with Mr. Fred DeCicco of the Alaska Department of Fish and Game, Fred told me that he was familiar with your work and had assisted you in the past in providing samples of char from certain lake systems in Alaska. It was from Fred that I obtained your address.

I am inquiring to see if you are still conducting genetic/taxonomic studies on char and if so would you be interested in getting specimens from relatively recently discovered and hitherto unknown populations of char from the Seward Peninsula in western Alaska. We have assigned these fish to the S. alpinus group based on morphology and meristic counts. I will be working in the area in late July and it may be possible for me to obtain specimens from these lakes that are accessible primarily by helicopter. These fish occur only in certain high mountain glacial cirque lakes and are the only fish species present as far as we know. These lakes have barriers which prevent the entry of other fish and some have barriers which prevent their escapement to areas downstream. These fish may have been reproductively isolated for several thousand years not only from the waters outside this mountainous area but from each other. There are about 50 of these cirque lakes. Not all contain fish but many of them do. The area is nutrient poor and the fish are very slow growing and may be sensitive to disturbance or exploitation. The BLM would be interested to know if these are genetically distinct populations that might require the protection of the Endangered Species Act.

If you are still working in this area of genetics or are otherwise interested in exploring the potential for working jointly on a project aimed at finding out more about these

"new" populations then I would welcome your reply. You may call me at my office (907) 474-2341 or at home at (907) 488-9733 or write at the return address on the envelope. I also have an office FAX 474-2281.

Sincerely,

Joe Webb

Joe Webb

cc Fred DeCicco

JOSEPH F. WEBB
Fisheries Biologist

Bureau of Land Management
Kobuk District
1150 University Avenue
Fairbank, AK 99709-3844
(907) 474-2341

August 16, 1995

University of Wisconsin, Milwaukee
3209 N. Maryland Ave.
Milwaukee, Wisconsin 53211

Dear Dr. Phillips:

I am glad I got the opportunity to talk with you on the phone the other day. I hope your trip to Juneau was safe and pleasant. This letter I am enclosing in the package with the tissue samples is for the eyes of your assistants as well. (And they should be aware that I am sending you a copy of this to your Seattle business address so they should not feel the necessity of forwarding this letter to you.)

Anyhow I am extremely pleased at the possibilities offered by your interest in the char populations we discovered. The implications relative to taxonomic and genetic questions are obvious. I hope your analysis will help us determine what actions we should take regarding future work in this area. There are a great number of lakes in this mountainous area that have these isolated char populations-isolated from downstream, lowland areas and reproductively isolated from each other as well.

The samples are from two different lakes in the same lake basin. There should be no difference between the two because the lakes are just a hundred yards apart with a small stream connecting them. However, I am separating them for the remote possibility that they are different.

At this point I will not mention the precise location where the samples were taken. If analysis of your data indicates further sampling is desirable from the same or from other lakes then I will divulge the exact locations if we develop a joint project. The lakes are typically populated by only one species and the productivity in terms of biomass or other measures is very low. The lakes, with one exception, are not impacted by any human activities, including sport fishing and may be extremely sensitive to environmental disturbance or population perturbations. At this point it is probably sufficient to know that the lakes are in some mountains about 40 or 50 miles north of Nome, Alaska. Only one of the lakes has a name. The name I have put on the samples is a name I made up so I could have a handy reference.

I am leaving on a trip to the lower 48 states and will return in early September. I plan on calling you then and discussing this project with you in more detail. Thank you very much for the interest you are taking in these fish and this project. I am enclosing two photos, one of the fish and the other of the lake they were taken from.

Sincerely,

Joe Webb

A Review of Research on Lake Resident Arctic Char, *Salvelinus alpinus*: 1980-1992

By

Graham J. Davis

and

Joseph F. Webb

Kobuk District
D.O.I., Bureau of Land Management
Fairbanks, Alaska

May 1993

ABSTRACT

This review summarizes research performed on lake resident Arctic char, Salvelinus alpinus, since the comprehensive review of Johnson (1980). This review also summarizes the prime limnological studies conducted on Alaskan lakes. Arctic char have a Holarctic distribution and exist as anadromous, stream resident and lake resident populations. They also exist as normal and dwarf sized morphs (forms) within lake and stream resident populations. In Alaska, the preponderance of evidence suggests that only lake resident populations occur. Until 1987 the Alaska populations were known to occur in certain lakes in the Brooks Range and foothills area on the North Slope and in southwestern Alaska. In 1987 biologists with the U.S. Bureau of Land Management discovered previously unknown populations of Arctic char in some lakes of glacial origin in the Kigluaik Mountains on the western Seward Peninsula. Arctic char may be the only species of fish occurring in these lakes and they occur several hundred miles from other known populations on the North American continent. These fish are not only reproductively isolated from other areas of Alaska but populations in each watershed where they occur in the Kigluaik Mountains are isolated from other watersheds where they occur. This comprehensive review was undertaken to attempt to determine if there was a possibility that these may be unique races or populations, whether special management action should be considered, and whether additional research should be performed.

Until recently the different forms of char were considered by some biologists to be different species. Recently there has been a great deal of controversy among biologists specializing in salmonid biology as to whether Arctic char are one or more than one species. More recently, work performed in Europe suggests the different morphs coexisting in certain lake and river-lake systems are all of the same species that evolved from a sympatric ancestor. Some studies indicate that food type, quality, and quantity may be a major factor in determining the occurrence and abundance of a particular morph. Other studies indicate that parasitism, heavy metals, degree of eutrophication of the lake, quality of spawning habitat, average temperatures and turbidity may influence the abundance of the different morphs.

The major determining feature of the dwarf morph is its small size at sexual maturity. But the more important feature is the retention of juvenile color patterns (parr marks) into adulthood.

Other features sometimes include a benthic feeding behavior with a slight subterminal placement of the mandible as compared to the normal (large) forms with a terminally placed mandible.

There is general agreement that most char lake system are relatively young, dating back to post-pleistoscene times. This could be interpreted that the populations inhabiting the lakes are young or have had a short evolutionary history. However, such systems could have migrated geographically over a large area for much longer time. Some biologists believe that young lakes,

INTRODUCTION

The purpose of this review is to summarize the status of research on lake resident Arctic char, Salvelinus alpinus, as a basis for developing a better understanding of Arctic char populations in pristine alpine lakes in the Kigluaik Mountains on the Seward Peninsula north of Nome. This review stresses developments in the field since the comprehensive review of Johnson (1980). Suggestions for initiating studies on the ecosystem structure and dynamics of the lakes and associated systems are also given.

There are four well-established species of Salvelinus, the char genus in Alaska: Salvelinus alpinus (Arctic char), S. fontinalis (brook trout), S. namacush (lake trout),and S. malma (Dolly Varden). Two other species, the validity of which there are some questions, are S. angayukaksurak (angayukaksurak char) and S. confluentus (bull trout). It appears that there are no anadromous Arctic char in Alaska. Hence this review stresses lake resident Arctic char.

The Arctic char is a uniquely adaptable fish with a Holarctic distribution. It extends farther north than any other freshwater fish and has been studied in lakes up to Latitude 82° N. The mechanisms leading to establishment and maintenance of this one species in such harsh and stressful environments are poorly known. No special biochemical mechanisms,such as ones associated with respiration or resistance to freezing have been found. As suggested in a later discussion, the high degree of ecophenotypic plasticity found in Arctic char could contribute to the survival of the species under stressful conditions. That is, the morphology, behavior and, no doubt, physiology of the fish can change in one generation in response to poorly known stimuli in a changing environment. Research and controversy in this area have been extensive in the past 10 years and therefore this is a recurring theme in this review.

Arctic char flourish in the Arctic but they are also found in the Subarctic and in the Alps and other mountains in Europe. In a few areas, such as the northeastern coastal region of the United States, they are found in lakes in temperate regions.

The current distribution of Arctic char appears, in large part, to be associated with movement of the fish from glacial refugia in early post-Pleistocene times to lakes and rivers in association with phenomena such as isostatic rebound associated with melting of glaciers. Recently there has been lively controversy as to the origin of different forms (morphs) of char observed in the same lake or lake-river system. One group is convinced that there were migrations from different refugia (allopatric origin) which gave rise to three different species of Arctic char in Scandinavia alone. Others support the concept of the morphs developing from a single ancestral group (sympatric origin). Based on recent population and hatchery studies combined with increasingly sophisticated studies of the molecular systematics of Arctic char, it is apparent that the morphs (ie., dwarf and normal) are usually ecophenotypic expressions of a sympatric ancestor.

Normally Arctic char are very sensitive to pollution and tend to disappear with cultural eutrophication and lowered dissolved oxygen. Through history Arctic char have been important in subsistence by groups such as Eskimos, Lapps and Alpine people of Europe. It is commonly caught by sports fisherpersons around the Arctic including Alaska. There is some commercial fishing but it will probably never assume great importance due to the inability of slow-growing stocks to withstand high levels of predation.

The Kigluaik Mountains are on the Seward Peninsula approximately 35 miles north of Nome, Alaska. The range is about 45 miles long, 12 miles wide and runs east-west. Peaks and ridge lines rise sharply from around sea level to elevations up to 1433 m (Mt. Osborne). Tundra dominates the vegetation; for the most

part, the Kigluaiks are treeless except for a few stunted willow. Within the mountains are many lakes and small ponds of glacial origin ranging in size from less than a hectare to the 485 ha Glacial Lake. Many of the lakes are cirque lakes, most of which have outlets which are tributaries of larger streams which flow from the Kigluaik Mountains into either the Imuruk Basin to the north or Norton Sound to the south.

Kretsinger (1987) found Arctic char in five of six Kigluaik lakes surveyed. No other species were caught, but two different morphs were caught in Crater Lake. The smaller (but still large) form had parr marks on mature adults (dwarf form) and the larger form had no parr marks on the mature adults (normal form). More information on the physical characteristics of two of these lakes along with data on the Arctic char populations is given in APPENDIX A. Similar data on other lakes are given for comparison.

In August 1992 we found much smaller adult dwarfs with parr marks in a small pond in a seepage zone just below a cirque lake. The taxonomic status of these fish is not certain; the material is now being studied by Dr. James Reist (Fred DeCicco, personal communication 1992).

These two preliminary surveys indicate that more detailed studies of char populations here could make a significant contribution to our knowledge of char biology and systematics as well as provide information for management decisions for a unique and beautiful mountain system. For example, information on spawning and size and age structure of the different populations would be needed in relation to permitting sports fishing in some of the lakes.

Based on an extensive survey of the literature, the Arctic char lakes of the Kigluaiks are unlike any other Arctic char lakes studied. Most of the Kigluaik lakes are cirque lakes. No mention has been made of Arctic char studies in cirque lakes. Too, since most of the cirque lakes have no influent streams, this could make studies of allochthonous inputs into the lakes important but perhaps difficult to quantify.

The Kigluaik Mountains form an alpine, maritime, subarctic (barely) permafrost, tundra and rock system. These factors contribute forcing functions associated with things such as weather, climate, and the nature, degree and timing of allochthonous inputs. Worldwide, the number of Arctic char lakes driven by all the factors listed above must be small; I know of no other such lakes in Alaska.

Lake studies in Alaska appear to be moving apace. Toolik Lake and other lakes along the Dalton Highway on the northern slopes of the Brooks Range are being studied under grants to the Ecosystems Center at Woods Hole. This includes population studies of lake resident Arctic char. Limnological studies of well over 100 Alaskan lakes have been made by scientists of the Alaska Department of Fish and Game. Information on the Arctic char lakes of the Kigluaik Mountains would extend and complement these other studies in contributing to a greater understanding of limnology and fisheries in Alaska. Watershed and limnological studies in the Kigluaiks would develop valuable baseline information in reference to changes which may occur in association with phenomena such as air pollution associated with the Arctic haze, global warming and acid rain. The proximity of Seward Peninsula and the Kigluaik Mountains to Asia may contribute to the value of baseline data here.

Two appendices are included:

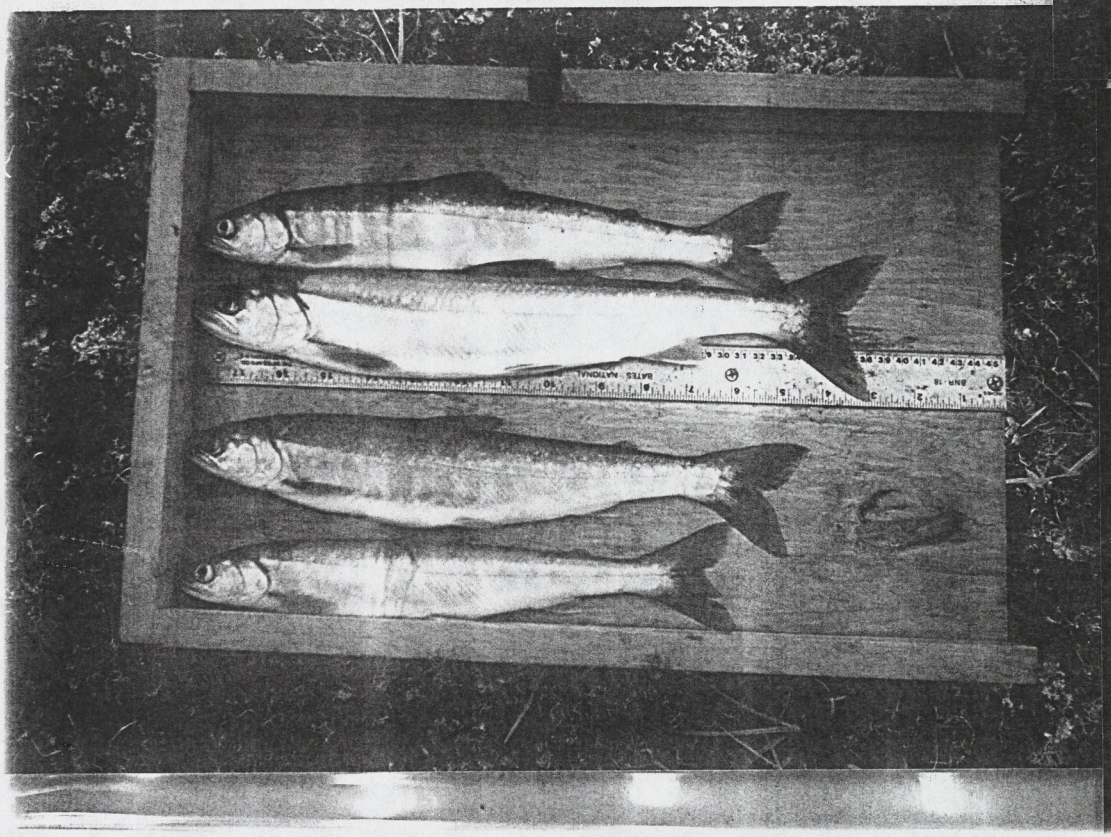
APPENDIX A. Summary Information on Some Arctic Char Lakes.
APPENDIX B. Summary Information on Fishing Techniques and Data Collection.

coupled with low species diversity makes for immature biological systems which are unstable and that a climax system may not evolve. The ratio of primary productivity to mean annual biomass is suggested by some to be a measure of ecosystem stability. A low P/B ratio indicates the existence of a steady state. Char lakes usually have low P/B ratios and that coupled with high mean ages of char in lakes with unexploited populations defines that environments of char lakes usually exits as a climax community.

Recent taxonomic studies employing the techniques of molecular systematics has created both controversy and unity among biologists concerned with speciation in Arctic char. However, most of the modern literature seems to support the contention that the different forms of Arctic char are all of the same species and that Dolly Varden, S. malma, is a distinct species. Most of this work has been done in Europe with some being done in Canada and practically nothing in the literature of work done in Alaska, if any. Mitochondrial DNA diversity techniques are beginning to replace protein electrophoresis as the method of choice in studying speciation and subspeciation in fishes.

In designing limnological studies of lakes in the Kigluaik Mountains it is suggested that the initial studies should be modeled after the Bear Lake research of the Alaska Department of Fish and Game and follow the manual developed by their Lomnological Section (Koenings, 1987). Longer term studies should be performed in some cases and should follow the work done at Toolik Lake by Hobbie, et al. (1991).

Arctic Char
Seward Peninsula, Alaska
July, 1995
unnamed lake at
head of Falls Creek.



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Dr. Robert Behnke
Dept of Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523

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Y rates
— recognition

computers — models

Ill. Technique

Ellie Jones
498-1223

DeCicco, Fred

From: DeCicco, Fred
To: Bob Behnke
Subject: char
Date: Wednesday, September 25, 1996 2:07PM

Hi Bob,
Sorry that it has taken so long for me to get back to you regarding Bering Dolly Varden, etc, but I just returned from my field work in western Alaska and am trying to get caught up on correspondence and sift through the stack of junk that has accumulated on my desk over the summer. In addition, I just finished hosting the ISACF bunch. They were able to travel to both Nome and Kotzebue, and see some fish. Overall the workshop was a great success, but as the only organizer, my sleep patterns suffered.

I was able to set some nets in previously unsurveyed maar lakes on the northern tip of the Seward Peninsula (see ARCTIC, Vo. 49, No.1 (March 1996) P 62-69).
These lakes are very interesting. North and South Devil Mt. Lakes both contained Arctic char as did South Killeak Lake. North Killeak Lake contained only Least Cisco and 9-spine stickleback. Apparently it is common in European lakes that once a plankton feeding coregonid is established in a lake, it outcompetes Arctic char. Anyway, I have a couple of specimens from these lakes set aside for you if you are interested. * Is it alright if I remove the otoliths before sending them? The ones for you are mature, at least judging by the secondary sexual characteristics of the male. The closest known population of Arctic char are the cirque populations in the Kigluaik Mountains. However, these fish could have existed in the maar lakes much longer than those in the Kig. Mts. and may either be earlier colonizers, the parent stocks from which the cirque lakes were colonized or may have been colonized at about the same time. According to David Hopkins, this area of the Seward Peninsula was not glaciated during the Wisconsin event, while the Kigluaik Mountain cirques were frozen 9,000 years ago. It will be interesting to compare the populations. I plan to send some samples to Ruth Phillips and probably also to Jim Reist at DFO for genetic work.

Back to Bering malma, I hope to collect some blood and get it to Ruth Phillips so she can look at chromosomes sometime next spring or summer, I'll also collect fins, or some other tissue. She has hearts already, but only a few, (6 or 8).

I have some photos of all of these fish. Do you want slides or prints?

I'll have some copies made and send them along.
Best Wishes,
Fred DeCicco

Bob, I sent this ~~via~~ e-mail some time ago but it did not go through
I tried again on 10/29/96 and am sending this hard copy in case
the same thing happens again.
The E-mail address I have for you is rjbfwb@cnr.colostate.edu
If this is incorrect, please let me know.   drop rjb
My E-Mail address is FDeCicco@Fishgame.state.ak.us

Best wishes,
Fred

Taranetz vs. high Arctic
(?)kers R.

– Yukon refugia – ancient relicts
Chukotsk – Elgygytgyn
– AC? Rept Sov. –
Chukotsk. divergence in AK?
– VNTR – Ruth Phil
pop. level.

Draft

Colorado State University

Department of Fishery and
Wildlife Biology
Fort Collins, Colorado 80523
(970) 491-5020
FAX (970) 491-5091

July 12, 1996

Mr. Fred DeCicco
Arkansas Dept. Fish and Game
1300 College Rd.
Fairbanks, AK 99701-1599

Dear Fred:

Thanks for more information on the "southern" or Bering form of northern Dolly Varden. They do appear to considerably differ in body form and life history but both have similar numbers of gillrakers and pyloric caeca, which explains why attention to these two forms has not been noted in the literature. The most probable explanation is separation and isolation during the last glacial period in different refugia. I'll enclose papers I recently wrote on coastal cutthroat trout and an apparant relict on Kamchatka. You can note correlations with Dolly Varden for similar opportunities to differentiate during glaciation, except that the cutthroat's range never became continuous again after glacier retreat.

I would suspect, based on geography and distribution of rainbow trout that the Dolly Varden of Kamchatka would be most similar to the Bering form of Alaska. Kamchatka, however, was never completely glaciated and salmonids could have persisted in limited areas during the ~~first~~ last glacial epoch.

The data Ruth Phillips obtained concerning divergence of the peculiar Seward cirque lakes ~~is~~ charr is surprising. Based on sequences of internal transcribed spacers (ITS 1 only - evidently

From: "Nick Karas" <nickaras@prodigy.net>
To: "Benhke, Dr. Robert J." <fwb@picea.cnr.colostate.edu>
Subject: Fw: char please.2
Date: Mon, 22 Feb 1999 10:59:31 -0500
X-MSMail-Priority: Normal
X-Mailer: Microsoft Outlook Express 4.72.2106.4
X-MimeOLE: Produced By Microsoft MimeOLE V4.72.2106.4

Bob:
I think I may have stirred up a bee's nest.
Nick
-----Original Message-----
From: Nick Karas <NKaras990@compuserve.com>
To: Nick Karas <nickaras@prodigy.net>
Date: Monday, February 22, 1999 11:01 AM
Subject: char please.2

----------Forwarded Message----------

From: Joe Nelson, INTERNET:joe.nelson@ualberta.ca
To: [unknown], INTERNET:ewurzbacher@fisheries.org
[unknown], NKaras990

CC: "Richard Robins", INTERNET:crr@falcon.cc.ukans.edu
"Jim Williams", INTERNET:jim_williams@nbs.gov
[unknown], INTERNET:joe.nelson@ualberta.ca
"Ed Crossman", INTERNET:crossman@rom.on.ca
"Carter Gilbert", INTERNET:carter@flmnh.ufl.edu
"Hector Espinosa-Perez", INTERNET:hector@servidor.unam.mx
"Bob Lea", [75357,376]

Date: 2/20/99 2:06 PM

RE: char please

Sender: joe.nelson@ualberta.ca
Received: from pilsener.ucs.ualberta.ca (pilsener.ucs.ualberta.ca
[129.128.5.19])
by arl-img-12.compuserve.com (8.8.6/8.8.6/2.18) with ESMTP id OAA17879;
Sat, 20 Feb 1999 14:05:55 -0500 (EST)
Received: from odum.biology.ualberta.ca (odum.biology.ualberta.ca
[129.128.82.250])
by pilsener.ucs.ualberta.ca (8.9.1a/8.9.1) with ESMTP id MAA15712;
Sat, 20 Feb 1999 12:05:45 -0700 (MST)

Date: Sat, 20 Feb 1999 12:05:45 -0700 (MST)
Received: from ODUM/SpoolDir by odum.biology.ualberta.ca (Mercury 1.43);
20 Feb 99 12:06:00 -0600
Received: from SpoolDir by ODUM (Mercury 1.43); 20 Feb 99 12:05:50 -0600
Received: from [129.128.82.242] (129.128.82.242) by odum.biology.ualberta.ca
(Mercury 1.43) with ESMTP;
20 Feb 99 12:05:45 -0600
X-Sender: nelson@odum.biology.ualberta.ca
Message-Id: <v03102702b2f450b14e20@[129.128.82.242]>
Mime-Version: 1.0
Content-Type: text/plain; charset="us-ascii"
To: ewurzbacher@fisheries.org, NKaras990@compuserve.com
From: Joe Nelson <joe.nelson@ualberta.ca>
Subject: char please
Cc: "Ed Crossman" <crossman@rom.on.ca>,
"Hector Espinosa-Perez" <hector@servidor.unam.mx>,
"Carter Gilbert" <carter@flmnh.ufl.edu>,
"Bob Lea" <75357.376@compuserve.com>, joe.nelson@ualberta.ca,
"Jim Williams" <jim_williams@nbs.gov>,
"Richard Robins" <crr@falcon.cc.ukans.edu>

Hi Nick & Eric,

Nick, as you may know your comments re char versus charr were passed on to me.
It is good to go into the history of the change in spelling as you are attempting & we do welcome comments.
However, this is a matter that has been delt with a great length & is as far as I am concerned its settled (it is simply not productive to revisit the question-- the spelling is char (I am not certain if you had copy of my earlier email but I did want to pass these comments on to you-- I am not certain what sort of evidence would change our minds because char is just too entrenched). I'll not go into reasons why I think some advocated charr in 60s in NA but let me pass along a few [edited] email comments I had & I hope they help!

1. From Dick Robins who with Reeve Bailey put enormous work into the question--
Joe: Re char we looked into this in great detail involving classicists in the celtic languages. The answer to that search was that char was the correct and proper spelling. [It seems that everything was all set until some (not all please) who apparently had no knowledge of the problem and no background in the language adopted the spelling charr & in later conversations they agreed they had not understood the problem]- Dick

2. From my Canadian colleague who likes colour but likes char! Ed Crossman-
Joe

> If you are going to suggest you prefer the US spelling of colour this is an agreement that word spelling changes over the years. If US users want to spell it color how can they insist on what they say is the original spelling of char, as charr. Vianney Legendre and other Quebecois are for many original French spellings, etc. The Concise Oxford Dictionary to Current English, 4th Ed. has on p197 "char- hill trout of Wales etc." that is the first meaning of the word provided. Only in the 3rd meaning of char, = burn scorch etc., does it include, as an alternative (-rr). I doubt that a Webster's dictionary has Charr, but I did not checkIt seems to me the committee has opted for simplicity in other instances so lets do so here. I'm for char!
>
> Ed Crossman, ROM, Toronto

Again I do appreciate your trying to help but lets leave it char -- we of the Names committe are & I can only say lets agree on one spelling for sake of clear communication.
Thanks,
Joe, Chair of AFS/ASIH Fish Names Committee

Joseph S. Nelson
Dept. Biological Sciences,
University of Alberta,
Edmonton, Alberta T6G 2E9
Canada
ph 403-492-4741 (area code changes to 780 effective 25 Jan 1999)
e-mail joe.nelson@ualberta.ca

Sent via email
11/15/96

To: FDeCicco@Fishgame.state.ak.us
From: Judy Terrel <judyt@picea.cnr.colostate.edu>
Subject: Letter from Bob Behnke
Cc:
Bcc:
X-Attachments:

Mr. Fred DeCicco
Alaska Department of Fish and Game
1300 College Road
Fairbanks, AK 99701-1599

Dear Fred:

We would very much like to examine any charr specimens from the northern Seward Peninsula (after you remove otoliths) and any photos of these fish. As I've mentioned before, it's somewhat surprising that preglacial relict charr populations, comparable to what occurs in Chukota lakes, haven't been discovered in Alaska. For strictly lacustrine charr, a lack of suitable connecting lakes across the Bering land bridge could have been an effective block to Asian-North American transfer. In ISACF no. 5 (1991), Savvaitova discussed the three sympatric charr populations in the Pegtymel Lakes of Chukota -- "deepwater," "long-headed," and "deep-bodied" charr. The deepwater charr have modal gill raker counts of about 35-37 (about 55-60 pyloric caeca). Why aren't sympatric populations of Arctic charr found in Alaskan lakes?

Who were the ISACF people you hosted? Did you have a meeting? A proceedings? I don't believe I have a proceedings after no. 5 of 1991.

Pardon my e-mail illiteracy. I can be reached through our department's address of fwb@cnr.colostate.edu -- be sure to put my name in the body of the message because several people use that address.

Regards,
Bob Behnke

Colorado State University

Department of Fishery and
Wildlife Biology
Fort Collins, Colorado 80523
(970) 491-5020
FAX (970) 491-5091

June 3, 1996

Dr. Ruth Phillips
Department of Biological Sciences
University of Wisconsin - Milwaukee
Milwaukee, WI 53201

Dear Ruth:

Diagnosis of AK charr

The eight large Wulik R. charr are magnificent examples of northern Dolly Varden. In such large, old specimens male sexual dimorphism is pronounced -- some with kypes like Pacific salmon. Gill raker counts are 19-23 (21.1) and pyloric caeca about 25-30 - very typical of S. m. malma. The six specimens from the Nome River have about identical counts, 20-23 (21.3) and ca. 25-30, but have a very different morphology. The rounded (vs. strongly laterally compressed) body, relatively small, more obtuse head with thin, straight maxillary and tiny teeth on jaws presents a "dainty" appearance. These traits were used by Chereshnev to differentiate Arctic charr from Dolly Varden. Considering the number of gill rakers and caeca and their numerous small spots, all diagnostic of Dolly Varden, I don't believe that these Nome charr are a form of S. alpinus. Evidently, they had made one ocean migration, returned to the river, and after another ocean migration would have sexually matured and spawned in the following year (in the year after collection made). How would these "intermediate" Nome fish appear after two or more migrations and after sexual maturity attained? I'll have to inquire with Fred DeCicco for more information. In any event, I'm sure they do not represent intermediacy between northern and southern Dolly Varden or between Dolly Varden and Arctic charr.

Did you obtain genetic data comparing the Nome charr with the Wulik charr?

I received copies of the information sent to you by Joe Webb, except for an appendix giving taxonomic data. I'm curious as to the number of gill rakers in the peculiar charr of the cirque lakes on the Seward Peninsula. The percent sequence divergence you obtained from ITS is impressive. What populations of erythrinus, taranetzi, and malma did you use? There is a possibility that small, isolated populations could give highly divergent results from rapid, independent local evolution and/or by retaining primitive patterns largely lost in large, contiguous populations. The fish in the photos resemble S. alpinus typical of ultra

oligotrophic lakes. Can you obtain other lines of evidence on relative divergence to support or question the ITS results?

Over the past few years I have mentioned the diversity in the alpinus complex recorded in Siberia from the Lena River basin in the west to the Chukokst Peninsula in the east which suggests that one or more of these forms (in addition to the typical "erythrinus" and "taranetzi" types) should occur in Alaska.

Enclosed are copies of pages just sent by Sergei Aleckseyev to Don Proebstel concerning dwarf and normal charr of Namarakit Lake (Lena basin) which average about 36 and 38 rakers. Sergei brought some of these charr to CSU last year. They are highly divergent morphologically, but evidently very close genetically. A deepwater dwarf charr with about 33 rakers occurs in several lakes of the Chukokst Peninsula which may be of the evolutionary line. Do they occur in Alaska also?

Sincerely,

Robert Behnke

To: Donald Proebstel

Hi, Don, I leave on the 2-nd of June and I shall be back to Moscow by the 10-15-th of July. After that I shall leave Moscow on approx. the 20-th of July till the middle of August. Please decide before July whether or not you participate in our expedition and send me a message. If you do, I shall send you more detailed information about the expedition in July. I shall phone to Moscow a couple of times in June, so if there is urgent information, you can send it to Andrew and perhaps I shall get it in Transbaikal.

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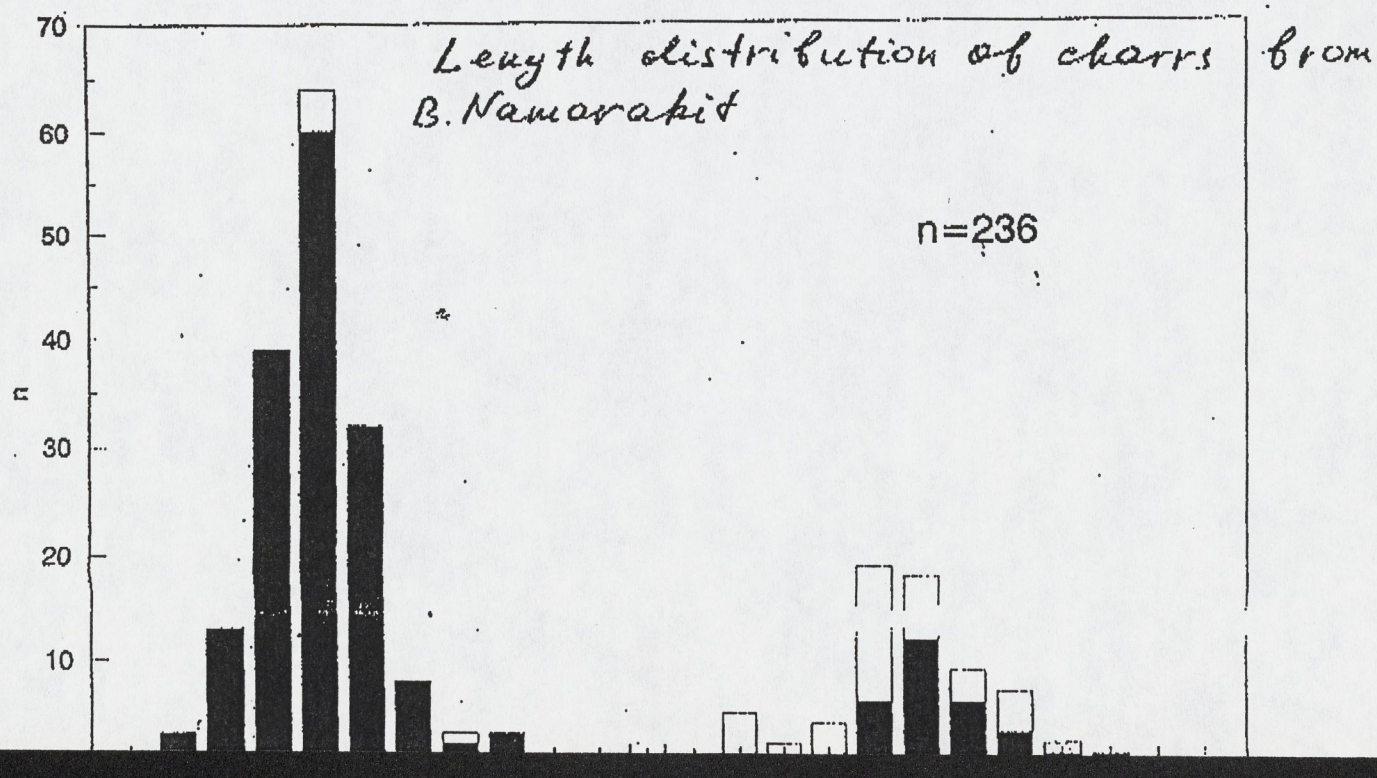
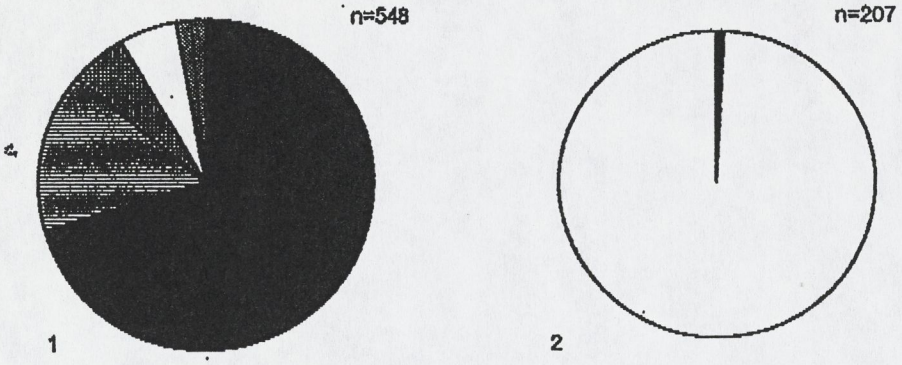


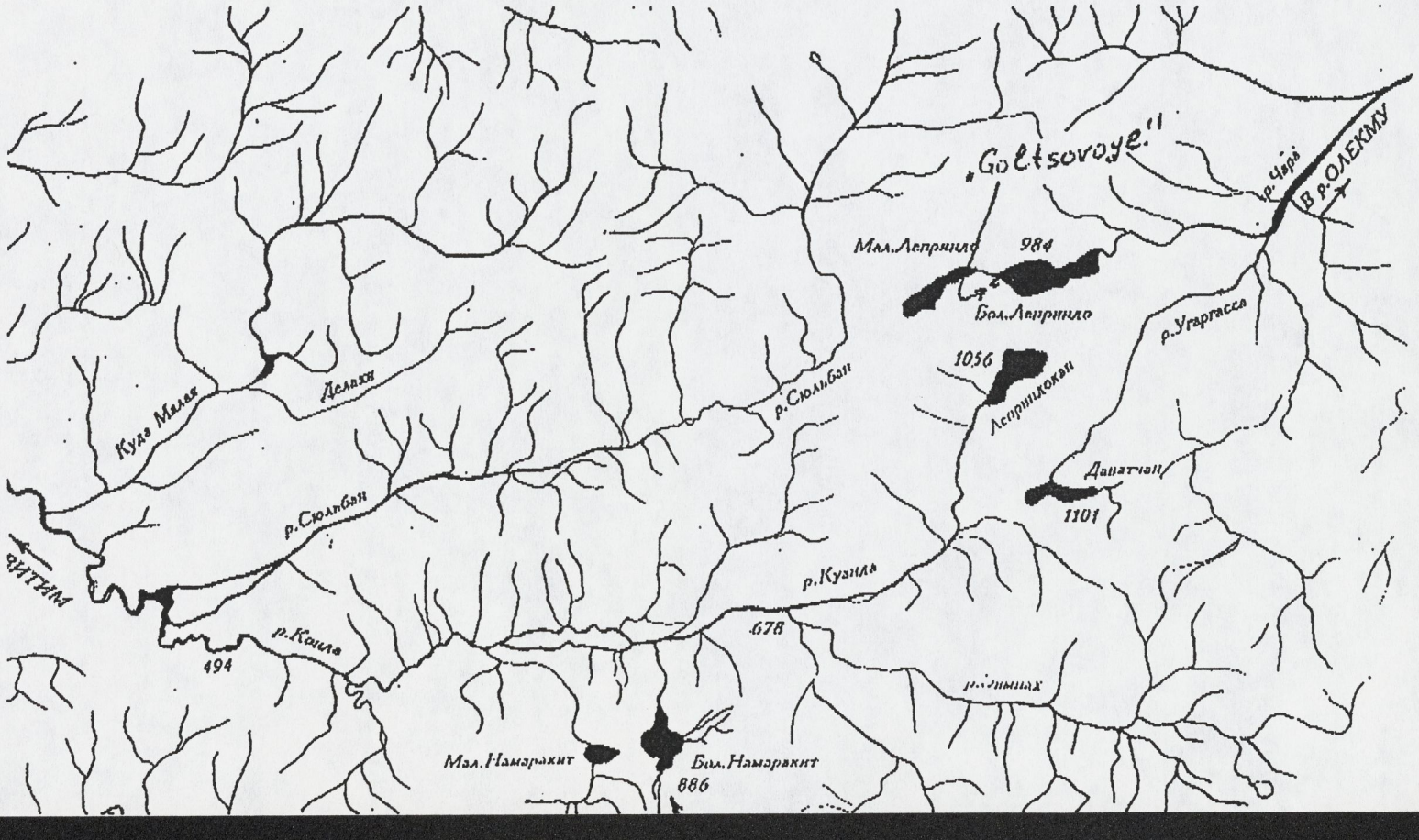
Catches near the shore (1) and in the center of the lake, depth ~25m (2)

Уловы в оз. Б.Намаракит у берега на свале (1) и в центре на глубине 25 м (2)



- окунь *Perca fluviatilis*
- хариус *Thymallus arcticus*
- арктический голец (нормальный) *S. alpinus ("normal")*
- арктический голец (карликовый) —"— ("dwarf")
- сибирскиий голец *Nemacheilus barbatulus toni*
- гольян Лаговского *Phoxinus lagowskii*

Map of the region



Counts

Таблица 3. Меристические признаки гольцов из оз. Б.Намаракит

normal dwarf

признак	"нормальные", n=50[1] lim	M	σ	карликовые, n=50 lim	M	σ	r	I
sb	34-42	38.1	1.64	33-41	36.6	1.57	0.810	22.5**
rb1	10-12	10.7	0.54	10-12	11.1	0.67	0.939	12.2**
rb2	10-11	10.5	0.5	10-12	10.6	0.57	0.976	2.6
D	8-10	9.42	0.64	8-10	9.36	0.56	0.989	2.2
A	8-10	8.56	0.54	7-10	8.58	0.61	0.988	1.4
P	12-13	12.5	0.5	11-13	12.1	0.53	0.928	10.4**
V	7-9	8.02	0.25	7-9	8.06	0.31	0.996	0.8
ll	126-139	132	3.51	122-142	132	4.20	0.810	14.5
pc	42-68	53.5	5.91	38-67	52	6.05	0.724	30.2
vt	64-67	66.3	0.81	63-66	65	1.02	0.583	50.2***

Примечание. [1] для sb n=46, для ll n=23. sb – число жаберных тычинок, rb1 – число жаберных лучей слева, rb2 – справа, D – число ветвистых лучей в спинном, A – в анальном, P – грудном, V – брюшном плавнике, ll – число чешуй в боковой линии, pc – число пилорических придатков, vt – число позвонков, r – показатель сходства, I – критерий идентичности (Животовский, 1982, звездочками отмечены случаи достоверных отличий между нормальными и карликовыми гольцами). Остальные обозначения, как в табл. 1.

Age composition, growth

Таблица 5. Возрастной состав и наблюденные длины гольцов из оз. Б.Намаракит

normal dwarf

age возраст годы	"нормальные" ♂ самцы n	FL, lim M±m	♀ самки n	Fl., lim M±m	♂ карликовые самцы n	FL, lim M±m	♀ самки n	FL, lim M±m
6	–	–	–	–	1	188	–	–
7	–	–	–		4	162–183 176±4.8	1	177
8	13	263–334 302±6.6	10	260–320 297±5.9	8	153–196 177±5.9	–	–
9	14	275–341 318±4.6	10	251–340 310±7.6	3	155–177 168±6.5	3	172–220 191±14.6
10	4	310–325 317±3.5	9	303–330 315±3.0	11	173–238 192±6.5	3	175–197 184±6.6
11	2	297–325 312	1	330	12	163–196 183±2.6	7	173–197 184±2.9
12	–	–	–	–	9	166–195 183±3.2	6	172–209 194±5.4
13	–	–	–	–	7	172–192 182±2.7	2	187–195 191
14	–	–	–	–	7	165–196 179±4.8	4	173–227 188±13.0
15	–		–	–	4	173–207 187±14.5	3	192–192 192±0.0
16		–	–	–	5	181–230 193±8.2	2	188–212 200
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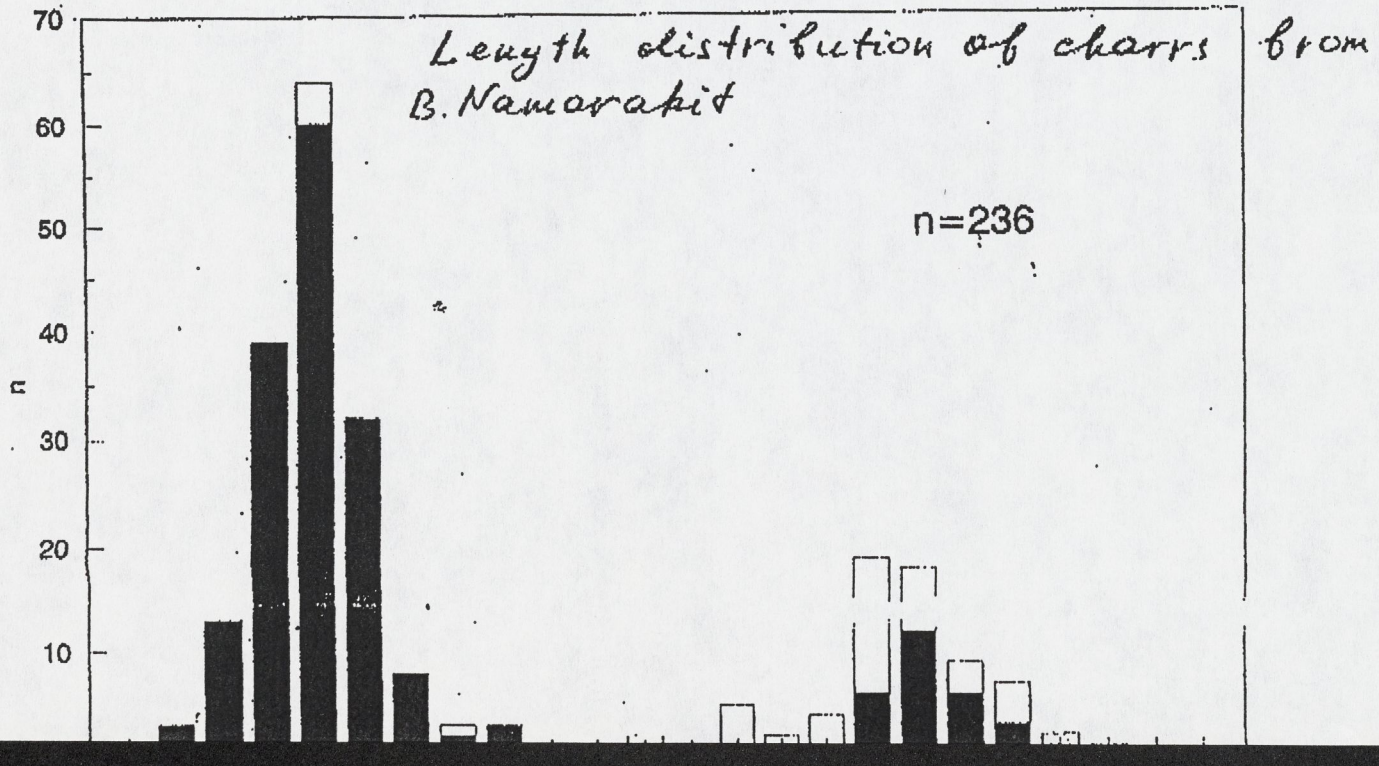

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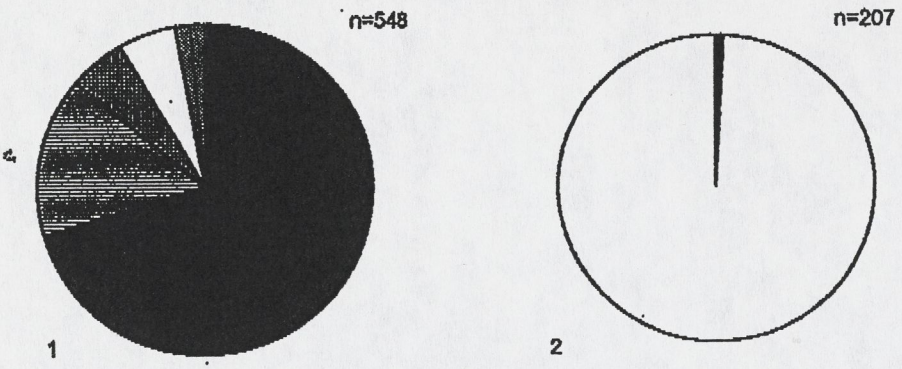

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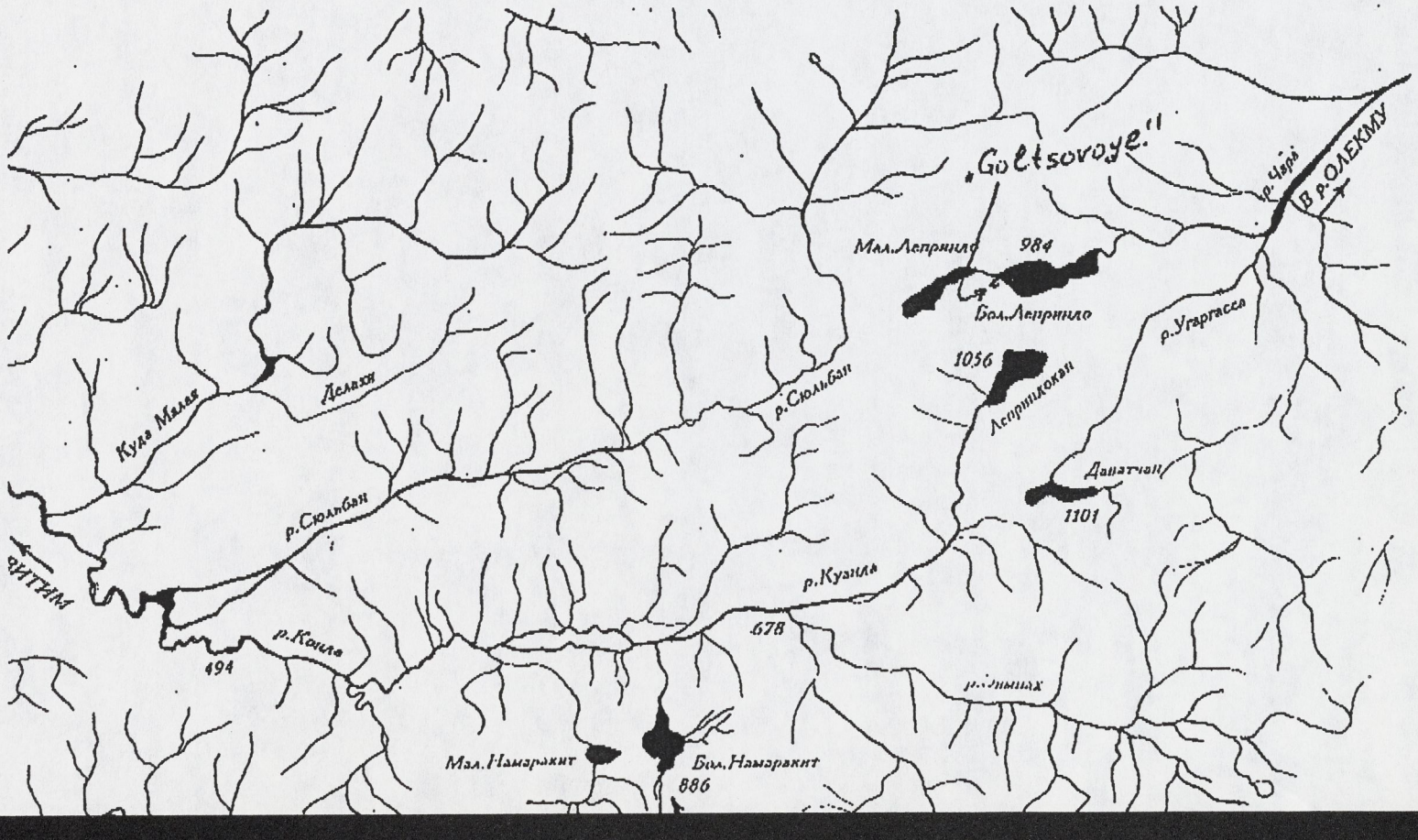

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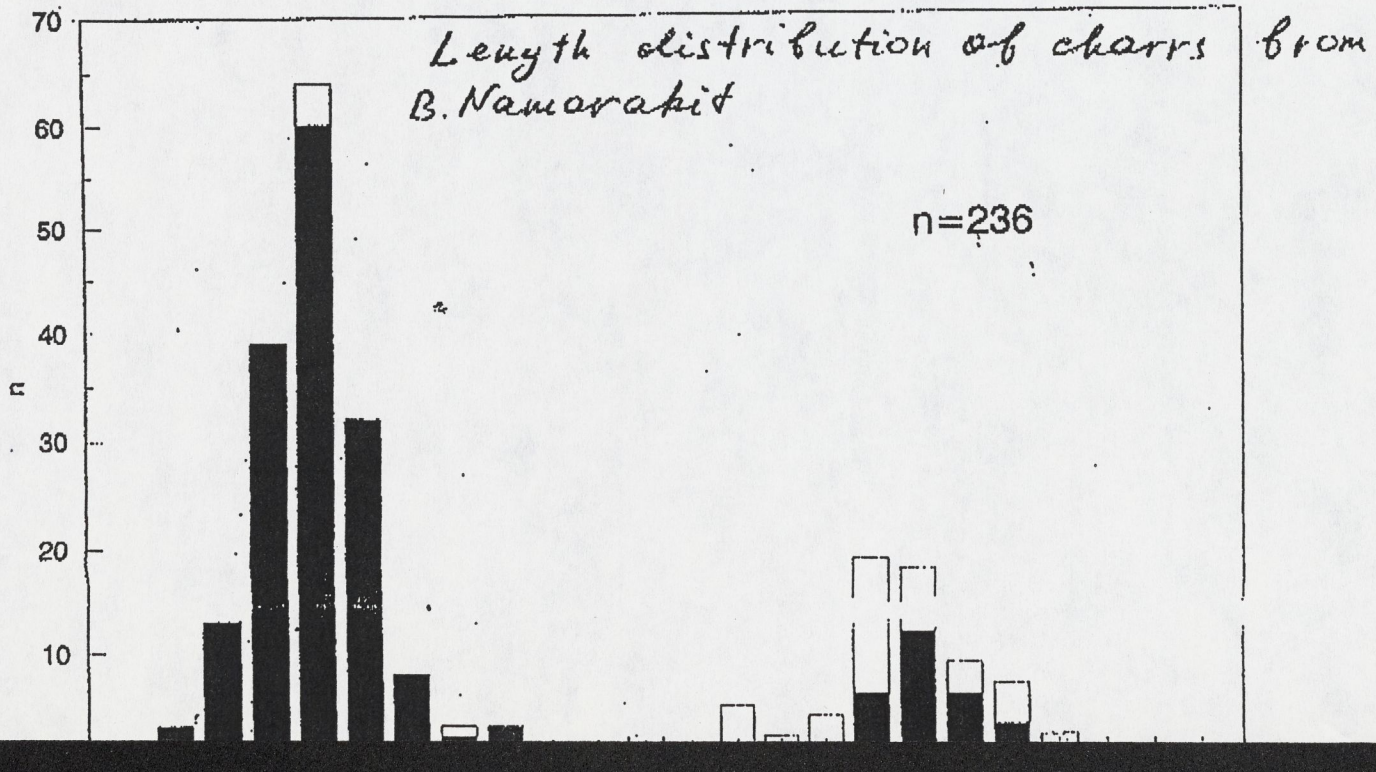

UNIVERSITY OF WISCONSIN MILWAUKEE

Department of Biological Sciences
Lapham Hall
PO Box 413
Milwaukee, WI 53201

UWM

Linn Sajdak

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8 Walk R.

2 None R (intermediate step)

Dr. Robert Behnke
Dept. Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523

UNIVERSITY OF WISCONSIN MILWAUKEE

College of Letters and Science
Department of Biological Sciences

UWM

Dr. Robert Behnke
Dept. Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523

May 25, 1995

Dear Dr. Behnke:

The following Dolly Varden char have been fixed in formalin and are shipped wrapped in ethanol soaked cheesecloth. The fish are labeled with the collector's numbers (at the dorsal fin) and our lab number (tied through the gill and mouth).

Fred DeCicco (Alaska Fish and Wildlife) collected these specimens. They were fixed in formalin in Dr. Ruth Phillips lab, University Wisconsin-Milwaukee.

There are eight adult spawners (2 males, and 8 females) of the Northern form collected from the Wulik River and are Wulik River stock. These are labeled by white tags. They are shipped in two bags. (One bag has 6 fish-- S0060-94 through S0064-94, and S0066-94; another bag has two fish-- S0065-94, and S0067-94) Their numbers and sex are as follows:

Collector's number	sex	lab number	↑	↓	Σ
5993	F	S0060-94	9	11	20
5994	F	S0061-94	10	13	23
5995	M	S0062-94	9	12	21
5996	F	S0063-94	9	12	21
5997	F	S0064-94	10	12	22
5998	F	S0065-94	9	12	21
5999	M	S0066-94	8	11	19
6000	F	S0067-94	10	12	22

19-23
(21.1)

I.T. compressed of kypes

There are six anadromous fish from Nome River that are non-spawners. The collector identified these as being probable Nome River Stock, and probable intermediate form. These fish have blue tags. They are in one bag.

Collector's number	lab number	↑	↓	Σ
30737	S0068-94	10	13	23
30738	S0069-94	9	13	22
30739	S0070-94	9	12	21
30740	S0071-94	9	12	21
30741	S0072-94	9	12	21
30742	S0073-94	9	11	20

20-23
(21.3)

round bodies
"dainty" jaws
small teeth
resemble alpinus
spots D.V.

c2 25-30 cae

Lapham Hall • PO Box 413 • Milwaukee, WI 53201

414 229-4214
FAX 414 229-3926

Sorry it took us so long to get these to you. The preservation took longer than planned as I was fitting it in amongst my many other responsibilities. If you do not want to put them in your collection, we have arranged with the Milwaukee Natural History Museum to take our specimens. Please let us know your wishes. If you have any questions, give us a call at (414)475-7256 and we will try to answer.

Sincerely,

Linn Sajdak

Linn Sajdak for Dr. Ruth hillips

* - genetic analysis.
?

* - BLM fellow
re Nome

send note to

Gen. dir.

Isaker
Chukotka