Robert H. Smith
2351 Hillside Dr
Central Point OR
97502

Oct 17, 1989

Dear Bob:

Got home last Friday (oct 13) and mighty glad to be here. That Sawtooth adventure turned out to be kind of a survival deal. We packed in to the lake (8400 feet) in a snowstorm and then it snowed for 2 days with about 6-8 inches on the ground and there was still snow left 10 days later when I left. Fortunately it didn't get really cold - only down to about 23° F but the wind was a problem - gale force night and day for the last 3 days and blew down my tent.

I was able to fish for parts of 5 days of the ten days I was there and I did catch a Sunapee - just one, a female of about 16". She was a typical arctic char - long & lean, forked tail, very silvery with small yellow spots on the sides. Had numerous basibranchial teeth, 27 pyloric caeca and 13 gill rakers on the first arch both right and left (including both upper & lower arches). Her eggs were only the size of a pinhead so she would not spawn this year.

McNeilly drove down from Calgary, back-packed in and fished two days with me. He is a very knowledgeable fisherman and well posted in his technical reading. He caught a very colorful male Sunapee and what we considered to be a hybrid - a female that superficially looked like an Arctic char but with brook trout vermiculations on the back. I asked him to send it to you and told him how to preserve it and ship it so you should be getting it shortly.

It was a real pleasure for me to be with you again at Yellowstone and I appreciate all the kind things you said about me at the summary of the symposium. I have received my copy of the latest "Trout" magazine and the book is in there in the top 15, thanks to you. Also I thought your article on special regulations was excellent and should straighten out a lot of people about this controversial subject.

I'll send you a print of the fish as soon as I get the film developed. Hope I get a good one

Please give my regards to Sally.

All the best,

Bob

Central Pt., OR.
Oct 21 1989

Dear Bob:

Enclosed are a couple of prints of the Sunapee I caught at Sawtooth Lake. These don't really show much except the *alpinus* like conformation. The basic ground color is more bluish on the prints than it appeared to me in the bright sunlight - it looked silvery, almost whitish. Also the large cream colored spots along the abdomen show up better on the prints than they did to me in the bright sun. The other fine spots were yellowish or slightly orange along the sides and greenish white along the back but don't show up well on the prints.

I have reread all of the literature I have on the Sunapee and I don't find anything that fits the low meristic values I found on pyloric caeca and gill rakers. Of course everything I have read pertains to the Floods Pond population and this fish came from Sunapee stock. Anyway, I have been wondering if these low values could indicate a hybrid influence.

It seems odd to me that the Sunapee can live sympatrically with the brook trout in its native waters but will hybridize with brook trout in Idaho but then we are dealing here with two displaced fishes, the brook trout probably a domestic strain.

Hopefully by now you have received the specimen from McNeilly. This one had large pink spots well distributed along the sides and I am wondering if she had mature eggs.

All the best,

Bob

Sunapee trout ♀
Sawtooth Lake, Idaho
Oct 8 1989

382 02 NHN4

Sunapee trout ♀
Sawtooth Lake, Idaho
Oct 8 1989

Robert H Smith
2351 Hillside Dr
Central Point OR 97502

JACKSONVILLE OR PS OCT 23 '89 U.S. POSTAGE ≈ 0.45

Sawtooth

Dr. Robert J. Behnke
c/o Dept. of Fishery & Wildlife Biology
Colorado State University
Fort Collins, Colorado 80523

1978 Gillnet

7 fantrawler

1 hybrid (BKT)

15, 16, 18, 19, 17, 17 19

15 16 17 17 18 19 19

17.3

3 species - 3 sorpet hybrids

15, 17, ~~18~~, 19, 19, 19, 20, 21 (18 hybrids)

3(18.6)

2 a/c team

3 hybrids

20	21	22	23	25
5	3	3	1	1

(21.2)

Discussion Note

Sawtooth lake - closer to idealized niche of Sunapee
(colder temp, only brook)

idealized niche - the area that Sunapee would occupy if not influenced by other species (limited by physical factors - ie. Temp, O_2)

actual niche - range is smaller since other species such as brook and [redacted] lake trout "push" in or overlap sunapee range.

Candlestick pond, [redacted]
Newfoundland

highly supressed actual niche

L.C.

Behnke 1972

Hunter 1970

1918
Kendall 1914 - 1916
1974, 1975
Kirchels 1976 — Kornfield et. al, 1980
1980 — Locke 1926
Powers 1980
Quadri 1974

Rodeheffer 1935
Rombough et. al. 1978

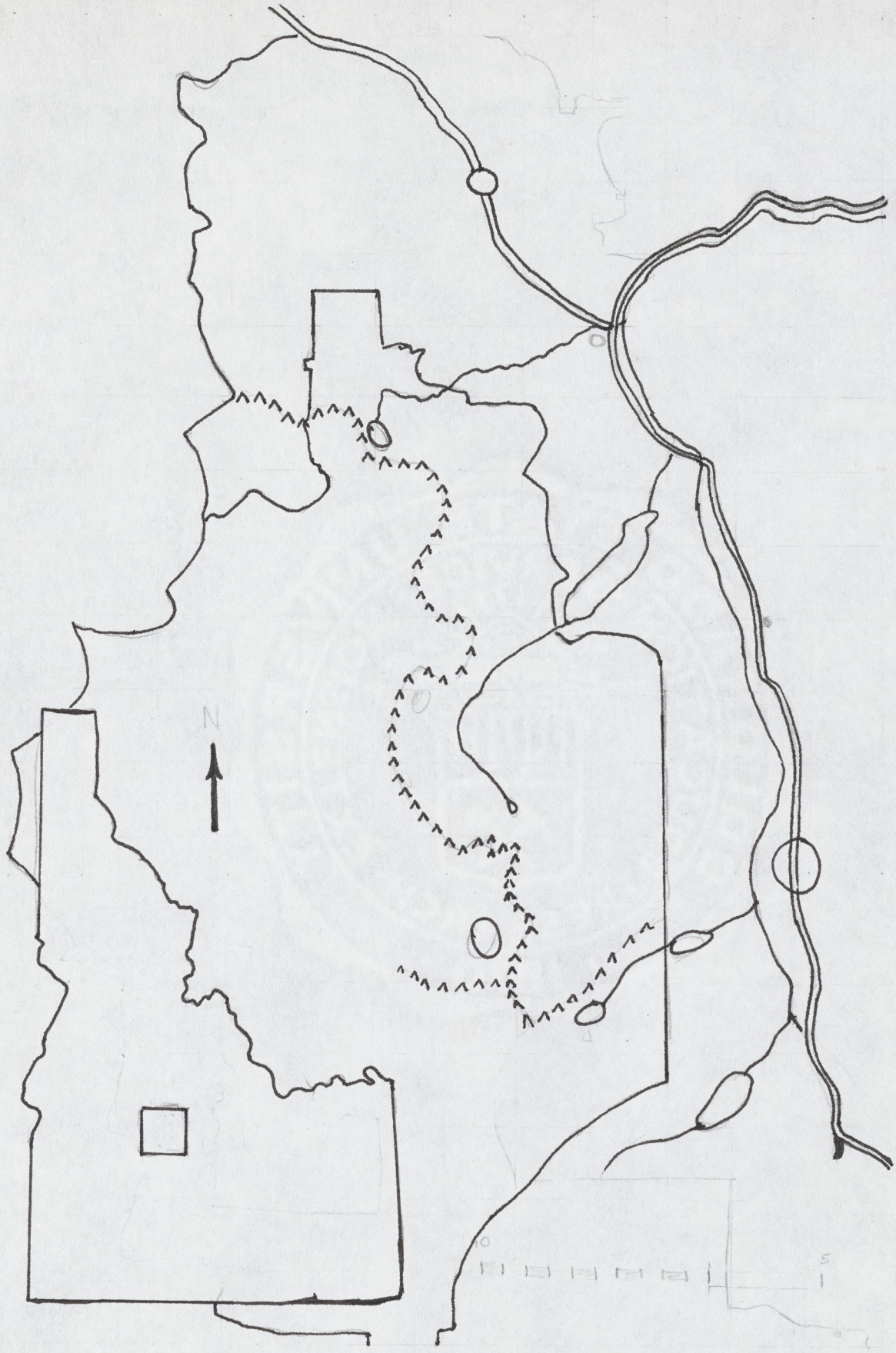
S Kreslet 1973
Troyer & Behnke 1974

V. D.
Vladykov 1954. Taxonomic characters of the eastern North American chars (Salvelinus and Cristivomer). J. Fish. Res. Board Can. 11(6): 904-932.

Waters 1960

Waters, C. A. 1960. A study of the life history and taxonomic position of the blueback trout, Salvelinus oquassa (Girard). Masters Thesis, Univ. of Maine. 90 pp.


21
SALMON R.
STANLEY
SAWTOOTH L.
REDFISH L.
N
VERNON L.
ALICE L.
ALTURAS L.
75
10 0 10 20 30 40 Km


N
0
5
10 KM

Behnke, R. J. 1972. The systematics of salmonid fishes of recently glaciated lakes. J. Fish. Res. Board Can. 29: 639-671.

_____. 1980. A systematic review of the genus Salvelinus, p. 441-481, in: E. K. Balon (ed.), Charrs: Salmonid fishes of the genus Salvelinus. Dr. W. Junk, The Hague.

Hunter, J. G. 1970. Production of arctic char (Salvelinus alpinus L.) in a small arctic lake, Keyhole Lake, Victoria Island, Northwest Territories. Fish. Res. Board Can. Tech. Rep. 321: 1-190.

Kendall, W. C. 1912 Fishes and fishing in Sunapee Lake. Rep. U.S. Bur~~eau~~ Fisheries, 783: 96 pp.

_____. 1914 The Fishes of New England. The Salmon Family, Part I. The Trout or Charrs.. Mem. Bost. Soc. Nat. History 8 (1): 103 pp.

_____. 1916. The Rangeley Lakes, Maine; with special reference to the habits of the fishes, fish culture, and angling. ~~861: 483-554 in~~ Bull. U.S. Bur. Fisheries, 861: 485-554.

Kircheis, F. W. 1974. Species management plan: the Sunapee trout. Maine Dept. ~~In~~land F. and Game Vol. 7, pt. 1, 22 pp.

_____ 1975. Draft blueback trout management plan. Typewritten manuscript. Maine Dept. Inland F. and Game, 26 pp.

_____ 1976. Reproductive biology and early life history of the Sunapee trout of Flood's Pond, Maine. Trans. Am. Fish. Soc. 105: 615-619.

———. 1980. The landlocked charrs of Maine: the Sunapee and the blueback - pp. 749-755, in E.K. Balon (ed.) Charrs: Salmonid fishes of the genus Salvelinus. Dr. W. Junk, The Hague.

Kornfield, I.L., K.F. Beland, J.R. Moring and F.W. Kircheis 1980. Genetic similarity among endemic arctic charr (Salvelinus alpinus) and implications for management. Can. J. Fish. Aquatic Sci. ~~(in press)~~. 38(1): 32-39.

GH1 C143

Locke, S.B. 1926. Progress of fish planting work in the Redfish Lake section, Idaho, 1925. ~~pp. 1-61 in:~~ Eleventh Biennial Rep. Idaho Fish and Game. pp. 47-61.

Powers, G. 1980. The brook charr, Salvelinus fontinalis. pp. 141-203. in E.K. Balon (ed.) Charrs: Salmonid fishes of the genus Salvelinus, Dr. W. Junk, The Hague.

Quadr., S.O. 1974. Taxonomic status of the Salvelinus alpinus complex. J. Fish. Res. Board. Can. 31: 1355-1361.

Rodehaffer, W.A. 1935. A survey of the waters of the Challis National Forest, Idaho. Typewritten manuscript, U.S. Bur. Fisheries, Wash. D.C.

Ramsbough, P.J., S.E. Barbour, and J.J. Kerekes. 1978. Life history and taxonomic status of an isolated population of Arctic char, Salvelinus alpinus, from Gros Morne National Park, Newfoundland. J. Fish. Res. Board Can. 35: 1537-1541.

Skreslet, S. 1973. The ecosystem of the Arctic lake Nordlaguna, Jan Mayen Island. III. Ecology of arctic charr, Salvelinus alpinus L. Astarte 6: 43-54.

Trojnar, J.R. and R.J. Behnke. 1974. Management implications of ecological segregation between two introduced populations of Cutthroat trout in a small Colorado lake. Trans. Am. Fish. Soc. 103(3) 423-430.

Kent Ball (tells us that he) has also found Sunapee char in Alice Lake yet he found only stocked cutthroat in Vernon Lake. Ball does not plan to net the other lakes originally stocked by Mr. Locke. ~~It is interesting~~

It is interesting to note the Alice Lake ~~was~~ also was stocked with rainbow trout (Fingerlings), ~~in 1923 and 24~~, 19 adult silverside shiners ~~in 1923~~, and L.L. salmon fingerl. ~~just prior to stocking of Sunapee~~ (Locke 1926). ~~2,000 land-locked salmon (also stocked in Alice Lake in 1925. (Locke 1926).~~ prior to Sunapee stocking fingerlings ~~char in 1925.~~ The presence of rainbow trout apparently had little effect on the char since it has survived. Limited spawning at the inlets may be a factor ~~for~~ for both rainbow and salmon survival. Little is known concerning the Sunapee char of Alick Lake and further research is recommended.

Sawtooth Lake was ~~later~~ stocked in 1927 with smelt (Osmerus mordax) to provide refr. smelt → forage for the Sunapee (~~Added after 1930~~). Sunapee generally respond favorably to smelt introductions, ~~with a~~ significantly increasing in size (Kendall 1913). In 1941, Brook char were stocked (7,000) from U.S. Hagerman refr. brook stocking → Hatchery( ). Therefore Sunapee and Brook char ~~have~~ have lived ~~sympatric~~ together for 37 years.

Sunapee-Brook char interactions are usually limited. Kirchies (1976) reports no hybridization ~~with brook~~ between the two species in Floods Pond, and that both occupy different niches. Because Sawtooth Lake is much colder and deeper than Floods Pond and other oquassa strongholds, Sunapee may be using the entire lake and therefore increasing contact with Brook ~~trout~~ char. Limited shoal (3%) and streams (only the outlet) may also increase interaction. Different ref. to chars hybrid spawning techniques and different photoperiod responses may be enough to keep the two species distinct.

In artificial environments, hybrids are possible.

R + Disc.
(2)

large insects, snails and small fish as they age.
Waters (1960) shows similar food habits for the blueback char.

a digested unidentifiable fish (120 mm) and another Sunapee char (145 mm). Kirchies (1976) revealed in his study that young sunapee feed on zooplankton, changing to dipteran larvae. This clearly shows dietary overlap, but competition is usually avoided by habitat differences. The brook char ~~is a~~ lives in streams and littoral regions, while the Sunapee char inhabits the ~~deep, cold waters of the~~ hypolymnion (Newell 1958) (Kirchies 1976), in ~~cooler~~ temperatures in the neighborhood of ~~50°F~~ or less 10°C.

conver. → check Kendall 1913

Sawtooth Lake is unique in that it is much colder than other Sunapee char waters, with July temperatures of only 10°C (Rodeheffer 1935). If temperature is the limiting factor of the upper limit of destribution, then Sunapee in Sawtooth Lake should be found throughout the lake year round. Rodeheffer (1935) reports ~~sing~~ "Several fish slightly smaller were seen among the logs near the outlet". These fish were probably juvenile Sunapee taking advantage of near shore shelter, but may indicate that the Sunapee does exploit the entire water column. Further sampling is needed to determine if Sunapee are using the upper levels during the summer months.

The examination of morphological and meristic characters, appearance, and their comparison with the literature leaves no doubt that in known Salvelinus is ~~the Sunapee char.~~ S. alpinus oquassa. Stocking evidence also shows that 1000 fingerlings were stocked in Sawtooth Lake in 1925 (previously barren) (Locke 1926; Rodeheffer 1935).) Other neighboring lakes stocked with Sunapee in 1925 include ~~Upper Inlet~~ Redfish Lake, Vernon Lake, Alice Lake, and five lakes on the upper inlet to Big Redfish Lake, Idaho.

The Sunapee char eggs were furnished by the New Hampshire Fish and Game Commissioner (Locke 1926). This would pinpoint the source of the stocked Sunapee as Sunapee Lake, NH. Thus the Sawtooth Lake Sunapee char are living representatives of native Sunapee char of Sunapee Lake. Once thought extinct, the type species has survived.

By observing phenotypic differences, we found 4 specimens that were intermediate between brook and Sunapee char. The other fish were easily recognized by such characters as tail margin, mottling on dorsal and caudal fin, dorsal color, shape, and the color of the anterior edge of the ventral fins.

One of the suspected hybrids was classified as a brook char (S.L. = 180). This specimen's tail is forked more like a Sunapee, its caudal fin is not mottled, the dorsal fin is mottled, the ventral fins show the black marking following the white, and the dorsal mottling is not as pronounced. This fish also lacks basibranchial teeth.

Three other suspected hybrids were classified as Sunapee char (S.L. = 154, 231, 196). The first (154) has predominantly Sunapee characteristics including no dorsal mottling on the back or in the caudal fin. However, mottling in the dorsal fin and black marks in the ventral fins indicate brook char genes. The largest suspected hybrid (231) has the body coloration of a Sunapee, yet there are black marks in the ventral fins and the caudal fin is nearly square, although it lacks the distinct mottling characteristic of fontinalis. The last suspected hybrid (196) has a nearly square tail and has some black marking in the ventral fins, although these marks are not as pronounced as those in the fontinalis specimens. The fish lacked the dorsal mottling, on the back and on the dorsal and caudal fins.

Principal components analysis and Versatec plotting also revealed hybridization. The suspected hybrids mentioned above were plotted on a single axis according to their first principal components values. Hybrids fall between the two populations (Figure 2). To be sure that these hybrids were just not population extremes, the Sawtooth Lake data

The nine characters used in the principal component analysis include ~~H.L.~~ H.L., U. J. L., C.P., Gill rakers (1st Arch) (upper-lower-total), A.B.L., and dorsal and anal fin rays.

was plotted with (data from Averill Pond, Floods Pond, and Sunapee Lake ~~Kendall (1914)~~. taken from Kendall (1914). The suspected hybrids again fell inbetween the brook char and Sunapee populations (Figure 3).

The computer plotting ~~and phenotypic~~ also includes the largest Sunapee char as a hybrid. This specimen lacks basibranchial teeth.

Together, the principal components analysis and phenotypic observations clearly prove the presence of ~~hybrids~~ Sunapee-Brook char hybrids in Sawtooth Lake. Hybrids are not ~~particularly~~ common and no "hybrid swarm" (which occurs between rainbow and cutthroat (Salmo clarki) trouts) exists. Spawning observations at Sawtooth L. in the future may ~~provide some~~ give better insight to brook-Sunapee char interactions.

Hybridization may be occuring ~~since it~~ because both species were artificially stocked and haven't evolved together in ~~the~~ Sawtooth L.. Perhaps hybrids will gradually disappear as time marches on. Hybrids have been known in artificial environments. For example, the U.S. Bureau of Fisheries reports propagating S. fontinalis x S. a. oquassa hybrids from 1903-1907.

4 R+D

Management of S. a. oquassa and other Salvelinus is just coming into its own. Sunapee and blueback char stocking efforts in Maine are part of comprehensive management plans (Kirchies 1974, 1975) Kornfield et al. (1980) proposes that Sunapee, blueback, and Quebec red chars all be managed as separate populations of the same subspecies. Trojnar and Behnke's paper (1974) illustrates the ecological importance and management implications of sub-species isolation. For future protection

In high Arctic lakes where primary production rates are extremely low, chars are sites of large biomass accumulation (Hunter 1970, Skreslet 1973). Although slow growing in these environments, total biomass of chars exceeds that of other fish. Kendall (1916) reports Sunapee reaching maximum weights near 4kg. Kirchis (1976) reports the average lengths of adults in Floods Pond, In Floods Pond (Kirchies 1976) the average length for adult males was 250mm and 300mm for females.

Because they are slow growing, and attain large sizes, the char cannot withstand high fishing pressure. The large size attained, however, can provide additional trophy fish as well as delicious protien. Because most of the suitable oligotrophic lakes (suitable) for Sunapee stocking are in high elevation areas, Sunapee will only be taken by a handful of adventurous anglers. The catching of one of these large chars can only add to one's wilderness experience. During fall spawning, the brilliant reds, oranges and yellows transform the Sunapee into a prize to be treasured by any angler.

One of the major management implications of the discovery of the Sunapee in Idaho is that a once popular sport fish can efficiently utilize the cold environment of oligotrophic lakes in the Rocky Mountains. By stocking Sunapee char into suitable lakes, Biomass can be significantly increased and trophy size fish can provide food and fun.

Although hybrids do occur, the ecological segregation between brook and Sunapee chars is significant. Each assimilating biomass from making more efficient use of the food resources and enhancing fish production, its own niche, In future stocking operations, care should be taken not to mix populations of S. a. oquassa (i.e. blueback with Sunapee) so as to perpetuate the genetic diversity. Populations should not be subjected to outside human influences such as water level manipulation, stocking of competitors (i.e. Lake trout, Salmon), and decreasing water quality.

The Sunapee char has a unique potential for greater fish production that wilderness managers and fish culturists should take advantage of.

Acknowledgments

We are very thankful for Steve Culver's generous help in statistical and Computer analysis.

	S. a. aquassa Range	$\bar{x}$	S. fortinalis Range	$\bar{x}$	
Total L. (mm)	127-487	218	157-319	209	
Std. L. (mm)	106-420	195	134-274	177	
Head L./Std. L. %	22.8-25.3	24.0	24.5-30.9	27.4	*
Upper Jaw / Head L.	41.4-59.4	48.6	54.3-65.1	60.6	
Caudal ped. Depth/std L.	7.3-9.2	8.4	9.4-11.4	10.5	*
1st Arch gillraker up	7-9	8	6-9	7	
lower	12-16	14	9-13	11	
total	20-25	21	15-21	18	
2nd Arch upper	7-10	7	6-8	7	
lower	12-14	13	9-12	11	
total	19-24	21	16-19	17	*
3rd arch upper	6-9	8	5-8	7	
lower	11-14	12	9-11	10	
total	17-23	20	15-19	17	
4th arch upper	4-6	5	3-7	4	
(lower)	10-12	11	7-9	8	
total	14-18	16	56-73 10-16	65 13	
B'stegal rays rt	8-11	10	9-12	10	
Left	9-13	11	9-13	11	
Dorsal R.	9-10	9	8-10	9	
Anal	7-9	8	7-9	8	
Pectoral	13-15	14	12-14	13	
Pelvic	8-10	9	8-9	8	
Scales above lat. line	36-46	39	39-47	45	
Scales 2 rows above	176-222	199	163-188	176	
Dentition	0-13	5	0	0	*
Anal Basal L./Std. L	9.3-10.7	9.2	12.2 7.3-11.9	10.5	
Fork L/Tail L.	41.7-66.7	51.5	54.5-78.8	70.3	*
Dorsal Depr. L./Std. L.	16.0-20.0	18.0	19.4-24.5	21.2	*
4 arch total upper	26-32	29	21-30	25	
lower	46-55	49	35-44	42	*
total	72-86	78	56-73	65	*
4th rear rakers upper	7-10	9	5-8	7	*
lower	8-10	9	6-8	7	*

2nd largest (Hybrid?)

vertabrae counts

	60	61	62	63	64	65
S. a.	1		3	1	3	6

$\bar{x} = 63.6$

	57	58	59
S. f.	4	2	8

$\bar{x} = 58.3$

s.f. 3-9 $\bar{x}$ 4.8

sess code	S. alpinus * Squassa * N=13													S. fontinalis N=14													
	1	2	9	12	5	11	7	3	4	8	10	13	6		11	1	12	13	10	6	2	3	4	5	8	7	14	9	
data sheet #	1	2	9	12	45	11	16	3	14	8	10	13	6	$\bar{X}$	11	1	12	13	10	6	2	3	4	5	8	7	14	9	$\bar{X}$
Total L	487	188	193	271	243	133	149		140					218	319	177	183		194	235	201		211						209
	343	181	227						128				154		218	222	170		178	218	240		157						
Std. L.	420	154	162	231	110	106	130							195	274	149	155		164	198	169		180						177
	259	154	189	196	125	116									185	185	143		148	185	204		134						
% Head L./Std L	22.8	25.3	24.7	24.7	22.7	24.5	23.1							24.0	29.6	27.5	24.5		29.3	25.8	26.6		25.6						27.1
	24.9	24.0	24.3	24.5	23.2	23.3									27.6	29.7	24.5		26.4	27.6	30.9		27.6						
% Upper Jaw L/Hd L.	54.2	48.7	45.0	52.6	44.0	42.3	43.3							48.6	63.0	61.0	57.9		30.9 61.6	60.8	55.6		58.7						60.6
	54.2	59.4	47.8	54.2	41.4	44.4									60.8	63.6	54.3		61.5	64.7	65.1		56.8						
Caudal ped D/std. L. %	8.1	9.1	9.1	8.6	8.6	7.3	8.5		8.5					8.4	10.6	10.7	10.3		11.0	11.1	9.5		9.4						10.5
	8.3			7.4	9.2	8.0	8.6								11.4	10.3	10.5		10.1	10.3	10.8		11.2						
1st arch gill rakers (up)	8 9 8 3 8	0 9	0 7	0 7	3 7	2 8	3 8	3 7	0 7	0 8	0 9	0 10		8 1	8	1 7	0 7	0 6	0 6	2 7	3 6	0 8	0 9	3 8	0 7	0 8	6 7	2 8	0 7	1
lower	12 0 13 0 14	0 13	0 13	0 14	2 13	0 13	1 14	1 13	1 13	0 15	1 16	0 14		1.0	13	0 10	0 11	0 10	0 12	1 11	6 9	0 11	0 11	0 11	0 10	0 11	0 11	6 13	0 11	1
total	20	21	22	22	20	21	20	21	22	20	20	23	25	21	21	17	18	16	18	18	15	19	20	19	17	19	18	21	18
2nd arch gill rakers (up)	7 4 9 3 10	0 9	3 9	0 10	5 7	3 8	3 8	4 7	0 8	3 8	1 9	3		7 2	8	2 6	1 6	1 7	3 7	6 6	4 6	3 7	3 7	3 7	3 7	2 7	3 7	2 8	1	7 2
(lower)	12 7 13 8 14	7 12	3 13	7 13	5 12	7 12	7 12	9 13	0 13	8 14	4 14	7		8 6	7	8 11	4 10	3 10	0 11	5 11	7 10	5 9	4 11	7 12	6 10	5 10	9 11	6 11	0	11 5
total	19 22 24	21	22	23	19	20	20	20	21	22	23			21	19	17	16	16	18	18	16	15	18	19	17	17	18	19	17	
3rd Arch raker (up)	7 2 8 3 9	2 7	3 8	3 ~~10~~	~~5~~ 7	~~3~~ 8	~~3~~ 8	~~4~~ 7	0 8	~~3~~ 8	~~1~~ 9	~~3~~		8 2	8	2 6	2 5	2 7	2 7	2 5	3 6	1 7	2 6	2 8	2 6	2 8	3 6	3 8	3 7	2
(lower)	12 8 13 7 14	7 11	7 13	9 ~~13~~	~~5~~ 12	~~7~~ 12	~~7~~ 12	~~9~~ 13	0 13	8 14	~~4~~ 14	~~7~~		8 6	11	7 9	6 11	6 10	6 10	5 10	7 9	6 10	5 10	7 11	7 10	5 11	7 10	7 11	5 10	6
total	19 21 23	18	21	~~23~~ 19	18	~~20~~ 19	~~20~~ 19	~~20~~ 21	~~20~~ 17	21	22	23		20	19	15	16	17	17	15	15	17	16	19	16	19	16	19	17	
4th arch rakers (up)	6 7 7 9 ~~5~~ 10	4 7	6 9	5 9	5 9	5 8	4 9	5 9	5 9	5 9	5 9	5 9		5 9	5	7 4	8 5	8 4	7 4	6 5	6 3	5 4	7 5	8 6	7 4	6 7	8 4	7 4	7 4	7
(lower)	10 11 ~~10~~ 11 ~~10~~	10 9	12 9	11 10	10 8	10 8	10 8	12 9	11 10	12 9	11 9	12 9		11 9	9	8 8	8 7	7 8	8 7	9 7	7 6	9 6	9 7	8 9	7 8	6 9	8 7	9 8	7 9	8 7
total	16 18 16	14	18	16	15	15	14	15	17	16	17			16	14	12	11	11	12	14	10	13	14	15	12	16	13	13	13	
4 Arch Total (upper)	28 32 32	29	30	28	26	29	27	27	27	29	31			29	29	23	21	23	24	24	21	25	27	29	24	30	24	28	25	
(Lower)	46 50 53	46	51	51	46	46	48	49	48	52	55			49	44	38	40	37	41	41	35	39	41	43	38	41	41	44	42	
total	74 82 85	75	81	79	72	75	75	76	75	81	86			78	73	61	61	60	65	65	56	64	68	72	62	71	65	72	65	
13 stegal rays (rt)	11 11 10	11	11	10	10	10	9	8	10	9	11			10	12	9	10	10	11	11	11	9	9	11	10	9	11	9	10	
(left)	12 11 11	13	11	10	11	11	10	9	10	9	11			11	13	10	10	10	12	11	10	9	10	11	11	11	11	9	11	
Br. Dorsal R.	9 9 9	9	10	9	9	10	10	9	9	9	10			9	8	9	9	9	9	9	9	10	10	9	9	10	9	10	9	
Bran. Anal R.	8 9 9	8	9	8	7	7	9	9	9	9	9			8	8	7	7	9	8	7	7	9	8	8	7	8	8	8	8	
Pectoral	14 14 13	14	14	14	15	14	14	13	13	15	14			14	12	13	14	13	13	14	13	13	13	14	13	12	14	12	13	
Pelvic	9 9 8	9	9	9	9	9	9	9	9	10	10	9		9	8	9	8	8	9	8	8	9	8	9	9	8	9	8	8	
Scales above lat. line	39 46 39	38	38	44	40	41	36	36	38	40	38			39	47	41	39	39	44	45	45	44	41	39	41	42	43	39	45	
Scales 2 rows above lateral line	220 195 193	214	193	184	222	198	188	207	176	194	202			199	176	183	175	171	175	188	169	173	183	182	167	179	175	163	176	
Dentition	0 5 8	1	13	1	15	6	0	6	1	3	3			5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Anal basal L./SL	8.6	8.4	9.9	9.0	7.3	10.4	10.0							9.2	7.3	10.1	11.6	9.8		11.6	10.0		9.4						10.5	
	7.9	9.1	9.0	10.7	10.9	8.6									10.8	11.4	9.1	10.8		11.4	12.2		11.9						
% fork L./tail L.	59.7	57.9	47.0	51.6	52.5	34.8	52.4	54.2						51.5	68.4	71.4	71.4	70.0	78.4	68.8	67.7		70.3						
	66.7	52.6	44.7	54.2	41.7										78.8	73.0	54.5	60.0	75.8	72.2	78.3								
% Dorsal Depr. L/std. L	18.3	18.7	18.8	18.2	17.9	18.0	19.5	20.0	16.0	16.0	16.0	16.4	19.2	18.0	22.3	20.0	21.5	21.6	21.3	19.6	21.3	22.3	20.7	20.0	19.5	24.5	19.4	22.4	21.2	

Independent Study I. The discovery of the New England Sunapee Char in Sawtooth Lake, Idaho.

II Authors Behnke - Wagner

III Address

IV Abstract

V introduction

A. Purpose (Identification of unknown char from Sawtooth L.)

1. Prove identity of Char

2. Explore management implications

a.) niche separation + effecient utilization

B. History

1. Past/distribution + ~~popularity~~ Discussion end eventual extinction in Sunapee L.

Original

2. ~~Fig~~ O

C. Taxonomic synopsis

- part of relict S. alpinus incl. aureolus oquassa marsteni

VI STUDY AREA

A. Location - figure

B. Physical characteristics

C. Comparison with other known Sunapee Lakes.

1) Likeneses similarities

2) Differences

VII METHODS AND MATERIALS

A. Gill netting

B. ~~Vertabrae counts~~ Basibr. + scale staining

C. morphological + meristic characters measured

1. Conventional

2. Additional

D. Stomach contents

E. Computer systems

VII RESULTS

A. Fish data ~~compared with literature~~ definitely a Sunapee Stocking history

Table 1

B. Differences with Brook Trout + diagnostic characteristics.

Table 2

C. Vertabrae results & comparison (Vladikov)

D. Stomach Contents.

VII DISCUSSION

A. ~~Fish~~ Is a Sunapee - Comparison w/ Literature
Stocking data

B. Significance of Discovery (Genotypic)

C. Cohabitation & effacient utilization

D. Management suggestions - Past Popularity
~~inter~~ ecological segregation w/ brook trout to increase fish productivity in Rocky Mtn. oligotrophic lakes and produce trophy size fish

VIII ACKNOWLEDGEMENTS

~~VIII~~ IX REFERENCES

Mgt

Slow growth, can't take not much fishing pressure but fish can accumulate large biomass over time, providing unique recreation opportunity for adventurous fisherman

RESULTS AND DISCUSSION

Examination of morphological and meristic characters revealed significant differences between S. fontinalis and the unknown specimens we recognize as S. a. oquassa. We found 27 characters to be statistically significant within a 95% confidence limit. These results of the t-test, plus three other observable diagnostic characteristics, are presented in table 1. INSERT TABLE I HERE

S. fontinalis had a much larger head, longer upper jaw, and thicker caudal peduncle than oquassa. These observations agree with Kendall's (1914) early discriptions. Dorsal depressed lengths and anal basal lengths were greater in fontinalis. The caudal peduncle depth shows no overlap in our data and thus is a useful diagnostic character.

The depth of tail fork was much deeper in oquassa. Vladykov (1954) also notes this difference. The more slender forked tail of the Sunapee is better adapted for migrations and pelagic cruising, than the brook char. The square shaped of the brook charr's tail is adapted for fast turning in the confined space of littoral areas and shallow streams (Powers 1980).

Gillraker values were lower in fontinalis for every gill arch. The lower arm of every arch showed significant differences between the two species. This influence the significance of the individual arch totals. The total for the lower arm of the four gill arches shows excellent separation. Kendall (1914) and Vladykov (1954) also show higher gillraker averages in oquassa.

Two of the Sunapee lacked basibranchial teeth, one of which is the largest fish in the sample (487 mm). This may be evidence for hybridization. None of the fontinalis specimens had basibranchial teeth. Vladykov (1954) notes the presence of these teeth

in the Sunapee and the absence in fontinalis.

Anal rays were shown significant in the t-test, but when the data is found to practical values, anal ray counts are not diagnostic. Pelvic and pectoral rays average 8 and 13, respectively, for fontinalis and 9 and 14 for the unknown. The overlap value makes these counts poor for individual separation, but may be useful when comparing populations. Vladykov (1954) did not find rays counts to be a useful diagnostic tool.

Caeca counts averaged 35 for aquassa and 32 for fontinalis, and were not significantly different in this study.

~~Total lengths averaged 218 mm for aquassa and 209 mm. for~~
Total lengths ranged from 127 to 487 mm ($\bar{x}$=218) for aquassa and from 157 to 319 ($\bar{x}$=209) for fontinalis. As evidenced by thier large size, the Sunapee char appears to be well adapted to effecient utilization of the nutrient-poor hypolymnion in which it lives.

Vertabral counts by Dr. Wallace gave the following results:

species	N	Number of vertebrae									
		57	58	59	60	61	62	63	64	65	$\bar{x}$
S. a. aquassa	14	–	–	–	1	–	3	1	3	6	63.6
S. fontinalis	14	4	2	8	–	–	–	–	–	–	58.3

The specimen with 60 vertebrae was the second largest fish. This may be evidence of hybridization, although examination of other characters reveals no further evidence.

Stomachs of the fontinalis specimens contained caddisfly cases, beetle larvae, small crustacea, grasshoppers, and dipteran larvae, pupae, and adults. In the stomachs of the unknown, (midge larvae, grasshoppers) and other dipterans were also found. The largest Sunapee contained two fish in its stomach;

* - Note Sawtooth L

max. surface temp,

ca. 50° in summer -

This means sunapee

can utilize whole lake

-- not only thermocline &

hypolimnion as they are

restricted to in Maine.

PHONE CALL

Date_____

M. _____

You were called at_____

By M. _____

Return the call to_____

The message was_____

_____

_____

_____

_____

Discussion • No new literature

successes, failures, obj. accomplished? Insights

Salmon were introduced early into Sunapee L. yet Sunapee trout did not die out. Why? - Salmon may not have been numerous enough since they did not spawn in the streams - artificially reproduced.

Some evidence of hybrids, yet no hybrid swarm? - Sunapee trout live in deep water - spawn on rocky shoals - brookies spawn in streams + live in shallower water

No hybrids in Flood's Pond, yet hybrids in Sawtooth. Why? No streams to spawn in at Sawtooth. Different niches yet may spawn together - impassable falls above + below

the hybridization betw S.a. + S.f. may disappear with time, as each becomes more specialized

introduced smelt did not survive in Sawtooth - No stream to spawn in.

Why are sunapee large + blueback sub-dominant ?

Conclusions - summary of Key findings

Deep H_2O sp - hard to catch for anglers in high alpine lakes, although spawning time is a possibility. Late spring + early fall.

Stock smelt + Sonoper in lakes suitable to nat'l reprod. of both.

Spread distribution to insure future survival - Flood's Pond threatened.

In ME mgt plan

OFFICE MEMO

TO:

Date

FROM: Sunapee

SUBJECT: — smelt stocked shortly before 1872

REMARKS: ?"golden" trout started to be caught ca. 1875
-- large specimens - 5-7 lbs. not known before —
Probably after smelt stocked, they changed feeding habits,
became more abundant & much larger and became known
to anglers. - smelt & landlocked salmon introduced
into Rangely lakes quickly led to extinction of blueback
but not golden trout in Sunapee - why? stocking of lake
trout in Sunapee did cause extinction - why?

what size in Flood's when smelt were native?

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

S. alpinus oquassa

SPECIES Sunapee Trout LOCALITY Sawtooth L. Idaho

COLLECTED BY Kent Ball DATE 1978

Cat. # _____ Measurements by Eric Wagner DATE Sept 22, 1980

Specimen #

	1	2	9	12 (suspected hybrid)	45			
Total L.	487	343	188	181	193			
Standard L.	420	289	154	154	162			
Body D	95	59	30	30	30			
Head L	96	72	39	37	40			
~~Orbit L~~		13						
Upper Jaw L	52	39	19	22	18			
~~Dors. Orig. to Snt. tip~~	193	142						
~~Dorsal fin basal L~~								
Dorsal fin depressed L	77	54	29	28	29			
~~Adip. fin depressed L~~	25	19						
Caudal peduncle D	34	24	14	14	14			
~~Caudal peduncle L~~ Fork Length	40.	31	16	18	16			
Vertebrae (L. of crotch gillraker / to L. of lower arch)		5/27	3/13	3/16	2.5/13			
1st Arch gillrakers (up)	8/4	8/3	8/0	9/0	7/0			
(lower)	12/0	13/0	14/0	13/0	13/0			
(total)	20	21	22	22	20			
Branchiostegal rays right	11	11	10	11	11			
(left)	12	11	11	13	11			
Dorsal rays	9B	9B	9B	9B	10B			
Anal rays	8B	9B	9B	8B	9B			
Pectoral fin rays	14	14	13	14	14			
Scales in lateral line								
Scales above lateral line	39	46	39	38	38			
Scales 2 rows above lat.	220	195	193	214	193			
Pelvic fin rays	9	9	8	9	9			
Pyloric caeca								
Dentition	0	5	8	1 tiny	13			
Anal Basal L	36	26	13	14	16			
Upper Front rakers 2,3,4 arch	7 7 6	9 8 7	10 9 5	9 7 4	9 8 6			
lower	12 12 10	13 13 11	14 14 11	12 11 10	13 13 12			
Upper rear rakers 2,3,4 arch	4 2 7	3 3 9	0 2 10	3 3 7	0 3 9			
lower	7 8 9	8 7 10	7 7 10	3 7 9	7 9 9			

12. Possible Hybrid

surapee but has:
black in Ventral fins
marking in dorsal fins
no mottling on back or in caudal

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salvelinus fontinalis LOCALITY Sawtooth Lake, ID

COLLECTED BY Kent Ball DATE 1975

Cat. # _____ Measurements by Eric Wagner DATE Oct 1, 1980

Specimen #	2	3	4	5	8	7	14 *Hybrid	9
Total L.	194	178	235	218	201	240	211	157
Standard L.	164	148	198	185	169	204	180	134
Body D								
Head L	48	39	51	51	45	63	46	37
Orbit L								
Upper Jaw L	31	24	31	33	25	41	27	21
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L	35	33	41	37	33	50	35	30
Adip. fin depressed L								
Caudal peduncle D	18	15	22	19	16	22	17	15
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	6/0	8/0	9/2	8/0	7/0	8/0	7/2	8/10
(lower)	9/0	11/0	11/0	11/0	10/0	11/0	11/6	13/0
(total)	15	19	20	19	17	19	18	21
Branchiostegal rays right	11	9	9	11	10	9	11	9
(left)	10	9	10	11	11	11	11	9
Dorsal rays	9B	10B	10B	9B	9B	10B	9B	10B
Anal rays	7B	9B	8B	8B	7B	8B	8B	8B
Pectoral fin rays	13	13	13	14	13	12	14	12
Scales in lateral line								
Scales above lateral line	45	44	41	39	41	42	43	39
Scales 2 rows above lat.	169	173	183	182	167	179	175	163
Pelvic fin rays	8	9	8	9	9	8	9	8
Pyloric caeca								
Dentition	0	0	0	0	0	0	0	0
Fork Length	21	18	29	25	22	26	21	18
Anal Basal L.	16	16	23	21	17	25	17	16
up Front rakers 2,3,4 arch	6 6 3	6 7 4	7 6 5	7 8 6	7 6 4	7 8 7	7 6 4	8 8 4
Lower	10 9 7	9 10 9	11 10 9	12 11 9	10 10 8	10 11 9	11 10 9	11 11 9
up rear rakers 2,3,4 arch	4 1 5	3 2 7	3 2 8	3 2 7	2 2 6	3 3 8	2 3 7	1 3 7
lower	5 6 6	4 5 6	7 7 8	6 7 7	5 5 6	9 7 8	6 7 7	0 5 8
tongue teeth	8	8	10	6	8	8	9	8
L. Jaw Nerve Fossa	7	5	5	6	7	6	6	6

#14. Suspected Hybrid

Tail is forked more like sunapee
mottling on back is not pronounced
caudal fin is not mottled, yet dorsal fin is
Black marking in ventral fins

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salvelinus alpinus of vassa LOCALITY Sawtooth Lake, Idaho N=13

COLLECTED BY Kent Ball DATE

Cat. # Measurements by Eric Wagner DATE Oct 3, 1980

Specimen # ← susp. Hybrid susp. Hybrid

	11	16	3	14	8	10	13	6
Total L.	227	271	243	133	149	127	140	154
Standard L.	189	231	196	110	125	106	116	130
Body D								
Head L	46	57	48	25	29	26	27	30
Orbit L								
Upper Jaw L	22	30	26	11	12	11	12	13
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L	34	45	39	18	20	17	19	25
Adip. fin depressed L								
Caudal peduncle D	14	20	18	8	10	9	10	11
Caudal peduncle L								
Vertebrae		↓						
1st Arch gillrakers (up)	7 | 3	7 | 2	8 | 3	8 | 3	7 | 0	7 | 10	8 | 0	9 | 0
(lower)	14 | 2	13 | 0	12 | 1	14 | 1	13 | 1	13 | 0	15 | 1	16 | 0
(total)	21	20	21	22	20	20	23	25
Branchiostegal rays right	10	10	10	9	8	10	9	11
(left)	10	11	11	10	9	10	9	11
Dorsal rays	9B	9B	10B	10B	9B	9B	9B	10B
Anal rays	8B	7B	7B	9B	9B	9B	9B	9B
Pectoral fin rays	14	15	14	14	13	13	15	14
Scales in lateral line								
Scales above lateral line	44	40	41	36	36	38	40	38
Scales 2 rows above lat.	184	222	198	188	207	176	194	202
Pelvic fin rays	9	9	9	9	9	10	10	9
Pyloric caeca								
Dentition	1	15	6	0	6	1	3	3
fork length	20	21	28	13	13	11	10	13
Anal Basal L.	17	23	21	8	13	11	10	13
upper front rakers 2,3,4 arch	10 | 6 | 5	7 | 7 | 5	8 | 8 | 5	8 | 7 | 4	7 | 8 | 5	8 | 7 | 5	8 | 8 | 5	9 | 8 | 5
lower	13 | 13 | 11	12 | 11 | 10	12 | 11 | 10	12 | 12 | 10	13 | 13 | 10	13 | 10 | 12	14 | 12 | 11	14 | 13 | 12
upper rear rakers 2,3,4 arch	5 | 5 | 9	3 | 3 | 9	3 | 4 | 8	4 | 4 | 9	0 | 2 | 8	3 | 4 | 9	1 | 3 | 9	3 | 2 | 9
lower	5 | 7 | 10	7 | 8 | 8	7 | 8 | 8	9 | 8 | 8	0 | 7 | 9	8 | 9 | 9	4 | 9 | 10	7 | 9 | 9
tongue teeth	10	10	8	10				
L. Jaw nerve Fossa	6	6						

#3 - Possible Hybrid

square like tail

suggestion of black in ventral fins

lacks mottled back

Dorsal and Caudal fin free of marking

#16 Possible Hybrid

lack of mottling on back

black mark in ventral fins

caudal squarish, but lacks distinct mottling

body coloration more like sunapee

caudal fin not prominently marked - may be due to excessive handling

Table 1. ~~Means, ranges, and standard deviation of diagnostic characters of Salvelinus alpinus oquassa and Salvelinus fontinalis, plus some observable differences.~~

Table 1. Significant characters for differentiating between Salvelinus Fontinalis and Salvelinus alpinus oquassa.

characteristic	S. a. oquassa $\bar{x}$	range	S.D.	S. fontinalis $\bar{x}$	range	S.D.
H.L./S.L. (%)	~~27.3~~ 24.0	~~24.5-30.9~~ 22.7-25.3	~~1.97~~ .83	27.3	24.5-30.9	~~1.97~~ 2.0
U.J.L./H.L.(%) U. ~~Jaw~~/H.L.(%)	48.6	41.4-54.4	5.8	60.6	54.3-65.1	~~3.50~~ 3.5
C.P./S.L.(%) C.P./S.L.(%)	8.4	7.3-9.2	.6	10.5	9.4-11.4	.59 .6
GLT ~~Lower~~	~~13.5~~ 13.35	12-16	1.0	11.0	9.0-13.0	~~1.11~~ 1.1
GT 1	21.3	20-25	1.5	18.3	15.0-21.0	~~1.73~~ 1.7
GU 2	8.4	7-10	1.0	6.8	6.0-8.0	.70 .7
GL 2	12.8	12-14	.8	10.6	9.0-12.0	.76 .8
GT 2	21.2	19-24	1.6	17.4	15.0-19.0	~~1.28~~ 1.3
GU 3	7.5	6-9	.8	~~6.6~~	5.0-8.0	~~1.08~~ 1.1
GL 3	12.2	10-14	1.1	10.2	9.0-11.0	.70 .7
GT 3	19.7	17-23	1.6	16.8	15.0-19.0	1.56 1.6
UR 3	3.1	2-5	1.0	2.2	1.0-3.0	.58 .6
LR 3	7.4	7-9	.9	6.1	5.0-7.0	.86 .9
GL 4	10.8	10-12	.8	8.4	7.0-9.0	.75 .8
GT 4	15.9	14-18	1.3	12.8	10.0-16.0	1.6
GU	28.8	26-32	2.0	25.1	21.0-30.0	3.0
GTL	49.3	46-55	3.0	40.2	35.0-44.0	2.6
GTT	78.2	72-86	4.5	65.4	56.0 73.0	5.2
ANAL RAYS	8.5	7-9	.8	7.8	7.0-8.0	.70

Gillraker

ABL/SL ~~degree of forking~~

D Bpt/SL

Depth of tail fork

95%

97.5%

95% A

Hubbs + Lagler

CHARACTERISTIC	S. a. Oquassa			S. fontinalis		
	$\bar{x}$	range	σ	$\bar{x}$	range	σ
95% P_1 ~~PECTORAL RAYS~~	13.9	13 – 15	.6	13.1	12.0 – 14.0	.7
95% P_2 ~~Pelvic Rays~~	9.1	8 – 10	.5	8.4	8.0 – 9.0	.5
95% scales above lateral line (scal. above) ~~Scales ab~~ S_1	39.5	36 – 46	2.9	42.1	39.0 – 47.0	2.6
scales 2 rows above lateral line (lat. scales) S_2	198.9	176 – 222	13.7	175.6	163.0 – 188.0	6.9
95% Basibranchial teeth ~~teeth~~	4.8	0 – 15	4.8	0	0 – 0	0
95% A. B. L. / S. L. (%)	9.2	7.3 – 10.7	1.0	10.5	7.3 – 12.2	1.3
depth of tail fork / degree of forking (%)	7.7	5 – 10	1.4	4.8	3.0 – 9.0	1.6
D. Op. L. / SL (%)	18.0	16 – 20	1.4	21.2	19.4 – 24.5	1.4

Dorsal Color — uniform Dark Green ~~color~~ ~~Dark Mottling~~ — Dark Mottling

Tail Margin — Truncate — Forked

Anterior margin color of Ventral fins ~~color~~ — white and ~~black~~ black — white only

~~Body Depth~~ — ~~Deep~~ — ~~Slim~~

~~Body depth is useful in smaller specimens, but loses diagnostic value as size increases.~~

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salvelinus Fontinalis LOCALITY Sawtooth Lake, ID N=14

COLLECTED BY Kent Ball DATE 1978

Cat. # _____ Measurements by Eric Wagner DATE Sept 23, 1980

Specimen # ♂ ♀

	11	1	12	13	16	6
Total L.	319	218	177	222	183	170
Standard L.	274	185	149	185	155	143
~~Body D~~ B.D.	78	39	31	45	35	35
Head L	81	51	41	55	38	35
~~Orbit L~~	16					
Upper Jaw L	51	31	25	35	22	19
~~Dors. Orig. to Snt. tip~~	137					
Dorsal fin basal L						
Dorsal fin depressed L	61	37	32	40	33	28
~~Adip. fin depressed L~~	22					
Caudal peduncle D	29	21	16	19	16	15
~~Caudal peduncle L~~ Fork L	29	26	20	27	20	18
Vertebrae L/Gr.rakers/lower arch	5/32	3.5/21	2/16	3.5/21	3/16	
1st Arch gillrakers (up)	8/1	7/0	7/0	6/0	6/2	7/3
(lower)	13/0	10/0	11/0	10/0	12/1	11/6
(total)	21	17	18	16	18	18
Branchiostegal rays right	12	9	10	10	12	11
(left)	13	10	10	10	12	11
Dorsal rays - Db	8B	9B	9B	9B	9B	9B
Anal rays - Ab	8B	7B	7B	9B	8B	7B
Pectoral fin rays P_1	12	13	14	13	13	14
Scales in lateral line						
Scales above lateral line	47	41	39	39	44	45
Scales 2 rows above lat.	176	183	175	171	175	188
Pelvic fin rays P_2	8	9	8	8	9	8
Pyloric caeca						
Dentition	0	0	0	0	0	0
~~Tongue teeth~~		10	9	8	8	8
~~Ext. Nares width~~	14	7	6	8	5	
Anal basal L	20	20	15	21	18	13
~~upper~~ frontrakers 2,3,4 arch	8 8 5	6 6 4	6 5 3	6 7 4	7 7 4	7 5 5
lower	11 11 9	11 9 8	10 11 8	10 10 7	11 10 8	11 10 9
upper rear rakers 2,3,4 arch	2 2 7	1 2 8	1 2 8	1 2 7	3 2 6	0 3 6
lower	8 7 8	4 6 8	3 6 7	0 6 8	5 5 7	7 7 7

S. fontinalis

#12 insect fragments, beetle larvae, adult midges, (wings) + caddis & stone particles.

#3 adult Diptera (tiny ~2-3mm) very sparse food.

#5 grasshoper, caddis larvae, many insect fragments

#9 - insect fragments (ie wing, legs) stone

~~#7~~

14 - many insect frag. - chironomy caddis, beetle,

#11 - MANY insect fragments - adult Fly (4mm) many adult fly head capsules - 1 fresh water shrimp (≈4mm) grasshopper remains

#8 - tiny insect fragments - 1 caddis fly case

#6 a few insect fragments

#4 - many insect fragments - 4 caddis fly case with larvae inside

#10 - insect (Diptera) larvae & pupa

#1 insect (Diptera)

S. fontinalis

	Food	Sex
#13	Insect Parts (Grasshopper Leg)	mature male
#2	Adult Insect Emerg. Beetle parts, Grasshopper Leg parts	mature male
#7	Adult Insect Emerg.	immature ♀

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES S. Frontinalis LOCALITY

COLLECTED BY DATE

Cat. # Measurements by DATE

Specimen #

	A	B	C					
Total L.	276	300	324					
Standard L.	239	263	277					
Body D								
Head L	62	56	67					
Orbit L	12	10	12					
Upper Jaw L	31	29	37					
Dors. Orig. to Snt. tip	120	128	146					
Dorsal fin basal L	25	29	31					
Dorsal fin depressed L	37	44	46					
Adip. fin depressed L	20	20	20					
Caudal peduncle D	26	26	29					
Caudal peduncle L	38	44	42					
Vertebrae								
1st Arch gillrakers (up)	8 | 1	6 | 4	6 | 2					
(lower)	13 | 1	12 | 8	12 | 4					
(total)	21	18	18					
Branchiostegal rays right	9	11	9					
(left)	9	11	10					
Dorsal rays	11	11	12					
Anal rays	10	11	11					
Pectoral fin rays	15	15	14					
Scales in lateral line	117	130	125					
Scales above lateral line	42	49	41					
Scales 2 rows above lat.								
Pelvic fin rays	10	10	10					
Pyloric caeca								
Dentition								
Pectoral length	25	34	42					

S. alpinus

#5 (larges) - 2 fish (120-130mm)

#6 midge larvae - sparse ~~undi~~identifiable

#7 - tiny insect fragments in intestine

#2 - grasshopper legs in stomach - tiny insect fragments in intestine

#14 - insect wings & legs ; 1 midge larvae

#9 - insect larvae (Diptera) - few adults

#8 - 2 tiny midge larvae

#3 - HYBRID?? = insect larvae (Diptera) ; adults ; grasshopper legs in stomach ;

#10 - insect LARVAE (Diptera) ; 1 tiny midge larvae

#13 - small insect leg in intestine

#11 - insect larvae (Diptera) w/ ADULTS also

#12 - HYBRID OR FONTINALIS = 1 med size beetle, insect larvae (Diptera)

#4 - extremely large amount of midge larva ; few insect larvae (Diptera)

#1 - Hybrid? = grasshoppers; insect larva (Caddis Fly) (Diptera) ; ~~of~~ diptera adults ; small beetle.

17 Plain dorsal fin golden Trout

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES S. Alpinus LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen # 9 10 11 12 13 14 — Montanalis or hybrid

	9	10	11	12	13	14
Total L.	185	127	227	179	141	133
Standard L.	154	106	188	155	117	112
Body D				34		
Head L	38	26	46	37	28	25
Orbit L	10	6.5	11	10	8	7
Upper Jaw L	19	11	21	22	12	11
Dors. Orig. to Snt. tip	71	50	90	75	53	51
Dorsal fin basal L	17	12	20	16	13	12
Dorsal fin depressed L	26	18	33	27	22	18
Adip. fin depressed L	11	5	11	9	6	6
Caudal peduncle D	13	8	14	15	9	9
Caudal peduncle L	29	19	32	25	23	20
Vertebrae						
1st Arch gillrakers (up)	8 | 0	8 | 0	7 | 0	5 | 0	8 | 0	8 | 0
(lower)	14 | 1	15 | 1	15 | 2	13 | 0	15 | 2	14 | 0
(total)	22	23	22	18 | 0	23	22 | 0
Branchiostegal rays right	11	10	10	11	9	10
(left)	10	11	10	12	9	10
Dorsal rays	12	12	11	12	12	12
Anal rays	11	11	11	11	10	10
Pectoral fin rays	13	14	14	14	14	14
Scales in lateral line	142	148	130	133	130	148
Scales above lateral line	37	29	38	40	30	34
Scales 2 rows above lat.						11½
Pelvic fin rays	9	10	9	9	9	
Pyloric caeca	33	39	36	29	38	31
Dentition	6	?	3?	0	4	0
Pectoral	13	12	14	12	[illegible]	
Dorsal	12	10	10	12	[illegible]	
Anal	10	10	10	10	[illegible]	
Pectoral Length		19		25	21	19

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

8 17 - plain dirsal fin golden trout

SPECIES S. alpinus LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

*hybrid — hybrid?

Specimen #	1	2	3	4	5	6	7	8
Total L.	274	339	233	196	392	156	212	149
Standard L.	234	289	199	164	457	131	176	121
Body D								
— Head L	58	74	48	41	98	29	44	29
— Orbit L	12.5	14	12	10	16	8	10	8
— Upper Jaw L	30	38	25	18	53	13	20	12
— Dors. Orig. to Snt. tip	114	143	90	79	195	60	78	54
— Dorsal fin basal L	28	31	26	20	51	16	20	13
— Dorsal fin depressed L	44	48	41	29	74	25	29	21
— Adip. fin depressed L	13	18	12	9	22	5	9	7
— Caudal peduncle D	21	24	18	14	33	11	15	10
— Caudal peduncle L	32	50	29.5	30	74	23	34	24
Vertebrae		60						
1st Arch gillrakers (up)	7 | 0	8 | 2	8 | 3	7 | 0	8 | 4	9 | 0	8 | 0	7 | 0
(lower)	13 | 0	12 | 0	12 | 0	13 | 0	12 | 0	16 | 2	14 | 0	14 | 3
(total)	20	20	20	20	20	25	20 | 0	21
— Branchiostegal rays right	10	11	10	11	11	11	9	9
— (left)	11	11	11	11	12	11	11	9
— Dorsal rays	12	12	13	13	12	12	10	10
— Anal rays	10	10	11	14	12	11	9	11
— Pectoral fin rays	15	14	15	15	14	13	13	13
— Scales in lateral line	116	125	117	129	145	139	136	144
Scales above lateral line	41	47	41	43	40	35	42	29
Scales 2 rows above lat.			—					
— Pelvic fin rays	9	10	9	10	9	9	9	9
Pyloric caeca	31	27	33	47	—	42	39	39
Dentition	17	5	9	12	0	6?	7?	10?
? Pectoral	15	15	15	15	14	14	13	12
? Dorsal	9	9	9	10	9	11	10	10
? Anal	9	9	10	13	10	10	9	10
Pectoral length	39			27	63	24		21

~~X~~5 largest - no teeth

2 fish in stomach

1 is 145 mm. alpinus

other too digested (ca. 120 mm).

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

plain dorsal fin golden trout

SPECIES S. Alpinus LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen #	1 (conversion hybrid)	2	3 (hybrid)	4	5	6	7	8
Total L.								
Standard L.	234	289	199	164	392	131	176	124
Body D								
Head L	.248	256	241	250	250	221	250	240
Orbit L	.053	048	060	061	041	061	057	066
Upper Jaw L	.128	131	126	110	135	099	114	099
Dors. Orig. to Snt. tip	.487	495	452	482	497	458	443	446
Dorsal fin basal L	.120	107	131	122	130	122	114	107
Dorsal fin depressed L	.188	166	206	177	199	191	165	124
Adip. fin depressed L	.056	062	060	055	056	038	051	058
Caudal peduncle D	.090	083	090	085	084	084	085	083
Caudal peduncle L	.137	173	148	183	189	176	193	199
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES ~~S. alpinus~~ S. confinalis LOCALITY Sawtooth L., Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen #

	12	13	14					
Total L.	175	219	212					
Standard L.	149	186	183					
Body D								
Head L	40	55	47					
Orbit L	10	11	11					
Upper Jaw L	25	35	27					
Dors. Orig. to Snt. tip	75	88	84					
Dorsal fin basal L	18	22	23					
Dorsal fin depressed L	30	37	36					
Adip. fin depressed L	11	12	11.5					
Caudal peduncle D	16	19	17					
Caudal peduncle L	23	32	33.5					
Vertebrae								
1st Arch gillrakers (up) #	4 | 0	3 | 0	5 | 0					
(lower) #	11 | 0	(10) | 0	11 | 0					
(total)	15 | 0	13 | 0	16					
Branchiostegal rays right	10	10	12					
(left)	10	10	12					
Dorsal rays	11	10	12					
Anal rays	10	10	11					
Pectoral fin rays	14	13	14					
Scales in lateral line	112	103	104					
Scales above lateral line	36	43	42					
Scales 2 rows above lat.			143					
Pelvic fin rays	8	8	9					
Pyloric caeca	35	37	36					
Dentition	0	*	0					
Pectoral	~~12~~	14	14					
Dorsal	~~8~~	9	11					
Anal	~~4~~	10	9					
Pectoral length	27							

*- possibly many very tiny teeth

(1)

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES *S. fontinalis* brook trout LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen #	(4)	(1)	(5)	(2)	(3)	(6)	(7)	(8)	(9)
Total L.	235	218	216	230	178	192	169	203	157
Standard L.	197	185	185	203	151	164	144	169	134
Body D									
Head L	51	51	51	62	39.5	49	35	43	37
Orbit L	11	11	~~10~~ 11	11	10	11	10	9	10
Upper Jaw L	30	30	~~28~~ 32	40	24	29.5	19	23	22
Dors. Orig. to Snt. tip	89	89	~~110~~ 91	99	68	82	67	76	58
Dorsal fin basal L	25	23	~~30~~ 23	37	20	19	19	20	18
Dorsal fin depressed L	40	36	~~4~~ 36	46	33	34	29	32	29.5
Adip. fin depressed L	13	15	~~18~~ 11	14	10	14	11	12	12
Caudal peduncle D	22	22	~~22~~ 20	22	16	17	15.5	17	15.5
Caudal peduncle L	34	30	~~33~~ 31	33	28.5	30	26	30	25
Vertebrae									
1st Arch gillrakers (up)	9 | 0	7 | 0	8 | 0	8 | 0	8 | 0	5 | 0	7 | 0	7 | 0	5 | 0
(lower)	11 | 0	10 | 0	11 | 0	11 | 0	11 | 0	(8) | 0	11 | 0	10 | 0	13 | 0
(total)	20 | 0	17	19	19	19	13 | 0	18 | 0	17 | 0	18
Branchiostegal rays right	9	10	10	10	19	11	11	11	10
(left)	9	10	10	10	10	11	11	12	10
Dorsal rays	11	11	11	11	12	12?	10	12	10
Anal rays	11	10	10	9	10	10	9	10	9
Pectoral fin rays	13	13	14	13	14	13	14	12	14
Scales in lateral line	109	115	~~111~~ 115	111	112	113	113	106	109
Scales above lateral line	39	41	(48)	52 (?)	42	42	39	40	44
Scales 2 rows above lat.			173		139		151		125
Pelvic fin rays	8	9	8	8	9	8	8	9	8
Pyloric caeca	31	29	35	36	38	29	33	29	31
Dentition	0	0	1-2	0	0	0	0	0	0
Pectoral	13	14	14	13	12	13	13	13	14
Dorsal	11	10	(9)	10	10	9	10	11	10
Anal	11	9	9	9	10	9	9	10	9

#4 20 rakers but many rudimentary.

(10)	(11)
187	323
159	278

39	82
9	12
21	53
71	140
19	37
31	57
11	17
17	29
27	43

6	0	8	0
12	0	11	0
18		19	

11	11
11	12
12	17
10	
12	12
112	115
40	50

10	9	
33	37	
0	0	
12	~~12~~	14
11	11	
10	10	

#15, ? -hybrid ?

7/13 rel. long = #1
20 rakers S. alpinus

17 basibranch. teeth

♀ well developed eggs.

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES S. Alpinus LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen # (Brook)

	9	10	11	12	13	14	15	16
Total L.								
Standard L.	154	106	198	155	117	112		
Body D								
Head L	247	245	245	239	238	223		
Orbit L	065	061	059	065	068	063		
Upper Jaw L	123	104	112	142	103	098		
Dors. Orig. to Snt. tip	461	472	479	484	453	455		
Dorsal fin basal L	110	113	106	103	111	107		
Dorsal fin depressed L	169	170	176	174	188	161		
Adip. fin depressed L	071	047	059	058	051	054		
Caudal peduncle D	084	075	074	097	077	080		
Caudal peduncle L	188	179	170	161	197	179		
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES S. fontinalis LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen #	4	1	5	2	3	6	7	8
Total L.								
Standard L.	197	185	185	203	151	164	144	169
Body D								
Head L	259	276	276	305	262	299	243	254
Orbit L	056	059	059	054	66	067	69	053
Upper Jaw L	152	162	135	197	159	180	132	136
Dors. Orig. to Snt. tip	452	481	600	488	450	500	465	450
Dorsal fin basal L	127	124	162	182	132	116	132	118
Dorsal fin depressed L	203	195	254	227	219	207	201	189
Adip. fin depressed L	066	081	097	069	66	85	076	071
Caudal peduncle D	112	119	124	108	106	109	108	101
Caudal peduncle L	173	162	222	163	189	183	181	178
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES S. fontinalis LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ ~~Measurements~~ conversions by _____ DATE _____

Specimen #

	9	10	11	12	13	14		
Total L.								
Standard L.	134	159	278	149	186	183		
Body D								
Head L	276	245	295	268	296	257		
Orbit L	025	052	043	067	059	060		
Upper Jaw L	164	132	191	168	188	148		
Dors. Orig. to Snt. tip	433	447	504	503	473	459		
Dorsal fin basal L	134	119	133	121	118	126		
Dorsal fin depressed L	220	195	205	201	199	197		
Adip. fin depressed L	090	069	061	074	065	063		
Caudal peduncle D	116	107	104	107	102	093		
Caudal peduncle L	187	170	155	154	122	183		
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES S. fontinalis (Brook Trout) LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen #	1	2	3	4	5	6	7	8	9
Total L.									
Standard L.	185	203	151	197	185	164	144	169	134
Body D									
Head L	.28	.31	.26	.26	.28	.29	.24	.25	.28
Orbit L	.06	.05	.07	.06	.06	.07	.07	.05	.07
Upper Jaw L	.16	.19	.16	.15	.14	.18	.13	.14	.16
Dors. Orig. to Snt. tip	.48	.49	.45	.45	.6	.5	.47	.45	.43
Dorsal fin basal L	.12	.18	.13	.13	.16	.12	.13	.12	.13
Dorsal fin depressed L	.19	.26	.22	.20	.25	.21	.20	.19	.22
Adip. fin depressed L	.08	.07	.07	.07	.09	.09	.08	.07	.09
Caudal peduncle D	.12	.11	.11	.11	.12	.10	.11	.10	.12
Caudal peduncle L	.16	.16	.19	.17	.22	.18	.18	.18	.19
Vertebrae									
1st Arch gillrakers (up)									
(lower)									
(total)									
Branchiostegal rays right									
(left)									
Dorsal rays									
Anal rays									
Pectoral fin rays									
Scales in lateral line									
Scales above lateral line									
Scales 2 rows above lat.									
Pelvic fin rays									
Pyloric caeca									
Dentition									

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES S. fontinalis LOCALITY Sawtooth L. Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen #

	10	11	12	13	14			
Total L.								
Standard L.	159	278	149	186	183			
Body D								
Head L	.25	.29	.27	.29	.26			
Orbit L	.06	.04	.07	.06	.06			
Upper Jaw L	.13	.19	.17	.19	.15			
Dors. Orig. to Snt. tip	.45	.50	.50	.47	.46			
Dorsal fin basal L	.12	.13	.12	.12	.13			
Dorsal fin depressed L	.19	.21	.20	.19	.19			
Adip. fin depressed L	.07	.06	.07	.06	.06			
Caudal peduncle D	.11	.10	.11	.10	.09			
Caudal peduncle L	.17	.15	.15	.17	.18			
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salvelinus alpinus LOCALITY Idaho, Sawtooth Lake

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen #

	1	2	3	4	5	6	7	8
Total L.	349	451	218	189				
Standard L.	298	400	182	160				
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	8 | 0	9 | vest.	8 | vestige	8	7			
(lower)	13 | 0	11 |	13 |	12	13			
(total)	21	20	21	20	20			
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays	9	9	9	9	9			
Pyloric caeca								
Dentition	✓ +tiny	0	✓	0	✓			

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

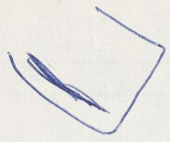
SPECIES S. fontinalis LOCALITY Idaho, Sawtooth L.

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by _____ DATE _____

Specimen #

	1	2	3	4	5			
Total L.	224							
Standard L.	195							
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7	7	7	3	6			
(lower)	11	10	11	10	10			
(total)	18	17	18	13	16			
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays	9	9	8	8	8			
Pyloric caeca								
Dentition	0	0	0	0	0			



anal cream + black borde

vs,

only light cream

fant, - alp.

body shape deep slim

spots. — chunky elonge

larger - small

more numerous sparse

more massive dentary

longer jaw

red spots

more rudimant. rakers

Dorsal

vs,

plain

sq. vs. forked

but as alpin.

sq. tail

+

deepen

body.

Wallace vert. count

	60	61	62	63	64	65	
Sunapee	1		3	1	3	6	63.6
	57	58	59				58.3
brook	4	2	8				

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salvelinus fontinalis LOCALITY Sawtooth LAKE, Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ - _____ Measurements by D.J. Wethington DATE 3/2/79

Specimen #

	1	2	3	4	5			
Total L.	217	243	320	236	214			
Standard L.	184	204	277	199	183			
Body D	44	50	78	50	47			
Head L	51	61	83	51	50			
Orbit L	12	13	13	11	11			
Upper Jaw L	30	39	52	30	31			
Dors. Orig. to Snt. tip	88	98	138	90	87			
Dorsal fin basal L	23	32	39	28	24			
Dorsal fin depressed L	38	51	60	43	38			
Adip. fin depressed L	16	16	20	14	12			
Caudal peduncle D	22	23	30	23	21			
Caudal peduncle L	32	36	45	34	33			
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

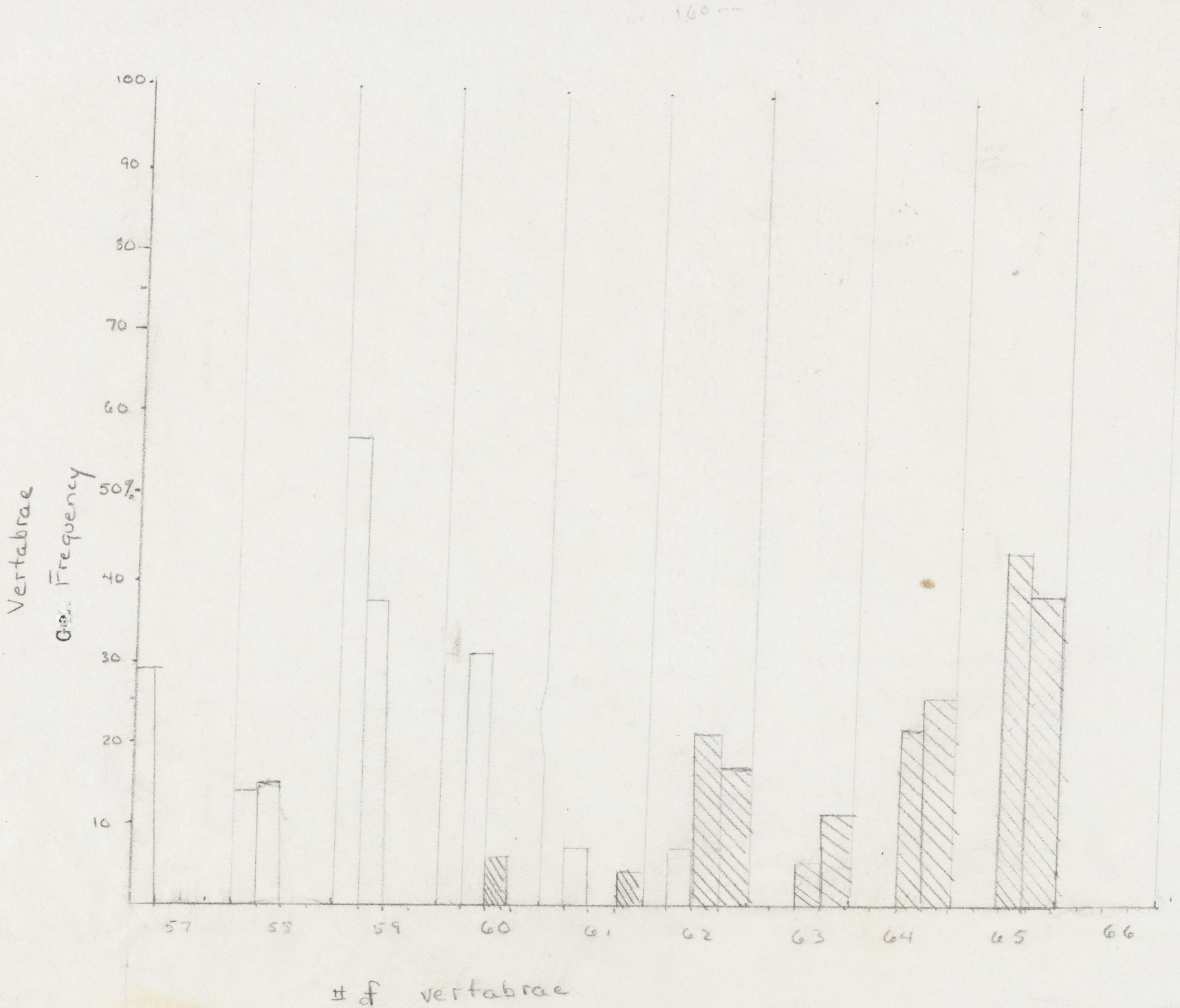
SPECIES Salvelinus ? LOCALITY Sawtooth Lake, Idaho

COLLECTED BY _____ DATE _____

Cat. # _____ Measurements by D.J. Wethington DATE 3/2/79

Specimen #

	1	2	3	4	5			
Total L.								
Standard L.								
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays								
Pyloric caeca								
Dentition								


160 mm
100
90
80
70
60
50%
40
30
20
10
Vertabrae
Frequency
57
58
59
60
61
62
63
64
65
66
# of vertabrae

	S. alpinus oquassa						S. fontinalis					
Head / Std	1	2	9	12	45	Average values	11 (possible hybrid)	1	12	13	10	Average values
Body D / SL % (18.5-22.6, 20.8-28)	22.6	20.4	19.5	19.5	18.5	20.1 %	28.5	21.1	20.8	24.3	22.6	23.5 %
* JL / HL %		54.2	48.7	59.4	45.0	52.7 %	63.0	60.8	61.0	63.6	57.9	61.3 %
* Dorsal Depr. L / SL %	18.3	18.7	18.8	18.2	17.9	18.4 %	22.3	20.0	21.5	21.6	21.3	21.3 %
* Ped depth / SL %	8.1	8.3	9.1	9.1	8.6	8.6 %	10.6	11.4	10.7	10.3	10.3	10.7 %
Ped d / Bd %	35.8	40.7	46.7	46.7	46.7	43.3 %	37.2	53.8	51.6	42.2	45.7	46.1 %
* Fork L / TL %	59.7	57.4	47.0	66.7	51.6	56.5 %	64.4	78.8	71.4	73.0	71.4	71.8 %
Fakers L / crotch L %		18.5	23.1	18.8	19.2	19.9 %	15.6	16.7	12.5	16.7	18.8	16.1 %
Dentoteeth		10										
Nares W / HL %		15.3	12.8	13.5	12.5	13.5 %	17.3	18.7	14.6	14.5	13.2	14.7 %
* Anal Basal L / SL %	8.6	7.9	8.4	9.1	9.9	8.8 %	7.3	10.8	10.1	11.4	11.6	10.2 %
* Groove fossa L. lower jaw		7						5	6	7	5	6
tongue teeth		10	10	8	12	10		10	9	8	8	9
* 4th rear gillrakers			10/10	7/9	9/9	9/9		8/8	8/9	7/8	6/7	7/7.5
* % Head L / SL		24.9	25.3	24.0	24.7	24.7 %	29.6	27.6	27.5	29.7	24.5	27.8 %

ERIC WAGNER

"NATURE BOY"

VLADYKOV, V.D. 1954. Taxonomic Characters of the Eastern North America Chars. J. Fish. Res. Bd. CANADA p. 904 - 931 v. 11.

S. aureolus In 1877 Bean estab. S. aureolus (golden or Sunapee Trout.

1854 - Girard described the blueback trout from Moosemegantic Lake, one of the Rangeley lakes, Me.

	dia Eyed egg		Sac Fry Total L. mm	wt. (g)	pigment
S. fontinalis	~~4.0~~ 4.4	.040	13.9	.040	
S. aureolus	4.7	.050	15.0	.033	
			17.1	.055	

Body Proportions
Greatest body depth - in case of Parr - characteristic
the young of fontinalis are stouter than young of s. alpinus

s. fontinalis Fork depth < 3% of Fork length
s. alpinus. - strongly forked.

Caeca counts not sig. of in this study but showed important in other studies (Vladykov 1954)

Table 2. Observable differences between Salvelinus fontinalis and Salvelinus alpinus oquassa.

Characteristic	S. fontinalis	S. a. oquassa
Dorsal Color	Dark Mottling	Uniform Dark Green
Tail Margin	Nearly Square	Forked
Ventral Fin Color	White, then black anterior margin	Only white anterior margin
Body Depth[1]	Deep	Slim

[1]Body depth is useful in smaller specimens but loses diagnostic value as size increases.

Vladykov - info on fry diff.

characters in Kendall 1914

T.L. (inches)

S.L. (mm)

b/a Hd L./S.L.

v/a Anal Basal L./S.L.

n/o upper jaw L.

gill rakers

Branchiostegals

Dorsal } total Rays
Anal }

CPD

H. characters to compare Kendall's #'s with mine

SIGNIFICANT

Head Length/SL.

Jaw Length/Hd L.

Caudal pedencle/SL

lower arch (1)

Total 1st Arch —

upper arch (2)

Lower arch (2)

Total arch 2 —

Upper arch 3 95%

lower arch 3

total arch 3 —

Upper rear 3 97%

Lower rear 3

lower arch 4

total 4 —

Total 4 upper arches

Total 4 lower aches

Total of totals for each arch

Anal Rays 95%

Pectoral 95%

Pelvic 95%

Scales above lateral scales 95%

teeth 95%

Anal Basal length 95%

TL - Fork length / TL

Dorsal depressed length /SL

Table 1. Selected ranges and averages of diagnostic characters of *Salvelinus alpinus oquassa* and *Salvelinus fontinalis*.

Characteristic	*S. a. oquassa*		*S. fontinalis*	
	range	$\bar{x}$	range	$\bar{x}$
Head length/Std. L. (%)	22.8-25.3	24.0	24.5-30.9	27.4
Caudal ped. dep./Std. L. (%)	7.3-9.2	8.4	9.4-11.4	10.5
1st Arch Gillraker upper	7-9	8	6-9	7
lower	12-16	14	9-13	11
total	20-25	21	15-21	18
4 Arch Total upper	26-32	29	21-30	25
lower	46-55	49	35-44	42
total	72-86	78	56-73	65
4th Rear Gillrakers upper	7-10	9	5-8	7
lower	8-10	9	6-8	7
Dentition	0-13	5	0	0.0
Fork L./Tail L. (%)	41.7-66.7	51.5	54.5-78.8	70.3

Report of the Bureau of Fisheries 1904

Washington, Gov. printing office

1903-4 artificially propagated. { Golden Trout; Sunapee Lake Trout (Sal.v. aureolus) can. Red Trout (S. marsteni) also Hybrid (S. fontinalis + aureolus listed) Trout

Golden Trout - 36,000 Fry
30 f.ing, yrlg, + Adult

Can. Red Trout - 13 f.ing, yrlg, Adult

Idaho recieved 251,200 eggs + fish (sp. unknown)

1905 157,490 fry to Nashau, N.H. station
269 F/Y/A Idaho 125,000 F + eggs

Hybrid listed here as well as Red + Golden as being propogated.

Baird, Cal 269 Golden Trout

1905-1906 Golden, Red, + Hybrid listed as propogated
218,265 fry

1906-1907
213,163 fry

Attempts made to collect eggs of Golden Trout (salmo roosvelti) from Volcano Creek, Calif.

Brood fish secured + sent to 3 stations for artificial propag.

Sun./can. Red/Hybrid prop.

Nashau N.H.

Lake Sunapee, N.H. Sept 17 - Nov. 24 Brook Trout Sunapee Tr + landlocked salmon } Source?

Cheney, A.N. 1897. Forest & Stream. XLVIII. 31.

- sunapees hard to strip if held in captivity.
- U.S. Fish Commission had collecting station of Floods Pond.
- largest taken = 3 lbs.
- Mr. Race of GreenLake Station reports that sunapee eggs are easily cultivated - eggs very vigorous & young fish easily reared.
- fish released at 8 months of age.
- very suseptible to temp. change

Commissioners Report. 1896. U.S. Commission of Fish & Fisheries. Wash. D.C. pages 12,14 & 15.

- Fiscal 1895 on hand 6,480 golden trout fry
- took from Floods Pond:
  - L.L. salmon: 4 adults=11,000eggs
  - brook trout: 119 adults = 46,000 eggs
  - * golden trout: 60 adults = 34,000 eggs
- distributed 21,700 fry & fingerlings and 10 adult & yearling golden trout
- brood stock returned to pond
- Green Lake hatchery

* golden trout is still used by some in Maine to refer to the Sunapee char

Report of the U.S Commissioner of Fisheries. 1925. Dept. of Commerce. Bureau of Fisheries. Wash. D.C. pages445, 464, 465.

- Federal Hatcheries handled 100,000 silver trout fingerlings in 1925.
-In Jan. 1925, the Quinault (Wash.) Station received 260,000* silver trout eggs fromLake Whatcom Hatchery of the Washington Fish Commission, the fish were to be marked and stocked as fry into the lower Quinault River near the ocean.
-The Rogue River (Oreg.) substation also received some silver trout eggs "from other stations".

silver salmon

* Sunapee char are often refered to as "silver trout" in some of the old literature
J.M.K.

Report of the U.S. Commissionerof Fisheries. 1926. Dept of Commerce. Bureau of Fisheries. Wash. D.C. pages,331, 348.

* Federal hatcheries handled 232,700 silver trout fingerlings in 1926.
-The Quinault (Wash.) Station reported stocking silver trout (marked RV - AD) resulting from the eggs received from the State of Washington ln 1925. This would be an 89.5% survival to SY size if this is the same lot of 260,000 eggs mentioned in the 1925 report.

Silver Salmon

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

BANGOR, ME 044
PM
3 JAN
1979

ALWAYS USE ZIP CODE

U.S. POSTAGE 15¢ OLIVER WENDELL HOLMES

Dr. Robert Behnke
Colorado State University
Fort Collins, Colorado
80523

Titcomb - 1901
- red trout - 4 lbs, 4 smelt
- ditto lat
- cold water forms - [illegible]
glacial relicts.
- status of Aureolus?
Sunapee

ENJOY MAINE—HELP US CONSERVE IT.

STATE OF IDAHO

DEPARTMENT OF FISH AND GAME

SALMON SUBREGIONAL OFFICE
P. O. BOX 1336
SALMON, IDAHO 83467

October 10, 1980

Mr. Eric Wagner
120 Garfield St.
Fort Collins, CO 80524

Dear Mr. Wagner:

I'm returning a copy of your letter with your questions answered on it. As you can see, we don't have much information on the fish in Sawtooth Lake. We have not attempted any ecological studies on sunapee trout until now. I just returned from collecting fish for age and growth, food habits, etc. I collected sunapee trout from another lake, so Idaho has two populations.

Sunapee are not sought by anglers because they don't know they are there. The populations are not threatened by fishing. The Sawtooth National Recreation Area already received very heavy use and we do not want to generate further problems by publicizing that there is a unique fish there.

I see no problem with writing a paper for your class, but I would appreciate it if you would not write any papers for public release.

Sorry I can't be of more help.

Sincerely,

Kent Ball

Kent Ball
Regional Fishery Biologist

KB:nb

120 Garfield St.
Fort Collins, CO 80524
September 30, 1980

Mr. Kent Ball

Regional Fishery Biologist

Idaho Dept. of Fish and Game

P.O. Box 1336

Salmon, Idaho 83467

Dear Mr. Ball,

I am a student at Colorado State University examining trout specimens for Dr. Behnke under work study funds. I am writing a technical paper on the discovery of the Sunapee Trout in Sawtooth Lake for my technical journalism class. The possibility of submitting an article to the "Progressive Fish Culturist" exists. I was wondering if you had any recent data concerning this fascinating fish. Some questions I have are:

1) Do you have any coloration descriptions of live fish? No

2) Is there much color variation? Yes

3) Are there any distinquishing characteristics that are vague on preserved specimens? No

4) What do anglers use to catch Sunapee Trout? Very few are being caught

5) When do anglers fish for them and how? They don't fish for "them", they just fish -

6) Have there been any observations of spawning? No

7) Do brook trout spawn at similar sites and times as the Sunapee? We no idea on sites - time similar

8) Any data on diet for brook and Sunapee trout of Sawtooth? No

9) What are brook trout habits in Sawtooth Lake? nothing unique

10) What are the present management practices? statewide 6 og limit + general season 6 fish/day May 24 - Nov 30

If you could answer any of these questions I would be grateful. Any other information would be greatly appreciated. I will, of course, send you a copy of my final report. The paper is due on Nov. 7. Thank you for your help. I look forward to hearing from you.

Sincerely,

Eric J. Wagner

Eric Wagner

STATE OF IDAHO
Department of Fish and Game
Salmon Subregional — P.O. Box 1336
Salmon, Idaho 83467

SALMON, ID
OCT 10
-PM
1989

USA
15c

TO: Mr. Eric Wagner
120 Garfield St.
Fort Collins, CO 80524

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

GLENN H. MANUEL
Commissioner

J. WILLIAM PEPPARD
Deputy Commissioner

34 Idaho Ave.
Bangor, Maine 04401

August 6, 1979

Dr. Robert Behnke
Colorado State University
Fort Collins, Colorado 80523

Dear Dr. Behnke:

It's too bad that there wasn't more time before you had to leave Orono last week. The fish Jon Stanley told you about was examined by me and turned out to be a Sunapee charr. It was caught in a gill net from 75' - 95' deep in Green Lake, Ellsworth, Maine. There were several lake trout in the net also and even 2 lake trout in the Sunapee. The fish was a mature male, 380 mm long and weighed 630 g. Sunapee were reported by Cooper in 1942 but have not been collected there for many years. This specimen was obviously a Sunapee with none of the lake trout features one might expect in a hybrid.

I'll discuss this further with you in West Yellowstone.

Sincerely yours,

Fred

Frederick W. Kircheis
Fishery Biologist

FWK/jpn

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

6 AUG 1979

U.S. POSTAGE 15¢ OLIVER WENDELL HOLMES

Green L. Snopee
[illegible] since 1942

350 mm.
630 g.

Dr. Robert Behnke
Colorado State University
Fort Collins, Colorado 80523

— Sunapee living w/ Lake Trout
w/ out hybridization
— Preying upon Lake Trout

ENJOY MAINE — HELP US CONSERVE IT.

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

GLENN H. MANUEL
Commissioner

J. WILLIAM PEPPARD
Deputy Commissioner

34 Idaho Ave.
Bangor, Maine 04401

December 29, 1980

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

Dear Bob:

Thank you very much for the photocopy of the Sunapee charr stocking information. I am pleased to have the source of the Sawtooth fish finally clearedup. I don't know when lake trout were first put into Sunapee Lake. Is there any chance that the Sawtooth fish could have any lake trout genes?

Have a Happy New Year.

Sincerely yours,

Fred

Frederick W. Kircheis,
Research Biologist

FWK/jpn

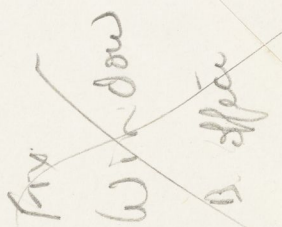
Kircheis

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

Any chance that Sunapee in Sawtooth have Lake Trout genes?

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

ENJOY MAINE---HELP US CONSERVE IT.



University of Idaho
College of Letters and Science
Department of Biological Science
Moscow, Idaho/83843
Phone (208) 885-6280

Dear Bob:

I am enclosing, under separate cover, the specimens of "sunapee" charr and brook Trout from Sawtooth Lake, collected in Oct. by Kent Ball. I separated them as 14 of each species. They are so separated in the large bags. I used dorsal fin markings and dorsal surface marking to separate the two. ~~The fin~~ Maybe you should check my ID.

The fish have been soaking in water, so they are ready to be put in alcohol.

The vertebrae counts are as follows

Sunapee (Hybrid?)

60	61	62	63	64	65
1		3	1	3	6

$\bar{X} = 63.6$

Brook Trout

57	58	59
4	2	8

$\bar{X} = 58.3$

The "sunapee" with 60 vertebrae was the second largest sunapee. I recounted a number of times but still get 60.

I will be interested in hearing what counts you get for pyloric caeca and gill rakers. Kent found some stocking information that I will copy and get to you.

I'll keep in touch

Sincerely

Dick

Wallace

BIOL. SCI.
006-X003

University of Idaho
Moscow, Idaho / 83843

MOSCOW IDAHO NOV-7'78 U.S. POSTAGE 15¢ PD 651858

Dr. R. J. Behnke
Dept. Fish. + Wildl. Biol.
Colorado State Univ.
Ft. Collins
Colorado 80523

Master Copy

Revised 1/16/78

SUNAPEE CHARR

(*Salvelinus alpinus*)

other scientific names: *Salvelinus alpinus aureolus*

Salvelinus aureolus

Salvelinus sunapee

Salvelinus sunapeus

Salvelinus sunapeensis

Salvelinus aureolo

Salvelinus oquasso

Salvelinus stagnalis

Salmo sunapee

Salmo oquassa

Salvelinus agassizii

Other colloquial names: Sunapee Trout

Golden trout

White trout

Silver trout

Silver salmon

Sunapee - lake trout

American saibling

Sunapee saibling

Sunapee char

Litrature cited

Bibliography on the Sunapee trout

Anonymous. 1891. Forest & Stream. XIX:479. } Not in morgan Libr

* Aiken, Walter. 1890. Forest and Stream. XXXV:313.

_____, and Frederic M. Day. 1890. Forest and Stream. XXXV:333.

Bean, T. H. 1886. Forest and Stream. XXVI:126. - not in morgan

Behnke 1972
_____. 1980 1887. Description of a supposed new species of char (Salvelinus aureolus) from Sunapee Lake, New Hampshire. Proc. U.S. Nat. Mus., 10:638-630.

_____. 1888. The American Angler. XIII:73-74. Not in morgan Libr.
1890. Forest and Stream. Dec. 18 p. 435

Brezosky, Peter E. n.d. Observations on the golden trout, Salvelinus aureolus, in Tewksbury Pond, Grafton, New Hampshire. Concord, N.H. Fish and Game Dept.

Chase, Earl H. (unpublished). Notes on Sunapee Trout (Salvelinus aureolus) Bean.

Cheney, A. N. 1892. Forest and Stream. XXXIX. } not at Morgan

_____. 1897. Forest and Stream. XLVIII:31.

Commissioners Report. 1896. U.S. Comm. of Fish and Fisheries, Wash. D.C. pp. 12, 14, & 15.

DeRocher, J. D. 1911 (?). Pers. Comm to W. C. Kendall.

Everhart, W. Harry. 1950. Fishes of Maine. The Dept. of Inland Fish. & Game, Augusta, Me. p. 49.

_____, and C. A. Waters. 1965. Life History of the blueback trout (Salvelinus alpinus) in Maine. Trans. Am. Fish. Soc. 94:393-397.

Fuller, John L., and Gerald P. Cooper. 1946. A biological survey of the Lakes and Ponds of Mount Desert Island, and the Union and Lower Penobscot River Drainage Systems. Me. Dept. Inland Fish. and Game. Fish Survey Rept. No. 7, pp. 91-92, 117-118, 212.

Garman, S. 1891. The Am. Angler. XIX:82-83.

Havey, Keith A. 1969. The Sunapee: Maine's Rarest Trout. Me. Fish and Game. XI (3):14-15.

Hodge, E. B. 1886. The Am. Angler. - Not at Morgan Libr IX:216. SH 11 M 3A3

Hoover, Earl E. 1937. Biological Survey of the Androscoggin, Saco and Coastal Watersheds. N.H. Fish and Game Dept., Survey Report. No. 2.

Hubbard, Walto F. 1912. Pers Comm. to Dr. W. C. Kendall.

Jordan, Frank M. 1901. Forest, Lake and River. The Fishes of New England and Eastern Canada. Vol. 1. p. 313.

Jordan, David S., and Barton W. Evermann, 1902, American Food and Game Fishes. Doubleday, Page & Co. New York, N. Y. pp 213-217.

Kendall, W. C. 1913. Fishes & Fishing in Sunapee Lake. U.S. Dept. of Commerce. Bur. of Fisheries. Document No. 783.

Kendall, W. C. 1914. The Fishes of New England. The Salmon Family, Part I. The Trout or Charrs. Mem. Bost. Soc. Nat. History. 8(1):43-55.

Kircheis, F. W. 1976. Reproductive biology and early life history of the Sunapee trout of Floods Pond, Maine. Trans. Am. Fish. Soc. 105: 615-619.

Kingsbury, C. A. 1886. The Am. Angler. IX:183-184.

McCleave, J. D., G. W. LaBar, and F. W. Kircheis. 1977. Within-season movements of displaced mature Sunapee trout (Salvelinus alpinus) in Floods Pond, Maine. Trans. Am. Fish. Soc. 106:156-162.

McPhail, J. D. 1961. A systematic study of the Salvelinus alpinus complex in North America. J. Fish. Res. Board Can. 18(5):193-814.

Newell, A. E. 1958. The life history and ecology of the Sunapee trout, Salvelinus aureolus (Bean). Concord, N. H. Fish and Game Dept. 14 p.

Qadri, S. U. 1974. Taxonomic status of the Salvelinus alpinus complex. J. Fish. Res. Board, Can. 31:1355-136.

Quackenbos, J. D. 1886. The Am. Angler. IX:196-197 and 233.

_____. 1886. Forest and Stream. 149.

_____. 1887. The Am. Angler. XI:119-120.

_____. 1887. The Am. Angler. XII:72, 151, 282, and 361.

_____. 1890. The Am. Angler. XVIII:369.

_____. 1893. Trans. N. Y. Academy of Science. XII:139-151.

_____. 1896. The American Saibling or golden trout. Fisheries, Game and Forestry Commissioners. State of N. Y.

Saunders, L. H. and G. Power. 1969. The Arctic Char. Salvelinus alpinus (linneaus) of Matamek Lake, Quebec. Naturalists Can. 96:919-934.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fish. Res. Board Can. Bull. 184. 966 pp.

Shurtleff, Wm. H. 1899. Forest and Stream. LII:468.

Sisson, R. F. 1950. Lake Sunapee's golden trout. Nat. Geog. Mag. (Wash. D.C.) 98:539-536.

Vlakykov, Vadum D. 1954. Taxonomic characters of the eastern North American ;ars (Salvelinus and Cristivomer). J. Res. Bd. Can. 11(6):904-932.

Vlakykov, Vadum D, and B. W. Corson. 1953. The taxonomic position of the Sunapee trout (Salvelinus aureolus). Quebec, Quebec Dept. of Fisheries, 9 p.

Walden, Howard T. 1964. Sunapee trout, Salvelinus aureolus Bean. Familiar freshwater fishes of America, New York, Harper and Row, p. 53-58.

Warfel, Herbert E. 1939. Biological survey of the Connecticut watershed. Concord, N. H. Fish and Game Dept., Survey Report 4:165-166.

Waters, Charles A. 1960. A Study of the Life History and Taxonomic Position of the Blueback Trout, Salvelinus Oquassa (Girard). A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science (in Zoology). University of Maine.

Kircheis, F.W. 1976. Radio equipped Sunapees. Me. Fish & Wildlife. Spring. pp. 28-30.

_____. 1976. The life of the Sunapee. Mr. Fish & Wildlife. Summer. pp. 2 - 4.

Kircheis, F.W. 1980. The landlocked charrs of Maine: the sunapee and the blueback. CHARRS: Salmonid Fishes of the Genus Salvelinus. Ed. E.K. Balon. Pub. Dr. W. Junk. The Hague. Chapter 25. pp749 - 755.

Balon, E.K. 1980. Early ontogeny of the North American landlocked arctic charr - sunapee, Salvelinus (Salvelinus) alpinus oquassa. Ed. E.K. Balon. Publ Dr.W. Junk. The Hague. Chapter 16. pp 563 - 606.

CHARRS: Salmonid Fishes of the Genus Salvelinus.

U.S. Bureau of Fisheries Report 1904, 1905, 1906, 1907, 1918

GIBBS, Jerry 1979 LOST SUNAPEE Trout found in Idaho, Outdoor Life Dec. p 48

Behnke R.J. 1972.

Kircheis 1974 Species mgt. plan: the sunapee trout, ME Dept. Inland F+W. Vol 7, Part 1 22p.

LOCKE, S.B 1929 whitefish, grayling, trout and Salmon of the intermountain region. U.S Bureau of Fisheries Rpt., App. V, pp 173-190

Kornfield, I.L., K.F. Beland, J.R. Moring, and F.W. Kircheis. 1981. Genetic similarity among endemic Arctic char (Salvelinus alpinus) and implications for management. Can. J. Fish. Aquatic Sci. Jan. 38: 32-39

both *12 fontinalis

1 & 3 "alpinus" myst hybrids, markings, sq. tail, body shape

	* 60	61	62	63	64	65	
Sunapee	1		3	1	3	6	(63.5) 63.6

~~*1 spec. & 1 identified as hybrid~~ spec. * 2 - lowest caecal count.

	57	58	59	
brook	4	2	8	58.3

basi branch. teeth - 1 of 15 (check *13 - may have teeth)

brook trout w/ basibranchial teeth 2 of 13 "golden"

w/o basibran. - incl. largest spec. - both "hybrids" have most teeth 9, 17 (others 1-7)

largest specimen w/ 2 fish in stomach - one is "golden" 145 mm other digested ca. 120 mm.

forked tail - mottled D. & C clear fins bl. & wh. border only white deep body slim spotting?

vs. sq

short, thick

rakers	13	14	15 76	17	18	19	20	
font.	1	1	1	1 2	4	4	1	17.3 15.700

long, slim

	20	21	22	23	24	25	
both "hybrid" alp.	5	1	4	2		1	21.5 13.60

check rakers 1-5 all = 20?

20

* *12, 179 mm. of alpinus = fontinalis & hybrid vert.?

18 rakers
no teeth
29 caeca
mottled markings

* 1, 3 hybrid 233, 271 mm.

(most teeth?

shape fins etc.

*2 w/ 60 vert. lowest caeca count 27

verify *12)

check spott dif.
body depth
tail fork

- lay out all spec -

Sawtooth L. 172 acres B&N no inlet 1935 survey depth 300 acres el.

Challis Nat. For. drainage Salmon R.

7 mi. hike to nearest road.

about 8 mi. S.W. of Stanley, Id.

1925 . Sunapee . stocked
1941 7000 brook from Ft Agerman hatchery.

Anglers report catching (An. Platts) -

1935 - US Bur. Fish. Surv. - Rodenheffer -

* Upper Sawtooth L. - fed by snow melt - - drains into lower Sawtooth (a small, shallow, one acre pond) - . Impassible falls separate -

* - examine food -
* summarize size

Survey data July 13-15 1935
very cold water - surface 50° at 3 P.M. July 13
thermocline formed at 40-50 ft.
max. depth 254 ft. - most entire lake > 50 ft. - shoal area
< 3% O_2 5.9 at surface 8.05 at 108 ft.
no food seen, no vegetation
stomachs of Sunapee trout show adult caddisfly, stoneflies, & beetles.
- Stocking - 1925 1000 Sunapee golden trout stocked -
el. 900 ft 20 hr. gill net set caught 12 8-9 in. spec., & very thin, slender, few smaller fish seen in outlet.
- Rec. stocking calif. golden trout.
= no other stocking records -
-1977 2 gill nets fished 10-90 ft. + 10-60 ft.
11 Sunapee + 26 brook trout.
108-216 mm. (167.6 mm)
1978 -
3 gill nets 25-50 ft. 20-60 ft. (2) " at South end
all fish caught (N=28) I examined.
+ Kirchen - letter + Bzl)
+ Salvelinus monq.
Floods Pond Me. via Craig Brook Nat. Hatch.

* Check US Fish Comm. Rep 1925 fr stocks
- Kirchen - 1895 Flood Pond cited.

Biol. Dept., Dalhousie Univ., Halifax Nova Scotia.

Rombough, P. J., S. E. Barbour, and J. J. Kerekes, Morphometrics, meristics and incidental life history of an isolated population of landlocked Arctic char, S. a., from Candlestick Pond, Gros Morne National Park, Newfoundland. submitted J. F.R.B.C. —rcvd. in rev. July 24, 78. —

90 ha lake, headwaters Humber R., el. 460 m - falls 45 km. down from lake.

S. a., S. fontinalis & Salmo salar in pond.

oldest age 7, largest 164mm wt. 42g.

food - Aug. Cladocera, + some insects

Sex, mature age III + F.L. Aug 19-20 118.6 mm

McPhail's west Arctic group alpinus = malma

- Oquassa group : European - by salar Osmerus - Lab. × E. Arctic intergrade alpinus

largely replaced by fontinalis.

D 10.76, A, 9.35, V. 8.89, P. 12.62.

rakers 5-8 7.41
12-17 13.08
18-25 20.54

branch. 7-9 8.51

caecae 25-41 32.53

Salvelinus (+ S. trutta)
(+ sympat. alpinus coregonus)

(1) * Sunapee, aquaeu / fontinalis intact

Rombough, P. J. and S. E. Barbour 1978. Life history and taxonomic status of an isolated population of arctic charr, S. a., from Gros Morne Nat. Pk., Newfoundland. J. F. R. B. C. 35(12): 1537-41.
- Candlestick Pond - slow growth, short life (max. size 164 mm; max. age 7, sex. mat. 3 fecundity 103)
w/ S. salar, S. fontinalis

- Rakers - N=32 x̄ 20.5 (18-25)
- Caeca . 15 x̄ 32.5 (25-41)

(1) Biol. Dept., Dalhousie Univ., Halifax N. S. B3H 4J1

(1) Campbell, R.N. 1979. Ferox trout, ~~Salmo~~ trutta, L. and charr, Salvelinus alpinus, in Scottish lochs. J. Fish Biol. 14(1): 1-29. charr - trutta
(1) The Nature Conservancy Council, Fraser Darling House, 9 Culduthel Rd, Inverness, Scotland.
* Yugoslav. trout - larr 28.5 kg. (=56 lb.)
* Wagner - Schindler 36 - lake trout biol. 446

- Andreev, V.L. ~~and~~ V. N. Ivankov, and A. M. Bronevskii. 1978. Ecology and morphological characters of malma of southern Kuril Is. - Soviet J. Ecology. 9(1): 43-48

Ruhlé, C. 1978. Biologie und Bewirtschaftung des Seesaiblings (Salvelinus alpinus) im Zugersee. Schweiz. Zeit. für Hydrol. (Rev. Suisse d'Hydrol) (~Swiss Jour. Hydrol.) 39(1): 12-45. ~ + Rufli ibid 40(1): 7-31 (1979) - sympat. whitefish Thun + Bielersee

Savvaitova, K.A. and V.V. Volobuev 1978. K ~~от~~ систематике арктических гольцов Salvelinus alpinus (Salmonidae, Salmoniformes). Zool. Zhur. 57(10): 1534-1546.

Sav. table pg. 1539

Some characters of S. alpinus - S. malma - Canad. Nat. Mus.

	Nelson L. N=3	Chesterfield Inlet (3)	Folstoi L. & Farm Cr.
rakers	23-26 (24.3)	23-26 (24.5)	20-24 (22.1) / 18-20 (19)
caeca	30-36 (33)	40-46 (42)	22-33 (27) / 29-36 (32.5)
	long thin	short fat	long thin / long thin

body form - morphol -

groups - malmoid, high ~~alpinoid~~ arctic, alpinoid not specific status -

S. o. oquassa

rakers

1st	2nd	3rd	4
8/13	9/5	8/4	6/10
13/0	13/8	13/7	11/16

7 holes in lower jaw

x = > 5% separation

S. fontinalis

8/1	8/2	8/2	5/8
13/0	11/8	11/7	9/7
21	19	19	

4-6 holes

	HdL/StdL.	%
DO-Snt TP / S.L	24.9	29.6
* Body D/SL	49.1	50.0
Orb.L/HdL	20.4	28.5
* JL/HL	18.0	19.8
D DL/SL	54.2	63.0
Adip/SL	18.7	22.3
Ped D/SL	6.6	8.03
Ped/BD	8.3	10.6
* ForkL / TL	40.7	37.2
rakerL/orchL	57.4	64.4
TongueTth	18.5	15.6
PectL/SL	10	8
Nares W / Ai Bas L	15.2	13.9
	11 / ~~23~~ 7.9	14 / ~~27~~ 11.3

4/4 38

←FOR COMMENT

TEMENT ABER

CONTINUATION

FORTRAN STATEMENT

IDENTIFICATION

Discovery of the New England Sunapee Trout in Idaho

— What is Trout of Sawtooth L.?
— How do you know?

— _____ 1975 Wm. Kent Ball, I.F.G., gillnets Sawtooth L.

description - size, elevation, county, etc. Besides brook trout, Salvelinus fontinalis, specimens of another species of Salvelinus occur. — Specimens sent to C.S.U. for identification.

~~Of a~~ Topography of lake - no native fishes (must be stocked) — Genus Salvelinus, only S. confluentus, bull trout native to Idaho. — obviously not bull trout.

. . . . Stocking history . . . . . Sunapee stocked 192 - brooker stocked 194 - . . .

Compare specimens w/ data from known Sunapee specimens (Kendall, etc.) . . .

— brook trout data / Sunapee (Sawtooth L.) data

— hybrids?

— Why don't they hybridize into hybrid swarm like cutthroat & rainbow? — niches in large lake - pelagic or littoral zones.

ecological relationships between brook trout & Sunapee - predator-prey

— . . . summary of bluebacks (Maine) & Sunapee - predaceous? size,

· What Kendall found Sunapee L. (U S Bur. Fish. Rep.)

— Historical review Sunapee trout - first name, - distribution (Kendall) natural history, interesting facts, etc. . - extinction in Sunapee & Averill lakes - only Blood Pond now (Kirchis)

- Post stocking . . . . . .

Why so difficult to get established? - needs large, deep, cold lake . . .

predator — size in Sawtooth indicates management potential in similar Rocky Mtn oligotrophic lakes — some discussion on

- classification - formerly S. oquassa - now S. alpinus oquassa
(Behnke 80)

Sawtooth L. -- characteristics, physical, chemical, biological.

relation relict Arctic charr & brook trout

Kendall 1914, 192 —

Waters MS thesis, blueback

FRBC - Condle Pond New Brunswick.

- typically brook trout dominated larger - but Sunapee ??

- Mysterious fish (deepwater charr) - blueback

believed extinct - then discovered in 1958 -

Summary of Information

8 Feb 1979
From: R.L. Wallace
Univ. Idaho

Sawtooth Lake
- about 8 mi WSW of Stanley, ID
- elevation 9000+ ft.
- about 172 acres
- no inlet
- Salmon River drainage
- maximum depth - 254 ft

Fish Stocking
- lake barren until first stocked
- 1000 sunapee trout stocked in 1925
- brook trout (7,000 from U.S. Hagerman Hatchery) stocked in 1941
- no other stocking

Recent Fish Collections

1977
- a collection was made in the fall
- 2 experimental gill nets, each 125 ft were used
- these sinking gill nets were set perpendicular to shoreline
- one from about 10 ft to 90 ft of water
- the other from about 10 ft to 60 ft of water
- sinking nets, resting on the bottom
- both were fished in the N.E. corner of the lake

Catch: the 11 sunapee trout plus 26 brook trout
Sunapee: Poor sample, poorly preserved
Brook trout: TL ranged from 108-216 mm TL ($\bar{x}$ = 167.6) - frozen, then thawed & measured, then preserved

1978
- another sample was taken
- the same 2 experimental sinking gill nets plus 1 100 ft experimental sinking net
- one net set in from 25 out to 50 ft of water
- another in from 20 to 60 ft of water
- the third about the same depth
- all nets were set in south end of lake

Catch: all fish caught were preserved and sent to Wallace at U.I., and on to Behnke at C.S.U.

2 references:

1) Idaho Department of Fish and Game. ~~Tenth~~ Eleventh Biennial Report for 1925-1926. (I sent you a copy of this) Locke would be the author I guess.

2) Rodeheffer, I.A. 1935. A survey of the waters of the Challis National Forest, Idaho. Dept. Commerce, Bur. Fisheries, 17 p. mimeo.

The Canadian red trout

353-356 Sn.

Titcomb 1901 Sixth Ann. Rep. For., Fish, Game Comm., St. N.Y.

"red trout" Four lakes in St. Alexis Township, Quebec.

All lakes w brook trout, which reach 5-6 lbs. exhibited at Pan Am. exposition

Propagated in hatchery - best caught thru ice

never taken on fly - seem to be bottom feeders

- would hit fly in hatchery pond - brook trout at surface, red trout on bottom

- Stocked. Lake Caroles - rich lake, abund. veg., food, ~~x~~ one of 4 lbs caught on minnow

- L. Ferron w/ abund. smelt, red trout stocked ~~x~~ avidly eat smelt - to 4 lbs. take fly & minnow.

cold water fish like mamaycush..

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

MAYNARD F. MARSH
Commissioner

J. WILLIAM PEPPARD
Deputy Commissioner

Fisheries Office
34 Idaho Ave.
Bangor, Maine 04401

March 7, 1978

Mr. Kent W. Ball
Regional Fishery Biologist
Idaho Dept. of Fish & Game
P. O. Box 1336
Salmon, Idaho 83467

Dear Mr. Ball:

Thank you very much for your letter! I have been trying to learn of the results of those stockings for a number of years and yours is the first report that I have had which indicates any possibility that the Sunapee has survived in Idaho. The fish sent to Idaho in the 1920's came from Floods Pond in Otis, Maine, via the Federal Hatchery at Craig Brook, Orland, Maine. I don't know if the hatchery shipped eggs, sac fry, or fingerlings, but I suspect that it was the latter, since this was the most common method used at that time.

Enclosed please find a bibliography and some reprints which I use in my lectures. I have marked some of the items which might provide you with the most useful information. The National Geographic article has some pretty good color photos of Sunapee charr but there is quite a lot of color variation between fish as you might imagine.

It is possible that the brook trout and the Sunapee charr of Sawtooth Lake could hybridize. Some hybridization work has been done in Sweden in controlled tests which prove that crosses between landlocked charr and brook trout can survive. However, the spawning characteristics and spawning times (at least here in Maine) are enough different to make such hybridization unlikely. The trout spawn in redds, with a one-on-one spawning technique, in late September and early October. The charr spawn in a manner similar to lake trout: scattering the eggs over a rocky bottom, several males attending each female, and the season being late October through late November. However (again!) the spawning habits of the landlocked charr are quite variable on a world-wide basis. In Norway and Sweden there are reports of redd-building charr and of broadcast spawners. One Sunapee from Floods Pond which was placed in a raceway environment proceeded to construct a redd in the presence of one male. So it is possible that some brook trout did spawn with some Sunapee charr in Sawtooth Lake. It is impossible to say that they didn't, since nothing is known of the spawning habits and fish characteristics in that lake.

As to your last question, I am not a taxonomist and have no basis except gross observation to make an opinion on the status of these fish. If one takes the definition of "reproductive isolation" as the basis for speciation, then the Sunapee is a different species from the Arctic charr. There are no reports of Arctic charr which spawn in the manner which I have observed the Sunapee charr using. They, therefore, would not interbreed even if they happened to come in contact with each other during the spawning season. But, using my previous paragraph as reference, the spawning habits of the "Arctic charr complex" are so plastic that anything is possible and the fact is that no one knows whether or not they would interbreed. In my own mind I tend to consider the Sunapee charr and the blueback charr (and all the other "species" of landlocked charr in Canada and the rest of the northern hemisphere) as Arctic charr in the same manner that the landlocked Atlantic salmon is considered to be no different from the anadromous Atlantic salmon.

I would very much like to be kept informed about the Sunapee charr in Idaho. If you locate other populations or learn interesting facts about the biology of the critter in Sawtooth Lake, please let me know and I'll do the same for you, if you are interested.

Sincerely yours,

Frederick W. Kircheis
Fisheries Research
Biologist

FWK/jpn
encl.
cc: Dr. Behnke

P.S. In case you haven't already done so, I'd like to suggest that you contact Dr. Robert Behnke, Colorado Cooperative Fishery Unit, Colorado State University, Fort Collins, Colorado 80521, concerning the Sunapee-brook trout hybrids. I know he would be interested and perhaps could give you some useful information.

W.C.
Kendall 1912 — Fishes + Fishing in Sunapee Lake — U.S. Fisheries Bureau Rpt.

Sunapee Lake

Physical

8 mi long 1¼ mi wide

65 to 80+ ft deep.
?100 in the deepest

In Forest + Stream of March 18, 1886 Quackenbos states that all fish on Sunapee attain an unusual weight.

Size attributed to smelt. 1867

Black Bass, 1868 Land Locked Salmon, Smelt introd. in 1870

Blueback introd. in 1878

~~White~~ ~~1877~~ not found

~~Wall-eyed pike 1876~~

~~Round white fish 1881~~

Loch Leven trout 1888-9

Brown trout 1888-9

~~Rainbow Tr~~ 1888-9

Chinook salmon 1904

~~Grayling~~ 1906

~~Silver salmon~~ 1909

L. Trout ?

S. fontinalis native to Sunapee
yet artificially propogated
5-6 lb fish not rare

Brook Trout - omnivorous - also eats smelt - larval
ascend brooks to spawn

Kendall believes white trout were once small like the Blueback of Rangeley

If brook trout reached a large size before smelt were introduced - small white trout may have been forage fish.

Brk Decreased with other introductions

Blueback - described by blueback in 1854 - ascends streams to spawn in Oct
caught in dipnets by the barrel
salmon wiped out blueback

after introduction of smelt in 1895 the numbers increased rapidly

In 1901 to 1904 the few bluebacks found in Rangely stream weighed 1-2 lbs or more. - attributed to smelt

report of the State fish commissioners of New Hampshire indicate on Apr. 26, 1878 3,000 + June 3, 1879 4000 Blueback planted in Sunapee L.

Sunapee (KENDALL 1912)

Known in Flood's Pond, Me long before european stock

Several reports indicate that Sunapee trout were native to the lake prior to bluebank introduction. (Forest & Stream Dec 18, 1890 Dr Bean p. 435)

1st distinguished in 1881. 2-3 lb.

average increase of 1 lb/yr under favorable conditions

the smelt, even small Sunapee trout (5 1/2 - 8 1/4") lives 60 - 90 or 100' deep

Chironomus Entomostraca

1 - 1 7/16" - chironomus larvae

Several strippings required to get all eggs

average size of Sunapee taken by Fish culturist ~ 1 lb

3 are larger & many smaller

1st white trout eggs taken in 1887 & made 1st plant in 1888

State Commission operated at Sunapee L. until 1900 & in that time planted 985,000 fry — No mention of where planted

In 1902 U.S. Bureau of Fisheries assumed work as a field station. 1st plant was made by Bureau in 1903 & operations continued until 1911. in this time 1,079,873 young white trout (mostly fry) were planted in the lake.

In 1890, 90,000 were planted by the State in other waters, but none in Sunapee

2,530,070 eggs taken from 4,500 Sunapee from 1904 - 1911

Mr De Rocher (U.S. Fisheries station at Nashua) in charge of Sunapee station

Fish are 2-3 lbs on average some 7 lb. when 1st started work in 1904

Now they average 1 1/4 lb.

Sunapee in chinook stomachs

The Sunapee Saibling: A fourth New england variety of Salvelinus

STATE OF IDAHO

DEPARTMENT OF FISH AND GAME

SALMON SUBREGIONAL OFFICE
P. O. BOX 1336
SALMON, IDAHO 83467
February 5, 1979

Mr. Dick Wallace
Department of Zoology
University of Idaho
Moscow, ID 83843

Dear Dick:

Sunapee trout were stocked in Sawtooth Lake in 1925 and brook trout (7,000 from U.S. Hagerman Hatchery) were added in 1941. Therefore, they have been living sympatrically for 37 years.

Yes, anglers have caught Sunapee trout from the lake. Bill Platts remembers catching them and thought they were smelt. Stacy Gebhard's daughter caught one from the bank in 1976.

I cannot say for sure how the size of the Sunapee and brook trout compare. All of the fish I collected in 1977 and 1978 were forwarded to you except the 1977 brook trout which are out in the freezer. None of these fish were measured by me. If you need length frequencies, you will have to get the Sunapee measured by Bob Behnke. I can measure the brook trout. Let me know if you need lengths.

Sawtooth Lake doesn't have an inlet.

Time permitting, I hope to spend some time at the lake in 1979. If you have any specifics you want from the lake, let me know.

I'm returning the copy of Salvelinus taxonomy. I read most of it and it is very interesting but pretty heavy reading. Thanks for the opportunity to review it. I should have taken it home - it's not the kind of thing to read at the office with continual interruptions. If you have it, please send me the literature citation. I photocopied part of it and may want to cite it in the future.

Sincerely,

DEPARTMENT OF FISH AND GAME
Joseph C. Greenley, Director

Kent

Kent W. Ball
Regional Fishery Biologist
Region 6

cc: Jeppson
encl: Letter to & from Fred Kircheis
Behnke's manuscript

Biol. Survey Conn. Watershed. 1939

Sunapee in SACO & Connecticut watersheds

Sugar R. System

Dan Hole, Averill, Flood's Pond only known lakes w/ Sunapee

12 fish taken in survey (gill nets 60-80ft)

largest 336mm

KENDALL 1912

Differentiating Characteristics

brook	Sunapee	Blueback
"Nivulations" (at all ages)	no nivulations many dark splotches.	blue back
	Slender form	
	basibranchial teeth	
	Anal 8	Anal 10
	Larger	8-10"
	Spawns on lakes shoals	stream spawner
	gillrakers shorter + curled	more numerous + not curled.

Young are distinguished from brookies by fewer parr marks

"In consideration of the experience which I have had with the American saibling, I would select it in preference to any other fish if I desired a salmonoid to rear from fry and obtain the best results in size and percentage matured,"

Mr. Merrill to Dr Quackenbos:

good experience rearing "I belive it to be one of the best subjects for the fish culturist among our Salmonidae, especially when the fry are reared to the yearling stage, ..."

saibling fry not effected by high temp.

"The American Saibling" Second Annual Report of the Commissioners of Fisheries, Game + Forest of New York for 1896, p 185-91.

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22222222    PPPPPPPPPPP     PPPPPPPPPPP      AAAAAAAAAA
222222222   PPPPPPPPPPPP    PPPPPPPPPPPP    AAAAAAAAAAAA
      22    PP          PP  PP          PP  AA          AA
      22    PP          PP  PP          PP  AA          AA
      22    PP          PP  PP          PP  AA          AA
      22    PP          PP  PP          PP  AA          AA
      22    PPPPPPPPPPPP    PPPPPPPPPPPP    AA          AA
 2222222    PPPPPPPPPPP     PPPPPPPPPPP     AA          AA
2222222     PP              PP              AAAAAAAAAAAA
2           PP              PP              AAAAAAAAAAAA
            PP              PP              AA          AA
            PP              PP              AA          AA
            PP              PP              AA          AA
            PP              PP              AA          AA
222222222   PP              PP              AA          AA
222222222   PP              PP              AA          AA

CSU
ER CENTER

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R = GREEN     GCUA
E = HH82

SITE A5

 12.45.18.
 80/09/26.

     7         8         9         10        11        12        13
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University of Idaho
College of Letters and Science
Department of Biological Science
Moscow, Idaho/83843
Phone (208) 885-6280

21 November 1978

Dr. Robert Behnke
Department of Fish & Wildlife Biology
Colorado State University
Ft. Collins, Colorado 80523

Dear Bob:

I assume the brook trout and sunapee trout arrived okay. I am enclosing copies of portions of 2 biennial reports (Idaho). The 10th report shows a picture of a native cutthroat taken from one of the high lakes in the Sawtooth region of central Idaho (Salmon River drainage). It sure looks like typical westslope spotting pattern to me. I thought you would be interested in seeing that.

The other report (11th) has the stocking data for the sunapee trout. Kent Ball made the copies of these reports. I will have to get the complete citation to be included in any publication.

I am also enclosing 3 slides of westslope cutthroat from the St. Joe River. You may have these to add to your collection of pictures.

Let me know the counts of the two samples. It will be interesting.

Sincerely,

Dick

Richard L. Wallace
Associate Professor of Zoology

RLW/dpa
Enclosures

University of Idaho
College of Letters and Science
Department of Biological Science
Moscow, Idaho/83843
Phone (208) 885-6280

February 9, 1979

Dr. R. J. Behnke
Dept. Fisheries and Wildlife Biology
Colorado State University
Ft. Collins, CO 80521

Dear Bob:

I am enclosing some material for you concerning the sunapee trout project:

1) a copy of a letter from Kent Ball to me with some answers to your questions
2) part of a 1935 report on a survey of Sawtooth Lake
3) a summary of information on the lake and the two recent fish collections (1977 and 1978).

One discrepancy appears. Kent Ball told me the lake was about 172 acres, but the survey (1935) notes the size at about 300 acres. I am not sure which is correct.

Kent sent me a number of additional pictures of the fish collected in both 1977 and 1978. I am duplicating some and will send a few to you as soon as possible.

Concerning your Western Salmo monograph, I have Section I (59p), Section II (pgs 1-141) and the part on rainbow and redband trouts (pg 173-195). Would you send me a copy of the missing section (pg 142-172) and anything else you have added after pg 195? I would appreciate it. Also, a U.S.F.S. employee in McCall, ID has asked me to summarize and send him the description (characters) and distribution of westslope cutthroat and redband trout. I have the information for the westslope but do not have all of the information on the redband trout. Would you be kind enough to jot down the expected meristic characters (I think I have enough on coloration) of the redband that would be found in the middle Snake River (i.e., Salmon, Payette, Boise, Owyhee, Malheur Rivers)? Do you have any evidence of redband populations (largely pure) in any of these areas in addition to the Owyhee and Salmon Rivers? Especially the Payette, Boise, and Weiser River drainages? This same biologist told me he will be going into some steep, isolated tributaries of the Snake River in the Hells Canyon area this summer and that he will collect some trout for me. That is an interesting area for westslope-redband trout. I will keep you posted.

I am still working on the north Idaho samples from Jim Cooper. Hope to finish them by April. He told me recently that he has another 30-40 populations he would like me to look at, so it appears I will be busy with Idaho fish for another year or so. I want to get into the Kootenai drainage

in B.C. this summer, if possible, to get some collections of both cutthroat and redband, if possible. I also am working on obtaining some summer steelhead samples from interior B.C. Again, I will keep you posted.

Thanks for anything you can send me from the above requests.

Best regards,

Dick

Richard L. Wallace
Associate Professor of Zoology

RLW:hs
Enclosures

STATE OF IDAHO

DEPARTMENT OF FISH AND GAME

SALMON SUBREGIONAL OFFICE
P. O. BOX 1336
SALMON, IDAHO 83467

November 20, 1980

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

Dear Bob:

Thank you for the copy of Eric Wagner's paper on the Sunapee charr. I may wish to refer to it in the future, but not without his permission.

I gill netted Alice and Vernon Lakes in September. Alice has viable reproducing populations of brook and Sunapee charr. I collected 12 Sunapee and 34 brook charr from Alice Lake with two 125' experimental nets. Vernon Lake has been stocked with Henrys Lake cutthroat and it was the only species I collected. Is it possible that the Sunapee coexists with brook charr, but can't compete with cutthroat? It's interesting to note that Mr. Locke stocked "one pack load rainbow trout and one pack load silverside shiners" in Alice Lake in 1924, the year before he stocked the Sunapee there.

All of the specimens I collected this year were sent to Dick Wallace. We are in the process of a life history comparison of both species from Sawtooth Lake.

At this time I do not have any plans to net the other lakes originally stocked by Mr. Locke in the Redfish Lake drainage. Each lake received only 50 fish and the chances of their survival is very slim.

Sincerely,

Kent

Kent Ball
Regional Fishery Biologist
Salmon Subregional Office
Region 6

KB:nb

STATE OF IDAHO
Department of Fish and Game
Salmon Subregional — P.O. Box 1336
Salmon, Idaho 83467

Kent Ball

Alice L. has

Sunapee w/ brook trout
(stocked 1924 w rainbows)
Vernon L. no sunapee found
only cutthroat.
— other lakes
Locke stocked w/
only 50 sunapee
(in Redfish L. area)
These not sampled.

SALMON, ID
NOV 21
PM
1989
83467

USA 15c

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

DEPARTMENT OF
INLAND FISHERIES AND GAME
STATE OFFICE BUILDING
AUGUSTA, MAINE 04330

MAYNARD F. MARSH
Commissioner

J. WILLIAM PEPPARD
Deputy Commissioner

34 Idaho Avenue
Bangor, Maine 04401
January 3, 1979

Dear Dr. Behnke:

Thank you for your informative letter of Dec. 4, 1978. Please excuse the delay in responding but I have been researching the possible source for these Sunapee Chars in Idaho. I could find nothing about the definiate source for the Idaho stock (see the attached photocopy) but I do not know of any Federal operation on Sunapee Lake, N.H. Perhaps someone in the N.H. Fish & Game Dept. could help you there.

In response to your hypothesis re: the predator-prey relationship in Sawtooth Lake; I would need more information. Here in Maine, I have been making Sunapee Chars transfers into waters with only brook chars in them. The results,

from my standpoint, have been disappointing. The Sunapee behave much as was reported for the bluebacks in the Rangeley's. Growth is slow, condition factor is low and the fish keep to deep water where they are difficult to catch. Seasonally, late spring & early fall, the Maine bluebacks and Sunapees are readily caught by anglers near the surface. As water temperatures begin to rise above 10°c the char move to deeper water where their food supply is restrictive and where anglers have difficulty in catching them. Wherever smelt (Osmerus mordax) are present the growth on Sunapees & condition factor are much improved. We also have had substantial growth improvements in bluebacks char

DEPARTMENT OF
INLAND FISHERIES AND GAME
STATE OFFICE BUILDING
AUGUSTA, MAINE 04330

MAYNARD F. MARSH
Commissioner

J. WILLIAM PEPPARD
Deputy Commissioner

when smelts have been stocked to provide a deep water forage species. It seems to me that the limiting factor for char growth is <u>not</u> the presence of brook trout but the absence of a sufficient food supply in the hypolimnion below 10°c.

I hope this rambling letter is of some value to you. If funds were not so tight I'd love to see Santoth Lake and its Sunapee Char. I am having great difficulty in

establishing a self-sustaining Seagee
water and perhaps I could get
some valuable insite in Idaho.

Perhaps some day....

Sincerely yours,

Fred Kindleis

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

BANGOR, ME 044
PM
7 MAR
1978

ALWAYS USE
ZIP CODE

Dr. Robert Behnke
Colorado Cooperative Fishery Unit
Colorado State University
Fort Collins, Colorado 80521

+ — Not surprising if hybrids

— Bill clear, S. confluentus 1 anomaly

— Japan — several generations — plius.

— No sterility arm Schultz

Monographiae Biologicae —

hybrids — markings

wavy vs. clear

D. C.

blck. w/white

pelvic ♂

— basibranch. —

♀ pelvic

— vert.

58-60 EB

63-65 ...

61-62

rakers

16-20 (18)

19-23 (21)

Bill Platts.

83

JOY MAINE — HELP US CONSE

TROUT UNLIMITED

SUNKHAZE STREAM CHAPTER
POST OFFICE BOX 92
BANGOR, MAINE 04401

14 January 1980

Mr. Jerry Gibbs
Update Trout/Salmon Editor
Outdoor Life
380 Madison Avenue
New York, New York 10017

Dear Mr. Gibbs:

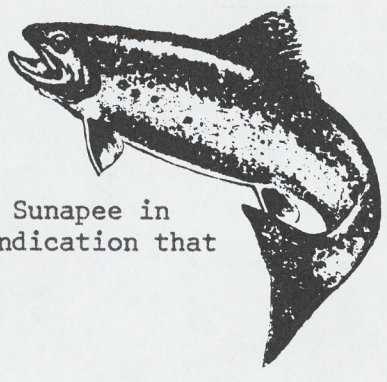
Reference your article "LOST SUNAPEE TROUT FOUND IN IDAHO", on page 48 of the December issue of Outdoor Life.

Sunapee Trout were named after the water in which they were originally found in the 1860's, namely Lake Sunapee in New Hampshire. The fish were also known to exist in one Vermont Lake, one other New Hampshire lake and Floods Pond in Maine. In or around 1925 these trout disappeared from Lake Sunapee due to hybridization with stocked Lake Trout and the fish that are now in Sawtooth Lake, Idaho, probably came from Floods Pond because at around that time, eggs from Maine were shipped to a Federal Hatchery in the State of Washington and from there eggs were supplied to a hatchery in Oregon and from the Oregon hatchery were introduced into Sawtooth Lake. SILVER SALMON not silver trout

We have a State Fisheries Biologist in this area, Mr. Frederick W. Kircheis, who has been working with Sunapee Trout since 1969, and through his efforts Sunapee Trout have been planted in South Branch Pond, Baxter State Park; Coffee Pond, Sebago Lake area of southern Maine; and Twin Ponds - Upper & Lower - to the northwest of Millinocket Lake. Although Mr. Kircheis has planted the Sunapee Trout in other lakes and ponds within the State of Maine, the waters mentioned above are where the fish seem to be doing the best. I might add that the Sunapee is surving and doing very WELL in Floods Pond.

In September of 1979, our Chapter of Trout Unlimited, made monies available to Mr. Kircheis for a trip to Sawtooth Lake, Idaho. Mr. Kircheis made the trip in the company of Idaho Biologist Kent Ball. The purpose of the trip was to see what characteristics Sawtooth Lake held that might give Mr. Kircheis a clue as to where he might find, in Maine, the type of water in Sawtooth and also what factors were concerning the survival of Sunapee Trout in Sawtooth. However, because the trip into Sawtooth had to be made by horse back they were unable to take a canoe or foldboat to enable them to get out on the water for a realistic survey.

Here are a few facts concerning Sunapee Trout:



1. 1,000 Sunapee charr were stocked in Sawtooth in 1925 by S. B. Locke, U. S. Forest Service Examiner headquartered in Ogden, Utah.

2. Locke surveyed the area in 1924 and stocked the Sunapee in 1925, and stocked 1,250,000 smelt in 1927. There is no indication that these SMELT ever survived.

"LOST SUNAPEE TROUT FOUND IN IDAHO" (CONT'D)

3. Rodeheffer surveyed the lake in 1934 and caught 12 Sunapee 8-9" long.

4. In 1941 7,000 Eastern Brook Trout were stocked in Sawtooth Lake.

5. Kent Ball surveyed Sawtooth in 1977 (October) and took 28 Brook Trout and 9 Sunapee.

6. Kent Ball again surveyed Sawtooth in October 1978 and took 16 Sunapee, 7 Brook Trout, and 3 fish which Bob Benhke feels were Brook TroutXSunapee hybrids.

7. Kent Ball surveyed again in August 1979 and took 1 Sunapee and 29 Brook Trout in 6 to 50 feet of water.

8. Upper Redfish Lake Inlet was stocked with 500 Sunapee in 1925. No record of any recovery.

Extensive research by Mr. Kircheis has enabled me to put forth the information contained herein.

I might add that when I saw the article concerning "Lost Sunapee Trout" in the December issue, my wheels started turning and, knowing that Sunapee were still alive and kicking here in Maine, had to hopefully set the record straight.

Sincerely yours,

Earl B. Eastwood

Earl B. Eastwood
Secretary
Sunkhaze Stream Chapter, Trout Unlimited

EBE/hs

Outdoor Life
380 MADISON AVENUE, NEW YORK, N.Y. 10017

– Sunapee Trout –

Dr. Robert Behnke
Department of Fisheries
Colorado State University
Ft. Collins, CO 80521

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

GLENN H. MANUEL
Commissioner

J. WILLIAM PEPPARD
Deputy Commissioner

Fishery Office
34 Idaho Ave.
Bangor, Maine 04401

September 25, 1980

Eric Wagner
120 Garfield
Fort Collins, Colorado 80524

Dear Mr. Wagner:

re: your letter of September 16, 1980

Since I last talked with Dr. Behnke in Montana I have had the opportunity to visit Sawtooth Lake with the regional biologist, Kent Ball. If you plan to publish anything concerning the Sunapee charr in Sawtooth Lake, I suggest you communicate with Mr. Ball at the following address: Salmon Sub-regional Office, P. O. Box 1336, Salmon, Idaho 83467.

As to your questions:

1) As far as I know there is no direct interaction between Sunapee and brook charr. They inhabit different areas of the lake, eat different food organisms, and spawn in different areas and in a different manner. I know that Dr. Behnke feels that some of the fish from Sawtooth Lake that he saw were hybrids, and they could be, but I have never seen such a thing here in Maine.

2) Sunapee charr are easily caught through the ice in winter. The rest of the year they inhabit quite deep water and can be difficult to catch. Maine anglers traditionally use raw lobster meat for bait while still-fishing for "silver trout" as they call the Sunapee.

3) In Maine, the Sunapee are reproducing in Floods Pond, a native water for the species, and in the South Branch Ponds, two waters which were stocked with Floods Pond fish. I am stocking five other waters with Floods Pond stock at this time. Kent Ball was going to examine some other waters in Idaho where records show that Sunapee were stocked at one time. He may have more information on that area for you.

4) I don't understand your question "Economic status". There is no great demand for angling Sunapee charr due to their relative scarcity, inaccessibility, and angler ignorance of their existance.

5) I suggest managing the species for the greatest protection possible while still allowing angler harvest. No different species should be stocked into waters containing Sunapee charr and separate populations of charr should not be mixed.

I am enclosing some additional information for your use. Please feel free to contact me if you have further questions.

Very truly yours,

Fred Kircheis

Frederick W. Kircheis,
Fishery Research Biologist

FWK/jpn
encl.
cc: Kent Ball

Fishery Office
Inland Fisheries & Wildlife
64 Idaho Avenue
Bangor, Maine 04401

FIRST CLASS

Mr. Eric Wagner
120 Garfield
Fort Collins, Colorado 80524

DEPARTMENT OF
INLAND FISHERIES AND WILDLIFE
284 STATE STREET
AUGUSTA, MAINE 04333

GLENN H. MANUEL
Commissioner

J. WILLIAM PEPPARD
Deputy Commissioner

34 Idaho Ave.
Bangor, Maine 04401

January 21, 1981

Mr. Robert Behnke
Dept. of Fishery & Wildlife Biology
Colorado State University
Fort Collins, Colorado 80523

Dear Bob:

Thank you for the note re: the stocking history of Sunapee Lake, N.H. It does seem that the Idaho Sunapee must indeed be the "Type" species for this fish and we are all fortunate that they have survived the ravages of mankind.

Enclosed are some maps, old and new, of the Rangeley Lakes System. If you haven't already, you might enjoy the following reference: Kendall, W.C. 1918. The Rangeley Lakes, Maine; with special reference to the habits of the fishes, fish culture, and angling. U.S. Gov't Printing Office. Document No. 861, Washington, D. C. I have a copy which was loaned to me by Kendall Warner but you may be able to get ahold of a copy out there somewhere.

I've been thinking about your hypothesis re: the amount of littoral vegetation and proportion of hypolimnion in a water and the size of the blueback and/or brook charr which might be present. I think that the Rangeley Lakes are not much different from Sunapee Lake. I have never been to Sunapee Lake but the descriptions I have read and the photos I have seen lead me to believe that it is one of our typical oligotrophic lakes which are so common in the Northeast. Certainly Black Lake, a current home for a native blueback charr population where the brook charr are quite large (5+ lbs) and the blueback charr are quite small (4-6" avg.) has a large proportion of hypolimnion and very little littoral vegetation.

I am more inclined to believe that basic fertility and structure of the food chain have much more to do with the relative size structure of the brook charr vs. the blueback charr than any interaction between the two species. Many of our blueback waters (all of which also contain brook charr) are situated in sterile environments. There is very little feed in the deep waters where the blueback prefers to live and therefore the fish growth is limited. Where we have had smelt introductions into these waters the growth of the bluebacks is reported to have improved. I feel that this improved blueback growth is due to the more adventurous nature of the smelt. The smelt commonly travel back and forth from the surface of these waters where food organisms are more abundant, to the cold depths where the bluebacks make their living by feeding on zooplankton, diptera larvae and, when available, smelt.

I would very much enjoy discussing this matter with you sometime. If you ever get another chance to visit the University of Maine I'd make the opportunity available for you to visit some of our Sunapee and blueback waters to see first hand what kind of habitat we are dealing with.

Sincerely,

Fred

Frederick W. Kircheis,
Research Biologist

FWK/jpn
encl.

P.S. Just this summer I documented reproduction by three year classes of Sunapee charr in a water where I have been stocking fall fingerlings since 1972.

UPPER RICHARDSON LAKE
(Molechunkamunk Lake)
Richardsontown (T4 R1) and Magalloway (T5 R1)
Twps., Oxford Co.
U.S.G.S. Oquossoc, Me.

Fishes

Salmon
Brook trout
(squaretail)
Brown trout
Hornpout
(bullhead)
Smelt
White sucker
Longnose sucker

Minnows
Fallfish
Lake chub
Creek chub
Pearl dace
Finescale dace
Redbelly dace
Common shiner
Fathead minnow

Physical Characteristics

Area - 4200 acres

Maximum depth - 108 feet
Mean depth - 44 feet

Temperatures
Surface - 73° F.
108 feet - 51° F.

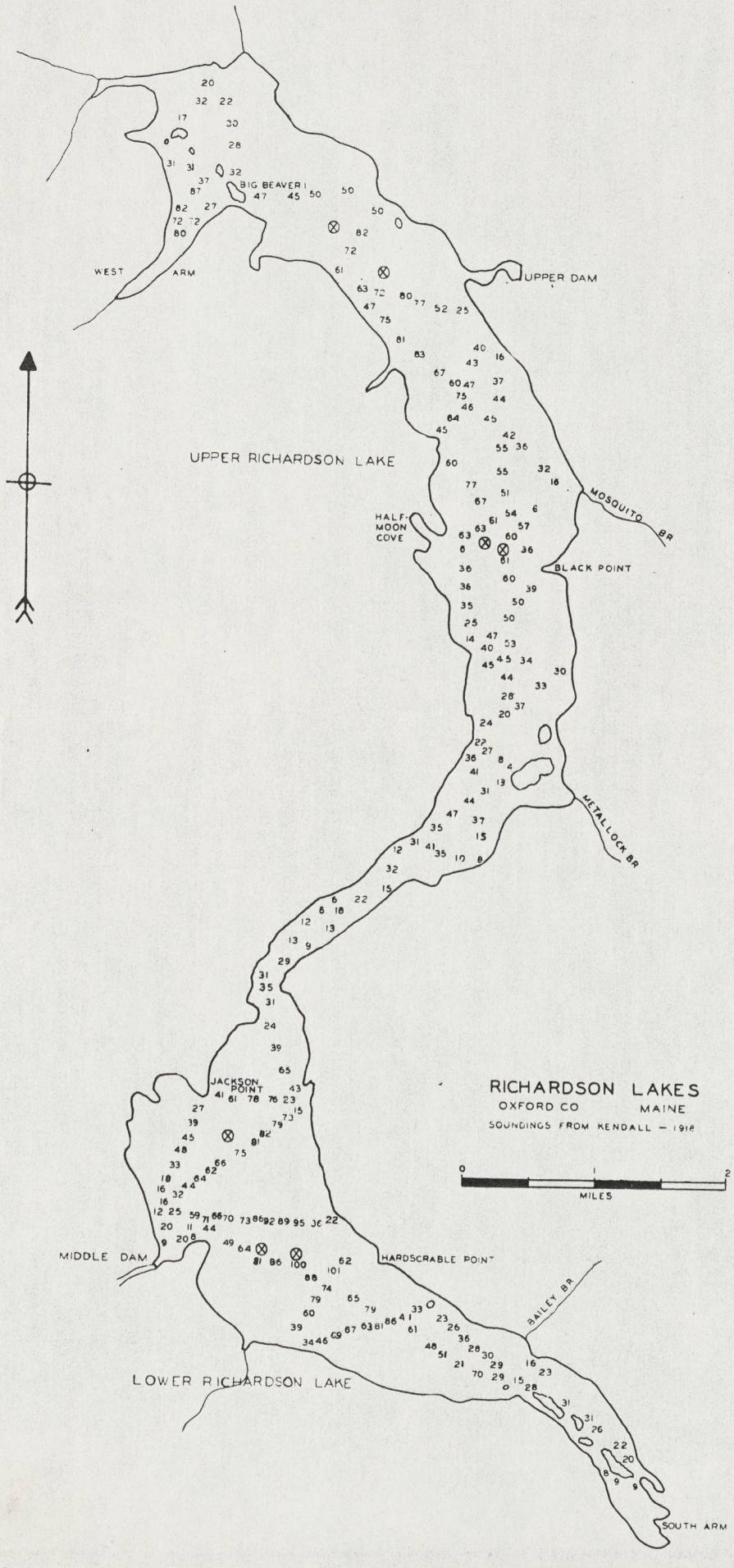
Suggested Management

Prior to the construction of the 22-foot dam at Middle Dam, Upper and Lower Richardson Lakes were separate bodies of water connected by a short stream. At present they are essentially one lake with two distinct basins and a shallow narrows between. The two parts, Upper and Lower Richardson Lakes, will be considered separately in these reports.

Upper Richardson Lake provides excellent water quality conditions for cold-water fishes. Tributary streams are reported as only fair spawning areas and should, consequently, be managed for their maximum possible production of young trout and salmon. Management should include scrupulous maintenance of unobstructed migration routes and stable water levels.

The ill-advised introduction of warm-water fishes into Upper Richardson Lake or any of the Rangeley Lakes would probably have disastrous effects on the salmon and trout populations. Game wardens and sportsmen should keep constant vigilance to prevent such introductions.

Surveyed - July, 1939
(Revised, 1953)


BIG BEAVER I
WEST ARM
UPPER DAM
UPPER RICHARDSON LAKE
MOSQUITO BR
HALF-MOON COVE
BLACK POINT
METALLOCK BR
JACKSON POINT
MIDDLE DAM
HARDSCRABLE POINT
BAILEY BR
LOWER RICHARDSON LAKE
SOUTH ARM
RICHARDSON LAKES
OXFORD CO MAINE
SOUNDINGS FROM KENDALL — 1918
0 1 2
MILES

39.8

MOOSELOOKMEGUNTIC and CUPSUPTIC LAKES

(Lower Oquossoc Lake, Lower Rangeley Lake)
Richardsontown (T4 R1), Adamstown (T4 R2), and
Lower Cupsuptic (T4 R3) Twps., Oxford Co.;
Rangeley (T3 R1) and Rangeley Twps., Franklin Co.
U. S. G. S. Rangeley, Oquossoc, and Cupsuptic, Me.

Fishes

Salmon
Brook trout
(squaretail)
Brown trout
Smelt
White sucker
Longnose sucker

Minnows
Fallfish
Creek chub
Blacknose dace
Pearl dace
Redbelly dace
Common shiner
Fathead minnow

Physical Characteristics

Area - 16,300 acres

Maximum depth - 132 feet
Mean Depth - 60 feet

Temperatures
Surface - 70° F.
117 feet - 45° F.

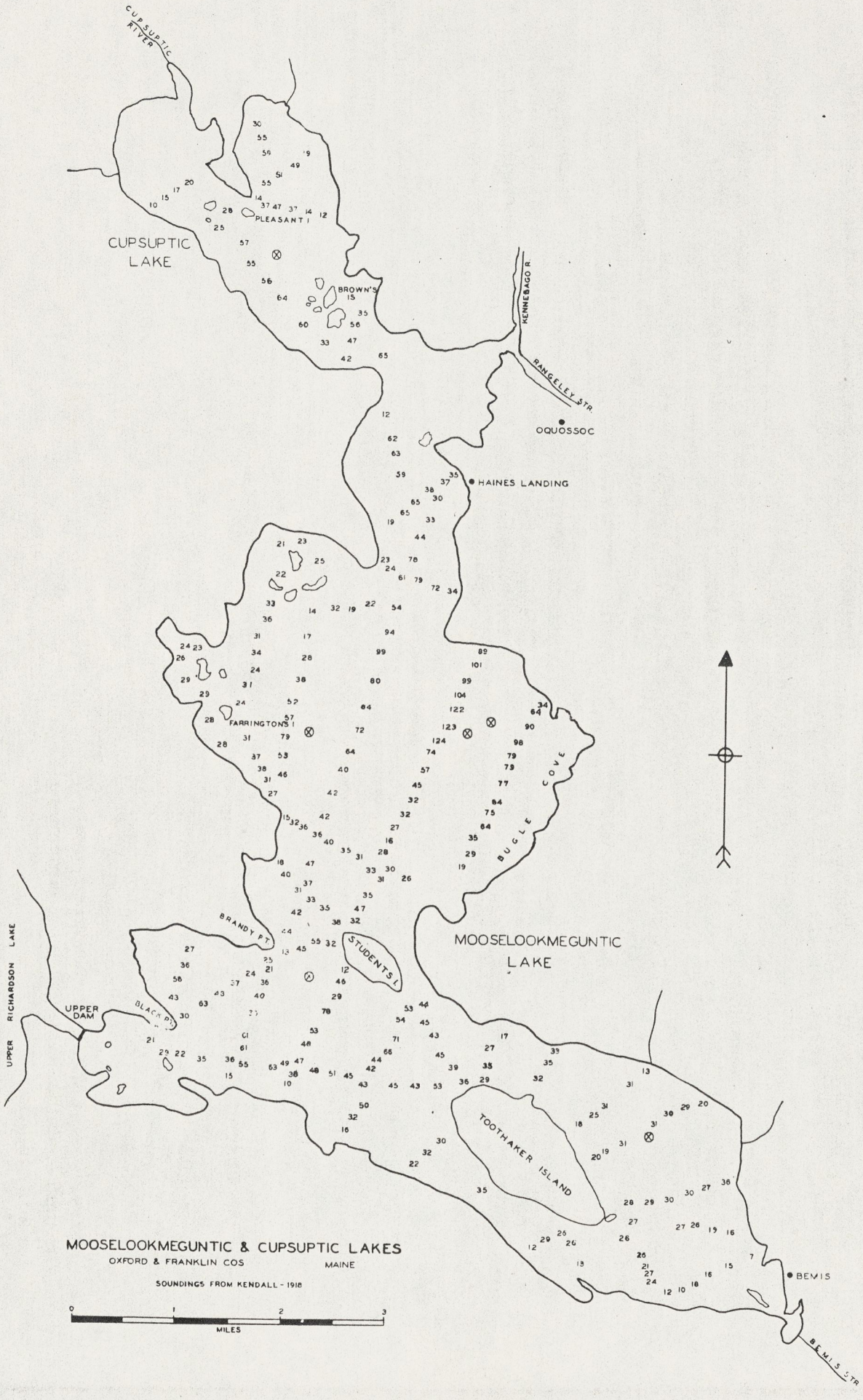
Suggested Management

Mooselookmeguntic and Cupsuptic Lakes are separate bodies of water that have been joined to make one lake by raising the water level of Mooselookmeguntic Lake by some 14 feet. This water level is maintained by a 20 foot dam at Upper Dam, the outlet of Mooselookmeguntic Lake. The two basins will be considered together in this report and the name Mooselookmeguntic will refer to both lakes.

Mooselookmeguntic Lake, as with all the Rangeley Lakes except Aziscohos, provides excellent temperatures, dissolved oxygen levels, and general water quality characteristics for cold-water fishes. These conditions, plus the absence of competing warm-water game fishes, provide a habitat that produces good salmon and trout fishing.

The 1939 survey showed Mooselookmeguntic Lake to have many tributaries which provide excellent spawning and nursery areas for trout and salmon. Management of Mooselookmeguntic Lake should certainly involve elimination or circumvention of obstructions and maintenance of stable water levels in these streams. This recommendation is particularly pertinent to Kennebago River, Cupsuptic River, and Bemis Stream, the main spawning areas for Mooselookmeguntic Lake and probably the best spawning streams in the Rangeley area.

Surveyed - July, 1939
(Revised, 1953)



MOOSELOOKMEGUNTIC & CUPSUPTIC LAKES

OXFORD & FRANKLIN COS MAINE

SOUNDINGS FROM KENDALL - 1918

0 1 2 3

MILES

RANGELEY LAKE

(Oquossoc Lake)

Rangeley Twp., Rangeley Plt., and Sandy River Plt., Franklin Co.

U.S.G.S. Rangeley and Oquossoc, Me.

Fishes

Salmon
Brook trout (squaretail)
Brown trout
Yellow perch
Hornpout (bullhead)
Alewife
Smelt
Eel
White sucker
Longnose sucker

Minnows
- Creek chub
- Lake chub
- Fallfish (chub)
- Common shiner
- Golden shiner
- Blacknose shiner
- Blacknose dace
- Redbelly dace
- Finescale dace

Banded killifish
Freshwater sculpin

Physical Characteristics

Area — 6000 acres

Maximum depth — 149 feet
Mean depth - 60 feet

Temperatures
- Surface — 73° F.
- 149 feet — 46° F.

Principal fishery: Salmon, brook trout

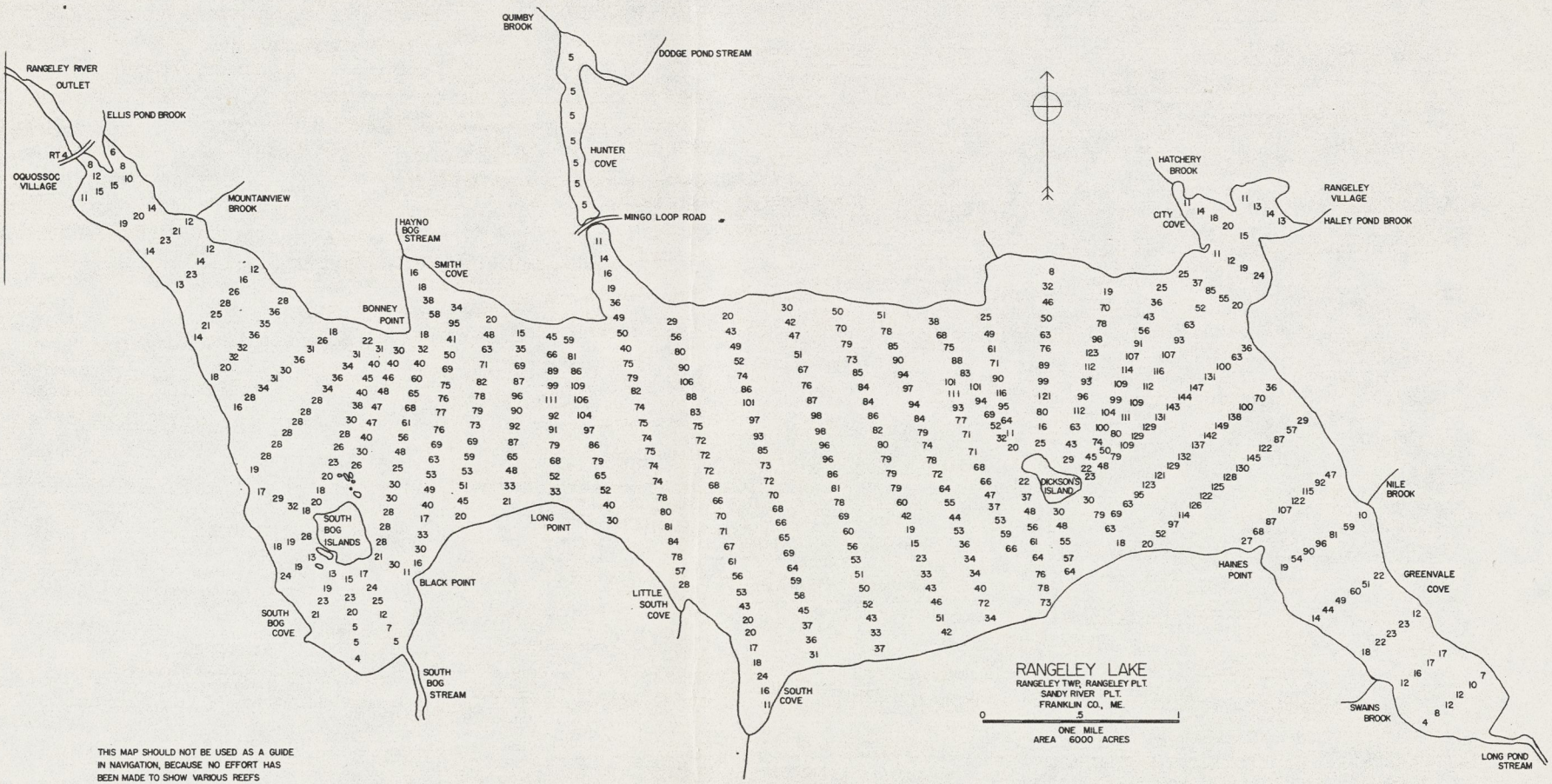
Rangeley Lake has been a nationally famous fishing water since the mid-1800's and was originally known for the many large (8-12.5 pound) brook trout it produced. Rangeley had no salmon and no smelt at that time and the brook trout fed on the small (6-9 inch) blueback trout, (*Salvelinus oquossa*). Salmon were introduced into the Rangeley Lakes in 1873 and these rapidly increased in numbers and size through the early 1900's. The largest salmon taken by an angler (16.5 pounds) was reported in 1903 and the largest salmon known from Rangeley Lake (18.5 pounds) was taken by hatcherymen in 1905. The blueback became virtually extinct about 1905, coincident with the great increase in numbers of salmon. Their extinction was presumably the result of competition from salmon and overfishing. Smelt were introduced about 1895, became numerous by about 1900 and have taken the place of the blueback trout as food for both brook trout and salmon. Brook trout predominated in the anglers' catches until the early 1900's when salmon became predominant. Since 1918, salmon have been taken more commonly than brook trout although in some years good catches of trout occur.

From the standpoint of water quality, Rangeley Lake is still highly suitable for trout and salmon, being virtually unchanged from the time the lake was first studied by the Department in 1939. However, the ability of Rangeley Lake to produce salmon and trout has been reduced through the unauthorized introduction of a number of fish species. Kendall, a renowned pioneer fishery biologist, reported in 1905 only nine of the 21 species now present. The most recent introduction was the banded killifish — first seen in 1975. The species having the most pronounced effect was the yellow perch, first reported in 1953. Perch increased rapidly in numbers and size during the early 1960's, feeding heavily on smelt. Smelt numbers began to decline noticeably, resulting in slower growing salmon. At this writing, the perch have stabilized and smelts are making a recovery but have not yet reached their former abundance.

The tributaries of Rangeley Lake are good spawning and nursery areas but their small size limits the number of salmon produced. Dodge Pond Stream produces mostly salmon and has one of the highest densities of young salmon in the state. South Bog Stream is the major source of brook trout. No salmon have been found there. Greenvale Stream produces both trout and salmon, with salmon outnumbering trout in most years. Hatchery salmon are stocked in the lake to supplement the wild population.

A long term study has shown that Rangeley Lake is best managed as a separate unit rather than in conjunction with the other lakes and streams in the drainage. The study, which followed the movements of salmon and trout from 1957 to 1966 when Rangeley Lake fish had free access to all parts of the drainage via a system of fishways, demonstrated that there were in this particular case, no advantages. Therefore, maintaining a screen at the outlet of Rangeley Lake is preferred to maintaining the fishway in Rangeley dam.

Surveyed August, 1939
(Revised 1953, 1976)
Maine Department of Inland Fisheries and Widlife
Published under Appropriation No. 4550
A Contribution from Dingell-Johnson Federal Aid Project F-28-P, Maine



RANGELEY LAKE

RANGELEY TWP, RANGELEY PLT.
SANDY RIVER PLT.
FRANKLIN CO., ME.

0 .5 1

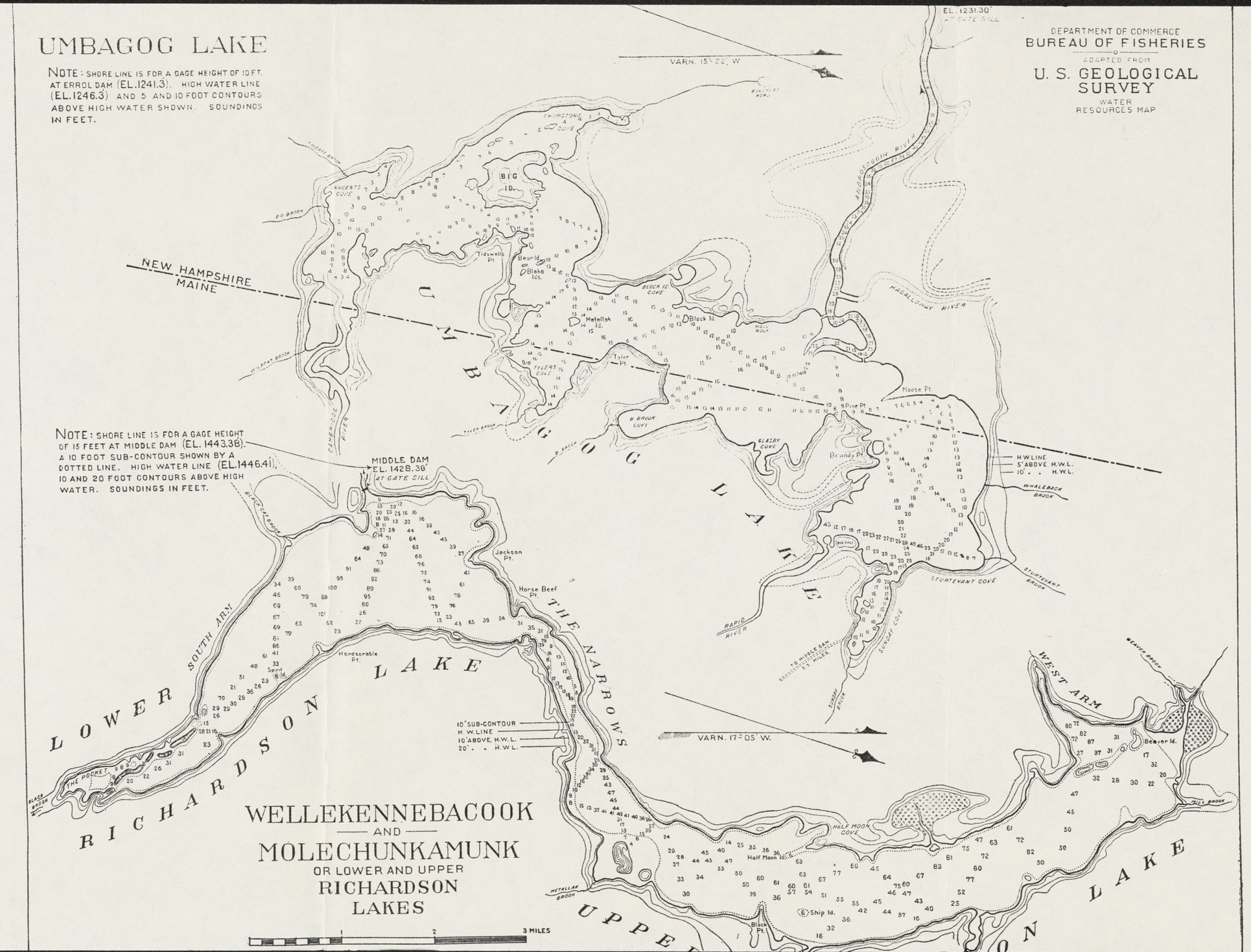
ONE MILE
AREA 6000 ACRES

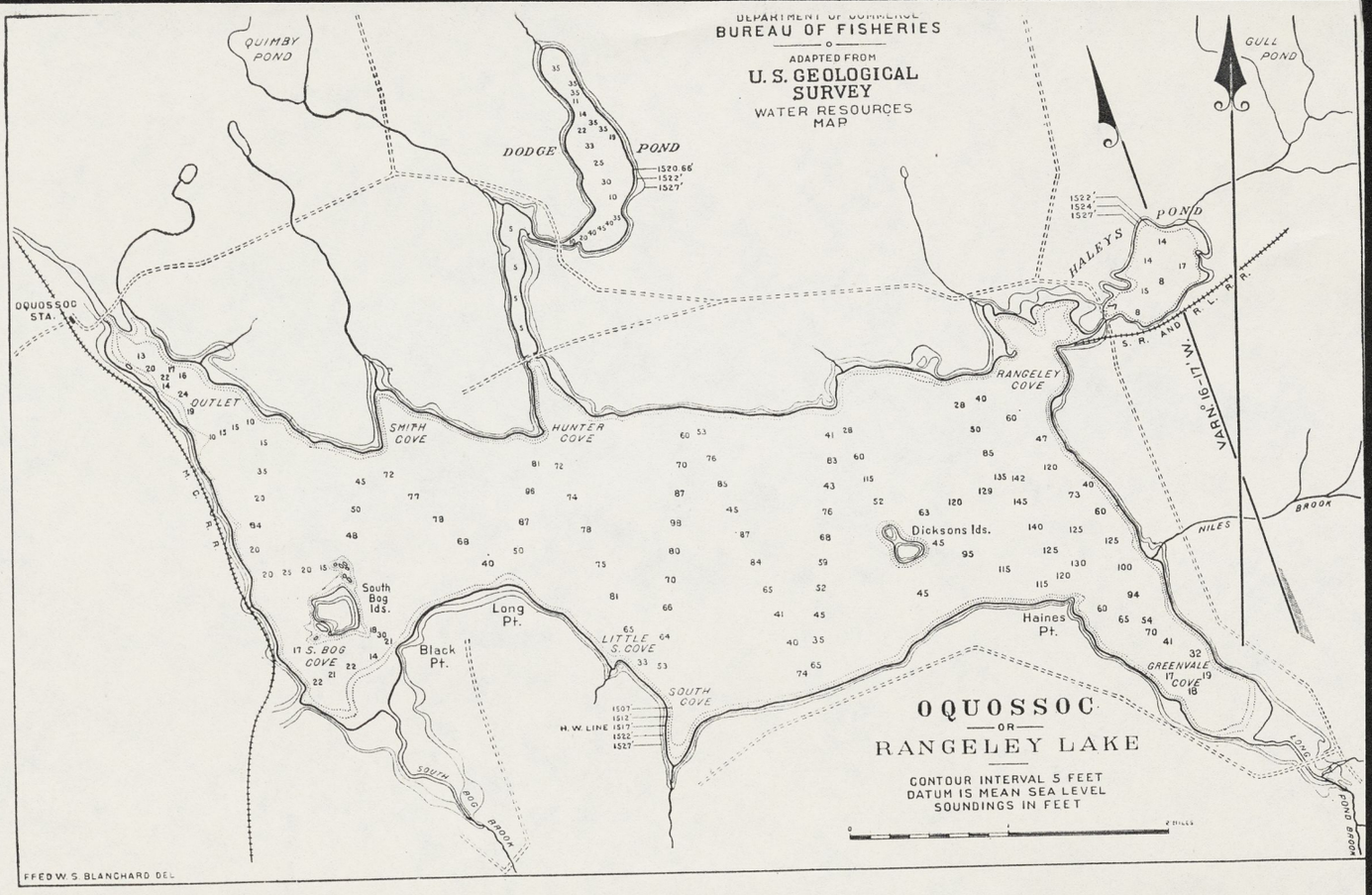
THIS MAP SHOULD NOT BE USED AS A GUIDE IN NAVIGATION, BECAUSE NO EFFORT HAS BEEN MADE TO SHOW VARIOUS REEFS WHICH MIGHT OCCUR BETWEEN SOUNDINGS.

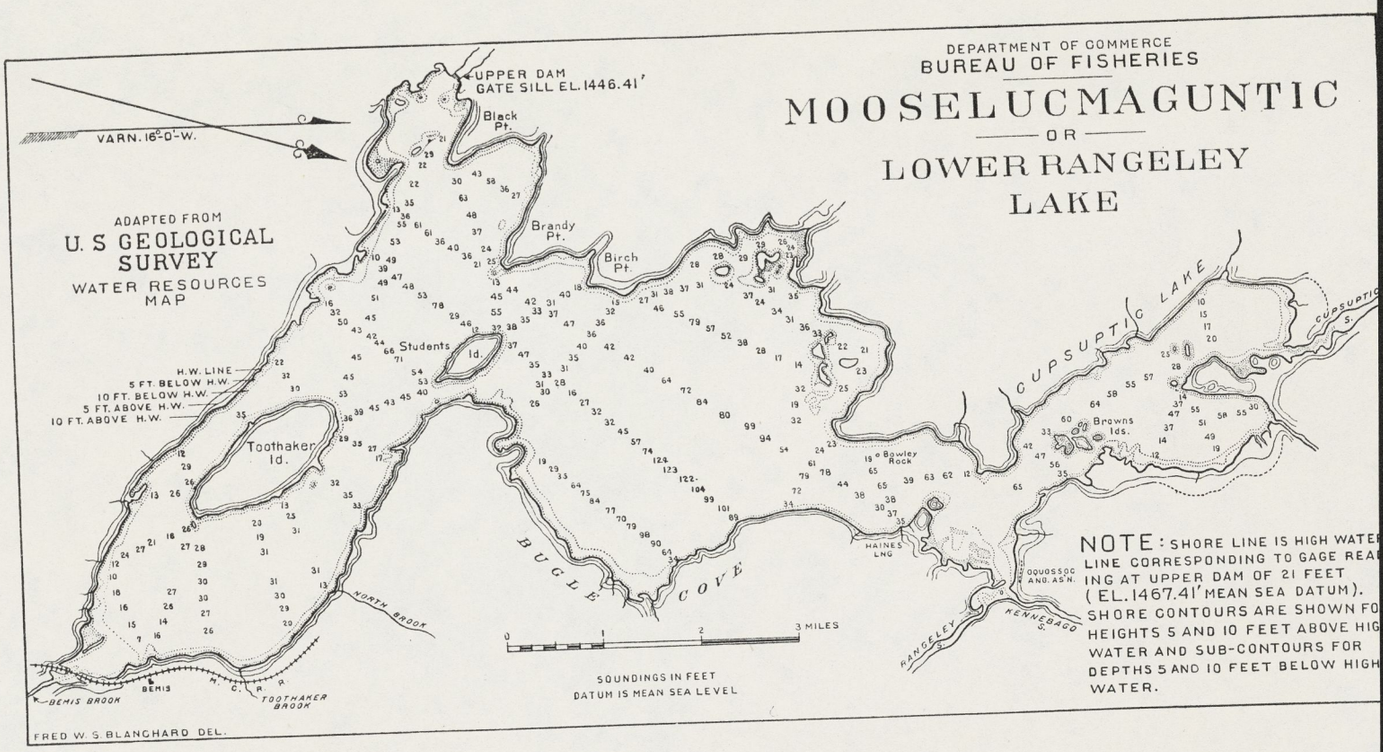
UMBAGOG LAKE

NOTE: SHORE LINE IS FOR A GAGE HEIGHT OF 10 FT. AT ERROL DAM (EL. 1241.3). HIGH WATER LINE (EL. 1246.3) AND 5 AND 10 FOOT CONTOURS ABOVE HIGH WATER SHOWN. SOUNDINGS IN FEET.

DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
TO
ADAPTED FROM
U. S. GEOLOGICAL SURVEY
WATER RESOURCES MAP




DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
ADAPTED FROM
U. S. GEOLOGICAL SURVEY
WATER RESOURCES MAP
QUIMBY POND
DODGE POND
GULL POND
HALEYS POND
OQUOSSOC STA.
OUTLET
SMITH COVE
HUNTER COVE
RANGELEY COVE
VARN. 16°-0'-W.
M. C. R. R.
S. R. AND R. L. R. R.
Dicksons Ids.
NILES BROOK
South Bog Ids.
S. BOG COVE
Black Pt.
Long Pt.
LITTLE S. COVE
SOUTH COVE
Haines Pt.
GREENVALE COVE
H. W. LINE
SOUTH BOG BROOK
LONG POND BROOK
OQUOSSOC
OR
RANGELEY LAKE
CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL
SOUNDINGS IN FEET
FRED W. S. BLANCHARD DEL.


DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
MOOSELUCMAGUNTIC
OR
LOWER RANGELEY LAKE
ADAPTED FROM
U. S GEOLOGICAL SURVEY
WATER RESOURCES MAP
VARN. 16°-0'-W.
UPPER DAM
GATE SILL EL. 1446.41'
Black Pt.
Brandy Pt.
Birch Pt.
Students Id.
Toothaker Id.
H.W. LINE
5 FT. BELOW H.W.
10 FT. BELOW H.W.
5 FT. ABOVE H.W.
10 FT. ABOVE H.W.
CUPSUPTIC LAKE
Browns Ids.
Bowley Rock
BUGLE COVE
HAINES LNG
OQUOSSOC ANG. AS'N.
RANGELEY
KENNEBAGO S.
NORTH BROOK
BEMIS BROOK
BEMIS
M. C. R. R.
TOOTHAKER BROOK
0 1 2 3 MILES
SOUNDINGS IN FEET
DATUM IS MEAN SEA LEVEL
NOTE: SHORE LINE IS HIGH WATER LINE CORRESPONDING TO GAGE READING AT UPPER DAM OF 21 FEET (EL. 1467.41' MEAN SEA DATUM). SHORE CONTOURS ARE SHOWN FOR HEIGHTS 5 AND 10 FEET ABOVE HIGH WATER AND SUB-CONTOURS FOR DEPTHS 5 AND 10 FEET BELOW HIGH WATER.
FRED W. S. BLANCHARD DEL.

F. W. Kircheis

Fishery Office
Inland Fisheries & Wildlife
34 Idaho Avenue
Bangor, Maine 04401

BANGOR, ME 044
PM
JAN21

FIRST CLASS

Mr. Robert Behnke
Dept. of Fishery & Wildlife Biology
Colorado State University
Fort Collins, Colorado 80523