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832-2261 local 252

ONTARIO

WHEN REPLYING KINDLY QUOTE
THIS FILE NUMBER

DEPARTMENT OF LANDS AND FORESTS

Research Branch,
Maple, Ontario,
Feb. 15, 1971.

Colorado Cooperative Fishery Research Unit,
243 Forestry Building,
Colorado State University,
Fort Collins, Colorado, U.S.A.

Dear Sir:

I am up-dating an annotated bibliography of available literature on brook trout x lake trout hybrids which was originally prepared by one of our scientists in 1960.

Could your office please advise us whether you have made any plantings of hybrid trout (S. fontinalis x S. namaycush) in lakes of your state since 1960.

If reference in writing has been made to such plantings in any of your reports, I would appreciate reprints if available.

We have reprints of two papers which were recently published in connection with the Ontario hybrid program (Berst, A.H. and G.R. Spangler, 1970. Population dynamics of F₁ splake (Salvelinus fontinalis x S. namaycush) in Lake Huron. J. Fish Res. Bd. Canada 27: 1017-1032, and Tait, J.S. 1970. A method of selecting trout hybrids Salvelinus fontinalis x S. namaycush) for ability to retain swimbladder gas. J. Fish. Res. Bd. Canada 27: 39-45). I would be pleased to send either of the above, on request.

Thank you.

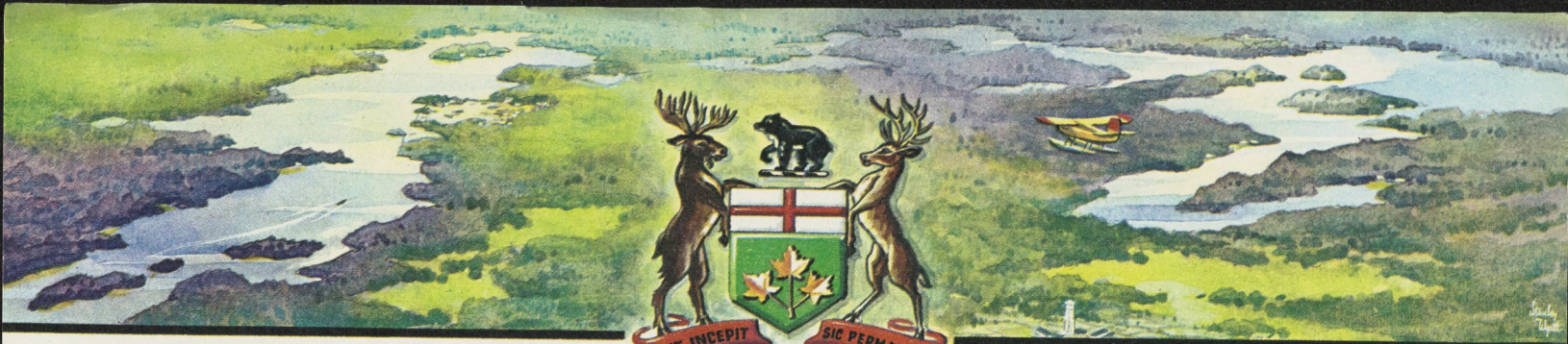
- Alex Mac.

AHB/mh

Yours very truly,

A.H. Berst
A.H. Berst,
Research Scientist

PLEASE QUOTE DEPARTMENT FILE NUMBER IN ANY REPLY



TELEPHONE

832-2261 ext. 291

WHEN REPLYING KINDLY QUOTE
THIS FILE NUMBER

ONTARIO

DEPARTMENT OF LANDS AND FORESTS

Research Branch,
Maple, Ontario,
Canada.
February 19, 1971.

Dr. Robert Benke,
Assistant Unit Leader,
Colorado Cooperative Fishery Unit,
Colorado State University,
Fort Collins, Colorado. 80521.

Dear Dr. Benke:

Thank you for your letter of Feb. 10th in
which you requested information on the capture of large
splake.

The largest splake from Lake Huron was a male
F₁ hybrid, fork length 76.8 cm, total length 78.7 cm,
weight 7.5 kg, age 8 years, caught by Purvis Fisheries
November 8, 1969 at Greene Island (south of Manitoulin
Island). The fish was planted as a yearling by the Ontario
Department of Lands and Forests.

We also have data on 2 male F₁ splake from
Chrysler Lake in the Gogama District (Ogilvie Township) of
Ontario. The fish were captured by experimental gill nets
in October, 1960. The fork lengths were 80.0 cm and 79.4 cm
and the weights, 7.1 and 6.9 kg respectively. Both fish
were 7 years of age. These fish were also planted as year-
lings.

I trust that this is the information which
you require.

Yours very truly,

A.H. Berst
A.H. Berst,
Research Scientist.

AHB/j1

PLEASE QUOTE DEPARTMENT FILE NUMBER IN ANY REPLY

Dr. Don E. McAllister
Curator of Fishes
National Museum of Natural Sciences
Ottawa, Ontario, Canada K1A 0M8

[1975 reprints]

S. siber (landlocked)

~~range~~

Hudson Bay drainage

Otish Mtn. paper

- charr vs. cher

French - English name paper

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

SYLLOGEUS

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No.5

Stanley W. Gorham, Don E. McAllister

THE SHORTRNOSE STURGEON, *ACIPENSER BREVIROSTRUM*, IN THE SAINT JOHN
RIVER, NEW BRUNSWICK, CANADA, A RARE AND POSSIBLY ENDANGERED SPECIES



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Ottawa, Canada, February, 1974

Litho in Canada

The Shortnose Sturgeon, *Acipenser brevirostrum*, in
the Saint John River, New Brunswick, Canada,
a rare and possibly endangered species

Stanley W. Gorham
New Brunswick Museum
Saint John, N.B.

and

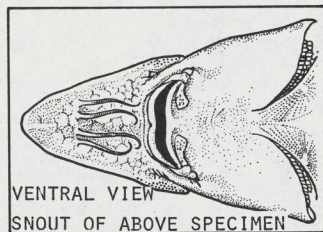
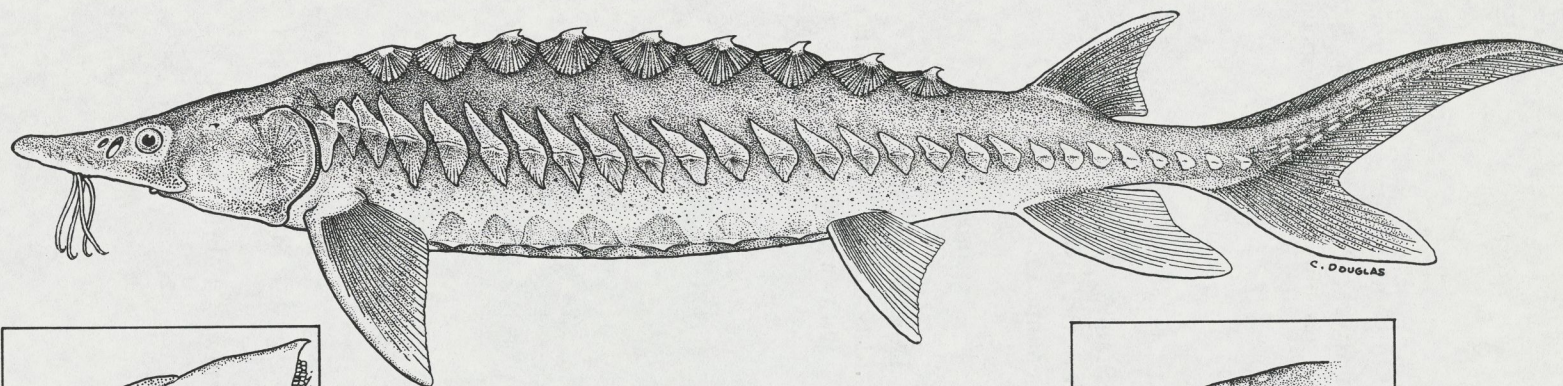
Don E. McAllister
National Museum of Natural Sciences
Ottawa, Ontario

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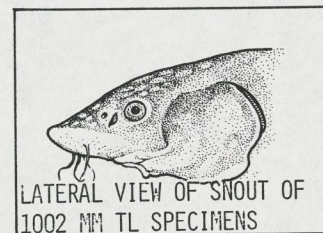
National Museum of Natural Sciences
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Musées nationaux du Canada

Ottawa, February, 1974



VENTRAL VIEW
SNOUT OF ABOVE SPECIMEN



LATERAL VIEW OF SNOUT OF
1002 MM TL SPECIMENS

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FRONTISPIECE Drawing of specimen of shortnose sturgeon from the Saint John River, N. B. (NMC67-331) 560 mm in fork length and 636 mm in total length.

RÉSUMÉ

Description taxonomique de l'esturgeon à museau court, *Acipenser brevirostrum* LeSueur, 1818, du réseau fluvial de la rivière St-Jean, au Nouveau-Brunswick, donnant de nouveaux caractères d'identification. Renseignements sur la répartition géographique, la taille, la croissance et la pêche. Records nouveaux de longueur totale, 1353 mm, et de la pesanteur, 13.8 kg, du Nouveau Brunswick. Signes indiquant que cette population, la seule au Canada, est en régression. Recommandation des mesures de protection suivantes: réduction de la pollution, limitation de l'emploi de pesticides; augmentation à 14 pouces de la dimension minimale des mailles tendues des filets employés pour la pêche à l'esturgeon; présentation de statistiques distinctes sur les prises d'esturgeon à museau court et d'esturgeon noir, *A. oxyrinchus*, dans le réseau fluvial de la rivière St-Jean et programme de recherches pour déterminer l'importance numérique, le recrutement et les déplacements de cette espèce ainsi que l'emplacement des frayères et des zones d'alevinage.

INTRODUCTION

The shortnose sturgeon, *Acipenser brevirostrum* LeSueur, 1818 has been placed on the lists of rare and endangered species for the United States (Miller, 1972), Canada (McAllister, 1970), and the world (Miller, 1969). The shortnose sturgeon has been recorded from Atlantic coast drainages in the United States from Maine to Florida, but it has disappeared from many of these and the only viable population in the U.S. may be that in the Sheepscot River in Maine.

In Canada only one river system supports the shortnose sturgeon, the Saint John River system in southern New Brunswick. Its presence in the Saint John system has been briefly noted by Scott and Crossman (1959), Leim and Day (1959), Trites (1960), Gorham (1965), Leim and Scott (1966), Gorham (1970), McAllister (1970), and Meth (1973). Magnin (1963) presented data on age, length, and biology of 10 specimens from the Saint John near Fredericton. Vladykov and Greeley (1963) provided a key to the species of *Acipenser* in the western North Atlantic and a figure, description, and synonymy of the shortnose. Gorham (1971) published new records of specimens in the Saint John system and data on length and weight.

The present paper provides new information for a series of specimens from the Saint John system on distribution, length and weights. Ages are reported for 10 specimens. A taxonomic description of the Canadian population is given for the first time. Standard and new characters for a series of shortnose are compared with the sympatric Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus* Mitchill, 1814. The status of the shortnose is discussed.

Taxonomy

Sturgeons may be distinguished from other fishes by dorsal, lateral and ventrolateral rows of bony scutes on the body, the prolonged upper lobe of the caudal fin, and the 4 barbels on the underside of the snout.

The only sturgeon co-occurring with the shortnose in New Brunswick is the Atlantic sturgeon, *Acipenser o. oxyrinchus*. The following key summarizes the best characters for separating the two species in the Saint John River system.

Key to Sturgeons in New Brunswick

- 1 (2) Intestine dark. No enlarged bony plates between base of anal fin and lateral row of scutes, Fig. 1. Mouth width inside lips more than $\frac{3}{5}$ of width of bony interorbit. Snout short and blunt, Fig. 2. Total length probably never exceeds 1370 mm ($4\frac{1}{2}$ feet)..... shortnose sturgeon, *Acipenser brevirostrum*
- 2 (1) Intestine light. 2-6 bony plates at least pupil-sized between anal base and lateral row of scutes, Fig. 1. Mouth width inside lips less than $\frac{3}{5}$ of bony interorbit. Snout long and pointed, Fig. 2. Total length up to 4267 mm (14 feet)..... Atlantic sturgeon, *Acipenser o. oxyrinchus*

Shortnose sturgeon from the Saint John River system have not previously been described. Taxonomic characters are therefore presented for 32 male and female specimens ranging from 310 to 879 mm in fork length, and compared with 14 Atlantic sturgeon from 489 to 934 mm from the

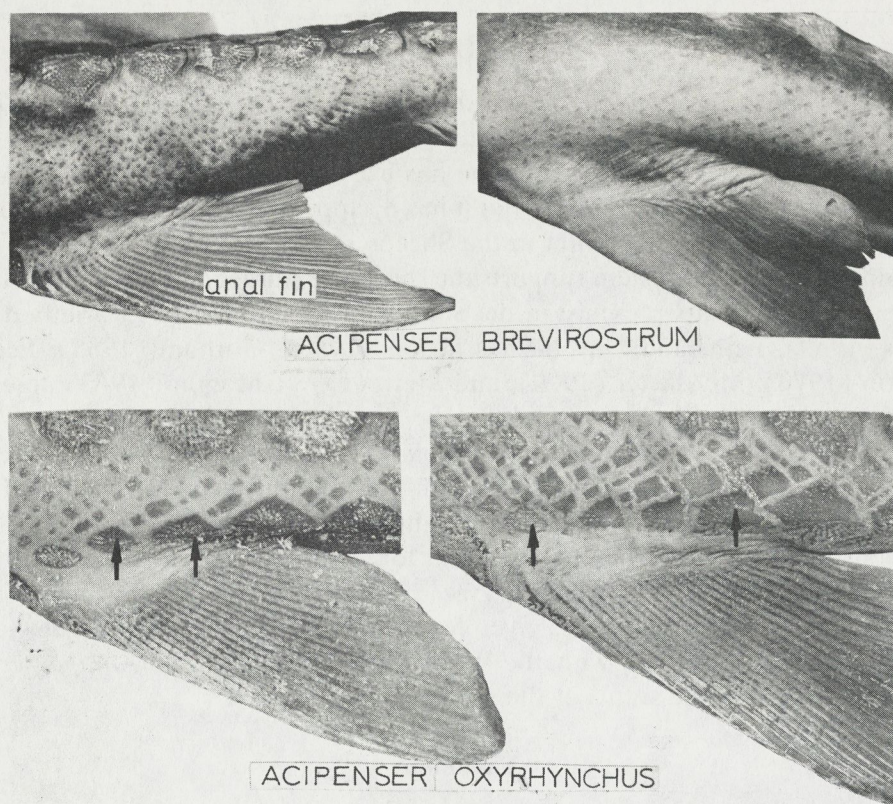


Fig. 1. Shortnose sturgeon, *Acipenser brevirostrum*, above; Atlantic sturgeon, *Acipenser o. oxyrinchus*, below. Note the normal-sized scales above the anal fin in the shortnose sturgeon and the small bony plates (arrows) in the Atlantic sturgeon.

Saint John drainage. For one character, supra-anal plates, a few additional specimens from the same drainage were examined. Frequencies for the different characters are listed for the two species in Tables 1 and 2 at the end of the paper.

The characters were determined as follows. Mouth width was measured as the lateral distance between the inside corners of the mouth. Snout length was measured from the tip of the snout to the anterior fleshy border of the orbit, head length from the tip of the snout to the posterior border of the opercular bone, and the interorbital width as the least bony width between the eyes. Total length was taken from the distance between vertical lines at the tip of the snout and the posterior tip of the dorsal lobe of the caudal fin in its natural position. Fork length was taken similarly but back to the distal edge of the caudal fin on the midline. The loss of the tip of the dorsal lobe of the caudal sometimes made total length an unreliable measurement.

All anal rays were counted; the anterior fulcrum was omitted. Counting was facilitated by scraping the rays with a scalpel to remove skin and mucus. Dorsal scutes were counted from the dorsal fin to the head excluding the scutes which interdigitated with the cranial plates. Lateral scutes were counted between the cleithrum and the base of the caudal fin. The smaller posterior lateral scutes were counted as long as they fell on the midline. The ventral or more properly ventrolateral

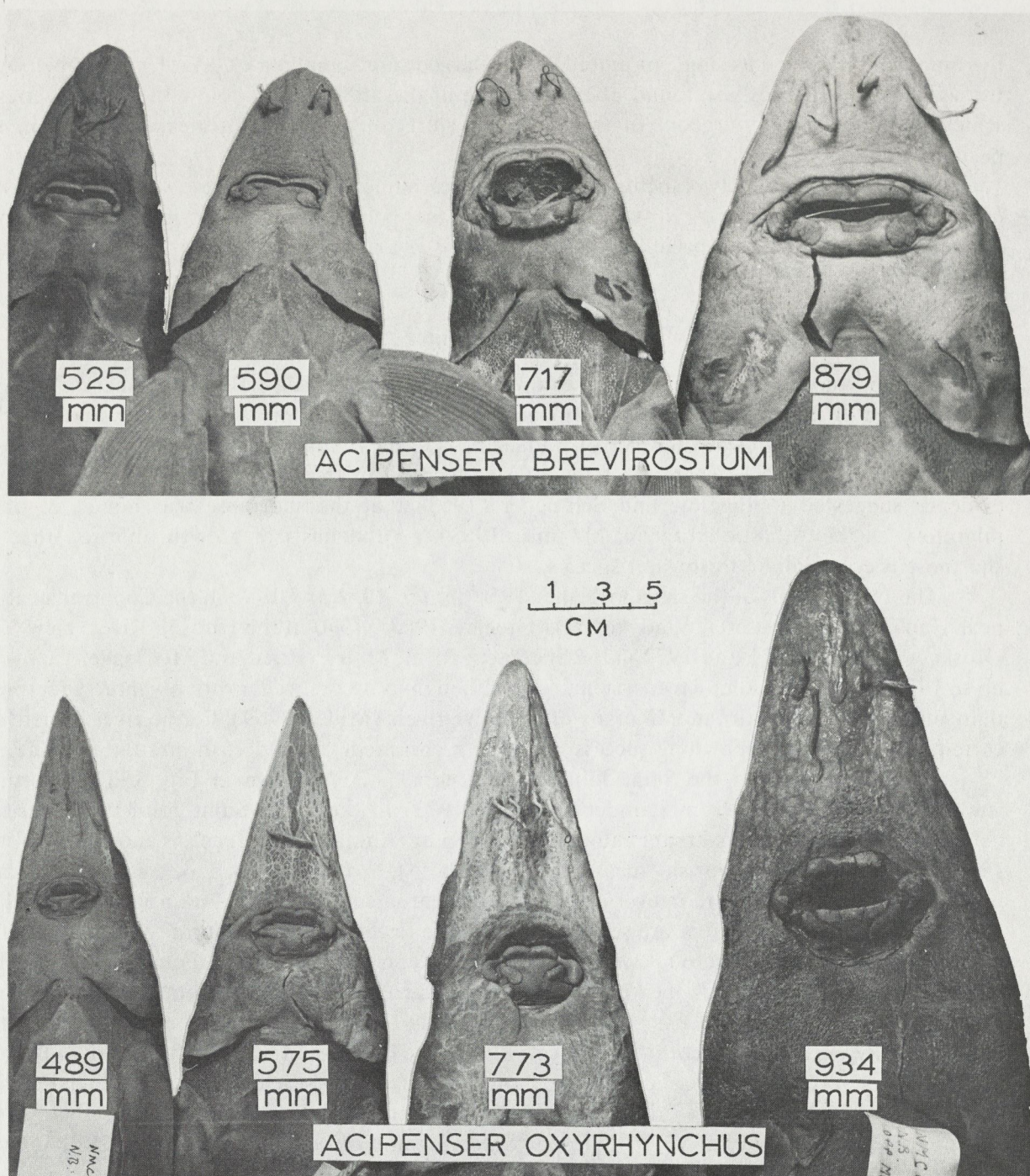


Fig. 2. Shortnose sturgeon, *Acipenser brevirostrum*, above; Atlantic sturgeon, *Acipenser o. oxyrinchus*, below. Note the relatively shorter, blunter snout and the wider mouth in the shortnose sturgeon (fork lengths of each indicated in mm.).

scutes were counted between the pectoral and pelvic fin origins. The postdorsal scutes which lie just behind the dorsal fin and the preanal scutes which lie in front of the anal fin and immediately behind

the anus were recorded as single or paired. The enlarged supra-anal plates, Fig. 1, probably formed through fusion of scales, are found above the base of the anal fin and below the lateral series of scutes in the Atlantic sturgeon. In the shortnose sturgeon only small scales are found in this position.

Authors have used two spellings for the species name of the shortnose sturgeon, *Acipenser brevirostrum* and *Acipenser brevirostris*. The former is the spelling used in the original description by LeSueur and is correct, the species name being treated as a nominative singular noun in apposition to the generic name.

Distribution

The shortnose sturgeon is found in drainages of the Atlantic coast of North America from Big Lake George of the St. Johns River drainage, Putnam County, Florida (Vladykov and Greeley, 1963) north to the Saint John River of both King, Queen's, Sunbury, and lower York counties, southern New Brunswick. There are a few marine records for the United States but the available evidence suggested to Bigelow and Schroeder (1953) that the shortnose was not as regularly migratory as the Atlantic sturgeon. Magnin (1963), on the basis of growth, inferred that the shortnose is essentially a freshwater species.

The only records of the shortnose after 1950 are for: 1951 and 1952 in the Connecticut River near Hadley, Massachusetts (Vladykov and Greeley, 1963), 1970 in the Hudson River, New York (Koski et al 1971), 1971 and 1972 in the Sheepscot River, Maine (Fried and McCleave, 1973) and up to 1973 in the Saint John River system, N.B. Although its occurrence is probably more widespread than this, it has been extirpated in many of its native rivers (Miller, 1969). For no river is there any current information on spawning success or on the recruitment of young fish into the population.

The distribution in the Saint John River system, N.B. is shown in Fig. 3. The shortnose sturgeon is known there from Pamdenec (Meth, 1973) in the lower Saint John to Fredericton (Magnin, 1963) 65 miles upstream and in the intervening tributary Kennebecasis and Belleisle bays, French Lake in Sheffield Parish (record based on photo), Washademoak Lake, and Grand Lake. Adults have been taken there in every month of the year in contrast to the Atlantic sturgeon where specimens exceeding three feet are seldom taken in the lower Saint John during winter (one of 40 and another of 48 inches were taken in the mouth of Kennebecasis Bay, 19 February 1973). Most of the 17 sites of capture are located where the river or tributary is .5-3.2 km ($\frac{1}{3}$ -2 miles) wide. Depths of capture in sunken gillnets varied from 3-18 m (10-60 feet), but most were 9-18 m (40-60 feet). Long Reach is tidal. According to Rogers (1940) the limit of salt water is the mouth of Belleisle Bay. There are records from Public Landing, Purdy's Point and Westfield from Long Reach but none seawards in N.B. According to Trites (1960) the upper 10 metres of Long Reach is usually fresh but occasionally has a salinity of 15PPT. Deeper waters usually have salinities of 10 to 20PPT. Trites reported trawling shortnose at salinities exceeding 15PPT in Long Reach. Downstream where salinities tend to be higher there are records only of Atlantic sturgeon, none of shortnose. For May-June, August and December the temperatures of the upper 10 metres in Long Reach are 12-14°C, 16-18°C, and 0-1°C, and for 11-40 metres for the same periods 5-12°C, less than 16°C, and 2-9°C respectively. The depth and distributional information is based on specimens and reports obtained through the kind co-operation of commercial fishermen fishing sturgeon, gaspereau, striped bass, American eel, and Atlantic salmon.

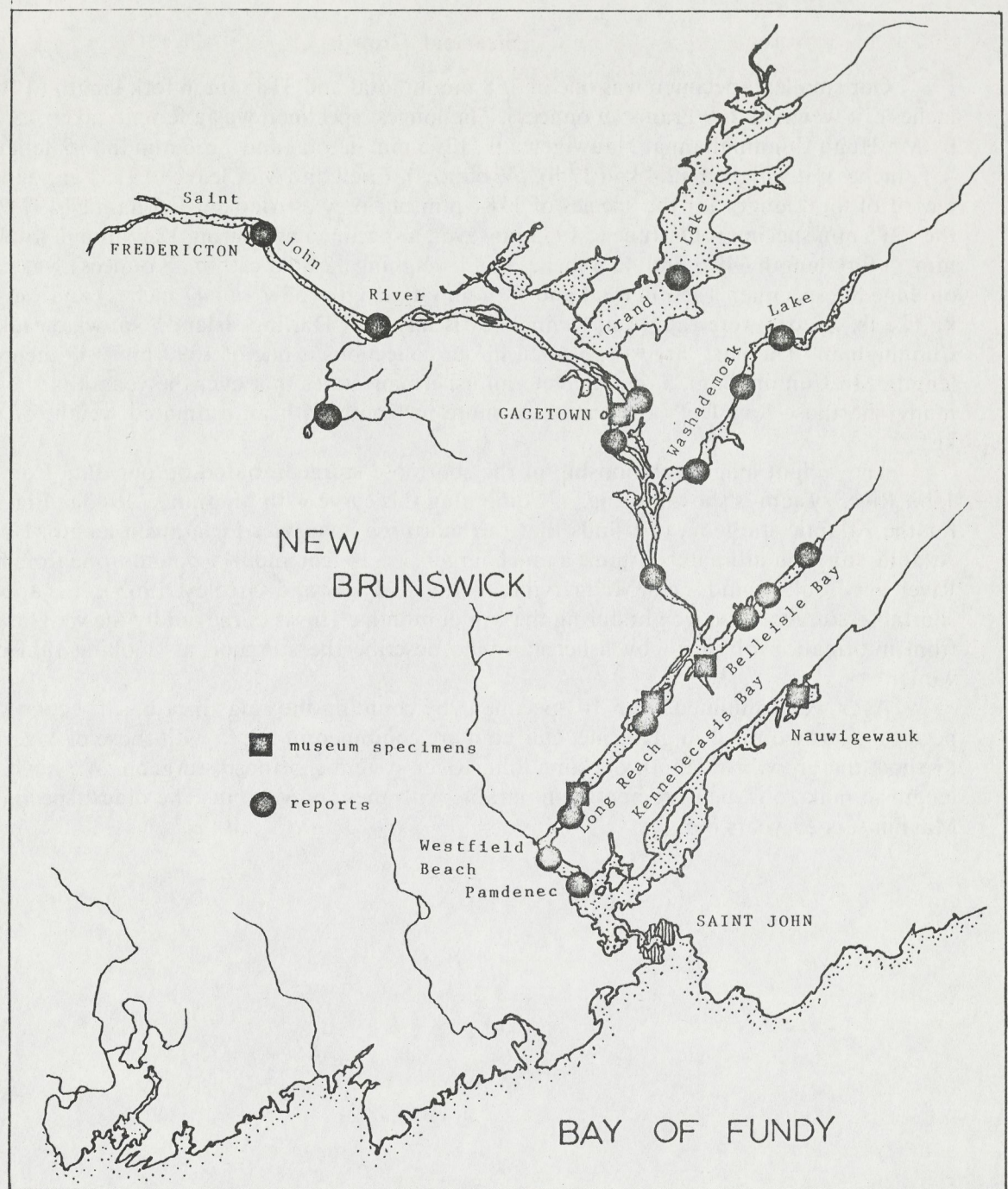


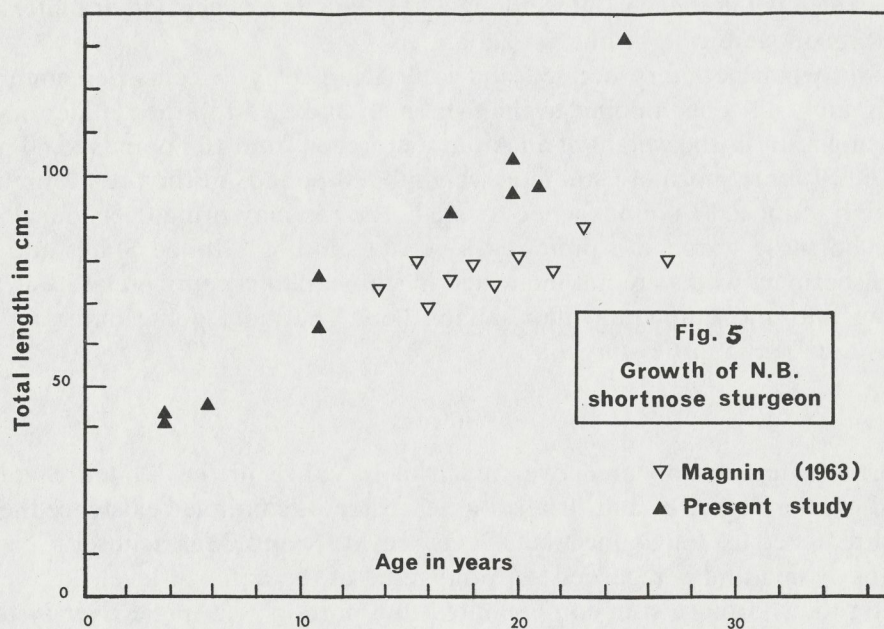
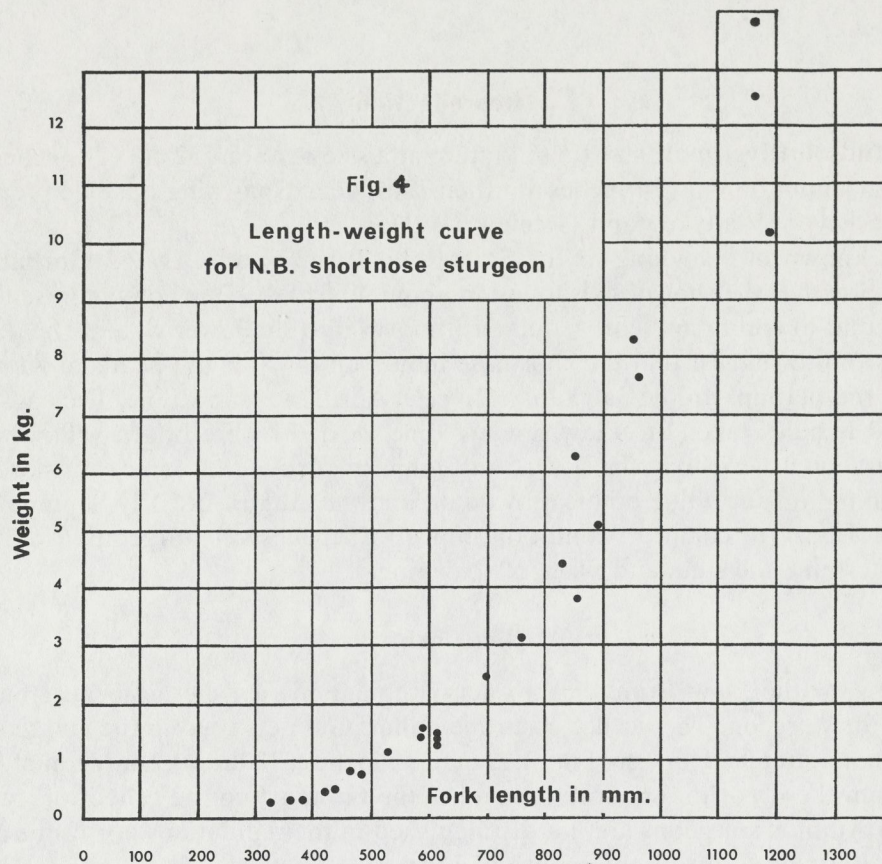
Fig. 3. Distribution of the shortnose sturgeon, *Acipenser brevirostrum*, in the Saint John River system in southern New Brunswick. We do not have the precise location for the Fredericton and Grand Lake records.

Size and Growth

Our smallest specimen was one of 368 mm in total and 318 mm in fork length (14½ and 12½ inches); it weighed 260 grams (9 ounces). The longest specimen was a female taken 18 June 1971 by Mr. Hugh Cunningham at Nauwigewauk, 1295 mm in total and 1156 mm in fork length (51 and 45½ inches); it weighed 12.4 kg (27 lb. 5½ ounces). Fried and McCleave (1973) announced a new record of total length for the species of 1181 mm but they overlooked Gorham's (1971) report of the 1295 mm specimen. On June 6, 1973 however, a specimen measuring 1257 mm in total and 1162 mm in fork length (49½ and 45¾ inches) and weighing 13.8 kg (30 lb., 8 ounces) was caught and on June 8 a specimen 1353 in total and 1194 in fork length (53¼ and 47 inches) and weighing 10.1 kg (22 lb, 2¾ oz) were caught in Kennebecasis Bay near Darlings Island, Nauwigewauk by Hugh Cunningham. The next largest specimen in our collections is one of 1090 mm (43 inches) in total length. Mr. Cunningham, a reliable veteran fisherman, states that over the years thar he was taken many shortnose four feet (1219 mm) or more in length with an estimated weight of 40 lb. (18 kg).

The weight-length relationship of the shortnose sturgeon based on our data from the Saint John River system is shown in Fig. 4. Comparing this curve with Magnin's (1963a) Fig. 21 and 22 for the Atlantic sturgeon, one finds that the shortnose is heavier for a given length. However the Atlantic sturgeon ultimately attains a much larger size-14 feet and 811 pounds, one from Saint John River at Middle Island, near Maugerville, N.B. (Vladykov and Greeley, 1963). It is apparent that shortnose sturgeon lose weight during the winter months. This is borne out by the weights taken and from information obtained by fisherman who describe the sturgeon as 'looking thin during the winter.'

Ages were obtained from 10 specimens by counting the rings in a basal section of the first pectoral fin ray dipped in glycerine. Our data are combined in Fig. 5 with those of Magnin (1963) to show the growth in length of Saint John River system shortnose sturgeon. We have used total length to make our measurements comparable with these of Magnin. The oldest specimen, one of Magnin's, is 27 years old.



Reproduction

In the Hudson River male shortnose mature at a size of about 52 cm (20 inches) in their fifth year, females at about 56 cm (24 inches) in their sixth year. Spawning has been reported in April for the Hudson River (Vladykov and Greeley, 1963).

Little is known of spawning in the Saint John River system. David Gorham, commercial fisherman, reports that the shortnose is found in about 40 feet (12.2 m) of water, seldom shallower, in winter, but that in spring and early summer it moves into shallower water. The dates of capture that we have seem to suggest that the shortnose moves up towards the heads of Kennebecasis and Belleisle Bays and perhaps up the Saint John River in April, May, and June. The eggs of a large and moderate-sized females taken at Nauwigewauk June 18, 1971 were bright yellow with no sign of darkening. Sturgeon fishermen of the lower Saint John River state that some shortnose sturgeon may be ripe or running in June while others may go on until late August or early September. In summer the roe becomes dark in colour, a condition typical of ripeness in sturgeons. Additional study is required to determine the time and place of spawning.

The Fishery

According to the New Brunswick Fishery Regulations a fisherman must have a sturgeon licence to fish for sturgeon. The licence costs one dollar. Gill nets used in the sturgeon fishery must have an extension (stretched) mesh of not less than 13 inches (330 mm). Sturgeon of less than 4 feet (1219 mm) from the tip of the snout to the end of the tail must not be fished for, caught or killed. Shortnose and Atlantic sturgeons are not distinguished in the regulations nor in the catch statistics. Sturgeon fishing is closed during the month of June.

One fisherman in the lower Saint John River system caught and kept 321 Atlantic and 2 shortnose sturgeon with a total processed weight of about 5550 pounds (2517 kg) from July 1 to September 15 using 3 gill nets each 180 feet long and 20 to 25 feet deep. Other undersized shortnose and Atlantic sturgeon were caught but not kept.

A sturgeon, when netted, processed and iced (icing costs 13 cents per pound of sturgeon) brings approximately 42 cents a pound to the fisherman and \$2.50 to the retailer on the American market. Processing reduces the weight of an Atlantic sturgeon from 100 pounds to 60 pounds or even less. A 4 foot (1219 mm) shortnose sturgeon weighing 20 pounds in the round might therefore be expected to weigh at most 14 pounds when dressed. The roe may bring over four dollars a pound. The roe of the shortnose sturgeon is preferred by dealers in both United States and Canada.

Salmon fishermen, who were not interested in sturgeon on a commercial basis, were troubled by them getting into and damaging their salmon nets. The more polite name for the shortnose sturgeon in this area is the 'little sturgeon'.

Status

The shortnose has disappeared over much of its range in the United States. The denser population and greater degree of industrialization threaten its continued existence there. It has been placed on the threatened list for Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, and Pennsylvania and is regarded as endangered at the national level.

In Canada the shortnose sturgeon is limited to a portion of a single river system. According to Nature Canada (1973) the Saint John River is badly polluted by pulp and paper mills, vegetable processing plants, and raw municipal sewage. Pollution is especially bad at Edmunston, Florenceville, and from Westfield down to the city of Saint John. Between Edmunston and Grand Falls

the dissolved oxygen level frequently approaches zero. These changes may be serious for bottom feeding fishes like sturgeons. However there does not seem to be evidence of gross pollution between Mactaquac and Westfield.

Each year a fair number of shortnose sturgeon are gill netted and the species is more common than previous evidence would have suggested. Because of the size of the shortnose sturgeon, the 13 inch stretched mesh regulation in the sturgeon fishery prevents large numbers of shortnose being caught and minimum size limit in few being kept, although many are still entangled because of their scutes. Others were or are caught in the smaller meshed gillnets set for Atlantic salmon and gaspereau. Sturgeon under four feet and those caught by fishermen without a sturgeon licence must, by law, be released. But in some cases sturgeon die in the nets before they can be released. Some of those released alive probably suffer a higher mortality rate.

Checking with fishermen operating several types of gear including eel traps and chain pickerel nets in the Saint John River system has failed to turn up any specimens shorter than 310 mm standard length which would be 1 to 2 years old, but one of 150 mm was reported in Kingston Creek near Belleisle Bay in late December or early January. We are unable to state whether reproduction has been unsuccessful in recent years and the population being fished consists largely of older individuals, or whether the various gear are not right or not properly placed to take young specimens.

In any case the continued existence of the shortnose sturgeon is in doubt. It is important to save the Saint John River population because it is the only Canadian population, it is restricted in area, and the northernmost for the species. Its continued survival in the United States is by no means certain. It may be noted that protective measures for the white sturgeon, *Acipenser transmontanus* have resulted in a quadrupling of the 1966-70 catch, 143,000 lbs, over the 1961-65 catch, 31,000 lbs (64,900 as opposed to 14,070 metric tons, Hart, 1973). Protection can be effective. Protective measures for the shortnose are warranted until we have assurance of reproductive success.

Recommendations for Protection

Measures have been taken to abate pollution in the Saint John River but there remains much to do especially from Edmunston to Mactaquac dam. Support to municipalities should be continued for the construction of sewage treatment plants adequate for present and future needs. It should be ensured that established industries are engaged in adequate pollution abatement programs and that proper pollution control facilities are built into new industrial plants. The use of pesticides affecting the bottom fauna should be restricted.

Consideration might be given to raising the minimum stretched mesh size of gillnets used in the sturgeon fishery from 13 to 14 inches. The new mesh size could be phased in to avoid increased cost to the fisherman. Catch statistics should distinguish the shortnose and Atlantic sturgeon for the Saint John River system fishery in New Brunswick.

A research project on the shortnose sturgeon should be supported.¹ Included in it should be a tagging program to determine the size of the population(s) and movements. Care should be taken to use methods that will not increase mortality, e.g. traps instead of gillnets. The recruitment of young sturgeons into the population(s) and the age structure should be determined. A search for the spawning and nursery grounds should be made so that they can be suitably protected. A few specimens should be sampled for stomach and pesticide residue analysis.

¹ Dr. M. Dadswell of the Huntsman Marine Laboratory, Brandy Cove, N.B. has begun an investigation of the shortnose sturgeon.

Summary

A taxonomic description including new diagnostic characters is given for the shortnose sturgeon, *Acipenser brevirostrum* LeSueur, 1818 in the Saint John River system, New Brunswick. Information on the distribution, size, growth, and fishery is presented. New records of total length 1353 mm and weight, 13.8 kg, for the species are provided from New Brunswick. Evidence is reported suggesting that this population, the only one in Canada, may be endangered, and even if not the American ones certainly are. The following measures are recommended for its protection: pollution abatement, pesticide restrictions, increase in minimum stretched mesh size for nets in the sturgeon fishery to 14 inches, presentation of separate catch statistics for the shortnose and Atlantic sturgeons in the Saint John system, and a research program to determine food, population size, recruitment, age structure, and movement, as well as the location of the spawning and nursery grounds.

Acknowledgements

The co-operation of the following commercial fishermen is gratefully acknowledged, Hugh Cunningham, Elmer Dixon, David Gorham, Sanford Henderson, and Raymond Tippetts. Dr. R.E. Balch supplied a record from French Lake, Sheffield Parish, Sunbury County. J.W. Carroll, Associate Director, Conservation and Protection, Department of Environment, supplied information on regulations. Dr. Fred F. Meth, Department of the Environment, Ottawa generously permitted access to his manuscripts on the ecology of the Saint John River basin and commented on the present study. Charles G. Gruchy, National Museum of Natural Sciences and Dr. Etienne Magnin, Université de Montréal, kindly criticized the manuscript. Charles H. Douglas drew the graphs and the frontispiece, Miss Jennifer Lewis the map.

Table 1. Frequencies of Body Proportions and Meristics in *Acipenser* from the Saint John River System, N.B.

																Mean	Standard Deviation
Mouth width x 100	24-27	28-31	32-35	36-39	40-43	44-47	48-51	52-55	56-59	60-63	64-67	68-71	72-75	77			
Snout length																	
<i>Acipenser brevirostrum</i>						1	1	7	8	6	2	3	3	1		60.06	7.72
<i>Acipenser o. oxyrhynchus</i>	8	5	1													27.71	2.84
Mouth width x 100	47-50	51-54	55-58	59-62	63-66	67-70	71-74	75-78	79-82	83-86	87-90						
Interorbital width																	
<i>Acipenser brevirostrum</i>					1	4	6	12	4	1	4					76.84	6.48
<i>Acipenser o. oxyrhynchus</i>	6	2	6													53.07	4.05
Snout length x 100	37-38	39-40	41-42	43-44	45-46	47-48	49-50	51-52	53-54	55-56							
Head length																	
<i>Acipenser brevirostrum</i>	2	4	6	7	6	5	3									44.03	3.33
<i>Acipenser o. oxyrhynchus</i>				1	0	0	1	3	5	6						52.86	3.16
Number of Lateral scutes	23	24	25	26	27	28	29	30	31	32	33	34					
<i>Acipenser brevirostrum</i>	2	2	4	9	4	3	3	0	3	1	0	1				27.06	2.61
<i>Acipenser o. oxyrhynchus</i>			4	2	3	3	0	1	1							27.00	1.88
Number of Gill rakers	15	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
<i>Acipenser brevirostrum</i>							2	2	1	4	3	5	6	5	2	1	27.62
<i>Acipenser o. oxyrhynchus</i>	1	1	2	3	4	2	0	0	1								23.43
Number of anal rays	18	19	20	21	22	23	24	25	26	27							
<i>Acipenser brevirostrum</i>	2	4	9	8	4	2	3										20.81
<i>Acipenser o. oxyrhynchus</i>						2	3	5	2	2							24.93

Table 2. Frequency of Scute Characters and Intestine Colour in *Acipenser* from the Saint John River System, N.B.

Species	Number of Dorsal Scutes								Mean	Standard Deviation
	6	7	8	9	10	11	12	13		
<i>Acipenser brevirostrum</i>		1	2	5	10	10	3	1	10.22	1.29
<i>Acipenser o. oxyrhynchus</i>			1	9	4				9.21	.58
Species	Number of Ventral Scutes								Mean	Standard Deviation
	1	2	3	4	5	6	7	8		
<i>Acipenser brevirostrum</i>	1	2	12	14	3				8.50	.88
<i>Acipenser o. oxyrhynchus</i>			5	3	4	2			9.21	1.12

Species	Double Postdorsal Scutes		Enlarged Supra-anal Plates	
	Present	Absent	Present	Absent
<i>Acipenser brevirostrum</i>	6	26	1	50
<i>Acipenser o. oxyrhynchus</i>	13	1	19	0

Species	Double Preanal Scutes		Intestine Colour	
	Present	Absent	Dark	Light
<i>Acipenser brevirostrum</i>	7	25	32	0
<i>Acipenser o. oxyrhynchus</i>	14	0	1	13

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No. 7

Vianney Legendre, J.G. Hunter and Don E. McAllister

FRENCH, ENGLISH AND SCIENTIFIC NAMES

OF MARINE FISHES OF ARCTIC CANADA

NOMS FRANÇAIS, ANGLAIS ET SCIENTIFIQUES

DES POISSONS MARINS DE L'ARCTIQUE CANADIEN



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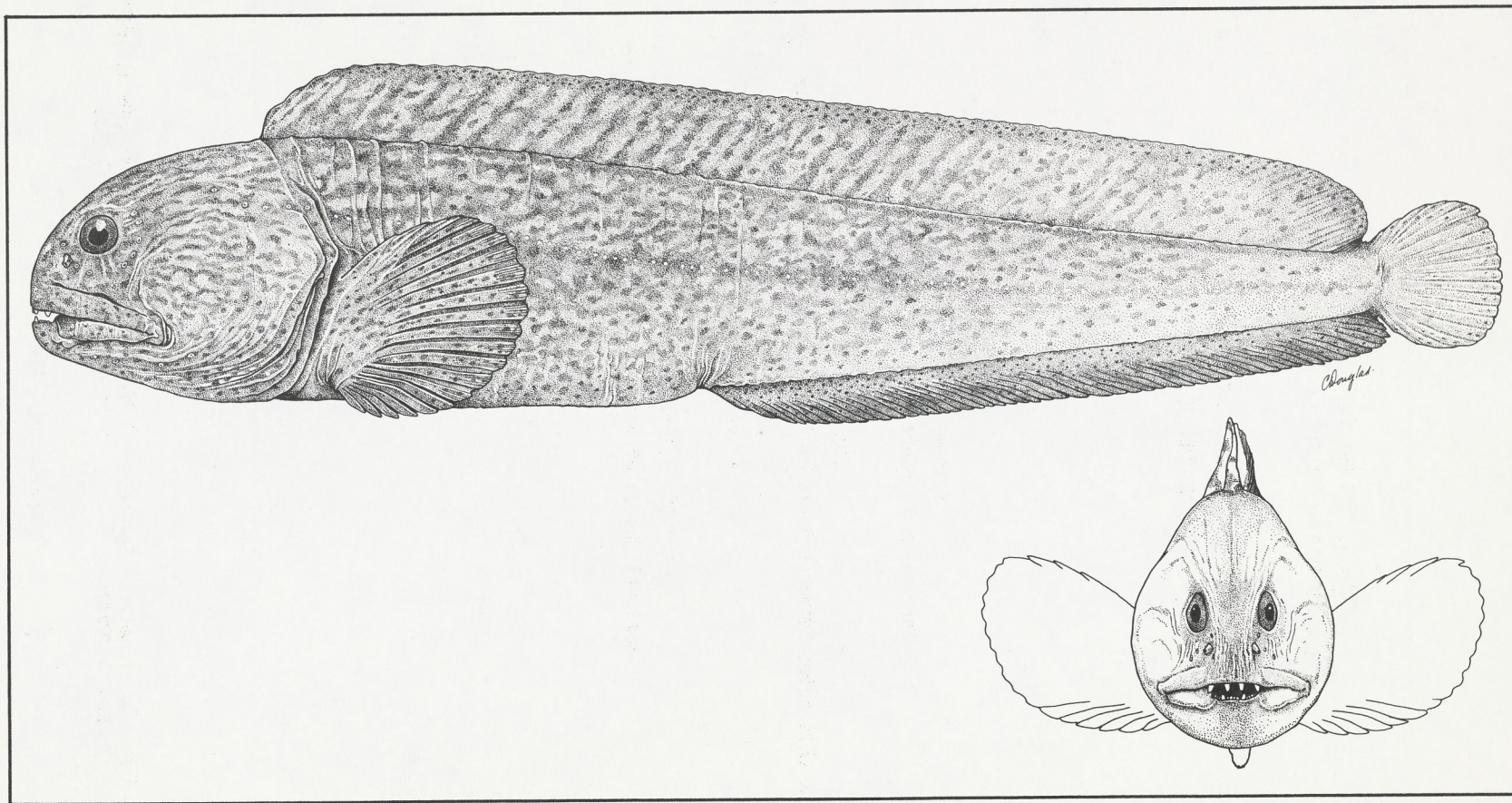
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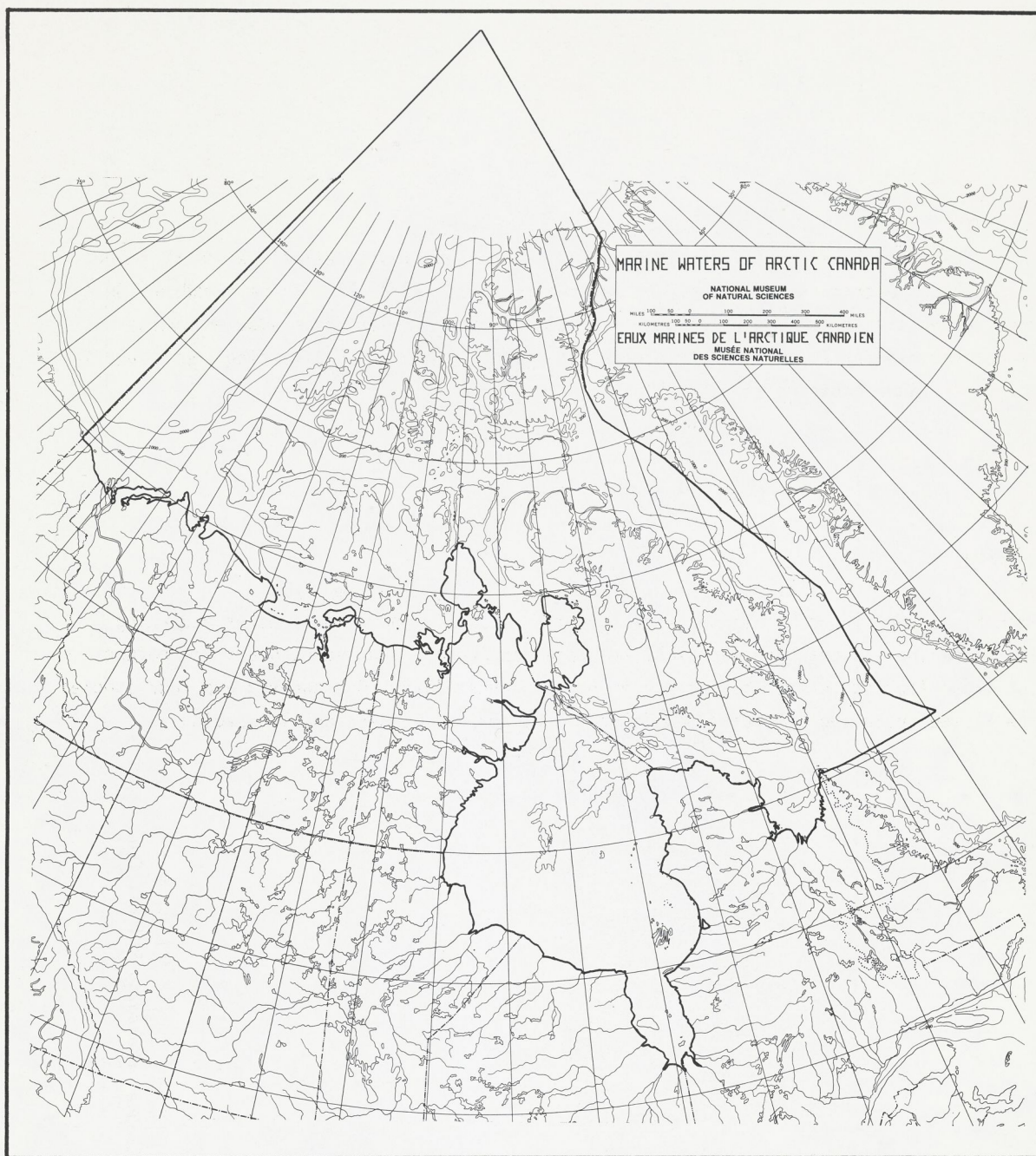
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Loup de Béring, *Anarhichas orientalis* Pallas, de l'inlet Bathurst, T. du N.-O.
Bering wolffish, *Anarhichas orientalis* Pallas, from Bathurst Inlet, N.W.T.



Carte 1. La ligne noire indique les limites géographiques des collections ayant servi à dresser la présente liste.

Map 1. The dark line encloses the area covered by the list.

RÉSUMÉ

La liste contient les noms français et anglais ainsi que les appellations scientifiques des espèces rencontrées dans les eaux marines et saumâtres de l'Arctique canadien. On a créé des noms vulgaires pour désigner les espèces qui n'en avaient pas ou qui portaient un nom peu approprié. La liste renferme les noms de 104 espèces dont cinq sont nouvelles pour l'Arctique canadien et six douteuses.

SUMMARY

French and English vernaculars are listed with scientific names of species occurring in the marine and brackish waters of the Canadian Arctic. New vernaculars are coined for those lacking them or having inappropriate vernaculars. One hundred and four species are listed including 5 species new to Arctic Canada and 6 questionable species.

INTRODUCTION

Le présent document a pour objet d'établir une liste des appellations vulgaires françaises et anglaises ainsi que des noms scientifiques des poissons connus, vivant dans les eaux marines de l'Arctique canadien. Il a fallu créer certains noms vulgaires, soit en anglais, soit en français, ou même dans les deux langues et, par ailleurs, certains des termes employés auparavant portaient à confusion ou n'étaient pas très appropriés. En ces temps d'intense exploration de l'Arctique, il est plus que probable qu'une liste à jour des diverses espèces de poissons se révélera utile. Les listes de McAllister (1960a, 1960b) sont systématiquement mises à jour et les noms de plusieurs espèces découvertes récemment dans l'Arctique canadien y figurent. Les renseignements sur la présence de ces nouvelles espèces seront fournies dans un autre document.

Les noms de toutes les espèces qu'on a recensées dans les eaux marines et saumâtres de l'Arctique canadien apparaissent ici; par contre, ceux des poissons, même connus, qu'on n'a signalés qu'au-delà des limites déterminées en sont exclus. Le secteur considéré englobe les eaux marines du Yukon et des Territoires du Nord-Ouest, y compris la partie canadienne du nord et de l'est de l'Arctique s'étendant, d'une part, jusqu'au Pôle Nord et, d'autre part, à mi-chemin entre l'archipel arctique canadien et le Groenland, ainsi qu'aux eaux du détroit et de la baie d'Hudson, et à celles de la baie James et de la baie d'Ungava (voir carte 1).

La terminologie anglaise établie auparavant se fondait principalement sur le travail de Bailey *et al.* (1970), et s'inspirait également de Leim et Scott (1968) et de Hart (1970), tandis que les noms vulgaires français découlent des travaux de Legendre, Scott et Bergeron (1964). On a dû créer un certain nombre de nouveaux termes pour les besoins de la présente nomenclature.

Le répertoire contient les noms de 20 familles et de 104 espèces de poissons, dont cinq sont nouvelles pour l'Arctique et six douteuses. Les noms scientifiques des espèces apparaissent en ordre alphabétique dans leurs familles ou sous-familles respectives, elles-mêmes arrangées selon l'ordre phylogénétique. Les renvois réfèrent le lecteur aux notes apparaissant dans la section "Néologismes" qui suit immédiatement la liste.

SYMBOLES

* nouveau pour l'Arctique canadien.

? existence hypothétique ne s'appuyant pas sur des spécimens.

noms vulgaires n'apparaissant pas (ou différant de ceux qu'on trouve) dans la liste de Bailey *et al.* (1970), publiée par l'A.F.S.

INTRODUCTION

The purpose of this paper is to establish a list of French and English vernaculars along with the corresponding scientific names for fishes known to occur in the marine waters of Arctic Canada. In some cases, vernaculars of one or both languages did not previously exist or previously applied vernaculars were misleading or inappropriate. In a time of active Arctic environmental exploration, it is hoped that an up-to-date summary of species would be useful. The lists of McAllister (1960a, 1960b) are updated taxonomically and several species new to the Canadian Arctic are included. The occurrence of the new records will be documented elsewhere.

All species of fishes known from the marine and brackish waters of Arctic Canada are included, and those even though known from just beyond its boundaries are excluded. The area covered includes the marine waters of the Yukon and the Northwest Territories and those of the Canadian sector of the Arctic north of the North Pole, and east to the midpoint between the Canadian Arctic Archipelago and Greenland, and those of Hudson Strait, Hudson, James and Ungava bays (see map 1)

Previously established English vernaculars, in general, follow Bailey *et al.* (1970), with a few being drawn from Leim and Scott (1968) and Hart (1970). Previously established French vernaculars are drawn from Legendre, Scott, and Bergeron (1964). New vernaculars were coined by the authors as required.

Twenty families and 104 species including 5 species new to Arctic Canada, and six questionable species are included. Species are arranged alphabetically by scientific name within family or subfamily which are themselves arranged phylogenetically. Footnote numbers in the list refer to the numbered comments under "Neologisms" following the list.

SYMBOLS

- * new to Arctic Canada
- ? occurrence uncertain and not documented by specimens
- # vernaculars not in (or different from those in) AFS list (Bailey *et al.*, 1970)

SPECIES / ESPÈCES

PETROMYZONIDAE - lampreys / lamproies (f.)

Lampetra japonica (Martens, 1868) - Arctic lamprey / lamproie arctique (f.)

SQUALIDAE - dogfish sharks / chiens de mer (m.)

Somniosus microcephalus (Bloch and Schneider, 1801) - Greenland shark / laimargue (f.)

RAJIDAE - skates / raies (f.)

Raja hyperborea Collett, 1879 - darkbelly skate[#] / raie boréale (f.)¹

Raja mollis Bigelow and Schroeder, 1950 - soft skate[#] / raie molle (f.)

Raja radiata Donovan, 1808 - thorny skate / raie épineuse (f.)

ACIPENSERIDAE - sturgeons / esturgeons (m.)

Acipenser fulvescens Rafinesque, 1817 - lake sturgeon / esturgeon de lac (m.)

CLUPEIDAE - herrings / harengs (m.)

Clupea harengus pallasii Valenciennes, 1847 - Pacific herring / hareng du Pacifique (m.)

SALMONIDAE - trouts / truites (f.)

Coregoninae - whitefishes / corégones (m.)

Coregonus artedii Le Sueur, 1818 - lake cisco / cisco de lac (m.)²

Coregonus autumnalis (Pallas, 1776) - Arctic cisco / cisco arctique (m.)

Coregonus clupeaformis (Mitchill, 1818) - lake whitefish / grand corégone (m.)

Coregonus nasus (Pallas, 1776) - broad whitefish / corégone tschir (m.)

Coregonus sardinella Valenciennes, 1848 - least cisco / cisco sardinelle (m.)

Prosopium cylindraceum (Pallas, 1784) - round whitefish / ménomini rond (m.)

Stenodus leucichthys (Güldenstadt, 1772) - inconnu / inconnu (m.)

Salmoninae - trouts / truites (f.)

Oncorhynchus gorbuscha (Walbaum, 1792) - pink salmon / saumon rose (m.)

Oncorhynchus keta (Walbaum, 1792) - chum salmon / saumon keta (m.)

? *Oncorhynchus nerka* (Walbaum, 1792) - sockeye salmon / saumon nerka (m.)^x

? *Oncorhynchus tshawytscha* (Walbaum, 1792) - chinook salmon / saumon chinook (m.)^x

^xBased on manuscript by J.G. Hunter giving reports from good sources but without voucher specimens. / D'après un manuscrit de J.G. Hunter citant des sources fiables, mais ne s'appuyant pas sur des spécimens.

Salmo salar Linnaeus, 1758 - Atlantic salmon / saumon atlantique (m.)

Salvelinus alpinus (Linnaeus, 1758) - Arctic charr # / omble chevalier (m.)³

Salvelinus fontinalis (Mitchill, 1814) - brook charr # / omble de fontaine (m.)³

Salvelinus namaycush (Walbaum, 1792) - lake charr # / touladi (m.)³

OSMERIDAE - smelts / éperlans (m.)

Hypomesus olidus (Pallas, 1814) - pond smelt / éperlan à petite bouche (m.)

Mallotus villosus (Müller, 1776) - capelin / capelan (m.)

Osmerus mordax (Mitchill, 1814) - rainbow smelt / éperlan arc-en-ciel (m.)

PARALEPIDIDAE - barracudinas / lussions (m.)

Notolepis rissoi krøyeri (Lütken, 1892) - white barracudina # / lussion blanc (m.)

Paralepis coregonoides borealis Reinhardt, 1837 - sharpchin barracudina # / lussion à menton (m.)⁴

MYCTOPHIDAE - lanternfishes / poissons-lanternes (m.)

Benthosema glaciale (Reinhardt, 1835) - glacier lanternfish # / lanterne glaciale (f.)

Lampanyctus crocodilus (Risso, 1810) - jewel lanternfish # / lanterne-joyau (f.)

? *Myctophum punctatum* Rafinesque, 1810 - spotted lanternfish # / lanterne ponctuée (f.)

GADIDAE - codfishes / morues (f.)

Gadinae - codfishes / morues (f.)

Arctogadus borisovi Drjagin, 1932 - toothed cod / saïda barbu (m.)⁵

Arctogadus glacialis (Peters, 1874) - polar cod / saïda imberbe (m.)⁵

Boreogadus saida (Lepechin, 1774) - Arctic cod / saïda franc (m.)

Eleginus gracilis (Tilesius, 1810) - saffron cod / navaga jaune (m.)

Gadus morhua Linnaeus, 1758 - Atlantic cod / morue franche (f.)

Gadus ogac Richardson, 1836 - ogac # / ogac (m.)⁶

Lotinae - burbots / lottes (f.)

Gaidropsarus ensis (Reinhardt, 1838) - threebeard rockling # / mustèle arctique à trois barbillons (f.)

Lota lota (Linnaeus, 1758) - burbot / lotte (f.)

MACROURIDAE - grenadiers / grenadiers (m.)

Coryphaenoides rupestris Gunnerus, 1765 - rock grenadier # / grenadier de roche (m.)

Macrourus berglax Lacépède, 1810 - roughhead grenadier # / grenadier berglax (m.)⁷

? *Nematonurus armatus* (Hector, 1875) - russet grenadier # / grenadier roux (m.)

Nezumia bairdii (Goode and Bean, 1877) - marlin-spike / grenadier du Grand Banc (m.)

ZOARCIDAE - eelpouts / lycodes (f.)

- Gymnelis viridis* (Fabricius, 1780) - fish doctor / unerak (m.)
Lycodes jugoricus Knipowitch, 1906 - shulupaoluk / lycode plume (f.)⁸
Lycodes mucosus Richardson, 1855 - saddled eelpout # / lycode à selles (f.)⁹
Lycodes pallidus Collett, 1878 - pale eelpout / lycode pâle (f.)
Lycodes polaris (Sabine, 1824) - polar eelpout # / lycode polaire (f.)¹⁰
Lycodes reticulatus Reinhardt, 1835 - Arctic eelpout / lycode arctique (f.)
Lycodes rossi Malmgren, 1864 - threespot eelpout / lycode à trois taches (f.)
* *Lycodes seminudus* Reinhardt, 1837 - longear eelpout # / lycode à oreilles (f.)¹¹

ANARHICHADIDAE - wolffishes / poissons-loups (m.)

- Anarhichas denticulatus* Krøyer, 1845 - northern wolffish / loup à tête large (m.)
Anarhichas lupus Linnaeus, 1758 - Atlantic wolffish / loup atlantique (m.)
Anarhichas minor Olafsen, 1772 - spotted wolffish / loup tacheté (m.)
* *Anarhichas orientalis* Pallas, 1814 - Bering wolffish # / loup de Bering (m.)¹²

STICHAEIDAE - pricklebacks / terrassiers (m.)

- * *Acantholumpenus mackayi* (Gilbert, 1895) - blackline prickleback # / terrassier à six lignes (m.)¹³
Anisarchus medius (Reinhardt, 1838) - stout eelblenny / lompénie naine (f.)
Eumesogmus praecisus (Krøyer, 1837) - fourline snakeblenny / quatre-ligne atlantique (m.)
Leptoclinus maculatus (Fries, 1837) - daubed shanny / lompénie tachetée (f.)
Lumpenus fabricii (Valenciennes, 1836) - slender eelblenny / lompénie élancée (f.)
Stichaeus punctatus (Fabricius, 1780) - Arctic shanny / stichée arctique (f.)

PHOLIDAE - gunnels / gonnelles (f.)

- Pholis fasciata* (Bloch and Schneider, 1801) - banded gunnel / sigouine rubannée (f.)

AMMODYTIDAE - sand lances / lançons (m.)

- Ammodytes dubius* Reinhardt, 1837 - northern sand lance / lançon du nord (m.)
Ammodytes hexapterus Pallas, 1814 - stout sand lance # / lançon gourdeau (m.)¹⁴

SCORPAENIDAE - scorpionfishes / scorpènes (f.)

- Sebastes marinus* (Linnaeus, 1758) - rosefish # / sébaste orange (m.)¹⁵
Sebastes mentella Travin, 1951 - redfish # / sébaste atlantique (m.)¹⁵

COTTIDAE - sculpins / chabots (m.)

- Artediellus scaber* Knipowitsch, 1907 - rough hookear # / hameçon rude (m.)¹⁶
* *Artediellus uncinatus* (Reinhardt, 1835) - snowflake hookear # / hameçon neigeux (m.)¹⁷
Cottunculus microps Collett, 1874 - polar sculpin # / cotte polaire (m.)

Cottus cognatus Richardson, 1836 - slimy sculpin / chabot visqueux (m.)
Cottus ricei (Nelson, 1876) - spoonhead sculpin / chabot à tête plate (m.)
Gymnocephalus tricuspis (Reinhardt, 1832) - Arctic staghorn sculpin / tricorne arctique (m.)
Icelus bicornis (Reinhardt, 1841) - twohorn sculpin / icèle à deux cornes (f.)
Icelus spatula Gilbert and Burke, 1912 - spatulate sculpin / icèle spatulée (f.)
Myoxocephalus quadricornis (Linnaeus, 1758) - fourhorn sculpin / chaboisseau à quatre cornes (m.)
Myoxocephalus scorpioides (Fabricius, 1780) - Arctic sculpin / chaboisseau arctique (m.)
Myoxocephalus scorpius (Linnaeus, 1758) - shorthorn sculpin / chaboisseau à épines courtes (m.)
Triglops murrayi Günther, 1888 - moustache sculpin / faux-trigle armé (m.)¹⁸
Triglops nybelini Jensen, 1944 - bigeye sculpin # / faux-trigle maille (m.)¹⁹
Triglops pingelii Reinhardt, 1831 - ribbed sculpin / faux-trigle bardé (m.)

AGONIDAE - poachers / agones (m.)

? *Agonus acipenserinus* Tilesius, 1811 - sturgeon poacher / agone-esturgeon (m.)²⁰
Aspidopharoides monoptyerygius (Bloch, 1786) - alligatorfish / poisson-alligator atlantique (m.)
Aspidopharoides olrikii Lütken, 1876 - Arctic alligatorfish / poisson-alligator arctique (m.)
Leptagonus decagonus (Bloch and Schneider, 1801) - Atlantic poacher / agone atlantique (m.)

CYCLOPTERIDAE - lumpfishes and snailfishes / poules de mer et limaces de mer (f.)

Cyclopterinae - lumpfishes / poules de mer (f.)

Cyclopteropsis jordani Soldatov, 1929 - smooth lumpfish # / petite poule de mer douce (f.)²¹
Cyclopterus lumpus Linnaeus, 1758 - lumpfish / grosse poule de mer (f.)
Eumicrotremus derjugini Popov, 1926 - leatherfin lumpsucker / petite poule de mer arctique (f.)
Eumicrotremus spinosus (Fabricius, 1776) - Atlantic spiny lumpsucker / petite poule de mer atlantique (f.)

Liparinae - snailfishes / limaces de mer (f.)

Careproctus reinhardti Krøyer, 1862 - sea tadpole # / petite limace (f.)²²
Liparis atlanticus (Jordan and Evermann, 1898) - Atlantic seasnail / limace atlantique (f.)
Liparis cyclostigma Gilbert, 1895 - dusky seasnail # / limace marbrée (f.)²³
Liparis harschelini Scofield, 1898 - bartail seasnail / limace de Beaufort (f.)²⁴
Liparis koefoedi Parr, 1932 - gelatinous seasnail / limace gélatineuse (f.)
? *Liparis liparis* (Linnaeus, 1766) - striped seasnail / limace barrée (f.)
Liparis tunicatus Reinhardt, 1836 - Greenland seasnail / limace du Groenland (f.)
Paraliparis bathybius Collett, 1879 - black seasnail # / limace noire (f.)²⁵
Rhodichthys regina Collett, 1879 - threadfin seasnail # / limace à filaments (f.)²⁶

GASTEROSTEIDAE - sticklebacks / épinoches (f.)

Culaea inconstans (Kirtland, 1841) - brook stickleback / épinoche à cinq épines (f.)
Gasterosteus aculeatus Linnaeus, 1758 - threespine stickleback / épinoche à trois épines (f.)
Pungitius pungitius (Linnaeus, 1758) - ninespine stickleback / épinoche à neuf épines (f.)

PLEURONECTIDAE - righteye flounders /plies (f.)

Hippoglossoides platessoïdes (Fabricius, 1780) - Canadian plaice[#] / plie canadienne (f.)

* *Hippoglossoides robustus* Gill and Townsend, 1897 - Bering flounder / plie de Bering (f.)²⁷

Liopsetta glacialis (Pallas, 1776) - Arctic flounder / plie arctique (f.)

Platichthys stellatus (Pallas, 1814) - starry flounder / flet étoilé (m.)²⁸

Reinhardtius hippoglossoides (Walbaum, 1792) - Greenland halibut (official market name:
Greenland turbot) / flétan du Groenland (m.)

NEOLOGISMS

1. *Raja hyperborea* - New French vernacular.
2. We prefer for Canadian usage the form *Le Sueur* as opposed to the Americanized *Lesueur*, as being most appropriate in a bilingual environment.
3. *Salvelinus* - Etymologically it is preferable to have a distinct spelling with a double-r ending for charr, the fish, to distinguish it from char meaning cleaning lady. Charr also accords with the double letter ending of such ichthyological words as parr and redd apparently of Scottish origin, which by their endings are distinguished respectively from par, a golf term, and red, the colour. Use of the word charr for the three species of *Salvelinus* not only better indicates their affinities with one another, but avoids use of that overworked name trout.
4. *Paralepis coregonoides borealis* - New French and English vernaculars based on the shape of the chin whose tip is less vertical and more pointed than in the other three species known in the western Atlantic.
5. *Arctogadus borisovi* and *A. glacialis* - New French vernaculars based on the presence and absence respectively of a mental barbel.
6. *Gadus ogac* - The name Greenland cod has been applied to this species though it occurs more widely in Canada. Where the species is most common - Canada and Greenland - the Inuit call it "ogac." Rather than impose the bookish and geographically imprecise name, Greenland cod, we think it best to adopt the name in use by the inhabitants of the country. The name "ogac" has the added advantage of being short and easily pronounced (see Legendre, 1961).
7. *Nematonurus armatus* - New English and French vernaculars based on the reddish brown colour of the fish.
8. *Lycodes jugoricus* - New French vernacular, "lycode plume", from the root "shuluk" of the Inuit vernacular which means "plume" or feather.
9. *Lycodes mucosus* - New French and English vernaculars based on the characteristic markings which have the colour and shape of saddles.

NÉOLOGISMES

1. *Raja hyperborea* - Nouveau nom vulgaire français.
2. Au Canada, l'usage favorise l'épellation "Le Sueur" par opposition à la forme "Lesueur" employée aux États-Unis, la première étant davantage appropriée à un milieu bilingue.
3. *Salvelinus* - Etymologiquement, en anglais, il est préférable de doubler le "r" à la fin du terme "char" servant à désigner l'omble chevalier, afin d'éviter toute confusion avec "char" au sens de "femme de ménage". Ainsi orthographié, "charr" concorderait aussi avec certains termes ichthyologiques comme "parr" (saumonnet) et "redd" (frayère), probablement d'origine écossaise, dont on a doublé la consonne finale pour les distinguer respectivement de "par" (normale du parcours au golf), et de "red", indiquant la couleur rouge. En plus d'établir plus clairement les affinités entre les trois espèces de *Salvelinus* baptisées du nom de "charr", l'emploi de ce terme permet d'éviter l'usage abusif du mot "trout".
4. *Paralepis coregonoides borealis* - Les nouveaux noms vulgaires anglais et français de cette espèce s'inspirent de la forme du menton dont l'extrémité est moins verticale et plus pointue que chez les trois autres espèces connues dans l'ouest de l'Atlantique.
5. *Arctogadus borisovi* et *A. glacialis* - En français, les nouvelles appellations vulgaires de ces deux espèces se fondent sur la présence ou l'absence de barbillon.
6. *Gadus ogac* - Cette espèce porte souvent les noms de morue de roche ou morue du Groenland, bien qu'on la rencontre principalement au Canada. Là où elle est courante, soit dans les eaux du Canada et du Groenland, les Inuit l'appellent "ogac". Aussi croyons-nous préférable d'adopter le terme indigène plutôt que d'imposer le nom plus recherché, mais géographique-ment incorrect, de "morue du Groenland". La nouvelle appellation a, en outre, l'avantage d'être brève et de se prononcer facilement (voir Legendre, 1961).
7. *Nematonurus armatus* - Nouveaux noms vulgaires français et anglais choisis en fonction de la couleur brun roux des individus.
8. *Lycodes jugoricus* - "Lycode plume", le nouveau nom vulgaire français, est tiré de la racine du terme populaire "shuluk", qui désigne une plume en langue inuk.
9. *Lycodes mucosus* - Nouveaux noms vulgaires français et anglais rappelant les taches caractéristiques qui sont de couleur cuir et en forme de selles.

10. *Lycodes polaris* - We prefer to use polar eelpout / lycode polaire for this species to accord with the scientific name. The AFS list used polar eelpout for *Lycodes turneri*. We suggest ribboned eelpout / "lycode rubanée" in reference to its markings, for that species. The AFS name for the circumpolar *L. polaris*, Canadian eelpout, is geographically inappropriate.

11. *Lycodes seminudus* - New French and English vernaculars which refer to the rather long opercular lobe characteristic of the species.

12. *Anarhichas orientalis* - New French vernacular based on its occurrence in the Bering Sea.

13. *Acantholumpenus mackayi* - The AFS list introduced the name pighead prickback for this species. We have in hand probably the biggest museum series in existence; none of our specimens have heads resembling those of pigs. Therefore we have coined new vernaculars referring to the dark lines on the body.

14. *Ammodytes hexapterus* - The species is known from the Atlantic, Arctic and Pacific oceans making the adjective Pacific inappropriate. We therefore propose new vernaculars referring to its stoutness compared to *A. dubius*.

15. *Sebastes marinus*, *S. mentella* - The AFS list did not distinguish these two species. We therefore restrict redfish / "sébaste atlantique" to the bright red *S. mentella* and rosefish / "sébaste orangé" to the orange or yellowish-red coloured *S. marinus*.

16. *Artediellus scaber* - New vernaculars, the adjective applying to the rough tubercular skin.

17. *Artediellus uncinatus* - There are already nine species from our area imaginatively labelled with the adjective Arctic. We propose the names snowflake hookear / "hameçon neigeux" to replace "Arctic hookear sculpin." Snowflake refers to the white spots scattered on the dorsal fins of the male.

18. *Triglops murrayi* - New French vernacular.

19. *Triglops nybelini* - New English vernacular in reference to the big eye, and new French vernacular.

10. *Lycodes polaris* - Nous préférons utiliser les termes "polar eelpout / lycode polaire" comme équivalents du nom scientifique de cette espèce. Nous retrouvons dans la liste de l'A.F.S. (American Fisheries Society) les mots "polar eelpout" pour désigner le *Lycodes turneri*, mais nous proposons "ribboned eelpout / lycode rubanée" pour ce dernier. L'appellation "Canadian eelpout" choisie par l'A.F.S. est peu appropriée en raison de la répartition quasi circumpolaire de l'espèce.

11. *Lycodes seminudus* - Les nouveaux noms vulgaires français et anglais ont trait au lobe operculaire allongé qui caractérise l'espèce.

12. *Anarhichas orientalis* - Nouveau nom vulgaire français choisi en raison de la présence de cette espèce dans la mer de Béring.

13. *Acantholumpenus mackayi* - L'A.F.S. avait, dans sa liste, introduit le nom de "pighead prickback" pour désigner cette espèce. Le Musée national des Sciences naturelles possède probablement la plus vaste collection au monde de spécimens de cette espèce et, chez aucun de ceux-ci, la tête ne rappelle celle du porc. Nous avons donc rebaptisé l'espèce en fonction des lignes foncées apparaissant sur le corps.

14. *Ammodytes hexapterus* - L'espèce existe dans les océans Atlantique, Pacifique et Arctique, rendant l'emploi de l'épithète "pacifique" inappropriée. Nous proposons donc de nouvelles appellations ayant trait à la robustesse de ce poisson par rapport à l'*Ammodytes dubius*.

15. *Sebastes marinus*, *S. mentella* - La liste de l'A.F.S. n'établit aucune distinction entre ces deux espèces. Nous limitons donc l'emploi des termes "redfish / sébaste atlantique" au *Sebastes mentella*, de couleur rouge vif, tandis que "rosefish / sébaste orangé" désigne uniquement le *Sebastes marinus* de couleur orangée.

16. *Artediellus scaber* - Nouvelles appellations, l'épithète ayant rapport à la peau tubéreuse et rugueuse de ce poisson.

17. *Artediellus uncinatus* - Il existe déjà, dans les eaux arctiques du Canada, neuf espèces dont le nom est affublé de l'épithète "arctique". Nous proposons donc de remplacer "Arctic hookear sculpin" par les termes "snowflake hookear / hameçon neigeux". Ce qualificatif a trait aux taches blanches dispersées apparaissant sur les nageoires dorsales du mâle.

18. *Triglops murrayi* - Nouveau nom vulgaire français.

19. *Triglops nybelini* - Nouveau nom vulgaire anglais rappelant le grand oeil de ce poisson et nouveau nom vulgaire français.

20. *Agonus acipenserinus* - New French vernacular referring to its sturgeon-like head and bony plates.

21. *Cyclopteropsis jordani* - New vernaculars referring to the smooth skin almost lacking tubercles.

22. *Careproctus reinhardti* - New French vernacular.

23. *Liparis cyclostigma* - New adjective, dusky, to replace polka-dot, incorrectly associated with the colouration of this species. "... a color description applying to...*Crystallichthys cyclospilus* was added to the diagnosis of *cyclostigma* as the latter was passing through the press, ..." (Gilbert and Burke, 1912).

24. *Liparis herschelini* - New French vernacular referring to the Beaufort Sea in which the species is found.

25. *Paraliparis bathybius* - New vernaculars referring to the black colour of this species.

26. *Rhodichthys regina* - New vernaculars referring to the thread-like lower pseudopelvic rays of the pectoral fin.

27. *Hippoglossoides robustus* - New French vernacular based on the English.

28. *Platichthys stellatus* - New French vernacular based on the English.

20. *Agonus acipenserinus* - Nouveau nom vulgaire français faisant valoir la ressemblance de la tête et des plaques osseuses de ce poisson à celles de l'esturgeon.

21. *Cyclopteropsis jordani* - Nouveaux noms vulgaires ayant trait à la peau lisse, presque entièrement dépourvue de tubercules.

22. *Careproctus reinhardti* - Nouveau nom vulgaire français.

23. *Liparis cyclostigma* - Le nouvel adjectif "marbré" semble mieux adapté à la coloration de ce poisson. "... au moment de mettre sous presse, une description de la couleur du ... *Crystallichthys cyclospilus* a été ajoutée à la diagnose du *cyclostigma*..." (Gilbert et Burke, 1912).

24. *Liparis herschelini* - Nouveau nom vulgaire français indiquant qu'on trouve cette espèce dans la mer de Beaufort.

25. *Paraliparis bathybius* - Nouveaux noms vulgaires se rapportant à la couleur noire de ce poisson.

26. *Rhodichthys regina* - Nouveaux noms vulgaires se rapportant aux rayons pseudopelviens inférieurs, filiformes des nageoires pectorales.

27. *Hippoglossoides robustus* - Nouveau nom vulgaire français tiré de l'anglais.

28. *Platichthys stellatus* - Nouveau nom vulgaire français tiré de l'anglais.

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Review of:

The Urohyal in Fishes

D. E. McALLISTER

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Page 325



Environment
Canada

Fisheries and
Marine Service

Environnement
Canada

Service des pêches
et des sciences de la mer

The Urohyal in Fishes. *Takaya Kusaka.* University of Tokyo Press. 1974. 320 p., 10 text-figures + 700 figures. \$50.00. Distributed by International Scholarly Book Services, P.O. Box 4347, Portland, Oreg. 97208, USA.

Comparative studies have appeared in recent years on the branchial and hyoid arches. This book considers variation in the teleostean urohyal, a median ventral bony element lying between these arches and linking them with the shoulder girdle.

A short introduction presents the terminology and methodology used and makes generalizations about the form of the urohyal. An impressive 714 species representing 460 genera, 184 families, and 21 orders were investigated. The specimens studied were mainly from Japanese waters but these were supplemented by some material from the South Pacific and Indian oceans. Unfortunately the author did not secure specimens from eight orders and several suborders to complete the study.

The body of the text consists of illustrations and descriptions of the material studied. Line drawings depict the urohyal of each species in dorsal, lateral, ventral, front, and rear views accompanied by a

10-mm scale. The drawings are clear, and judging from a few with which I compared specimens, are accurate. The urohyal displays a remarkable variety of forms from scimitar to hook, paddle, and wing shapes. The text accompanying each drawing includes the scientific name, the locality at which the study material was collected, measurements and proportions, and, on occasion, comments comparing the urohyal with that of related species. The volume is completed by a short list of references and indices of scientific and Japanese names. The book is beautifully printed in sepia on tinted paper and is well bound.

Takaya Kusaka has contributed significantly to our knowledge of the form of the teleostean urohyal. He has made useful generalizations on the relationship of the form of the urohyal to the proportions and behavior of the fish. He forbore deducing taxonomic relationships from his data, thus providing a challenge to some enterprising taxonomist. The book will also be of value to the evolutionist and osteologist. Despite the many figures, the price of \$50.00 is high and probably beyond the budget of most.

D. E. McALLISTER

Curator of Fishes
National Museum of Natural Sciences
Ottawa, Ont.

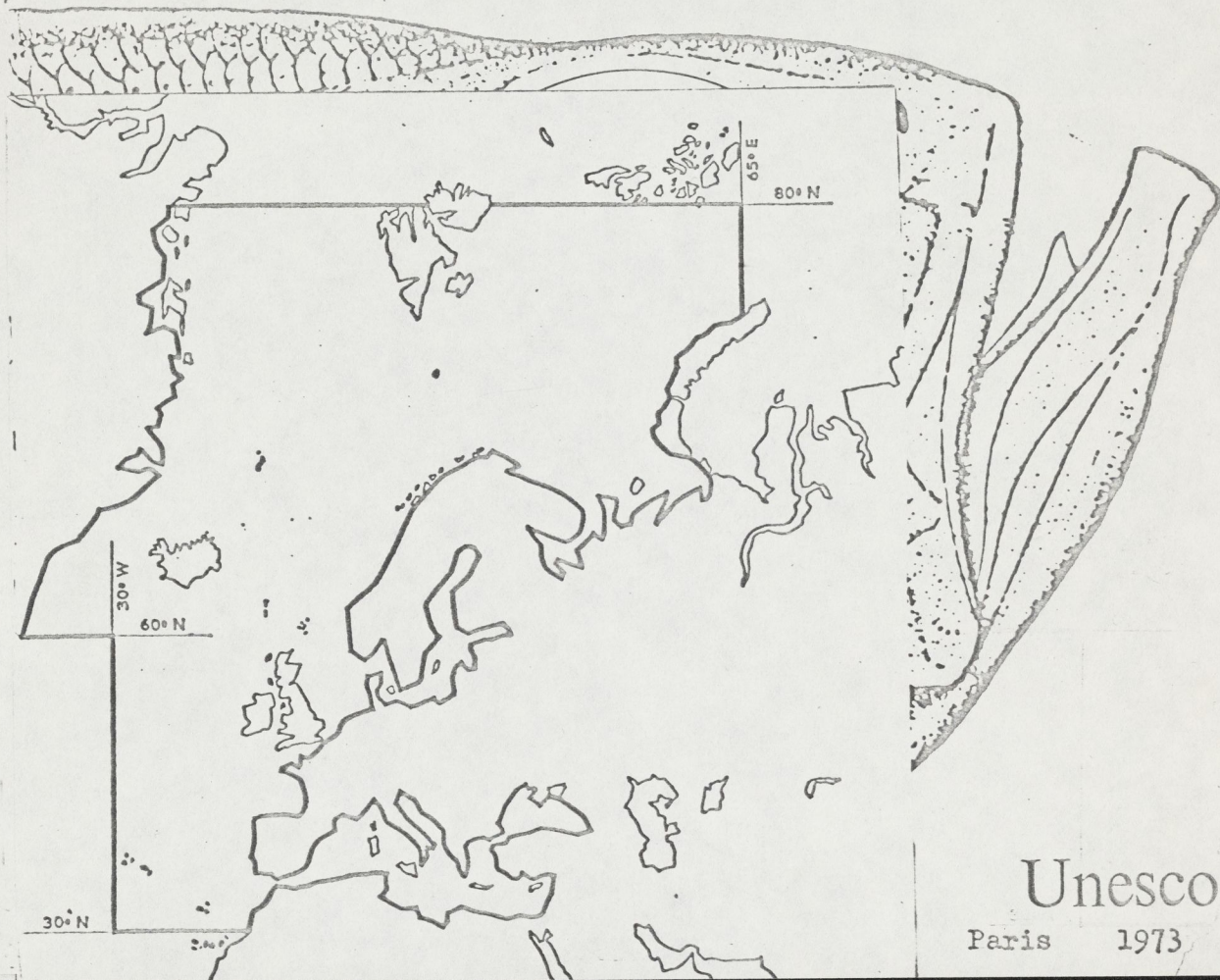
(R47)

Check-list of the fishes
of the north-eastern Atlantic
and of the Mediterranean

Clofnam I

Catalogue des poissons
de l'Atlantique du nord-est
et de la Méditerranée

Reprinted from Volume 1, pp. xxii + 683
(Volume 2, the Bibliography has 331 pages)
Editors/Rédacteurs:
J.C.Hureau & Th.Monod



Unesco
Paris 1973

49

Osmeridae

by V. A. Kljukanov & D. E. McAllister

G: 2

Sp: 3

- 49.1 **OSMERUS** [Artedi] Linnaeus, 1758 Gender: M
 Syst. Nat., ed. X : 310 (type: *Salmo eperlanus* L., by subs. design., Int. Comm. zool. Nomencl. Direction 69).
Eperlanus Rutty, 1772, Nat. Hist. County Dublin, 1 : 358 (type: *E. Schonfeldii* Rutty, by monotypy).
- 49.1.1 **Osmerus eperlanus** (Linnaeus, 1758)
Salmo (*Osmeri*) *eperlanus* Linnaeus, 1758, Syst. Nat., ed. X : 310 ('*Habitat in Europa, fluvios primo vere adscendens*').
Eperlanus Schonfeldii Rutty, 1772, Nat. Hist. County Dublin, 1 : 358 (Ireland).
Salmo eperlano-marinus Bloch, 1783, *Naturgesch. d. Fische Deutschlands*, 1 : 229, pl. XXVIII (fig. 1) (North and Baltic Seas, Germany, Denmark).
Salmo (*Osmerus*) *spirinchus* Pallas, 1811, *Zoogr. rosso-asiat.*, 3 : 387 (*ex parte*) (Lakes and rivers of Germany and European Russia, Beloye Ozero, Lake Chudskoye).
Eperlanus vulgaris Valenciennes in Gaimard, 1844, *Voyage en Islande et au Groenland*, Atlas Zool.: pl. XVIII (fig. 2) (Iceland, species unknown in Iceland according to Saemundsson, 1949 : 92).
Osmerus eperlanus: Valenciennes, 1848, in Cuv. Val., 21 : 371 (North Sea) | Moreau, 1881, 3 : 541 | Day, 1883, 2 : 121, pl. CXXI (fig. 1) | Smitt, 1895 : 869, pl. XLI (fig. 1) (col.) | Mohr, 1941 : 504, fig. 1–11 | Poll, 1947 : 157, fig. 103 | Berg, 1948 (*ex parte*) : 441, fig. 267 | Jensen, 1949 : 73, 2 fig. | Duncker, 1960 : 86, fig. 24 | Wheeler, 1969 : 160 | Kljukanov, 1969, 48 (1) : 108, fig. 1, 4 (1), 5 (1), 6 (1–2).
Osmerus eperlanus eperlanus: McAllister, 1963, *Nat. Mus. Canada, Bull.*, 191 : 20, fig. 6.
 Complementary iconography. Andersson, 1942, pl. 123 | Berg *et al.*, 1949, pl. 82 (col.).
 Eggs, larvae and young stages. Ehrenbaum, 1894 : 39, pl. I | Grieb, 1946 : 31, fig. 2–6.
 Otoliths (sagitta). No data.
 Habitat, distribution and abundance. Littoral to inshore neritic, anadromous or strictly freshwater. 0–32 m, coast and drainages from Gulf of Bothnia to mouth of Loire River, France, including southern Norway and British Isles (Common), White Sea east to the Pechora River of Barents Sea (Rare).
 Common names. Stint [De], smelt [En], éperlan [Fr], spierling [Ne], nors [No, Sv], stynki [Pl], koryushka [Ru], kuore [Su].
- 49.1.2 **Osmerus mordax** (Mitchill, 1814)
Atherina mordax Mitchill, 1814, *Rep. nat. Hist. N.Y.* : 15 (New York).
- 49.1.2.1 **Osmerus mordax dentex** Steindachner, 1870
Osmerus dentex Steindachner, 1870, *Sitzungsber. Akad. Wiss. Wien*, 61 : 9 (De Katri Bay, Japan Sea).
Salmo (*Osmerus*) *eperlanus* Pallas, 1811, *Zoogr. rosso-asiat.*, 3 : 386 (*ex parte*) (mouth of Ob River, Bering and Okhotsk Sea).
Osmerus dyvinensis Smitt, 1882, *Öfvers. Vet.-Akad. Förh.*, Stockholm, 39 (Severnaya Dvina, White Sea).
Osmerus eperlanus dentex: Berg, 1948 : 437, fig. 266 | Andriashev, 1954 : 111.
Osmerus eperlanus mordax: McAllister, 1963 (*ex parte*), 191 : 15, fig. 6 | Bigelow & Schroeder, 1963 (*ex parte*) : 559.
Osmerus mordax dentex: Kljukanov, 1969, 48 (1) : 108, fig. 3–4 (3), 5 (3), 6 (4).
 Complementary iconography. Berg *et al.*, 1949, pl. 81 (col.) | Nakamura, 1963, fig. 29.
 Eggs, larvae and young stages. Unanyan & Soin, 1963 : 25, fig. 1–4.

Otoliths (sagitta). No data.

Habitat, distribution and abundance. Littoral to inshore neritic, seldom more than 2 km off shore, 0–20 m, anadromous. White Sea and south-eastern Barents Sea including southwestern Novaya Zemlya (common); along the coasts of Arctic Seas from Kara River, Kara Sea east to Cape Bathurst, Canada, in Pacific from the Bering Straits south to Northern Korea and Hokkaido and to Vancouver Island, Canada.

Common names. Rainbow smelt [En: Canada], koryushka [Ru].

- 49.2 **MALLOTUS** Cuvier, 1829 Gender: M
Règne animal, ed. II, 2 : 305 (type: *Salmo groenlandicus* Bloch, by orig. design.).

- 49.2.1 *Mallotus villosus* (Müller, 1776)
Clupea villosa Müller, 1776, *Zool. Danicae Prodrum.* : 50 (Islandos; *ex* Olafsen).

- 49.2.1.1 *Mallotus villosus villosus* (Müller, 1776)¹
Salmo arcticus Fabricius, 1780, *Fauna Groenl.* : 177 (Greenland).
Salmo groenlandicus Bloch, 1793, *Naturgesch. d. ausländ. Fische*, 8 : 99, pl. CCCLXXXI (fig. 1) (Greenland).
Salmo lodde Lacepède, 1804, *Hist. nat. Poiss.*, 5 : 156, 219 (Greenland, Iceland, Norway, Newfoundland).
Clupea lodna Hermann, 1804, *Observ. Zool.*, 12 : 316 (Iceland).
Mallotus villosus: Cuvier, 1829, ed. II, 2 : 306 | Smitt, 1895 (*ex parte*) : 876, pl. XLI (fig. 2–3) (col.) | Jordan & Evermann, 1896 (*ex parte*) : 520 | Jensen, 1948 : 79, fig. 17–18 | McAllister, 1963, 191 : 38 (*ex parte*).
Osmerus microdon Valenciennes, 1848, in Cuv. Val., *Hist. nat. Poiss.*, 21 : 385, pl. 621 (no locality).
Mallotus villosus villosus: Rumjanzev, 1946, 22 : 48 | Berg, 1948 : 451 | Andriashev, 1954 : 117 | Walters, 1955 : 293 | Bigelow & Schroeder, 1963 : 576, fig. 133–136 | Kljukanov, 1972, 51 (6) : 855, fig. 1, 2 (2), 3.

Complementary iconography. Berg *et al.*, 1949, pl. 85 | Rollefson *et al.*, 1960, pl. 10A–10B.

Eggs, larvae and young stages. Ehrenbaum, 1909 : 346, fig. 131 | Templeman, 1948 : 65, 68, fig. 18–20 | Bigelow & Schroeder, 1963 : 579, fig. 136.

Otoliths (sagitta). Hansen, 1943 : 121, fig. 28A–28B.

Habitat, distribution and abundance. Littoral to neritic and epibenthic on fishing banks, 0–300 m. From Svalbard to Oslo, Norway, and from Greenland (North to Scoresby Sound) to Novaya Zemlya including Jan Mayen, Iceland and the Faeroes, north to Medvezhy and Madezhda Islands and Franz Josef Land; in west Atlantic from Thule, Greenland and Hudson Bay and Labrador to Maine. Rare to exceedingly abundant with strong seasonal and annual fluctuations.

Common names. Lodde [De], capelin [En], angmagssak [Esk], capelan [Fr], lodna [Is], smælt [Ne], lodde [No, Sv], moiva [Ru].

1. The junior author is not convinced that sufficient evidence has been published to demonstrate the recognition of subspecies and therefore adds the following synonym to the synonymy: *Salmo socialis* Pallas 1814, 3 : 389, pl. LXXXI (fig. 2) (islands between Asia and America, Kamchatka, Avatcha bay, mouth of rivers Shupanova and Schemaetschik), distribution in the Pacific south to Washington and Korea.

Fishes Stranded During Extreme Low Tides in Minas Basin, Nova Scotia

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Bleakney, J. S. and D. E. McAllister. 1973. Fishes stranded during extreme low tides in Minas Basin, Nova Scotia. *Canadian Field-Naturalist* 87: 371-376.

Abstract. Twenty-one species of fishes caught in Minas Basin during extreme low-water tides included five new records: *Enchelyopus cimbrius*, *Myoxocephalus scorpius*, *Cyclopterus lumpus*, *Liparis atlanticus*, and *Lophius americanus*. Thirty-six species have now been found in this area.

Introduction

The greatest tidal range in the world occurs in the Minas Basin, Nova Scotia, but it is usually the height of the tides that is emphasized in the literature. The extreme lows are equally spectacular, but are seldom observed by biologists, as the majority of such tides center around March and October when field work is minimized. Because of the gradual slope of the shore in the Minas Basin (Figures 1 and 2), the maximal Extreme Low Water Springs (E.L.W.S.) expose additional square miles of sublittoral habitat for periods of usually less than 30 minutes. These E.L.W.S. present the intrepid field biologist with the unique opportunity of an evening's stroll over the sea bed of Minas Basin. The majority of such tides in Minas Basin occur between the hours of 6 and 9, either in the morning or evening.

Collecting

During such occasional extreme tides between 1966 and 1972, 21 species of fishes (Table 1) were collected by hand from the floor of the Minas Basin off Kingsport, Kings County, at a site with high-water depths of approximately 48 feet. This area (E in Figure 3) is about 6/10 of a mile from strand line. Above the low-tide limits, the shore is a relatively smooth sloping expanse of sand and mud, with outcroppings of sandstone over the upper shore, and areas of scattered rocks common to the lower shore (Figure 3). The latter are carried

by ice movement from other parts of the Basin and from rock fill in the many derelict wharves (Figure 4).

The field technique consisted simply of arriving about one hour before low tide and following the receding tide, searching the pools as they become exposed. The fast-flowing ebb current is turbid and also creates ripples making it difficult to see, however once the tide has receded from the pools the surface becomes calm and suspended matter quickly settles out. On the flood tide, the pools were worked over again; by then they contained tracks and trails in the fresh silt revealing the presence of forms not otherwise visible or suspected.

Extreme Low Water Spring tides that are less than 1 foot above Datum on Tide and Current Tables for Saint John, New Brunswick, present the one possibility of studying this benthic community *in situ* (Bleakney 1972). It is not an area that can otherwise be examined visually because severe turbidity discounts the possibility of using SCUBA or underwater TV. It is unlikely that dredging would reveal the pattern of depressions and elevations which characterize this sublittoral region creating a peculiar landscape of innumerable pools and troughs mostly 3 to 6 feet long (Figure 2). Most pools are 1 to 4 inches deep with a bottom composition of fine silt. It would be difficult effectively to seine this habitat because each depression is surrounded by a jagged sand ridge of firmly cemented worm tubes constructed by the polychaete *Sabellaria*

TABLE 1. — Fishes of Minas Basin, Nova Scotia

Species		Huntsman (1922)	Bousfield & Leim (1960)	Leim & Scott (1966)	Other records†	Number of specimens, present study
Sea lamprey	<i>Petromyzon marinus</i>			+		
Thresher shark	<i>Alopias vulpinus</i>	+	+	+		
+White shark	<i>Carcharodon carcharias</i>				1	
Little skate	<i>Raja erinacea</i>	+	+			6
Barndoor skate	<i>Raja laevis</i>		+	+		
Winter skate	<i>Raja ocellata</i>		+			1
Atlantic sturgeon	<i>Acipenser oxyrinchus</i>		+	+		
Gaspereau	<i>Alosa pseudoharengus</i>		+		1	
American shad	<i>Alosa sapidissima</i>	+	+	+		1
Atlantic menhaden	<i>Brevoortia tyrannus</i>				1	
Atlantic herring	<i>Clupea harengus</i>		+		1	
Atlantic salmon	<i>Salmo salar</i>	+	+			
Rainbow smelt	<i>Osmerus mordax</i>	+	+		1	1
American eel	<i>Anguilla rostrata</i>		+			
# Fourbeard rockling	<i>Enchelyopus cimbrius</i>					1
Atlantic cod	<i>Gadus morhua</i>	+	+			
Atlantic tomcod	<i>Microgadus tomcod</i>	+	+		25	17
White hake	<i>Urophycis tenuis</i>	+	+			2
*Silver hake	<i>Merluccius bilinearis</i>		+			2
Atlantic silverside	<i>Menidia menidia</i>		+	+		12
Mummichug	<i>Fundulus heteroclitus</i>		+			
Northern pipefish	<i>Syngnathus fuscus</i>		+			6
Smooth flounder	<i>Liopsetta putnami</i>		+		3	7
Winter flounder	<i>Pseudopleuronectes americanus</i>	+	+		1	18
Windowpane	<i>Scophthalmus aquosus</i>		+			2
Striped bass	<i>Morone saxatilis</i>	+	+	+		
Butterfish	<i>Peprilis triacanthus</i>		+			
Sea raven	<i>Hemirhamphus americanus</i>	+	+	+		10
Grubby	<i>Myoxocephalus aeneus</i>	+	+	+		5
# Shorthorn sculpin	<i>Myoxocephalus scorpius</i>					1
# Lumpfish	<i>Cyclopterus lumpus</i>					1
# Atlantic seasnail	<i>Liparis atlanticus</i>					6
Ocean pout	<i>Macrozoarces americanus</i>	+	+			4
Rock gunnell	<i>Pholis gunnellus</i>	+	+	+		7
Northern sand lance	<i>Ammodytes dubius</i>		+			
# Goosefish	<i>Lophius americanus</i> (Observed)					1
Total species	36					

†From a 1959 National Museum seine haul at Evangeline Beach except for Atlantic menhaden which is a Royal Ontario Museum specimen from Kingsport wharf.

New records.

*Picked up dead.

+Netted off Burntcoat Head, Cobequid Bay.

vulgaris (Verrill), a species not noted by Bousfield and Leim (1960) as occurring in the Minas Basin. The diameter of these tubes is only in the order of 2 mm but they have been built one upon the other to form an intertwining layer,

as thick as 5 inches, which is easily crushed underfoot. Rocks are sparse in this "Crunchy Zone," but such items as a wooden barrel, a wharf piling, a tree trunk, and a rectangular stone block have been observed and each



FIGURE 1. Kingsport shore, Minas Basin, from a position at the edge of the *Sabellaria vulgaris* tube-worm zone, approximately 48 feet below high-water level, which is evident at the undercut base of the sandstone cliffs. Note large boulder-like sandstone outcrops on upper beach, scattered rocks across lower beach, and foreground of sand grains cemented into a carpet of worm tubes. Footprints near basket demonstrate the "crunchy" aspect of this zone, which is exposed only briefly by low water spring tides. Photo was taken 23 June 1971, (2.1' tide), but trenches created by moving ice blocks in February and March 1971 are still evident.

possessed a rich epifauna of barnacles, porifera, hydrozoans, ectoprocts, and nudibranchs. The Atlantic sea snail, *Liparis atlanticus*, was usually found associated with such solid objects.

The Fishes

Table 1 lists the fish species collected and now deposited at the National Museum of Natural Sciences, Ottawa, as well as other museum and literature records reported from Minas Basin by Huntsman (1922), Bousfield and Leim (1960), Leim and Scott (1966), and Case (1968.) It includes those specimens collected or recorded on 14 of 24 field trips to Kingsport by the senior author, usually accompanied by students; and one collection made by the second author in August 1959. Smaller specimens were

invariably in the pools, but larger fish were more often conspicuously perched upon the exposed *Sabellaria* ridges. No attempt was made to collect the larger specimens of skates, flounders, sea ravens, lumpfish, and goosefish on each trip as the prime interest was invertebrates and the fish collections were deliberately limited to only a few specimens of each species. The composition of the ichthyological strandings of these E.L.W.S. was always a surprise, and no two trips ever produced quite the same faunal list. Often one species dominated in the immediate limited acreage of the search group. There were skate nights, sea-raven mornings, species-diversity evenings, and on 5 October 1971 the unique appearance of dozens of the northern pipefish *Syngnathus fuscus* in a Basin where *Zostera* is unknown.



FIGURE 2. Sublittoral fringe at Kingsport showing acres of ridges of sand cemented together by the polychaeta *Sabella ia vulgaris* and shallow pools between. Twenty-one species of fishes have been found stranded in this habitat during maximal E.L.W.S. There is a characteristic paucity of rocks in this area. (26 April 1967; $-0.3'$ tide.)

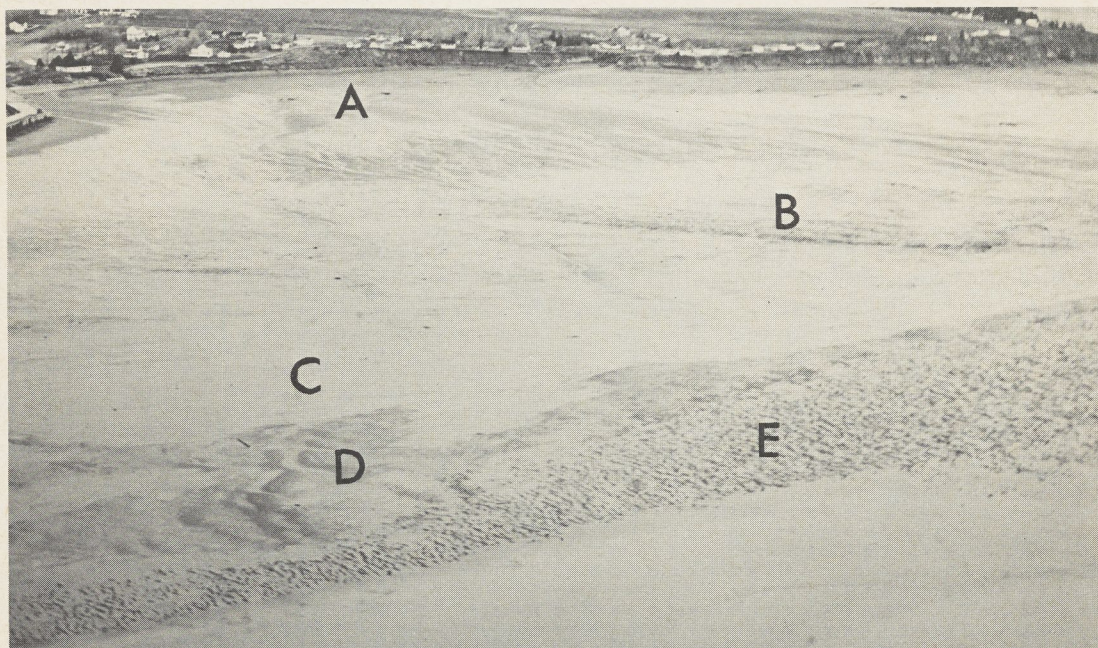


FIGURE 3. Air photo of beach area immediately east of Kingsport wharf, which is in upper left corner. Black objects on upper beach A, are sandstone outcroppings. The dark diagonal area B is strewn with rocks. Area C is muddy, D is sandy, and E consists of sand cemented together by the polychaeta *Sabellaria vulgaris*. (27 April 1971; $0.7'$ tide.)



FIGURE 4. Upper *Sabellaria* tube-worm zone showing ice-scoured trenches running diagonally from incoming tide. Stones in foreground and in centerground beside the basket (shown again in Figure 2) were transported by blocks of ice. (23 June 1971; 2.1' tide.)

Discussion

Twenty-one species were collected or observed on the Minas Basin tide flats. Benthic or benthopelagic species predominated and *Enchelyopus cimbrius*, *Myoxocephalus scorpius*, *Cyclopterus lumpus*, *Liparis atlanticus*, and *Lophius americanus* had not previously been reported from Minas Basin.

The reduced salinity of the basin, 29.0 to 30.5 reported by Bousfield and Leim (1960) and the discharge of the Avon and Schubencadie watersheds is reflected in euryhalinity of one third of the species. These are either anadromous, catadromous, or brackish-water tolerants.

Species stranded are deprived of the liquid medium upon which their vertical equilibrium depends and thus the presence of benthic fishes with flattened bodies, such as skates and floun-

ders, and those with large broad-base heads like the sculpins, liparids, and goosefishes is to be expected.

The turbidity fostered by extreme tides also presents potential difficulties, for Robins (1957) reported that much of the mortality in shore fishes during storms can be attributed to wave-disturbed sediments which clog the gills. Whether there has been selection for improved filtering mechanisms in Minas Basin populations has yet to be determined. Tomcod, the commonest Basin species, hake, and rockling are provided on the chin and filaments on the pelvic fin with barbels which bear taste buds (Herrick 1903), enabling these species to find food even though turbidity prevents visual prey location. Most of these species thus have one or more adaptations fitting them to live in this extensive Minas Basin intertidal zone with its dynamic semi-diurnal tides of nearly 50-foot amplitude.

Acknowledgments

The senior author was supported by a National Research Council Operating Grant and by many enthusiastic mud-splattered undergraduates. C. G. Gruchy critically read the manuscript.

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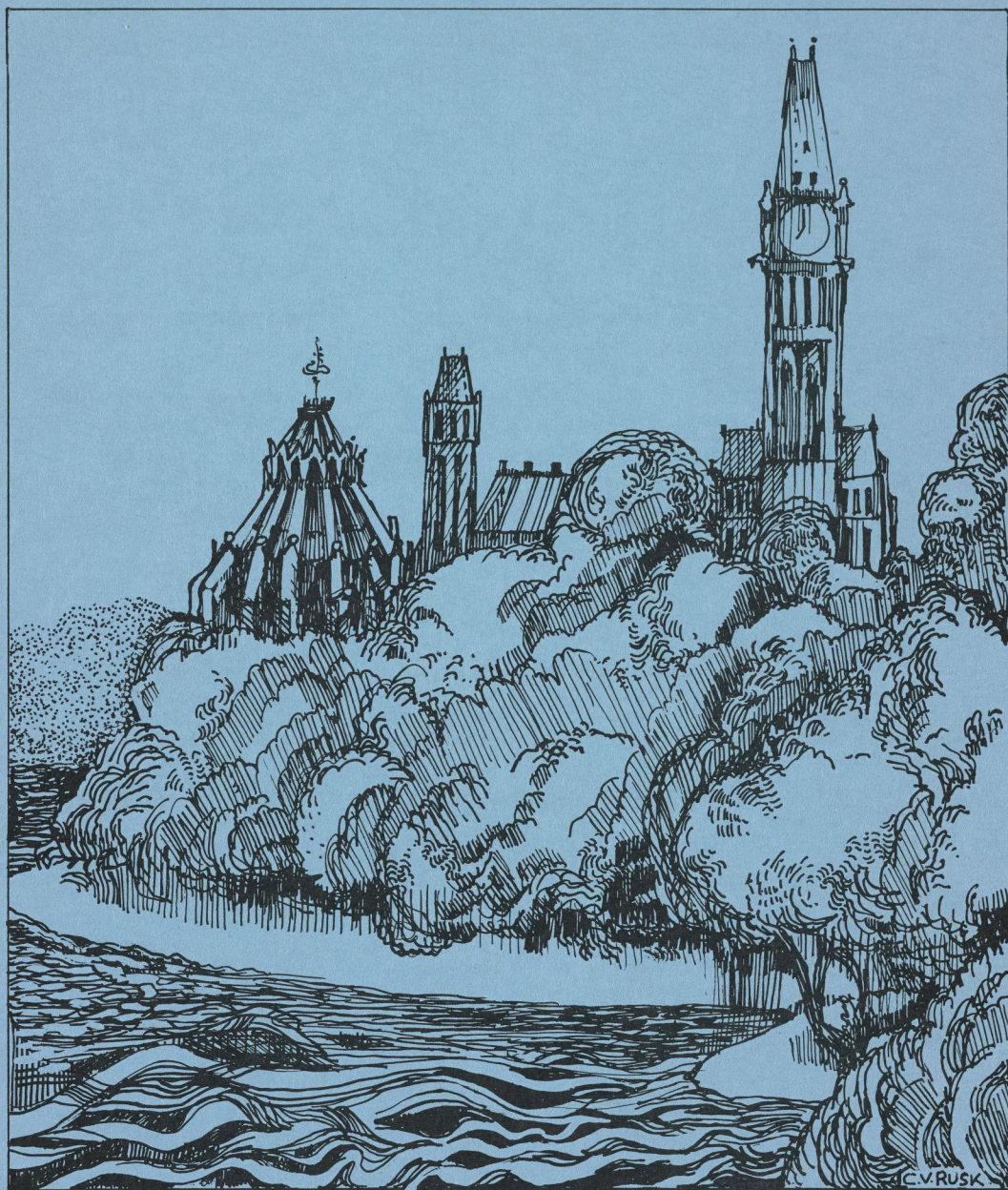
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**Fishes
of Canada's
National Capital
Region**

**Poissons
de la Région
de la Capitale
du Canada**



**D.E. McAllister
B.W. Coad**

**MSP 24 PDS 24
Ottawa 1974**

Fishes of Canada's National Capital Region

D. E. McALLISTER

B. W. COAD

This book is a tribute to the late Dr Jackson Sanford Hart, Principal Research Officer of the National Research Council of Canada.

A rich variety of 75 species of fishes lives in the rivers and lakes of Canada's National Capital region. This book seeks to assist the reader in identifying these species and in learning about their biology and distribution in the region. It is aimed at the amateur naturalist, the skin or scuba diver, and the angler. Perhaps it will also interest the biologist who wishes to locate populations of a certain species for study.

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Department of Fishery and Wildlife Biology

11 March 1980



Colorado State University
Fort Collins, Colorado
80523

Mr. Eric Parkinson
British Columbia Ministry of Environment
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c/o Institute of Animal Resource Ecology
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Vancouver, B.C. V6T 1W5
CANADA

Dear Eric:

I would assume that the native rainbow trout of the Dean River drainage should be typical coastal rainbows. However, the three specimens you sent bear a strong resemblance to the inland form of rainbow which I call the redband trout and which is commonly called Kamloops trout in B.C. The spots are relatively large and restricted to above the lateral line (versus small, profuse spotting in coastal rainbows). The parr marks are irregular, more oblong and are interspersed with smaller marks (versus more rounded parr marks in coastal rainbows). I counted 141, 143, 149 scales in the lateral series, which is about typical for upper Fraser R. Kamloops trout. The specimens have 19, 21, 21 gillrakers and 38, 52, 55 pyloric caecae. There is no indication of cutthroat trout influence.

Smith (1969, in Symposium on salmon and trout in streams) gave some taxonomic data on the summer-run steelhead of the Dean River. According to Smith the summer steelhead of the Dean have 129-149 scales and 17-21 gillrakers. I suspect that Smith counted the scales out to the caudal fin rays, instead of terminating the count at the end of the vertebral column. His counts for comparable samples seem about 5 to 6 higher than what I count.

Are your specimens from a resident or anadromous population? Could they be the result of stocking a new lake with Kamloops trout? The headwaters of the Dean are contiguous with headwater tributaries to the Fraser and stream transfers may have occurred to naturally establish resident stocks of Kamloops trout in the upper Dean drainage.

You mentioned you found a unique form of DLH-4 in this population. Does it occur in Dean River steelhead or in resident trout native to the contiguous parts of the Fraser basin?

Mr. Eric Parkinson
11 March 1980
Page 2

I suspect that the specimens represent an indigenous form. A management policy designed to protect the native form where stocking of hatchery trout occurs would have to consider if the lakes to be stocked have the native trout. In lakes stocked with hatchery trout, could the stocked fish run into rivers and hybridize with the native trout?

I can not say how distinct your specimens are from the summer-run Dean River steelhead discussed by Smith. They are, however, quite distinct from the rainbow trout I examined from Vancouver Island.

Sincerely,

Robert Behnke

RJB:kle

cc: Mr. William Pollard

Mr. Eric Parkinson
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Mr. William Pollard
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Canada.

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Sincerely,

ANALYSIS OF TROUT NATIVE TO SOME WESTERN VANCOUVER ISLAND STREAMS

Robert J. Behnke

November, 1981

SUMMARY

A total of 261 specimens, 124 collected in 1979 and 137 collected in 1980, from Saunders Creek, Heber River, Escalante River, Walbran Creek, Camper Creek, and Carmanah Creek, were examined to identify rainbow trout, cutthroat trout, and hybrids.

Cutthroat trout were found only in the collections from the lower Escalante River. Most other samples represent a predominantly rainbow trout genotype but with a slight cutthroat trout hybrid influence. This is especially true in those samples from above barrier falls. Habitat diversity evidently is the limiting factor governing the coexistence of rainbow trout and coastal cutthroat trout. Where suitable diversity is lacking (the absence of low gradient sections with sloughs and backwaters, and small tributary streams) the two species do not coexist and hybrid populations may result that mature at a small size (100 to 130 mm). In the samples of suspected hybrids examined, the influence of cutthroat trout is extremely slight.

CHARACTER EVALUATION

The basis for identification is my characterization of "typical" coastal rainbow trout, Salmo gairdneri irideus, and typical coastal cutthroat trout, S. clarki clarki, the two species native to Vancouver Island. A study of the systematics of cutthroat trout reveals three distinctly divergent branches of the species--coastal cutthroat trout, occurring along the Pacific Coast from Prince William Sound, Alaska, to the Eel River,

California, but rarely penetrating more than 200 km inland; the "westslope" cutthroat trout native to the upper Columbia River basin and to the South Saskatchewan and upper Missouri drainages; and the "Yellowstone" cutthroat trout of the upper Snake River and Yellowstone drainages. About 10 or 11 other subspecies of cutthroat trout represent subbranches off of the "Yellowstone" line. Thus, the coastal cutthroat trout represents a significant divergence long isolated from contact with any other form of cutthroat trout. There is, however, considerable genetic differentiation expressed in taxonomic characters and in life history and ecology found among local races of coastal cutthroat trout.

The evolutionary relationships of rainbow trout are more difficult to interpret because of the lack of geographic isolation between distinct ancestral forms. I currently recognize three major branches of S. gairdneri: a coastal rainbow trout (S. g. irideus); an interior group native to the Columbia River basin east of the Cascade Range and to the Fraser River basin above Hell's Gate (S. g. gairdneri), which is represented by races of steelhead, resident stream trout and lacustrine specialized forms ("Kamloops" trout); and, a more primitive group of the rainbow trout phylogeny native to segments of the Sacramento River basin, including the California golden trout, S. g. aguabonita. I have used the name "redband" trout for the latter two groups.

The taxonomic evidence indicates that considerable genetic interchange occurred during and since the last glacial epoch between all three major branches of the rainbow trout species. This makes it difficult to set definitive boundaries between the three major groups that would allow for consistent, positive identification.

Previous studies on British Columbia coastal cutthroat trout and rainbow trout found higher scale counts (in the lateral series) in rainbow

trout samples than in cutthroat trout--averaging about 150 in rainbows and 140 in cutthroat--(Vernon and McMynn 1957, Hartman 1956). Hartman also found mean values of 41.9 pyloric caeca in rainbow trout and 42.6 in cutthroat trout. At the time, these results appeared quite contrary to the common belief that rainbow trout could always be separated from cutthroat trout by fewer scales and more numerous pyloric caeca. Actually, the rainbow trout used in these studies was the interior redband or "Kamloops" trout (Cultus Lake stock) and the cutthroat trout was a resident stock of coastal cutthroat (Chilliwack Lake). The scale counts of interior redband trout typically average 140 to 155 and typical caecal counts average about 40. It is a common phenomenon for resident stocks of coastal cutthroat trout to have fewer scales in the lateral series than sea-run stocks (about 140 to 150 vs. 155 to 170).

From my previous studies I characterize coastal rainbow trout (S. g. irideus) by low scale counts (averaging about 120 to 135 in the lateral series and 24 to 30 scales above the lateral line), high pyloric caecal counts (typically 50 to 60), and a complete absence of basibranchial teeth. Coastal cutthroat trout (S. c. clarki) will average about 140 to 170 lateral series scales, 34 to 40 scales above the lateral line, about 40 pyloric caeca, and 100% occurrence of basibranchial teeth in pure populations. Other characters useful to separate coastal cutthroat trout from coastal rainbow trout are the longer head and jaw in cutthroat trout, narrower, elliptical shaped parr marks in cutthroat (vs. more rounded in rainbow), more heavily spotted adipose fin (often with black bordering edge) in cutthroat trout, and 9 pelvic fin rays in cutthroat trout vs. 10 pelvic rays in rainbow trout. There are fewer vertebrae in cutthroat (typically 60 to 63 vs. 62 to 65). Rainbow trout generally have more gillrakers (18-21 vs. 15-19) and better developed gillrakers (longer, attenuated

vs. short, blunt) than coastal cutthroat trout.

The character evaluation of the 261 specimens from 11 sites of 6 western Vancouver Island streams reveals that 11 specimens from the lower Escalante River are the only cutthroat trout found in the collections. There are 40 specimens of rainbow trout and two specimens identified as hybrids from the lower Escalante samples. The rainbows are probably young steelhead and the cutthroat probably represent young of a sea-run population. The other samples are identified as rainbow trout, although most of them have a definite, but very slight hybrid influence from cutthroat trout. Table 1 lists the characters found in the samples. There is a strong indication that Vancouver Island rainbow trout (and steelhead) average fewer pyloric caeca (40-50 vs. 50-60) than found in more southern populations of coastal rainbow trout. The samples collected in 1979 were partially decomposed and character values are only "best estimates." The 1979 sample values do, however, closely agree with the better preserved 1980 samples when compared from the same collection site.

Upper Saunders Creek

Nine specimens collected in 1979 show no definite indication of a cutthroat trout hybrid influence. The gillraker count (17-19) is somewhat lower than expected for pure rainbow trout but the scale counts (average 27.5 above lateral line and 124 in the lateral series) are typical values for coastal rainbow trout. No specimen has any sign of basibranchial teeth.

Upper Heber River

None of the 15 specimens collected in 1979 have basibranchial teeth, but scale counts (120-141 [131]) and more varied phenotypic appearance indicate a slight hybrid influence.

Lower Heber River

In contrast to other collections, the sample from the lower Heber River

Postglacial Fossil Fishes from Coppermine River, Northwest Territories, Canada

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McAllister, Don E. and Denis St-Onge. 1981. Postglacial fossil fishes from Coppermine River, Northwest Territories, Canada. *Canadian Field-Naturalist* 95(2): 203-205.

Fossils remains referred to Arctic Charr (*Salvelinus alpinus*), Arctic Grayling (*Thymallus cf. arcticus*), Northern Pike (*Esox cf. lucius*), and Slimy Sculpin (*Cottus cognatus*), were collected from freshwater, sandy-silt deposits at 66° 50' N, 115° 55' W. These may provide the earliest yet known Northwest Territories records of fishes originating from the Mississippian or Beringian refugia approximately between 8400 and 9000 years BP.

Key Words: fossil fishes, Coppermine River, Northwest Territories, *Salvelinus alpinus*, *Thymallus arcticus*, *Esox lucius*, *Cottus cognatus*, Pleistocene.

McAllister, Don E. and Denis St-Onge. 1981. Postglacial fossil fishes from Coppermine River, Northwest Territories, Canada. *Canadian Field-Naturalist* 95(2): 000-000.

Des débris fossils d'Ombre Arctique (*Salvelinus alpinus*), d'Ombre Arctique (*Thymallus cf. arcticus*), de Grand Brochet (*Esox cf. lucius*) et de Chabot Visqueux (*Cottus cognatus*) furent trouvés dans un dépôt de limon sableux à 66° 50' N, 115° 55' W. Ces restes représentent peut-être les témoins les plus anciens de poissons en provenance des refuges Mississippien ou Beringien des Territoires du Nord-Ouest approximativement entre 8400 et 9000 ans AP.

Mots clefs: Poissons fossils, Rivière Coppermine, Les Territoires du Nord-Ouest, *Salvelinus alpinus*, *Thymallus arcticus*, *Esox lucius*, *Cottus cognatus*, Pléistocène.

In this note we report on post-Wisconsin fish remains found in the valley of the Coppermine River at 66° 50' N, 115° 55' W, north-central District of Mackenzie, Northwest Territories. The Quaternary fish fauna of Canada is poorly known and Harington (1978) reports only two fossil fish collections for the Northwest Territories, and fishes from one of these have not been identified.

The fish remains occurred in an organic silty-sand unit, 1 m thick, at the top of a section which forms a 61-m-high bluff on the north side of the Coppermine River. Most of the outcrop is composed of outwash (sand, gravel, and drop stones) resting on an irregular till surface (boulders in sand-gravel matrix). These sediments are part of a hummocky terrain within the valley that are capped, in part at least, by the fossiliferous silty sand. A perched delta, 300 m upstream,

marks the level of a major glacial lake which formerly occupied the valley (Glacial lake Coppermine, St-Onge, in press). The 1-m-thick organic silty sand in which the bones were found appears to be river flood deposits which occur at an altitude similar to that of the delta.

Another major section, 30 m high, is exposed along a small stream (Quicksand Creek, 66° 49' 20" N, 116° 21' W), 15 km downstream from the high bluff. It shows three major units: bouldery till at the base; 22-25 m of varved sandy silts and clays covering the bouldery till; cross-bedded deltaic sands, 5-8 m thick which overlie the varves. In the deltaic sands is found a former channel filled with silty sand, rich in organic debris, and capped by a dense peat bed. The channel sequence is about 4 m thick. A piece of willow (*Salix* sp.) at the base of the channel fill has yielded an age of

8400 $\pm$ 80 (GSC-2959) while the peat at the top of the fill gave an age of 3210 $\pm$ 60 (GSC-2998).

National Topographic Series maps recently published (1979) by the Canadian Department of Energy, Mines, and Resources at a scale of 1:50 000 show that the top of both sections is at approximately 320 m asl. What then is the relationship between the fossil fish bed and the dated units in the Quicksand Creek section? It is difficult to imagine water being present at the top of the hummocky terrain unless it was part of Glacial Lake Coppermine. Because the fossiliferous bed occurs at an elevation corresponding to the highest level of the lake, it is reasonable to assume that the fish were alive during that period of maximum lake elevation, probably 8400–9000 years BP. This deduction has considerable paleoecological implications and will require substantiation by radiocarbon dating of organic material from the fossiliferous beds.

The fish remains studied consisted of numerous bones and scales, little eroded, in fine silty sand. All the bones and scales apparently originated from small specimens about 120 mm in standard length.

Species of Fossil Fishes

Four taxa of fishes were determined. From the bones identified, the relative frequency of taxa, with the most frequent first, seemed to be *Thymallus*, *Esox*, *Salvelinus*, and *Cottus*; the taxonomic position of many other bones difficult to determine were not identified. Catalogue numbers are those of the Paleobiology collection, National Museum of Natural Sciences, Ottawa.

Salvelinus alpinus, Arctic Charr

A single dentary (NMC 36122), 8.0 mm long, with the tips of the larger teeth hooked and pointing posteriorly, was identified as Arctic Charr. Jaw and tooth form distinguish this fossil from the Lake Charr (= Lake Trout, *Salvelinus namaycush*).

Harington (1978) did not list *Salvelinus alpinus* amongst the known Quaternary fishes of Canada and Alaska, so this specimen provides the first fossil record for this species in North America.

Thymallus c.f. *arcticus*, Arctic Grayling

Several small scales (NMC 36123) about 1.8 mm in diameter from juveniles of this species with their characteristic crenulate border (about five crenulations) were found. Among Canadian arctic fishes the Northern Pike (*Esox lucius*) is the only other species with crenulate scales, but the scales of pike have grooves running posteriorly from the crenulations, a feature lacking in these specimens.

We refer them to *T. arcticus*, rather than one of the Palearctic species, solely on the basis of provenance. Pleistocene *T. arcticus* have been reported from the Yukon Territory by McAllister and Harington (1968).

Esox c.f. *lucius*, Northern Pike

This species is represented by a few small dentaries (NMC 36124) about 11 mm long with teeth characteristic of the genus.

The fossils are identified as *E. lucius* instead of *E. niger*, *E. americanus*, or *E. masquinongy*, because it is unlikely that these three species would be found in the cool northern waters so soon after deglaciation. Evidently the Coppermine was deglaciated about 9500 BP. *Esox lucius* has been reported from late Pleistocene deposits in the Yukon Territory (Crossman and Harington 1970).

Cottus cognatus, Slimy Sculpin

The species was represented by a single almost complete preoperculum (NMC 36125). It is identified as *Cottus cognatus* rather than *Cottus ricei* because the spine forms a V with the body of the bone instead of a U. The bone is about 6.4 mm long, the spine 1.2 mm long. S. L. Cumbaa, D. E. McAllister, and R. E. Morlan have discovered a vertebral centrum attributable to *Cottus* from Pleistocene deposits in the northern Yukon Territory.

Discussion

The fossils bear significantly on the timing of dispersal of these species. All four had refugia in both the Beringia and the Mississippi system. Pike probably entered the upper Mackenzie from the Mississippi (McPhail and Lindsey 1970), hence the Coppermine population probably reached the area from the same source. These fossil pike thus fix the earliest known date for fish of Mississippian origin to have arrived in arctic Canada.

Slimy Sculpins presently in the Coppermine area appear to be intergrades between populations which survived glaciation in Beringian and Mississippian refugia (McAllister and Lindsey 1961), although closer in anal ray 'branching' to the form that survived in Beringia. Unfortunately the preoperculum does not have characters known to assign it to one of those forms. However, one can say that very shortly after the glacier had left the Coppermine area, *Cottus cognatus* from one of these refugia had already entered the region. Arctic Charr in the Coppermine area today display a mixture of forms which survived in Beringia and the Atlantic coastal plain (McPhail and Lindsey 1970).

The bones are all derived from small individuals thus suggesting shallow water. Possibly the fish were caught in a drying sandy pool near the margin of a river or lake, or an eroding sandy river bank collapsed into shallow waters. The four species are freshwater dwellers; none except for the Arctic Charr are anadromous.

The fine state of preservation of the bones and their

high density in the matrix suggest that further research on the fauna would be worthwhile. Additional species of, for example, Salmonidae, Catostomidae, or Gadidae may be represented. Occurrence of adult scales or operculas may reveal growth patterns and life cycles.

L. D. Farley-Gill, Quaternary Paleoecology Laboratories, Geological Survey of Canada, kindly identified a piece of wood as willow. We thank the National Museum of Natural Sciences scientists Stephen L. Cumbaa for confirming the identification of the Arctic Charr dentary and C. Richard Harington for criticizing the manuscript.

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Warmouth, *Lepomis gulosus*, a Freshwater Fish New to Canada

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Crossman, E. J., and Robert C. Simpson. 1984. Warmouth, *Lepomis gulosus*, a freshwater fish new to Canada. *Canadian Field-Naturalist* 98(4): 496-498.

The occurrence in Canada of the centrarchid *Lepomis gulosus* (Cuvier), Warmouth, is documented on the basis of specimens from the waters of Lake Erie in and near Rondeau Provincial Park and Point Pelee National Park.

Key Words: Warmouth, *Lepomis gulosus*, first Canadian record, Lake Erie

The latest northward movement of freshwater fishes into Canada, which began about 14 000 years ago as the Wisconsin glacier began to reduce, continues. Since 1968, at least six warm-adapted species which might be considered recent, natural migrants, have been reported from southern Ontario. Pioneer populations often go undetected, or are mistaken for known species, for several years prior to documentation.

The latest species to be documented is the centrarchid *Lepomis gulosus* (Cuvier), the Warmouth. The earliest known specimen was captured from Lake Erie at Rondeau Provincial Park (42° 17'N, 82° 31'W) by

Roger E. Roy on 5 June 1966 and is housed in the Rondeau Park Museum (RPM F103-66). Two further specimens were captured there in 1967, and three in 1968. No other specimens were reported until 31 March 1983 when one specimen (ROM 42752) was captured by G. Mouland farther west on Lake Erie in Lake Pond, Point Pelee National Park (41° 58'N, 82° 31'W).

Between 3 June and 18 October 1983, Mr. Mouland captured a total of 46 additional specimens from the same location. These consisted of 28 adults and 18 young-of-the-year. All but two of these were released alive. Two specimens, 155 and 90 mm TL, were

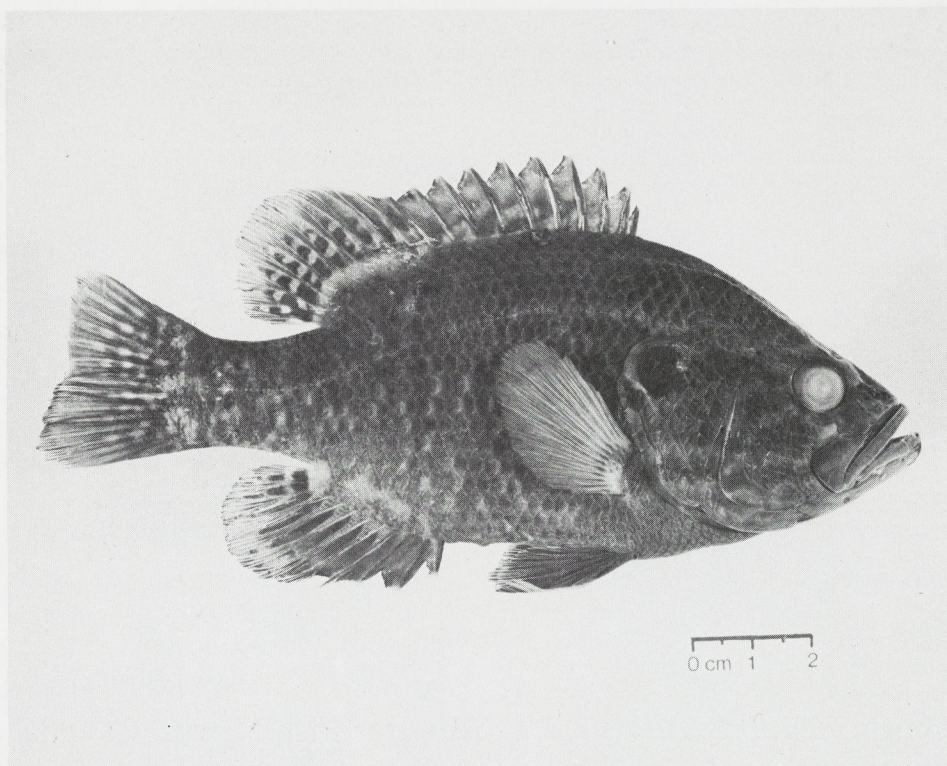


FIGURE 1. A specimen of *Lepomis gulosus* ROM 43022 captured by G. Mouland in Lake Pond, Point Pelee National Park, 3 June, 1983. The specimen is 155 mm TL. Note the large mouth, the three anal spines, and the round clear spots on the second dorsal fin.

retained as reference specimens (ROM 43022). No other records resulted from queries sent out, in late 1983, to all fisheries agencies along the Ontario shores of Lake Erie and of the Detroit and St. Clair rivers.

The only published notation of this species in Canada was a brief note (p. xv) in a section of new information added to the third printing (1979) of *Freshwater Fishes of Canada* (Scott and Crossman 1973).

The northern limit of distribution of the species (Lee et al. 1980) is a line from central Wisconsin to Maryland. The species extends southward to the Gulf coast, from Florida to Texas, and westward from the Atlantic coast to New Mexico. Although these Lake Erie records are the first from Canada, the species does occur farther north in Wisconsin (approximately 45°N, 89°W). The nearest populations are those in Michigan tributaries of Lake Erie rather than those across the lake in Ohio. Regardless of their source, it seems more likely that the pioneers moved around the shore rather than across the lake. In that case, one would have expected them to have appeared first at Point Pelee rather than Rondeau. It is also of interest

that, although no further specimens have apparently been seen at the original Rondeau location, a breeding population has been established at Point Pelee.

The known captures of Warmouth have been from ecological situations typical of sunfishes. Other centrarchids — *L. gibbosus*, *L. macrochirus*, *Pomoxis annularis*, *P. nigromaculatus*, *Micropterus salmoides*, and other "warm-water" fishes — *Amia calva*, *Ictalurus nebulosus*, *Perca flavescens* — were captured with this species at Rondeau Provincial Park in 1968.

ROM specimens (34267 Rondeau; 42752 and 43022 Point Pelee) were checked for meristic and morphometric characters. All values fall within the published ranges for the species.

Warmouth in Canada are most likely to be confused superficially with *Ambloplites rupestris*, Rockbass, and *Lepomis cyanellus*, Green Sunfish, the other small species of large-mouthed sunfishes. Existing keys to Canadian centrarchids, constructed without reference to *L. gulosus*, will probably identify specimens of *L. gulosus* as *L. cyanellus*. *Lepomis gulosus* differs from *Ambloplites rupestris* in having only

three anal spines instead of six. *L. gulosus* differs from *L. cyanellus* by the presence of many teeth on the tongue, round clear spots on the second dorsal fin (hard to see in preserved animals), and dark bands radiating out from the eye. *L. cyanellus* usually has an obvious black spot at the base of the last rays of the second dorsal fin and sometimes a less conspicuous one at the base of the last anal rays. There are no such spots on *L. gulosus*, and instead there is a line of black pigment across the base of all dorsal rays. Breeding males of *L. gulosus* do, however, have a bright orange spot at the base of the last dorsal fin rays.

All agencies along the Canadian shore of Lake Erie and its tributaries have been asked to watch for this sunfish and to report it in an attempt to document the rate of establishment of a new species. There have been recent records (Holm and Coker 1981; Nolte and Beletz 1984) of another sunfish, *L. humilis*, the Orangespotted Sunfish, new to the Canadian fauna. Those records (Cedar Creek — Lake Erie, Canard River — Detroit River) suggest that *L. gulosus* might appear north of Lake Erie as well.

Acknowledgments

We would like to thank the various people who recognized the possibility that they were dealing with a species new to Canada, and who assisted in making this information available to others: Roger Roy and

Bruce Thacker apparently caught the 1966 specimen and tentatively identified it as *L. gulosus*. At different times, specimens were checked and the identification verified by S. J. Nepszy and D. E. McAllister. We also acknowledge the assistance of K. H. Loftus, G. Moulton, W. B. Scott, J. H. Tadgham, M. Walters, and the representatives of Lake Erie agencies who replied to our queries. Erling Holm took the photo for Figure 1.

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The First Record of Grass Carp, *Ctenopharyngodon idella*, in Canadian Waters

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Crossman, E. J., S. J. Nepszy, and P. Krause. 1987. The first record of Grass Carp, *Ctenopharyngodon idella*, in Canadian waters. *Canadian Field-Naturalist* 101(4): 584-586.

An exotic cyprinid, *Ctenopharyngodon idella* (758 mm total length) was captured in Canadian waters of Lake Erie in September 1985.

Key Words: *Ctenopharyngodon idella*, Grass Carp, Lake Erie, first Canadian record.

The freshwater fish fauna of Canada continues to increase as a result of the northward movement of North American species which occurred previously only in the United States. Those events do not normally cause any considerable concern. The northward movement of certain exotic species introduced in the U.S. is another matter. The discovery of *Ctenopharyngodon idella* (Valenciennes) could be the beginning of a situation comparable only to that resulting from the escape into public waters years ago of captive Common Carp, *Cyprinus carpio*.

On 27 September 1985 P.K. captured a fish unknown to him in a trap net set in Lake Erie approximately 1 km off the west shore of Point Pelee National Park at the level of Lake Pond (41°57'40"N, 80°32'30"W). It was a male of the cyprinid species *Ctenopharyngodon idella*. When fresh, the specimen was 700 mm FL (fork length), 758 mm TL (total length) and 5.3 kg in weight (Figure 1).

Guillory (1980) indicated that there have been many records of this species from the state of Michigan in streams flowing into western Lake Erie and Lake St. Clair. The only records indicated by him for the state of Ohio were not from a Lake Erie tributary, but from an Ohio River tributary (Olentangy R.?) More recent Lake Erie records from Ohio are from the mouth of the Toussaint River west of Port Clinton, Ottawa Co., Ohio, 16 March 1985, and Trane Creek, western Lake Erie near Bono, Ohio, 30 April 1986 (personal communication, Ohio Department of Natural Resources). The only other record contiguous to Canadian waters is one on the south shore of Lake Ontario, near Rochester, N.Y. It would appear probable that this species has moved eastward around the end of Lake Erie from Michigan rather than across the west end of the lake. This route has been suggested for other recent immigrants (Crossman and Simpson 1984).

These Michigan and Ohio records are unusual since Allen and Wattendorf (1987) indicated that both diploid and triploid Grass Carp were prohibited in those two states.

The Grass Carp is a large, cylindrical cyprinid with a small, broad, blunt head, subterminal mouth, unspecialized lips and no barbels. The anal fin is far back on the body. The distance from the anal fin origin to the caudal base goes three or more times into the distance from anal origin to the tip of the snout (Pflieger 1975). The origin of the short-based dorsal fin (7 or 8 rays) is directly over or slightly behind the origin of the pelvic fins. Scales in the lateral line (40-45) are large compared to those of native cyprinids, and scales on the back and sides are prominently marked with dark pigment. Number and arrangement of pharyngeal teeth is often cited in North American literature as 2,4-4,2. Berg (1965), however, gave a range of combinations including one tooth in the inner row and five in the outer row. The right pharyngeal arch of the Lake Erie specimen (Figure 2) had 1, 5 teeth. These teeth are large and long, and the crowns are strongly compressed with deep parallel grooves on the sides and grinding surfaces. *Ctenopharyngodon* means "comb-like throat teeth." *C. idella* is a large cyprinid, said to reach 1 m in length (Smith 1979) and 32 kg (Berg 1965) or 45 kg (Fedorenko and Fraser 1978) in weight.

We suggest that the only probable confusion in identification in Ontario would be with large individuals of *Semotilus corporalis*. General body shape is vaguely similar, scales are large and prominently pigmented (differently, however), and pharyngeal teeth can be the same in number and arrangement. The head of *S. corporalis* is larger in relation to body length, the anal fin is farther forward (2+ times rather than 3+ times for the ratio given above for *C. idella*), and the crowns of the teeth would not be

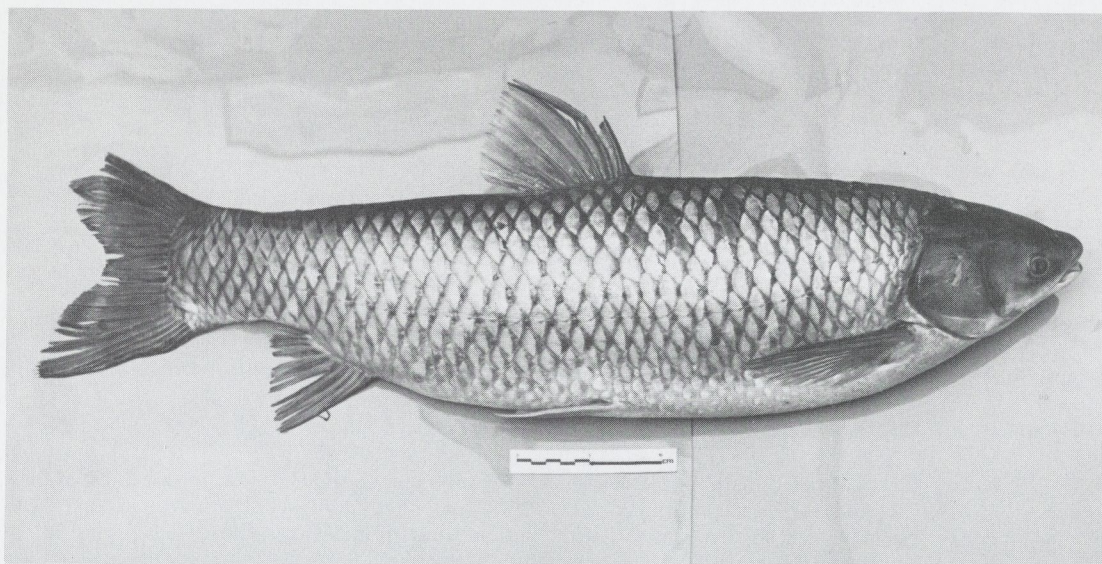


FIGURE 1. *Ctenopharyngodon idella* — 758 mm TL., male, Lake Erie, 1985. ROM 49248.

as compressed or grooved. Large *S. corporalis* would probably have visible flap-like maxillary barbels. *S. corporalis* does not presently occur in Lake Erie, so this confusion will not occur unless pioneers cross eastern Lake Ontario.

This species, sometimes referred to as the White Amur, was first introduced in Alabama and Arkansas from Taiwan and Malaysia and now exists in at least 40 U.S. states. Its native range is from the Amur River in Eastern U.S.S.R. south to the West River in

Southwest China and Thailand (Guillory 1980). It tolerates water temperatures of 0-35°C and oxygen concentrations as low as 0.0005 ppt (Guillory 1980). It is largely vegetarian, apparently consumes more than its body weight in food per day, and in Illinois, reaches 6.5 kg by its third summer (Smith 1979). Egg number was cited by Berg (1965) as 816 000 for an individual in the U.S.S.R. 76 cm in length and 7.4 kg in weight. This measure of reproductive potential is double that of the muskellunge, *Esox masquinongy*, one of the more fecund of local species, but lower than that of the carp, *Cyprinus carpio*. The testis of the specimen reported here was not highly developed.

The major apprehension, as stated by Pflieger (1975), is that *C. idella* may destroy fish and wildlife habitat by eliminating all vegetation. The Grass Carp was originally imported into the U.S. as a possible control of nuisance aquatic vegetation; potential damage to desirable vegetation represents its major detraction in Canada (see Fedorenko and Fraser 1978). Apparently (Anonymous 1987) Grass Carp "located in ponds have been known to eat the roots out from under plants growing along the shoreline and even drag vegetation down into the water once they have exhausted the supply of submerged and emergent water plants." It also consumes animal matter and may be a scavenger (Smith 1979) or predator on young fishes (Fedorenko and Fraser 1978). Smith and Shireman (1983) summarized much of the biology of this species.

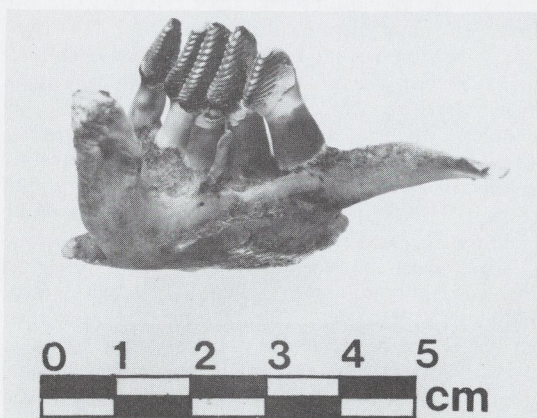


FIGURE 2. *Ctenopharyngodon idella*, showing the right pharyngeal arch with characteristic deep parallel grooves in the four teeth in the principal row.

The risk of an established population in Canada is somewhat lessened by the fact that it apparently grows well only in warm water, spawns (only?) in running water at 27-29°C (Wheeler 1975), and is not known to be established at most of the sites where it has been introduced (Guillory 1980). However, the northern limit of native distribution (approximately 50°N) corresponds to a line through Ontario at the level of Lake Nipigon.

Grass Carp supplied now from Stuttgart, Arkansas, for introduction in U.S. states are certified by the U.S. Fish and Wildlife Service to be triploid (Anonymous 1985) and therefore sterile. The nature of the testis of the Lake Erie specimen suggests that animal may not have been sterile.

Acknowledgments

Photos by Bill Robertson, ROM.

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National Museums
of Canada

Musées nationaux
du Canada

National Museum
of Natural Sciences

Musée national
des sciences naturelles

April 25, 1985

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

Dear Bob:

It seems about a 100 years ago that you wrote me to see if we had the "types" of Salmo irideus morpha argentatus Bajkov, 1927. I replied no.

I've just received a letter from D.B. Donald (enclosed) who states he is sending trout specimens from the type locality, Buffalo Prairie Lake and Caledonia Lake. Due to stocking the original fish may have been genetically replaced, swamped or diluted. *Would you like to see them after we've looked at them?*

I've restudied Bajkov's Catostomus catostomus lacustris and found a subspecifically distinct form in one of the four lakes from which he described it. So *it* might be worth checking into. *the Salmo morpha*

I'm trying to finish my list of fishes of Canada, and have started pecking at Marine fishes of Arctic Canada again, having finally got our new computer cataloguing system going.

What are you up to?

Give my best to Steve Platania.

Best regards,

Don E. McAllister,
Curator of Fishes

DEM/t1

TO
A DON McALLISTERFROM
DE D. B. DONALD

CWS.

SUBJECT
OBJET

National Park Fishes.

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N/RÉFÉRENCE

YOUR FILE - V/RÉFÉRENCE

DATE

MARCH 28, 84

The Parks Group - CWS will be ~~dis~~ disbanded as of MARCH 31. I am heading off to Regina to work with the Water Quality Directorate.

In the process of cleaning up my laboratory, fish were catalogued and will be sent to you shortly. Nothing unusual as far as I can see, except perhaps for the Wabassolake rainbows. These fish are from Bajkou's (1927) Buffalo Prairie lake. He based his subspecies on Salmo from this lake and Caledonia lake. You now have specimens from both locations. Salmo gairdneri has been stocked extensively for several decades throughout the region, and genetic purity of the present populations cannot be guaranteed.

I will be putting together a major synthesis of PARK fisheries resources over the next 2 or 3 years, as time permits. Thus, my interest in fish will continue for at least the next few years.

Don E. McAllister, Curator of Fishes
The National Museums Les Musees Nationaux
of Canada du Canada
Ottawa, Ontario K1A 0M8



VIA AIR MAIL
PAR AVION

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



**A Summary of Wild Steelhead Smolt
Enumeration and Habitat Productivity
Studies at Quinsam River, 1976-1984**

by

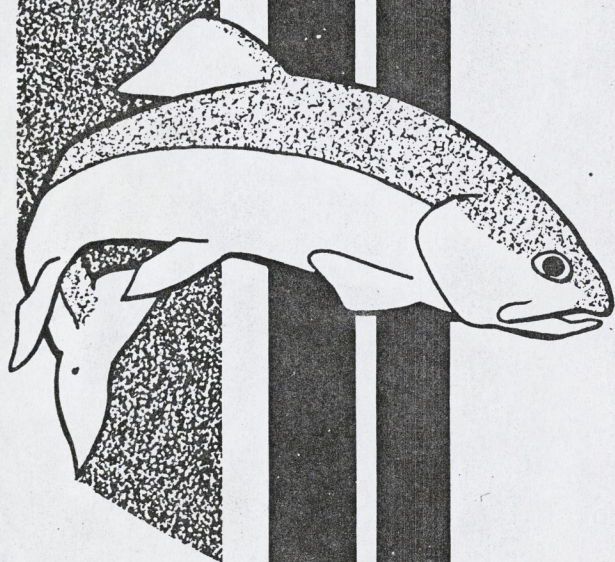
M. G. Lirette

R. S. Hooton

W. R. Olmsted

FISHERIES TECHNICAL CIRCULAR No. 67

1985



Province of British Columbia
Ministry of Environment

A SUMMARY OF WILD STEELHEAD SMOLT
ENUMERATION AND HABITAT PRODUCTIVITY STUDIES
AT QUINSAM RIVER, 1976 - 1984

by

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FISHERIES TECHNICAL CIRCULAR NO. 67

1985

ABSTRACT

Emigrant steelhead parr and smolts were enumerated at the Quinsam River counting fence by the Ministry of Environment and the Department of Fisheries and Oceans from 1976 to 1984. Total emigration during each of these years was calculated by mark/recapture. Age, length and weight data were collected from subsamples. Estimated mean numbers of steelhead parr and smolts emigrating from the Quinsam River were 14,446 and 6,975., respectively during the years of trapping. Smolt ages 2. and 3. comprised the majority of the sample, and age 2. was numerically dominant. Estimated smolt numbers were compared with the yield predicted by the Ministry's production model developed for Keogh River. This model overestimated Quinsam River smolt production by approximately 75 percent. Smolt yield resulting from outplanting above impassable barriers was slightly over 2 percent and represented minimal steelhead production. Factors which affected estimated parr and smolt production, and management implications are discussed.

ACKNOWLEDGEMENTS

The authors wish to thank Department of Fisheries and Oceans staff at Quinsam River hatchery for their assistance in providing data used in this report. L. Carswell was instrumental in coordinating Fish and Wildlife data collection requirements. A.F. Tautz, P.A. Slaney and V.A. Lewynsky contributed editorial comments.

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INTRODUCTION

The Campbell/Quinsam rivers, located on the east coast of Vancouver Island (Fig. 1) support substantial production of steelhead trout (Salmo gairdneri). Annual angling effort and catch per unit of effort for the Campbell/Quinsam rivers is estimated to be among the top five for Vancouver Island and among the top 15 in British Columbia (Steelhead Harvest Analysis 1978-79; 1979-80). In 1975, the Ministry of Environment (MOE) and Department of Fisheries and Oceans (DFO) initiated artificial production of Pacific salmon (Oncorhynchus spp.) and steelhead trout in the Quinsam River hatchery. Hatchery-produced smolts were first liberated to the Campbell/Quinsam rivers in spring, 1976 (Hooton 1978). The sport fishery for winter steelhead trout occurs from November through April and is generally concentrated on the lower 3 km of the Quinsam River and from the hydroelectric impoundment on the Campbell River mainstem downstream approximately 4 km to tidal waters. Summer steelhead trout which originate only from Campbell River are taken primarily in the Campbell River mainstem. Census data indicate annual angler effort of 4,000 to 7,000 days on both rivers for a combined catch of 500 to 700 wild steelhead trout (Carswell unpubl. data).

As part of a comprehensive evaluation program on the Campbell/Quinsam system, the present report has the objective of amalgamating smolt data collected at the Quinsam River counting fence from 1976 to 1984, and comparing production with that predicted by a model developed by Slaney (MS 1981). In addition, the results of stocking fry into the headwater of the Quinsam River will be examined.

STUDY AREA

The Quinsam River is 38.6 km in length from Upper Quinsam Lake to the Campbell River confluence (Bell and Thompson 1977) and is partially regulated in flow. The watershed drains an area of 200 km², and discharges ranged from 0.9 m³/sec to 218.0 m³/sec (Water Survey Canada 1983). Mean monthly flows are greatest from November to March and lowest from July through September (Water Survey Canada 1983). An average of 2.8 m³/sec is diverted from Quinsam River to Lower Campbell Lake to support hydroelectric requirements for the

Campbell River (Ballantyne 1960). Anadromous fishes can ascend the watercourse a distance of 21.7 km from the Campbell River confluence. Apparently, only steelhead trout can ascend the rock cascade obstruction, while a second obstacle 25.7 km from Campbell River and immediately above the confluence of Quinsam and Iron rivers, is impassable to all salmonids (Fig. 1). The Quinsam River hatchery and enumeration fence are located 3 km upstream from the confluence at the Quinsam with the Campbell River.

METHODS

SMOLT ENUMERATION

The Quinsam River diversion fence is constructed from steel and aluminum frame, and consists of 20 - 1.3 m wide panels which span a wetted width of 26.8 m. Panels were fitted with stop logs to divert flows and enhance juvenile salmonid trapping. From 1976 to 1984, varying numbers of panels were either stop logged or covered with plywood to prevent downstream passage of juvenile salmonids. These panels were fitted with 0.3 m (mouth diameter) Wolf traps to capture emigrant smolts. Dates of trapping varied from year to year but typically extended from late April to mid- to late June.

Traps were checked daily during each fishing day, adjusted and cleaned of debris. Trapped juvenile salmonids were collected in a live box. Totals of steelhead smolts and parr were recorded during each fishing day. All smolts and parr were released downstream of the traps following enumeration and biological sampling.

Trap efficiency was calculated by the mark/recapture of coho (O. kisutch) smolts marked either by adipose fin excision or by application of a coloured staple posterior to the dorsal fin. One to eight calibrations were done each season under various flows. Annual trap efficiency was calculated as the simple average of the mark/recapture calibrations. Total emigration was estimated as the total fence count divided by the proportion captured.

An additional complication was introduced by the varying periods over which the traps were run each year. Using the years for which the most extensive data were available (1976 and 1980), the proportion of the run emigrating during various time periods was calculated. These values were then used to estimate the proportion of the run emigrating during periods in other years when the traps were not operating. These adjustments were typically made at the beginning and end of the run and varied from 2 to 11 percent of the total estimate.

Subsamples of steelhead parr and smolts were weighed on an Ohaus Model 2610 balance (± 0.1 g) and measured (nose-fork; ± 1 mm). Fish were anaesthetized in 2-phenoxyethanol prior to measurement. Scale samples were taken from smolts only from the preferred area (Mosher 1963) and mounted between glass microscope slides. Ages were determined from the scale images magnified 100 times with a Lietz Pradovit projector.

BIOPHYSICAL INVENTORY

During September 1980, an inventory for the Quinsam River drainage was conducted using the methodology developed by the MOE for the Keogh River (Slaney MS 1981). The watercourse was subdivided into channel type and habitat units, and reach lengths and widths measured with an optical field rangefinder. Depth of each habitat unit was subjectively estimated, as were the following stream characteristics (percent of wetted area covered by):

- instream debris
- overstream cover within 1 m of the watercourse surface
- surface turbulence obscuring substrate visibility
- instream boulders

Table 1. Estimated numbers of emigrant steelhead smolts through the Quinsam River counting fence, 1976 - 1984

Year	Date	Numbers of Smolts Trapped	Trapping Coefficient	Estimated Total for Trapping Period	Percent Trapped	Estimated Total Emigration
1976	22/04-21/06	1,203	4.00	4,812	100	4,812
1977	26/04-11/06	3,234	1.63	5,276	97	5,439
1978	30/04-05/06	3,704	1.52	5,630	89	6,326
1979	01/05-05/06	529	15.97	8,448	89	9,492
1980	24/04-15/06	857	9.74	8,347	100	8,347
1981	01/05-17/06	656	9.55	6,265	92	6,810
1982	04/05-17/06	901	6.64	5,983	92	6,503
1983	13/04-06/06	806	8.89	7,165	97	7,608
1984	26/04-25/06	358	16.45	5,889	65*	9,060
Mean		1,361	8.27	6,424	91	7,155

* high discharges during the period of emigration resulted in a high percentage of days with no trapping effort. The calculated value is based on previous years trap efficiency and migration timing

Table 2. Estimated numbers of emigrant steelhead parr through the Quinsam River counting fence, 1978 - 1984

Year	Date	Numbers of Parr Caught	Trapping Coefficient	Estimated Total for Trapping Period	Percent Trapped	Estimated Total Emigration
1978	30/04- 05/06	8,362	1.52	12,710	89	14,281
1979	01/05- 05/06	1,020	15.97	16,289	89	18,302
1980	24/04- 15/06	1,996	9.74	19,441	100	19,441
1981	01/05- 17/06	1,051	9.55	10,037	92	10,910
1982	04/05- 17/06	1,679	6.64	11,149	92	12,118
1983	13/04- 06/06	1,083	8.89	9,628	97	9,926
1984	26/04- 25/06	746	16.45	12,272	76*	16,147
Mean		2,277	9.82	13,075	91	14,446

* high discharges during the period of emigration resulted in a high percentage of days with no trapping effort. The calculated value is based on previous years trap efficiency and migration timing

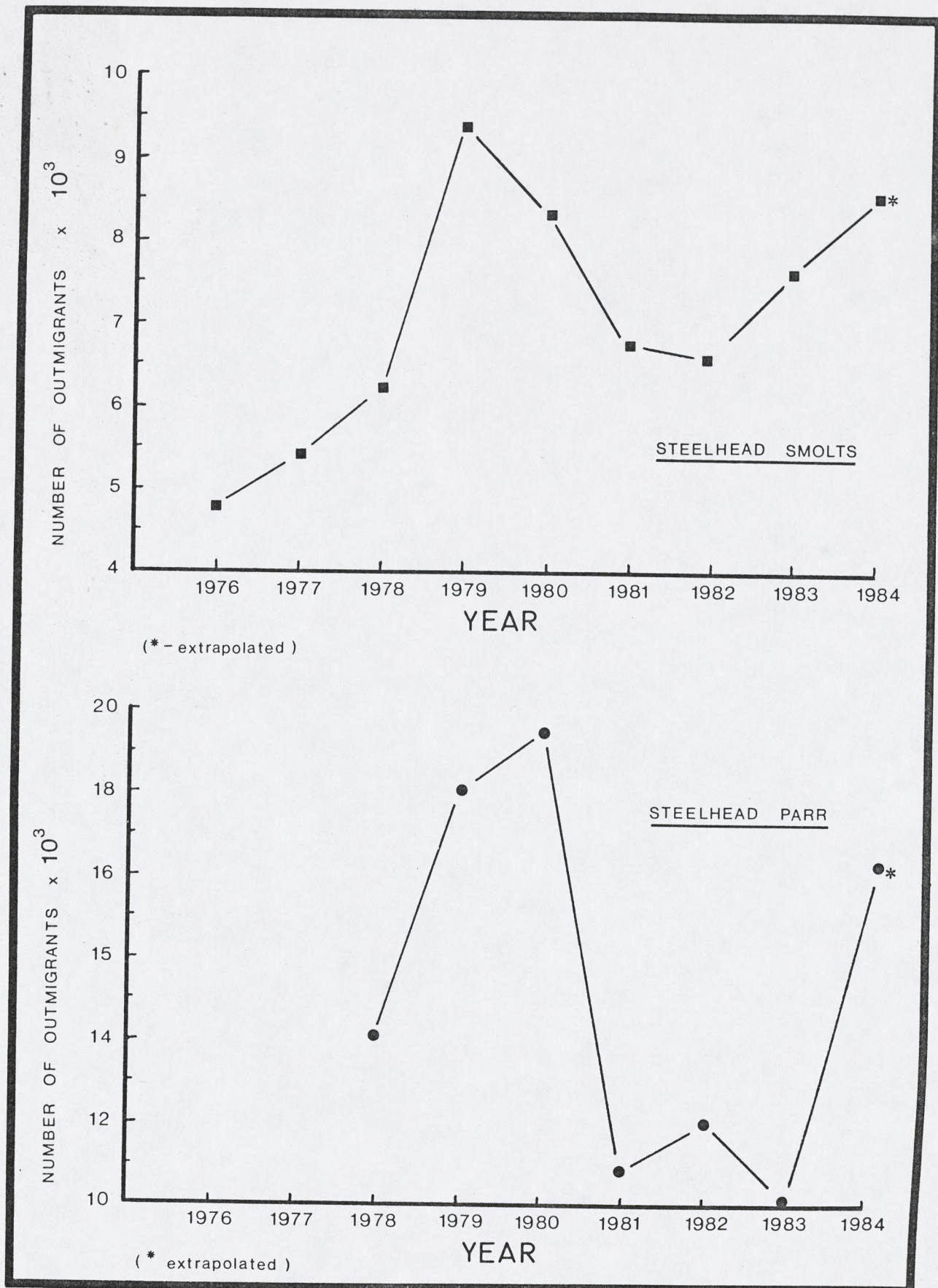


Figure 2. Estimated total steelhead smolts and parr emigrants, Quinsam River, 1976 - 1984.

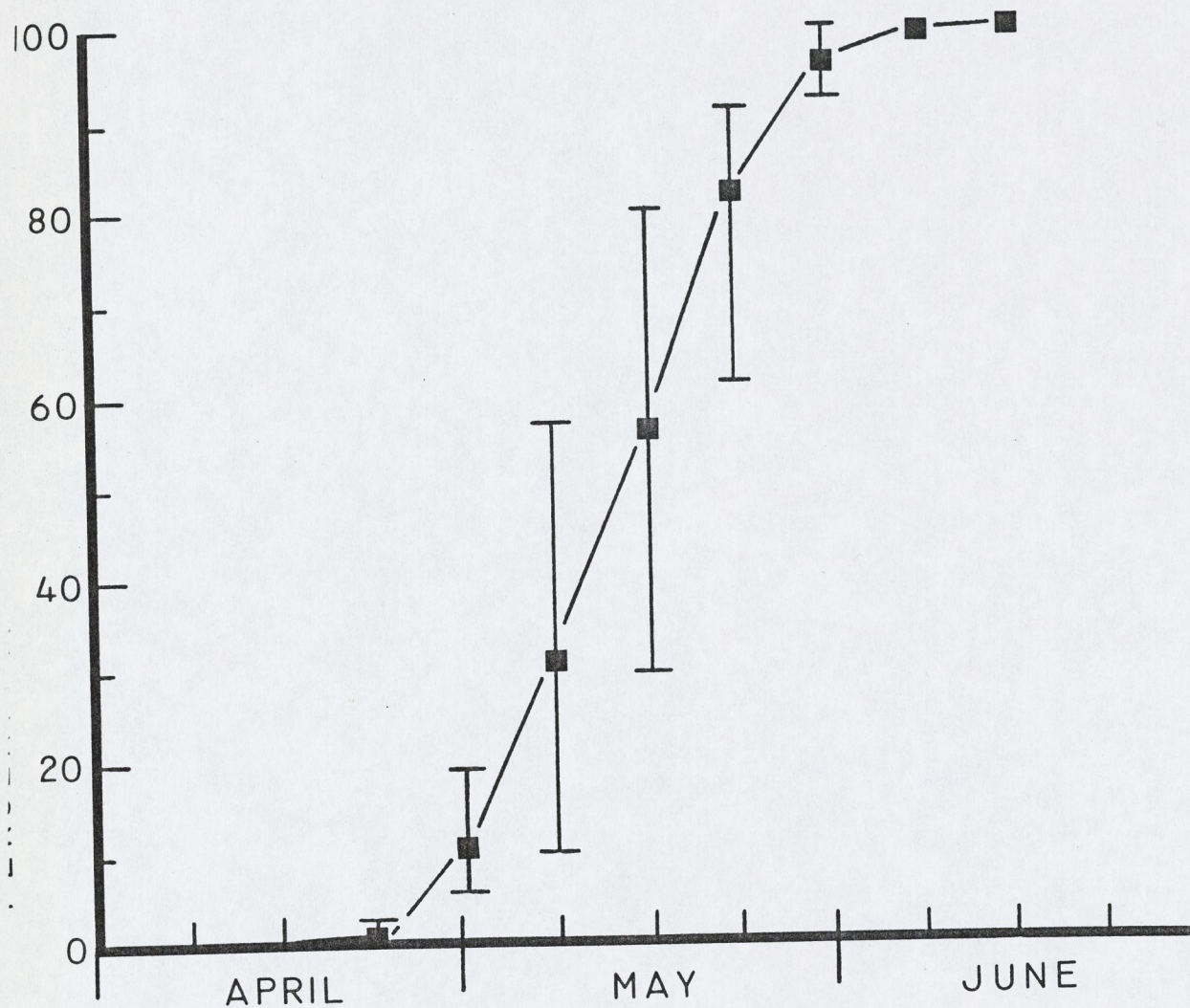


Figure 3. Timing of steelhead smolt migration through Quinsam River counting fence, calculated as mean accumulated percent migration per week (with ranges), 1976 - 1984.

From 1976 to 1981, mean length and weight of Quinsam River steelhead smolts was 170 mm and 48.0 g, respectively (Table 3). During this period, length ranged from 164 mm to 175 mm, and weight from 40.0 g to 52.2 g. Condition factor ($K = 100W [g]/L^3$) ranged from 0.91 to 1.02. From 1976 to 1981, mean length and weight of emigrant parr was 96.8 mm and 9.0 g. Condition factors ranged from 0.95 to 1.01.

Table 3. Mean lengths, weights and condition factors of steelhead smolts and parr sampled from Quinsam River counting fence, 1976 - 1981.

Year		n	Mean Length (mm)	SD	Mean Weight (g)	SD	K
1976	smolts	115	164.0	18.7	40.0	15.5	0.91
	parr	15	97.5	12.1	9.1	3.5	0.98
1977	smolts	138	174.3	24.9	50.5	24.6	0.95
	parr	120	93.3	13.4	8.2	3.6	1.01
1978	smolts	64	175.0	14.5	49.5	12.9	0.92
	parr	-	-	-	-	-	-
1979	smolts	99	172.5	19.1	52.2	17.8	1.02
	parr	49	87.9	12.4	6.8	3.6	1.00
1980	smolts	38	164.0	18.4	-	-	-
	parr	49	97.9	19.9	-	-	-
1981	smolts	87	171.7	19.1	46.1	16.7	0.91
	parr	50	107.3	15.8	11.7	5.0	0.95
mean smolts			170.3		47.7		
mean parr			96.8		9.0		

Scale analysis showed that, among smolts whose age could be determined, ages 2. and 3. comprised a large proportion of the sample. Age 2. smolts were generally dominant but their representation varied substantially between years (Table 4).

Table 4. Percent of steelhead smolts of various ages among all scale sampled smolts at Quinsam River counting fence, 1976 - 1981.

Year	Total Sampled	Readable Sample	<u>Percent Age Composition</u>			
			1.	2.	3.	4.
1976	112	66	0	56	44	0
1977	132	76	0	46	46	8
1978	92	46	0	80	20	0
1979	100	69	0	57	40	3
1980	41	35	0	69	29	2
1981	97	77	9	88	3	0

SMOLT YIELD CAPABILITY

Upstream of the counting fence, the Quinsam River contained about 400,000²m accessible steelhead habitat. However, the area above lower Quinsam Lake (Fig. 1) probably contained few if any wild steelhead (Slaney pers. comm.). Therefore, for the purpose of testing the smolt yield model, only the area between lower Quinsam Lake and the counting fence was considered. This section accounted for 331,200 m² of habitat, or 83 percent of the total accessible area.

The model used in this study provided estimates of habitat area for parr, based on basically four habitat types (Slaney MS 1981):

Flats - wide shallow (maximum 0.5 m) sections of streams with little surface turbulence (<10 percent) and low gradient <0.1 percent. Mean width/depth ratio of 18:1

Pools - deep sections of streams with turbulent heads, 0 gradient, <20 percent surface turbulence and mean width/depth ratio of 8:1

Glides - narrow, deep sections with turbulent surface (30 to 50 percent), mean width/depth ratio of 9:1 to 15:1, and gradient <0.2 percent

Riffles - shallow sloping drop, with surface turbulence >50 percent. Width/depth ratio of 24:1 and gradient >0.2 percent. Maximum depth <0.3 m

Each of these habitat types have been shown to support significantly different numbers of parr in the Keogh River on northern Vancouver Island. Flats were typically the poorest habitat with parr densities of 0.017 parr/m² followed by pools (0.064 parr/m²). Riffles could range from poor (0.017 parr/m²) to good habitat (0.150 parr/m²) depending upon the amount of instream and overstream cover associated with the riffle. The relation between cover and riffle standing crop ($r^2 = 0.83$) is:

$$Y = 0.0029 (X_b) + 0.0031 (X_c) - 0.004$$

where X_b = percent of protruding boulder cover

X_c = percent of overstream cover (cutbanks, roots, debris, logs and vegetation within 1 m of water surface)

Parr production was calculated as the weighted average of the above four habitat types adjusted between rivers for differences in total dissolved solids (TDS) and mean annual temperature. These factors were evaluated approximately as TDS/35 and TEMP/9 (C°).

Thus, a river with a TDS of 350 would have 10 times the density of parr as rivers with a TDS of 35. Smolt production was calculated as 40 percent of the parr capability. (On average, 40 percent of the numbers of parr in the Keogh River became smolt migrants one and two years later; Slaney pers. comm.).

In the Quinsam River, the section between lower Quinsam Lake and the counting fence was composed of 8.4 percent flats, 35.2 percent pools, 26.6 percent glides and 29.8 percent riffles (Table 5). Riffles had moderate to high instream (18 percent) and overstream (6.5 percent) cover. Calculating parr production from each habitat type and summing over the entire area provided an estimate of 23,457 parr, prior to adjusting for TDS and temperature variation.

Table 5. Habitat area and the potential parr yield from those areas in the Quinsam River between the hatchery weir and lower Quinsam Lake.

Habitat Type	Area (m ²)	Percent	Parr/m ²	Parr
Flats	27856	8.4	0.017	474
Pools	116492	35.2	0.064	7,456
Glides	88149	26.6	0.100	8,815
Riffles	98706	29.8	0.068*	6,711
Totals	331203	100.0		23,456

* calculated as $0.0029(18) + 0.0031(6.4) - 0.004$

The Quinsam River TDS was 43 and mean annual temperature 9.7°C , which provided adjustments of 1.23 (TDS/35) and 1.08 (TEMP/9). Incorporation of these values into the Quinsam model gave a parr yield estimate of 31,160. Conversion to smolts (0.4 x parr density) gave an estimate for the total area; 12,464 smolts, or 0.0376 smolts/m². Compared to the mean measured yield of 7,155 the model overestimated by about 75 percent.

Parr emigrating from upper Quinsam River during spring may have contributed to smolt production in the lower Quinsam and/or Campbell rivers. However, of 1,869 and 702 parr which were trapped and marked (adipose clip, coded wire tag) at the Quinsam River weir in 1980 and 1981, respectively, none were recovered as adults in subsequent sampling of angler caught steelhead. All other coded wire tag groups resulting from steelhead management activities in Quinsam River were represented in those samples. Final conclusions cannot be developed until the completion of the 1984-85 fishery.

SMOLT YIELD FROM HEADWATER STOCKING

From 1978 to 1981, 81,713 steelhead fry were stocked in various areas of the Quinsam River watershed upstream of impassable barriers to spawners (Fig. 1; Table 6). A total of 1,822 smolts which resulted from fry outplanting during these years were trapped, with an estimated mean fry to smolt survival of 2.4 percent, substantially less than in other Vancouver Island studies (Hume and Parkinson 1979). These data indicate minimal steelhead production as a result of fry outplanting in the Quinsam River drainage. However, it was evident that higher smolt yields were achieved from fry stocked in lotic habitats than from those stocked in lacustrine environments (Table 6).

ADULT RETURNS

Fluctuations in smolt yield should be reflected in subsequent adult steelhead returns. While estimates of run size are of importance to managers, their prediction is complicated by a number of factors. At Quinsam River, these included variations in the ocean residence period among smolts emigrating in different years (Hooton unpubl. data) and variations in ocean survival rate between different smolt crops (Slaney pers. comm.). Collectively, these factors greatly expanded the range for predicted adult returns. In addition, a method of calibrating the accuracy and precision of the prediction was not available. Any further attempt to use smolt yield data for predictive purposes was therefore abandoned.

Table 6. Estimated smolt production from headwater stocked steelhead fry, Quinsam River, 1979 - 1982.

Brood Year	Number Released	Date Released	Areas Released	Size (g)	Mark*	Number		Recaptured			Total	Percent Survival
						1979	1980	1981	1982	1983		
1978	26,671	Aug 15	upper, middle Quinsam Lake	1.8	VC	84	214	10	14		322	1.1
1979	16,496	Oct 16	Iron River	8.3	AC		20	413			433	2.6
1980	10,246	Oct 09	upper Quinsam & Iron Rivers	6.0	AC			-	303	27	330	3.2
1981	28,300	Sep 10	upper Quinsam River, middle lower Quinsam Lakes	9.0	LM				433	304	737	2.6
											Total 1,822	
											Mean Survival (%) 2.4	

* Mark Type - VC = ventral clip
 AC = adipose clip
 LM = left maxillary clip

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3

Zoogeography of Freshwater Fishes of the Hudson Bay Drainage, Ungava Bay and the Arctic Archipelago

E. J. Crossman
Don E. McAllister

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THE SCALELESS DRAGONFISH, *MELANOSTOMIAS VALDIVIAE* BRAUER, 1902, NEW TO THE FISH FAUNA OF ATLANTIC CANADA

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Introduction

A specimen of *Melanostomias valdiviae* (Family Stomiidae) 226 mm standard length, 241 mm total length was caught in a midwater trawl at about 500 meters southwest of Sable Island, Nova Scotia (42°08'09"N, 62°59'00"W) on 3 February 1982 at 2200 hours. This is the first record of this species from Canada (Leim and Scott, 1966; Morrow and Gibbs, 1964; Parin and Pokhil'skaya, 1978). The specimen is catalogued in the National Museum of Natural Sciences, Ottawa under NMC84-0279.

Description

The body is elongate and moderately compressed, greatest depth in standard length (SL) 9.0. The caudal peduncle is short and slender. The head length (HL) is 7.4 in SL, the eye is large (fleshy orbit 5.7 in HL) and the snout is shorter than the bony or fleshy orbit (5.9 in HL). The interorbital distance is 4.4 in HL. The mouth is large; snout to end of upper jaw is 1.1 in HL. The preanal and predorsal fin lengths are equal, 1.2 in SL. The prepelvic length is 1.5 in SL. The pectoral and pelvic fins are 2.6 and 1.0 in HL respectively. The barbel is 1.4 in HL. Its tip is slightly damaged but distally it is flattened with its length about twice its width. There appears to be one oval body on each side of the main stem. Jaw teeth are long and depressible. There are 7 teeth on the premaxilla, 6 on the anterior maxilla, 9 or 10 on each mandible, two pairs of teeth on the basibranchials, one on each side of the vomer and 4 or 5 on the palatines. The dorsal fin has 15 rays, the anal fin 19 rays, the pelvic fin 7 and the pectoral fin 5 rays. The dorsal, caudal, anal and pelvic fin rays are finely toothed laterally. The row of photophores from the isthmus to pectoral fin insertion (IP) numbers 8 followed by a gap and then 2 before the pectoral fin, the row from pectoral to pelvic fin insertion (PV) is 27, pelvic fin insertion to above anterior anal fin ray (VAV) is 14, from above anterior anal fin rays to end of row (AC) 10, the lateral row behind the opercle to above the pelvic fin insertion (OV) 26, and the lateral row from above the pelvic fin insertion to the end of the row above the anal fin (VAL) 12. The large, triangular photophore behind the eye is 7.1 in HL. Vertebrae number 53 including the urostyle. The specimen is a female. The head, body and fins are a deep brown in preservative, and from a distance the specimen appears black. The barbel has a pigmented stem.

This description agrees with those given in Regan and Trewavas (1930), Morrow and Gibbs (1964) and Parin and Pokhil'skaya (1978).

Distinctions

This species is distinguished from other North Atlantic *Melanostomias* by the flattened and expanded distal part of the barbel with a central stem and 2 or more

luminous ovoid bodies on either or both sides of this stem. The expanded part of the barbel tip is about twice as wide as its length, and the free end may be pointed but is never a long filament. Morrow and Gibbs (1964) illustrate variations in barbel structure.

Range

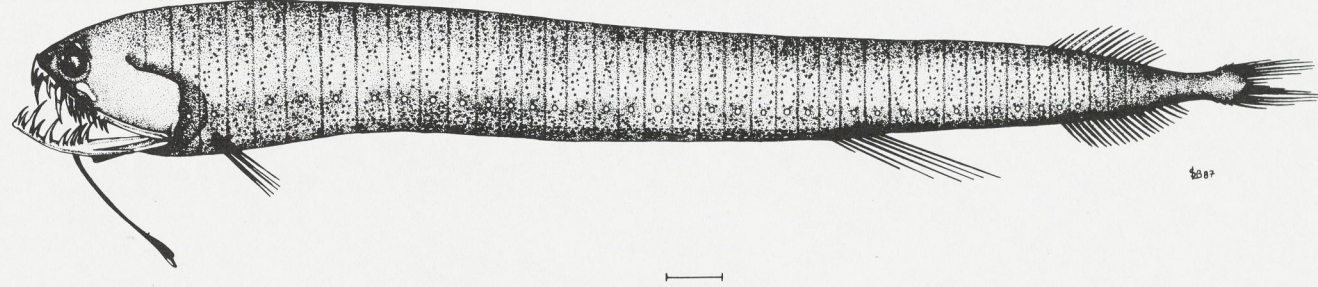
Known from the western North Atlantic Ocean between about 8° and 42°N, including the Gulf of Mexico, eastern and central North Atlantic from about 30°N to 52°N, South Atlantic from about 10°S to 40°S, and in the Indian and Pacific Oceans. This specimen is the first recorded in Canadian waters. Another specimen (Huntsman Marine Laboratory, catalogue no. H15781) was taken by the *Lady Hammond* off Nova Scotia outside Canadian waters at 40°10.63'N, 61°13.26'W on 18 February at 2330 hours in an Engel midwater trawl at 300 meters depth.

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**SEASONAL FOOD OF JUVENILE LAKE TROUT IN
U.S. WATERS OF LAKE ONTARIO¹**

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SEASONAL FOOD OF JUVENILE LAKE TROUT IN U.S. WATERS OF LAKE ONTARIO¹

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ABSTRACT. Stomach contents of 3,554 lake trout (*Salvelinus namaycush*), 100 to 449 mm in total length, captured with bottom trawls during April through October 1978-81 along the south shore of Lake Ontario were examined. Invertebrates appeared to be an important food of lake trout less than 200 mm long but were only occasionally eaten by larger fish. For all seasons and size groups of juvenile lake trout combined, the slimy sculpin (*Cottus cognatus*) was the principal forage fish, making up 42% (by weight) of identifiable fish remains. Young-of-the-year slimy sculpins were a major food of recently stocked yearling lake trout during July through October. Alewives (*Alosa pseudoharengus*) were the principal forage during April and May, and made up 28% (by weight) of the identifiable fish remains. They were rarely eaten during July and August, however, when lake trout remained in the hypolimnion and alewives were above it. Over 99% of the alewives eaten from April through August were yearlings and over 99% eaten during October were young-of-the-year. Rainbow smelt (*Osmerus mordax*) were the primary forage during July and August, but contributed only a small part of the diet during other seasons; overall, they made up 25% of identifiable fish remains. Johnny darters (*Etheostoma nigrum*) made up 4% of identifiable fish remains and were most common in stomachs of small lake trout during October.

ADDITIONAL INDEX WORDS: Fish management, sculpin, alewives, rainbow smelt, fish food.

INTRODUCTION

The lake trout (*Salvelinus namaycush*) was one of the dominant coldwater piscivores in Lake Ontario's pristine fish community. Commercial catches of lake trout were moderately high in the late 1800s, low near the turn of the century, peaked in the 1920s, and declined steadily during the 1930s and 1940s (Baldwin *et al.* 1979). The native stock apparently became extinct in the 1950s. Initial efforts to reestablish lake trout by stocking hatchery-reared fish (1953-64) were unsuccessful, possibly because mortality due to commercial fishing and attacks by sea lampreys (*Petromyzon marinus*) prevented the fish from attaining sexual maturity (Christie 1973). A sea lamprey control program was initiated in 1971, and annual releases of lake trout began anew in 1973. Large numbers of rainbow trout (*Salmo gairdneri*), brown trout

(*Salmo trutta*), coho salmon (*Oncorhynchus kisutch*), and chinook salmon (*O. tshawytscha*) were stocked along with lake trout and probably compete with them for the forage fish. An understanding of predatory-prey relations within Lake Ontario's coldwater fish community is essential for formulating fishery management practices that will optimize salmonid production without adversely affecting the forage base. This report provides information on how food of juvenile lake trout (here restricted to fish 100 to 449 mm in total length), collected during April through October 1978-81, varies with the season.

Observations on food of adult lake trout taken in commercial gillnets near Port Credit, Ontario, during June, July, and August 1927 were reported by Dymond (1928). He found that the predominant food during June was alewives (*Alosa pseudoharengus*), and included lesser numbers of ciscoes (*Coregonus* spp.), deepwater sculpins (*Myoxocephalus thompsoni*), and slimy sculpins (*Cottus cognatus*). Ciscoes were the predominant food

¹Contribution 593 of the Great Lakes Fishery Laboratory, 1451 Green Road, Ann Arbor, Michigan 48105

during July and August. However, this historical information is not comparable with current data because the composition of the forage base has changed. Deepwater ciscoes and deepwater sculpins are apparently extinct, lake herring (*Coregonus artedii*) are scarce, and rainbow smelt (*Osmerus mordax*), which became established about 1930, are now abundant. Observations on food of juvenile lake trout in Lake Ontario have not been published.

MATERIALS AND METHODS

Lake trout were captured during annual bottom trawling surveys by the U.S. Fish and Wildlife Service R/V *Kaho* at nine transects along the south shore of Lake Ontario (Fig. 1) to assess stocks of alewives (mid-April to mid-May), rainbow smelt (mid-June), juvenile lake trout (mid-July to mid-August), and slimy sculpins (October). Lake trout were also collected with bottom trawls near Oswego and Rochester during surveys to determine seasonal distribution of forage fishes. Trawl hauls were made along the contour at 10-m depth intervals (5-m intervals during the juvenile lake trout surveys). Range of depths varied among transects and also among surveys and years but usually covered the full range of depths at which juvenile lake trout occurred.

Stomach contents of lake trout were usually examined aboard the R/V *Kaho* immediately after capture, but when catches were large, the fish were placed in ice and examined on the following day. Total lengths (mm) and weights (g) of lake trout were recorded and food items in the stomachs were identified; numbers of identifiable fish in the stomachs, and total lengths of those that could be measured, were recorded. Occurrence of invertebrates was noted but numbers were not recorded, and estimates of weights or volume were not attempted. Ages of lake trout were determined from marks that had been applied at the hatcheries before the fish were stocked (clipped fins and maxillary bones or coded wire tags injected into the snout).

The percent (by weight) that each fish species contributed to the diet was determined for seven 50-mm length groups of lake trout for four seasonal periods as follows: (1) mean weights of identifiable fish remains that were measured were calculated from length measurements and a length-weight relation derived from fresh specimens; and (2) the mean weight was then multiplied by the total

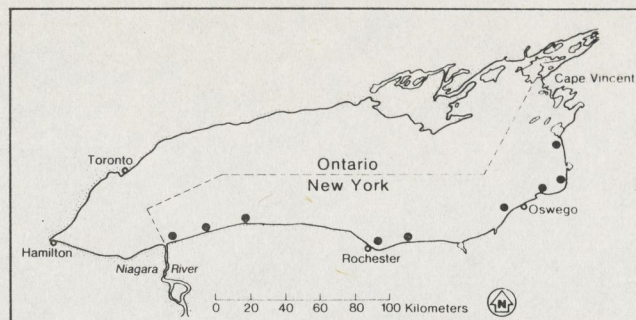


FIG. 1. Locations (•) in Lake Ontario at which juvenile lake trout were collected for food habit analysis.

number of individuals of that species in all stomachs. I assumed that the species composition of identifiable and unidentifiable fish remains was the same.

RESULTS AND DISCUSSION

Stomach contents of 3,554 lake trout (total lengths 100 to 449 mm; weights 7 to 990 g) were examined (Table 1). Only 130 stomachs were collected during 1978 but more than 900 were taken during each of the next 3 years. Since 86% of the lake trout were captured at depths of 25 to 55 m, data from all depths were combined. Generally no differences in diet among locations were evident, therefore data from all locations were combined.

Most lake trout examined were age I or II, all were hatchery-reared fish, and 97% had been stocked in U.S. waters of Lake Ontario. Some were stocked as young-of-the-year (YOY) in October at lengths of 75 to 100 mm, but most were stocked as yearlings in late May and early June at lengths of 130 to 160 mm. Length frequency distributions of age groups overlapped but the modal length intervals for yearling fish were 150 to 199 mm during July-August and 150 to 249 mm during October (Table 1). Modal length intervals of 2-year-olds were 200 to 299 mm in April, May, and June, 250 to 349 mm during July-August, and 300 to 399 in October. Three-year-olds made up 25% of the lake trout examined during April-May but only 5% during other months.

Incidence of empty stomachs among fish less than 200 mm long was 40% during April-May, 29% in June, 16% during July-August, and 20% in October (Table 1); among fish 200 mm long or longer the incidence was 10% in April-May, 19% in June, 30% in July-August, and 20% in October. Occurrence of empty stomachs varied greatly

TABLE 1. Numbers of stomachs examined, percent incidence of empty stomachs, and percent frequency of occurrence of invertebrates and fish in stomachs of lake trout captured with bottom trawls in U.S. waters of Lake Ontario during 1978-81.

Total length of lake trout (mm)	Months and (in parentheses) total stomachs examined ^a															
	April-May (723)				June (401)				July-August (1822)				October (608)			
	Occurrence (%)				Occurrence (%)				Occurrence (%)				Occurrence (%)			
	No.	Empty	Inv.	Fish	No.	Empty	Inv.	Fish	No.	Empty	Inv.	Fish	No.	Empty	Inv.	Fish
100-149	11	27	55	0	35	29	46	23	171	19	64	18	10	50	33	30
150-199	19	53	5	37	31	29	32	45	565	14	55	34	204	18	5	77
200-249	199	12	5	85	111	23	6	74	155	29	7	64	207	16	2	85
250-299	296	7	2	92	149	21	2	79	457	32	3	66	67	21	0	81
300-349	86	10	1	90	36	6	4	92	349	33	2	65	77	21	0	79
350-399	79	10	0	90	25	8	0	92	86	30	1	69	34	18	3	82
400-449	33	6	0	94	14	7	0	93	39	8	0	87	9	22	0	78

^aInv. = Invertebrates

among sampling dates within a given month and year and was probably influenced to some extent by storms. For example, in western Lake Ontario on 28 and 30 July 1981 the thermocline was less than 15 m deep; 100 lake trout were captured at depths of 20 to 45 m (mean 32.9 m) in water temperatures 4.0 to 6.2°C (mean 4.5°C) and only 5% had empty stomachs. Passage of a storm system depressed the thermocline and on 31 July-1 August 368 lake trout were captured at depths of 20 to 60 m (mean 37.8 m) in water temperatures 4.4 to 16.9°C (mean 10.5°C) and 58% had empty stomachs. The greater incidence of empty stomachs after the storm passed may have been due to the change in thermal regimes which interrupted feeding.

Invertebrates in the Diet as a Function of the Size of Lake Trout and the Availability of Invertebrates

Invertebrates found in lake trout stomachs were predominantly Isopoda (*Asellus communis*) and Amphipoda (*Pontoporeia affinis* and *Gammarus* sp.). Small numbers of the crustacean *Mysis relicta*, snails, clams and leeches, and insect larvae (mostly Chironomidae) were also consumed. Invertebrates were frequently eaten by lake trout less than 200 mm long but only occasionally by larger fish (Table 1). Lake trout less than 150 mm long fed exclusively on invertebrates during April-May; these were small 2-year-olds and yearlings that had been stocked the previous fall. A few recently stocked yearlings were captured during June; invertebrates were found in 41% and fish remains in 32% of their stomachs. Invertebrates continued to be important in the diet of yearling lake trout (especially those less than 150 mm long) during July and August. By

October, nearly all lake trout captured were longer than 150 mm and feeding almost entirely on fish.

Frequency of occurrence of invertebrates in stomachs of lake trout 100 to 199 mm long collected near the mouth of the Niagara River during July-August (the only time trawling was conducted there) was 87% compared with 32% for all other locations combined. Isopods were the principal invertebrates eaten by the lake trout taken near the Niagara River, whereas amphipods were more numerous in stomachs from other locations. Inasmuch as Hiltunen (1969) found the isopod *Asellus communis* almost exclusively in water less than 30 m deep, most of these organisms would presumably be unavailable to lake trout. However, currents from the Niagara River could sweep isopods into deeper waters in Lake Ontario adjacent to the river mouth where the present lake trout were collected.

Annual Variation in Species Composition of Fish in the Diet

Within a given season the portion of the diet composed of a particular forage species varied among years (Table 2). Differences between 1978 and the other years were largely due to small sample sizes in 1978, but differences among the other 3 years are more difficult to explain. Alewives increased from about one-fourth of the fish remains in 1979 and 1980 to 59% in 1981 which might suggest that their abundance increased in 1981. However, alewives were almost twice as abundant in lake trout stomachs in June 1979 as in June 1980 and 1981. These contrasting results from adjacent months were probably due to short-term differences in spatial distributions of the predator and prey rather than to changes in abundance of the

TABLE 2. Species composition (% by weight) of identifiable fish remains in stomachs of lake trout 100 to 449 mm total length captured with trawls in U.S. waters of Lake Ontario during 1978-81. (n = number of stomachs containing identifiable fish.)

Year	n	Forage fish			
		Alewife	Rainbow smelt	Johnny darter	Slimy sculpin
April-May					
1978	5	0	0	15	85
1979	121	24	10	13	54
1980	121	27	18	4	51
1981	254	59	20	1	20
June					
1978	12	56	6	1	37
1979	62	49	11	7	33
1980	80	28	14	1	57
1981	62	27	7	0	67
July-August					
1978	32	18	33	0	50
1979	215	1	27	3	70
1980	208	2	71	1	27
1981	194	2	69	1	28
October					
1978	21	3	0	1	96
1979	51	12	12	7	69
1980	143	65	8	4	23
1981	147	33	10	16	37

prey. During July-August 1979 rainbow smelt made up 27% and slimy sculpins 70% of the diet, but in 1980 and 1981 the composition was essentially the opposite. Since abundance of these two species changed only slightly during 1979-81 (unpublished data, Oswego Biological Station), factors other than abundance also affected lake trout diet during this sampling period. Therefore, data from all 4 years were combined to depict the typical diet.

Fish in the Diet as a Function of Their Seasonal Availability and Abundance

Seasonal availability of forage fishes to juvenile lake trout is largely dependent on the thermal regimen in Lake Ontario. The lake begins to stratify in June and a strong thermocline is usually established by early July. Lake trout remain in the hypolimnion during July and August and must feed on the forage fishes available there. Alewives are in

the epilimnion and are thus almost totally unavailable to juvenile lake trout. Johnny darters are in the upper portion of the thermocline and in the epilimnion and are thus also largely unavailable to juvenile lake trout. In contrast, slimy sculpins and most rainbow smelt occur only in the hypolimnion; thus during July-August these two species accounted for 97% of the identifiable fish remains in lake trout stomachs (Table 3). As Lake Ontario begins cooling in September, thermal stratification becomes less pronounced, and by late September it ceases to be a barrier for fish movement. Alewives and johnny darters begin to occur at greater depths, where they once again become available to juvenile lake trout.

The slimy sculpin was the predominant forage fish for all seasons and size groups of juvenile lake trout combined, making up 42% of the weight of identifiable fish remains in stomachs. They were the principal forage item during June and October and ranked second during April-May and July-August (Table 3). Mean lengths of slimy sculpins eaten were directly related to length of lake trout during every season (Table 4). The length-frequency of slimy sculpins indicated that YOY (5 to 25 mm long) entered the diet in July and were an important food of yearling lake trout from July through October. Stomachs of some yearling lake trout contained as many as 25 YOY slimy sculpins.

Overall, alewives composed 28% of the weight of identifiable fish remains in lake trout stomachs. Whereas they were the principal forage during April-May and a strong second during June and October, only six alewives were found in the 1,822 stomachs examined during July-August (Table 3). The reason may be that virtually the entire alewife population in Lake Ontario becomes pelagic and is restricted to the epilimnion during summer (unpublished data, Oswego Biological Station) and therefore is unavailable to lake trout, which remain in the hypolimnion.

Rainbow smelt were the primary forage species during July-August, but composed only a small part of the diet during other months (Table 3). Overall, 25% of identifiable fish remains were rainbow smelt; more were eaten by lake trout over 350 mm long than by smaller fish. Yearlings made up 8% of rainbow smelt in lake trout stomachs during April-May, 50% during June, and 44% during July-August. Only 22 rainbow smelt were found in lake trout stomachs collected during October, of which eight were YOY. Since rainbow smelt are small and semitransparent as YOY and as

TABLE 3. Species composition (% by weight) and total numbers of individuals of identifiable fish remains in stomachs of lake trout captured with trawls in U.S. waters of Lake Ontario during 1978-81. (n = number of stomachs containing identifiable fish, Al = Alewife, Sm = Rainbow smelt, Jd = Johnny darter, Sc = Slimy sculpin).

Total length of lake trout (mm)	Months and (in parentheses) total stomachs examined																			
	April-May (723)					June (401)					July-August (1822)					October (608)				
	n	Al	Sm	Jd	Sc	n	Al	Sm	Jd	Sc	n	Al	Sm	Jd	Sc	n	Al	Sm	Jd	Sc
100-149	0	—	—	—	—	6	0	32	0	68	22	0	53	2	46	1	0	0	0	100
150-199	6	0	0	69	31	10	0	20	39	41	136	0	28	5	67	114	27	8	14	51
200-249	136	44	7	9	40	54	34	7	8	51	69	3	33	3	61	139	50	1	15	34
250-299	213	48	7	7	38	88	43	7	1	49	216	2	42	1	55	37	50	13	12	25
300-349	63	46	4	3	47	25	42	4	0	54	141	1	76	1	22	44	15	11	2	72
350-399	57	42	20	0	38	21	25	13	0	62	41	0	85	1	14	21	22	35	9	34
400-499	26	16	60	0	24	12	22	24	0	54	24	6	53	0	41	6	67	0	1	32
Combined	501	41	17	5	37	216	34	11	2	53	649	2	62	1	35	362	35	11	9	45
Number of individuals		389	41	146	237		111	22	37	198		6	309	30	1,264		187	22	140	436

TABLE 4. Mean total length (mm) of slimy sculpins in stomachs of seven length groups of lake trout captured with trawls in U.S. waters of Lake Ontario during 1978-81. Numbers of slimy sculpins measured are shown in parentheses.

Total Length of lake trout (mm)	Months			
	April-May	June	July-August	October
100-149	—	37(5)	19(63)	25(1)
150-199	33(2)	51(5)	21(458)	33(138)
200-249	54(69)	48(57)	40(99)	36(172)
250-299	66(90)	61(56)	46(372)	54(16)
300-349	76(29)	57(30)	46(132)	71(44)
350-399	83(26)	86(20)	66(21)	66(12)
400-449	95(9)	89(11)	89(25)	68(4)

yearlings during April, May, and June, digestion would probably quickly render them unidentifiable; they may therefore have been eaten more frequently than our data indicate.

Johnny darters (*Etheostoma nigrum*) were most prevalent in stomachs of small lake trout during October and made up a greater portion of the diet (9%) then than at any other time. Overall they were a minor food item (Table 3), making up only 4% of the weight of identifiable fish remains. Other identifiable fish remains consisted of one spottail shiner (*Notropis hudsonius*), two trout-perch (*Percopsis omiscomaycus*), and five YOY gizzard shad (*Dorosoma cepedianum*).

At any given time, the diet of juvenile lake trout was no doubt dependent on abundance of various forage species at the depths where the lake trout

occurred. Different fish species and the various life stages of a given species are differentially vulnerable to sampling gear, and data for making meaningful comparisons of abundance among species are difficult to obtain. However, incidence of forage fishes in trawl catches in which juvenile lake trout were captured (unpublished data, Oswego Biological Station) was similar to the occurrence of those forage fishes in lake trout stomachs. For example, during July-August, when virtually no alewives were found in lake trout stomachs, few alewives were captured in the hypolimnion with trawls. On the other hand, slimy sculpins were generally abundant in trawl catches in which juvenile lake trout were captured. Because slimy sculpins are sedentary they may be easier to catch than active, schooling species such as rainbow smelt and alewives. It is not surprising that slimy sculpins were a major food item every month and were the predominant forage fish overall.

Alewives 2 years old or older in April-August and 1 year old or older in September-October were the most abundant fish in Lake Ontario (unpublished data, Oswego Biological Station), yet over 99% of the alewives eaten from April through August were yearlings and over 99% of those eaten during October were YOY. Mean lengths of alewives eaten did not differ among the seven 50-mm length groups of lake trout. However, yearling alewives in lake trout stomachs during April-May were significantly shorter ($P < 0.05$) than those in our bottom trawl catches (Fig. 2). The length-frequency of alewives in trawl catches could have been shifted toward larger individuals due to

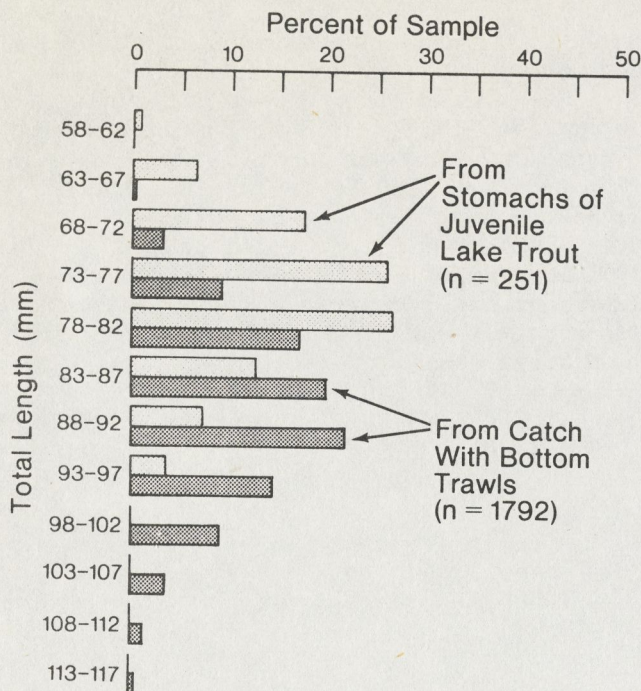


FIG. 2. Length-frequency of yearling alewives in samples obtained from Lake Ontario during April-May 1981.

selectivity by the trawl. However, alewives in the four largest length groups (98 to 117 mm) made up 14% of trawl catches but none were found in the 319 lake trout stomachs examined. It is difficult to understand the dearth of adult alewives (≥ 118 mm total length) in lake trout stomachs, considering that adult alewives were frequently abundant in trawl catches in which lake trout were captured. Small lake trout would no doubt have difficulty swallowing adult alewives, but lake trout 350 to 449 mm long should be capable of eating them. Perhaps smaller alewives and other forage species could be more easily captured.

Comparison with Other Lakes

Invertebrates contributed more to the diet of juvenile lake trout in Lake Superior than in Lake Ontario. Although lake trout over 200 mm long ate principally fish in both lakes, invertebrates continued to be eaten by more than half the lake trout 305 to 353 mm long and by 15% of those 406 to 429 mm long in Lake Superior (Dryer *et al.* 1965), whereas they were found in only 2% of lake trout 300 to 349 mm long and in none over 400 mm long in Lake Ontario. *Mysis relicta* was the principal invertebrate eaten in Lake Superior, followed by

the amphipod *Pontoporeia affinis*; isopods were not eaten. Greater dependence on invertebrates may have been due to lower abundance of forage fish in Lake Superior. Quantitative observations were not made but capture of *Mysis relicta* in Lake Ontario by impingement on the meshes of the bottom trawl suggested that they were relatively scarce at depths where juvenile lake trout occurred but were very abundant at greater depths. Cottids were the most important forage fish in both lakes. The second- and third-ranking forage species were alewives and rainbow smelt in Lake Ontario and rainbow smelt and *Coregonus* spp. in Lake Superior. Alewives were scarce in Lake Superior and coregonines were extremely rare in Lake Ontario.

Seasonal occurrence of rainbow smelt in lake trout stomachs was essentially opposite in Cayuga Lake and Lake Ontario. In Cayuga Lake rainbow smelt were commonly found in lake trout stomachs in early spring but were rarely found during summer, presumably because lake trout and rainbow smelt were isolated in distribution (Webster *et al.* 1959); most rainbow smelt may have been pelagic during summer (Galligan 1962). In contrast, rainbow smelt were the principal food item during July-August in Lake Ontario but were a minor food during other months.

Alewives were the major food of all lake trout longer than 127 mm during the summer in Cayuga Lake, New York (Webster *et al.* 1959). Lake trout 127 to 254 mm long also ate *Mysis relicta* and occasionally other invertebrates, but alewives were the staple of lake trout larger than 254 mm. Alewives move inshore to spawn in late June in both lakes. In Lake Ontario, they become pelagic and virtually all remain in the epilimnion during July and August and are unavailable to juvenile lake trout. Concerning Cayuga Lake, Galligan (1962) reported: "in 1950 the greatest density for alewives during July, August, and September occurred at about 70 feet, while that for lake trout occurred . . . at 90 feet." However, alewives were also collected in water as deep as 250 feet during July and August. Alewives evidently became pelagic in Cayuga Lake during the summer, but possibly to a lesser extent and also later in the summer than in Lake Ontario, due to differences in thermal regimes in the two lakes.

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MÉMOIRE

DATE 870423

A R. J. Behnke
DE Pierre Dumont

SUJET

1^o - Hucho hucho
2^o - Salvelinus salvelinus vs alpinus

Dear Mr. Behnke,

Thank you for your comments on
our report on non-native Salmonids propagation
in Quebec.

You will find included:

- additional information on hucho
- some information on the nomenclature
of Salvelinus salvelinus, according to
Mr. Viannay legends, now retired.

Pierre Dumont

Montréal, le 4 décembre 1985.

Dr. J. Holcik
Drienova 3
826 24 Bratislava
Czechoslovakia

N/R: 9003-01

Dear Dr. Holcik,

I wish to thank you for your letter and the trouble you take for sending the publications on **Hucho hucho**. On my side, I have obtain more informations on the origin of huchen in the Quebec Waters from M. Pierre-J. Paulhus, former Director of the Hatcheries Division for the Province, and now Director of l' Aquarium de Québec, in Quebec city. M. Paulhus was with Dr. Vladykov at the Russian Pavillon at Expo 1967, in Montreal when they meet two Russian physiologists from the University of Moscow or Leningrad (he is not sure) who had problems with the alimentation of their sturgeons. Pierre Paulhus solved their problems by giving them trout tablets. They were very enthousiast and Dr. Vladikov took the opportunity to ask them if it would be possible to obtain eggs of Huchen for some experiments. It seemed that the contacts were hard to get and finally they obtain eggs from Czechoslovakia, from a river going into the Danube River.

On the 20th of may 1967, Dr. Vladykov received 25 000 eggs from Czechoslovakia and finally decided to send them at the Baldwins-Mills Hatchery about one hundred miles east of Montreal, belonging to the Government of Quebec. And the fourtheenth of may of the following years, in 1968, 34 000 eggs were sent to Baldwin-Mills.

The 24 of april 1968, the following quantities of huchens were stocked (age 1 year⁺)

100	huchens at	Pointe-des-Cascades (lake Saint-Louis)
100	"	in Bassin Chambly (Widening of the Richelieu River)
150	"	in Rapides de Lachine (St-Lawrence River)
100	"	at Pointe-du-Buisson, (St-Laurence River)
100	"	at Valleyfield (Lake St-Francis, widening of the St-Lawrence River)

The 21 of june 1968, 5 000 fry were stocked in Caughnawagha Bay (lake St-Louis) and 6 000 in the same lake the 28 of june.

November 6, 1968, 100 fingerlings were stocked in lake Mandeville.

On June 5 1969, 200 fishes were deposited in Bassin Chambly, 200 in the St-Lawrence River. On June 9, 119 huchens were stocked in Lac Deligny, an average weight of 7 specimens per pound.

In the spring of 1972, eggs were obtained from spawning huchens at Baldwin Mills and the fishes from these eggs were stocked the following year, May 24 1973, at the age of one year⁺:

400 fishes were put in the St-Lawrence River
150 fishes were put at Pointe-des-Cascades
350 fishes were put in the Richelieu River

In April 1976, 3 males huchens were remaining and they were crossed with the eggs of 8 females rainbow trout *Salmo gairdneri*; 19 656 green eggs were obtained from which resulted 1 000 eyed eggs, and, at the end of June 1976, 300 fingerlings. Ninety-nine of this hybrid were stocked in Rapides de Lachine in 1978, 53 in 1979 at the same place. In November 1977, the length and weight of the 3 males were:

length (total)	Weight
71 cm	3.6 kg
72.4 cm	4.2 kg
76.2 cm	4.4 kg

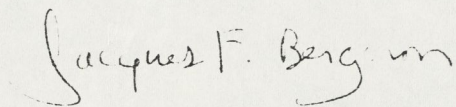
The huchen of Deligny brook (73° 18' 58" Long. W, 46° 22' 40" Lat. N) caught July 4 1973, had a weight of 3685 g and a length of 718 mm. The sex is unknown.

I send you a copy of the 1982 Edition of the Guide and the exact reference of the 1981 Edition reads as follows:

Bergeron, J.F. and J. Brousseau 1981. Guide des poissons d'eau douce du Québec. Gouvernement du Québec. Ministère du Loisir, de la Chasse et de la Pêche. Direction générale de la faune. Québec. 217 p.

Hoping that these informations will be at your satisfaction.

Sincerely yours,



Jacques F. Bergeron, biologiste
Service de l'aménagement et
de l'exploitation de la faune
6255 13^e avenue (Rosemont)
Montréal, QC
H1X 3E6



COPIE

Montréal, le 4 novembre 1982

Monsieur Jacques Lamarche
biologiste,
Polyvalente de Loretteville,
158 boul. des Etudiants,
Loretteville QC.
G2A 1N8

Monsieur,

Votre missive m'a été transmise par monsieur Vianney Legendre, maintenant à la retraite, concernant vos questions sur 4 espèces de poissons d'eau douce du Québec.

1) Selon McAllister et Coad (1974), le chat-fou liséré (Noturus insignis) a été découvert au lac Lapêche dans le parc de la Gatineau au début des années 1970. On le trouve naturellement dans les cours d'eau déversant dans l'Atlantique, de 250 kilomètres au sud d'Ottawa jusqu'en Georgie et dans des tributaires au sud du lac Ontario. Sa présence dans nos eaux est interprétée comme le vestige d'une répartition géographique autrefois plus vaste ou d'une introduction par l'homme. Par son allure générale, il ressemble à la barbotte des rapides mais s'en distingue notamment par une frange noire le long du bord des nageoires.

2) Le nom scientifique de la perchaude nord-américaine a varié depuis les 15 dernières années: Perca fluviatilis, Perca flavescens, Perca fluviatilis flavescens ont été employés dans des publications scientifiques. Le nom est encore flottant pour le moment jusqu'à ce que des études de morphologie comparée à l'échelle mondiale (Reeve M. Bailey) actuellement en cours au Michigan, soient menées à terme.

3) Le cisco du Nipigon (Coregonus nipigon) est devenu le toulibi parce que ce nom est indigène et qu'il est court. Référence: Salmo (Coregonus) tullibee Richardson, 1836: 201, 309, "The Tullibee", du cri: ottoneebes, modifié en français en "toulibi" par les pelletiers, nom utilisé dans la région de la baie d'Hudson et du nord-ouest du Canada.

Montréal, le 4 novembre 1982

4) La perche-blanche (Morone americana) est devenue gatte à la suite d'une erreur qui s'est perpétuée en chaîne. Tel que mentionné dans le document ci-joint en annexe, vous constaterez que le terme "gatte" est utilisé par les Acadiens du Nouveau-Brunswick pour désigner l'Alosa sapidissima, et en France, sur la côte atlantique du golfe de Gascogne, pour l'Alosa finta de Cuvier. Dès lors le nouveau nom français proposé est baret, un néologisme voulant signifier; bar petit (Legendre, 1979).

5) Vous constaterez également que Salvelinus salvelinus a remplacé Salvelinus alpinus. Linné avait originellement distingué, en Europe, 3 espèces pour l'omble chevalier: Salmo alpinus, nord de la Suède; Salmo salvelinus, Autriche; Salmo umbla, France et Suisse. Or, il arriva ultérieurement pour cette forme ainsi que pour d'autres formes de l'Amérique, que Richardson (1836: 169) créa le genre Salvelinus y incluant son espèce nominale arctique Salmo alipes, l'un des noms de l'omble chevalier de l'Amérique (nominale: n'existant que comme nom). De plus, les trois espèces du nord de la Suède, de l'Autriche, de la France et de la Suisse, nommées par Linné seraient une seule et même espèce (Smitt 1895, II: 830, 831; Fatio 1890, 5 (2): 396; Gossot 1946: 91). Alors, lequel parmi ces noms, Salvelinus alpinus. Salvelinus salvelinus et Salvelinus umbla, est celui qui doit être employé? C'est à la suite de recherches qui se sont étalées sur plus de 25 ans, de la lecture de nombreux ouvrages souvent dans la langue originelle et de l'examen de nombreux spécimens nord-américains et européens (France, nord de la Norvège), que Vianney Legendre, s'appuyant sur le Code international de Nomenclature zoologique (1964), conclua que le nom doit être Salvelinus salvelinus: il s'agit ici d'un cas de tautonymie, c'est-à-dire que le nom désignant l'espèce est ici identique au nom du genre; d'après le Code, (Article 68-d) un cas de tautonymie détermine automatiquement ce nom de l'espèce au titre de génotype (espèce-type du genre) (Article 68-d), tel celui-ci: Salvelinus salvelinus (Linné, 1758), génotype ou espèce-type du genre Salvelinus Richardson, 1836. " De surcroît, personne n'a jamais prouvé qu'il y a des différences de niveau spécifique (admisses par tous les systématiciens) de l'Eurasie (en toutes ses populations) et les diverses espèces nominales des Salvelinus suivants de l'est de l'Amérique du nord et de l'Arctique: S. alipes, hearni, hoodi, nitidus, rossi, tous de Richardson, et S. marstoni de Garman. Et, le nom Salvelinus alpinus transporté par des auteurs de l'Europe à l'Amérique n'a jamais été prouvé comme valable ou fondé par un travail quelconque de systématique comparée (voir par exemple, Morton et Miller, 1954) "(Legendre, 1982).

Espérant ces renseignements à votre satisfaction, veuillez agréer, Monsieur, mes salutations distinguées.

Jacques F Bergeron

Jacques F. Bergeron, biologiste
Service de l'aménagement et de
l'exploitation de la faune

Montréal, le 4 novembre 1982

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Article 68. *Espèce-type fixée dans la publication originale.*—Les dispositions du présent Article sont applicables dans l'ordre de priorité suivant.

(a) *Désignation originelle.*—Si une espèce nominale est désignée avec précision comme l'espèce-type d'un nouveau genre nominal au moment de l'établissement de ce dernier, cette espèce est l'espèce-type, sans égard à toute autre considération (type par désignation originelle).

(i) La formule "gen.n., sp.n." ou son équivalent exact, appliquée avant 1931 à l'une seulement des espèces nominales nouvelles incluses dans un genre nominal nouvellement établi, doit être interprétée comme une désignation originelle si aucune autre espèce-type n'a été désignée.

(b) *Emploi de *typicus* ou de *typus*.*—Si, au moment où un nouveau genre nominal est établi, l'une des espèces nouvelles incluses est nommée *typicus* ou *typus*, cette espèce est l'espèce-type.

(c) *Monotypie.*—Un genre établi à l'origine avec une seule espèce nominale incluse prend cette espèce comme type, sans que l'on ait à tenir compte du fait que l'auteur considèrerait le genre comme incluant d'autres espèces qu'il n'a pas nommées, ni du fait qu'il ait cité des synonymes, des sous-espèces, des noms inutilisables, et des espèces incluses ou identifiées avec doute (type par monotypie).

→ (d) *Tautonymie.*—Si, parmi les espèces nominales originellement incluses dans un genre nominal nouvellement établi, il en est une qui porte le nom générique comme nom spécifique ou subs spécifique, qu'il s'agisse du nom valide ou d'un synonyme cité, cette espèce nominale est ipso facto l'espèce-type (type par tautonymie absolue).

(i) Si, dans la synonymie d'une seule des espèces originellement incluses dans un genre nominal établi avant 1931, est cité un nom uninominal antérieur à 1758, identique au nouveau nom générique, cette espèce nominale doit être considérée comme l'espèce-type (type par tautonymie linnéenne).

Article 69. *Espèce-type non fixée dans la publication originale.*—Les dispositions du présent Article sont applicables dans l'ordre de priorité adopté ici, mais seulement aux genres nominaux établis avant 1931 sans espèce-type originellement désignée ou indiquée.

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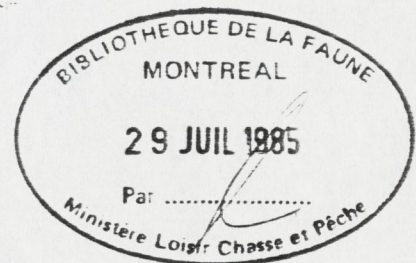
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Salvelinus salvelinus

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Ecosystem Shifts and Reintroduction of Arctic Char (*Salvelinus salvelinus* (L.)) after Liming of a Strongly Acidified Lake in Southwestern Sweden

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ABSTRACT

Before undergoing lime treatment in December 1979 Lake Stora Holmevatten was a strongly acidified oligotrophic lake. Much of the biota including all fish species, had disappeared during the acid period. The indigenous Arctic char population, which became extinct, had represented a unique genetic stock, classifying this lake with high national interest.

After lime treatment, pH and alkalinity were observed to increase substantially, and the high aluminium levels ($500 \mu\text{g l}^{-1}$) decreased to less than $100 \mu\text{g l}^{-1}$. Biomass levels of phytoplankton, zooplankton and benthic organisms increased within one to three years, following liming. Diversity of zooplankton and benthic fauna increased but the diversity of phytoplankton did not change significantly. In contrast to earlier studies, chironomid biomass increased following liming, suggesting that aluminium toxicity may have affected the larvae during the acidified period. The generally increased biomasses and shifts in phytoplankton and zooplankton species indicate that a higher net-production was one important effect of liming.

The introduced Arctic char preyed on a variety of food items, one of which, the introduced *Asellus aquaticus*, was of growing importance. The growth rate of the introduced Arctic char was higher than that of the previous, now extinct population. Occurrence of two-summer-old char in test catches in November 1982 showed that natural spawning was successful already by autumn 1980.

I. INTRODUCTION

The deterioration of ecosystems by acid deposition is extensive. Damage to stressed aquatic biota, especially fish populations, have been documented by many authors (HULTBERG and STENSON 1970, Almer *et al.* 1974; GRAHN *et al.* 1974, OVERREIN *et al.* 1980, MONITOR 1981, HARVEY *et al.* 1981; HAINES 1981, MUNIZ 1981, LAST 1982, HULTBERG 1984).

In Sweden, 18,000 lakes and 80,000 km of stream are estimated to have endangered or damaged fish and crayfish populations (MONITOR 1981). The increase in deposition of sulphur has been halted or even slightly reversed. Current acid-loading would, however, still increase the number of lakes in which the fish populations are lost.

Small forest lakes supporting populations of Arctic char (*Salvelinus* sp.) are all low buffer lakes and consequently most vulnerable to acid precipitation. Lake Stora Holmevatten is one such lake that lost its indigenous char population (cf MALM 1877) due to acidification between 1967 and 1971 (DICKSON *et al.* 1975).

This paper presents observations on ecosystem shifts and the reactions of reintroduced Arctic char (*Salvelinus salvelinus* (L.)) following the liming of Lake Stora Holmevatten.

II. MATERIALS AND METHODS

Site description

Lake Stora Holmevatten ($57^{\circ} 99' \text{ N}$, $11^{\circ} 96' \text{ W}$) is situated 109 m. a.s.l. in an area underlaid by granitic bedrock. The area is part of a forested highland about 10–15 km inland from the Swedish west coast. Topography, vegetation, and hydrology are similar to the River Anrãseã area described by ANDERSSON *et al.* (1984). Data describing the lake are given in Table 1. Lake Stora Holmevatten is dammed approximately 1.5 m and remnants of an older barrage indicate that the lake has been utilized as a water reservoir for centuries. The bathymetric map (Fig. 1) disclose two major basins (max. depths 25 and 30 m) and one smaller basin (max. depth 17 m) close to the outlet. Shal-

— Hooker in Canada

Tautonymie

S. salvelinus type of genus

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