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Native Lake Trout (*Salvelinus namaycush*) Stocks in the Canadian Waters of Lake Superior Prior to 1955[1]

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The decline of Lake Superior lake trout (*Salvelinus namaycush*) stocks after the sea lamprey (*Petromyzon marinus*) population explosion of the 1950s was both dramatic and decisive. Few native stocks remain to permit scientific data collection. However, interviews with old-time commercial fishermen suggest that there had existed many discrete or semi-discrete stocks within the lake. Historical documents in the form of government correspondence and reports, explorers' accounts, and Hudson's Bay Fur Co. records yield further evidence.

Possible stocks are distinguished on the basis of anatomical features (including weight, body shape, and coloration) and behavioral differences (including seasonal movements and spawning habits). The relevance of these criteria for stock identification is discussed.

Fishermen distinguished four general categories of *S. namaycush*: leans, fats or siscowets, half-breeds, and humpers or paperbellies. In addition, different "breeds" or forms of lean trout were commonly recognized. Often a form was known by a name referring to its most distinctive feature: blacks, redfins, yellowfins, grays, salmon-trout, red trout, moss trout, sand trout, and racers. These varieties are discussed and local spawning habits, grounds, and movements are summarized with maps, tables, and text. At least 200 former spawning grounds are identified, including 20 rivers which were once characterized by September runs of lake trout. Spawning locations for the deep-water, nonlean trout variants (paperbellies, half-breeds, and siscowets) are less easily discovered. Approximately 35 fishing grounds are noted, with spawning reported at 4 of these. Consideration is given to the possible existence of phenotypically distinct stocks of siscowet.

Key words: lake trout, *Salvelinus namaycush*; stocks, anatomical features, behavioral differences

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Le déclin des stocks de touladis (*Salvelinus namaycush*) du lac Supérieur après l'explosion de la population de grandes lamproies marines (*Petromyzon marinus*) des années 1950 fut à la fois dramatique et décisif. Il reste peu de stocks indigènes sur lesquels prélever des données scientifiques. Cependant, si l'on en croit les anciens pêcheurs, il y avait dans le lac plusieurs stocks distincts ou semi-distincts. Ceci est appuyé par des documents historiques, tels que correspondance et rapports gouvernementaux, comptes rendus d'explorateurs et dossiers de la Compagnie de la baie d'Hudson.

On peut différencier des stocks possibles par certaines caractéristiques anatomiques (y compris poids, forme du corps et coloration) et par des particularités du comportement (y compris déplacements saisonniers et moeurs reproductrices). Nous examinons la pertinence de ces critères dans l'identification des stocks.

Les pêcheurs distinguaient quatre catégories générales de *S. namaycush* : maigres, gras ou siscowets, métis et bossus ou « paperbellies ». Ils reconnaissaient en outre différentes « races » ou formes de touladis maigres. On désignait souvent une forme par sa caractéristique la plus distinctive : noirs, nageoires rouges, nageoires jaunes, gris, truites saumonés, truites rouges, truites de mousse, truites de sable et coureurs. Nous examinons ces variétés et résumons, à l'aide de cartes, tableaux et texte, les moeurs reproductrices locales, les frayères et les

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déplacements. On a pu identifier au moins 200 anciennes frayères, y compris 20 rivières jadis caractérisées par des remontées de septembre des touladis. Il est plus difficile de découvrir les frayères des variants d'eau profonde de touladis non maigres (« paperbellies », métis et siscowets). Nous mentionnons environ 35 lieux de pêche, à 4 desquels la ponte a été signalée. Nous examinons la possibilité de l'existence de stocks de siscowets phénotypiquement distincts.

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COGNIZANT of the severe losses inflicted on Lake Superior lake trout (*Salvelinus namaycush*) by the sea lamprey (*Petromyzon marinus*), both Ontario and American state governments embarked upon extensive restocking programs. Despite concerted efforts at rehabilitation, however, viable, self-reproducing populations have failed to re-establish themselves in large areas of the lake; here the catches are still predominantly of hatchery-reared lake trout. It is the opinion of some biologists that this slow rate of success has been due, in part, to early failures at tailoring planting strategies to the different site requirements and ecological characteristics of the lake's various trout stocks.

Although fisheries biologists are now aware that effective management must consider species on the level of individual stocks, only limited attempts have hitherto been made to identify lake trout stocks within the Great Lakes (Van Oosten 1927; Smith 1968; Organ et al. 1978; Peck 1978).

This paper provides historical background information by delineating traditional Canadian Lake Superior spawning grounds and identifying possible stocks existing prior to the advent of *P. marinus*. A study such as this is particularly relevant to Lake Superior for a number of reasons: (1) It is the largest of the Great Lakes and supported an important lake trout fishery. (2) Destruction of the native stocks has occurred more recently than in the other Great Lakes; therefore, proportionately more people are still alive who were familiar with these stocks. (3) As stated above, government agencies have placed special emphasis on trout rehabilitation for the lake. (4) Of all the Great Lakes, lake trout stock formation seems to have attained its greatest diversity in Lake Superior.

Fishermen have traditionally distinguished four general categories of lake trout within Lake Superior waters: leans, paperbellies or humpers, half-breeds, and fats or siscowets. Each tended to dictate different techniques for fishing and brought different prices at market (Lawrie and Rahrer 1973). Recent studies have allotted the first and the last subspecific status (Thurston 1962; Eschmeyer and Phillips 1965; Khan and Qadri 1970).

Within the category "lean lake trout," fishermen also claim the former existence of specific forms or "breeds," based on observed differences in behavior, habitat, and physical appearance. These differences became most apparent during the spawning season. A particular form may have been quite site specific, spawning only on certain selected grounds. On the other hand, a form may have constituted a general spawning run of fish, appearing at many places along the shores or shoals. (In illustration, Table 1 summarizes two historical descriptions of lake trout forms: the first pertains to the Upper Great Lakes in general, whereas the second refers strictly to the St. Ignace Island area of northern Lake Superior.)

The forms of lake trout described by fishermen imply, in certain instances, some degree of intraspecific isolation and stock formation. Historical documents suggest that people have recognized such stocks for many years; although incorrect in their penchant for assuming new species or subspecies, their observations were not without biological significance. Today there remain but scattered remnants of these original stocks.

Sources of Information

During the summers of 1978 to 1980 I interviewed ~85 commercial fishermen, sportsmen, and charterboat operators who had been personally involved with the pre-1955

TABLE 1. Historical examples of Great Lakes lake trout variants.

A) Goode (1884)
(In the summer of 1880 Louis Kumlien investigated the subject of local varieties of lake trout)
1) Green Bay Vicinity
Black Trout — salmon-colored flesh
Lake Trout — white flesh
2) Eastern shore of Green Bay, on the eastern shore of Lake Michigan
Two species of Mackinaw trout recognized by fishermen
3) Grand Traverse Bay, Lake Michigan
Reef trout — long, slim, coarse-meated variety taken in shallow water: when large called racers
Potbellies — short chubby variety, taken in deep water
4) Vicinity of Two Rivers, Wisconsin
Reef trout — large, lank, coarse flesh (see above)
Other form more highly prized, taken in deep water
5) South end Lake Michigan
Two forms, one darker-colored with red flesh being the more highly prized
6) Grand Haven
Two forms of Mackinaw Trout — Shoal-water trout and Deep-water trout
7) Thunder Bay, L. Huron vicinity
"Buckskin" — held in high esteem
Racer

B) Thomson (1883)
Varieties of trout
1) Salmon trout, weight up to 70 lb (1 lb = 0.454 kg)
2) "Siskowitt," weight up to 12 lb
3) Half-breed siskowitt, weight up to 5 lb
4) "Potgut," very inferior fish, weight up to 12 lb
5) Rock or black trout, weight up to 40 lb
6) Large gray or shovel-nose trout, weight up to 70 lb
7) "California trout," yellow spots and flesh, weight up to 10 lb
8) "Half-breed red trout," weight up to 15 lb
9) Common brook or speckled trout, weight up to 7 lb
10) Red trout, weight up to 42 lb

Canadian lake trout fisheries. It became evident that small-boat fishermen sometimes formed impressions of fish habits and habitats different from those of the large-scale tug operators, who could roam farther afield but tended to know individual grounds less intimately. The western end of the lake, with its greater number of sheltered bays, island areas, and nearshore grounds, has traditionally been more accessible to the former. Therefore, all efforts were made to corroborate verbal evidence, and this was possible for most areas of the lake. It should be noted, however, that certain regrettable gaps exist in the spawning ground maps, notably between Pukaskwa and Pic rivers, and along the north part of the Black Bay Peninsula. These are lonely stretches of shore, distant from fishing ports.

Fishermen were requested to indicate on Canadian Hydrographic Service (or National Oceanic and Atmospheric Administration) Great Lakes navigation charts the native lake trout spawning grounds with which they were familiar. These grounds, with the forms (or runs) of lake trout reported as having been dominant, are summarized in Fig. 1–3. Lake trout names are those employed by the interviewees. Spawning periods are reviewed in Table 2 and possible stocks noted.

Archival records were also consulted, and included many published and unpublished accounts of explorers, settlers, sportsmen, and naturalists. Especially useful were the journals and reports of the 19th century Hudson's Bay Company Posts on Lake Superior, and the overseers' reports and correspondence retained in the holdings of the federal Department of Fisheries and Oceans (in the Public Archives of Canada, Ottawa).

Criteria for Stock Identification

Fishermen tended to distinguish groups of lake trout on the basis of the following criteria.

Spawning Location and Time

Throughout the early years of Canadian fisheries management, much heated debate centered on whether closed season regulations were representative of the true spawning periods of the fish species they were designed to protect. It became obvious that the gravidity of a particular species could vary widely under the influence of genetic makeup, age, and local conditions such as food supply, current, and temperature. In bodies of water as vast as the Great Lakes, even the whole lake could not be considered as a single spawning unit. Along certain stretches of Great Lakes shoreline serial trends in annual lake trout spawning periods have long been recognized (see, for example, Smith 1968). In eastern Lake Superior, for instance, the commencement of spawning became progressively later from north to south. It was the practice of some fishermen to begin their fall season at the Pukaskwa River, moving to the Eagle River, the Dog (and sometimes the Bear) River, and lastly the Montreal River in order to sequentially exploit different shore- and river-runs. A similar latitudinal trend was evident along the Black Bay Peninsula: spawning at its northern end began 1 wk to 10 d earlier than at Thunder Cape.

Local conditions might obscure such general trends. Different groups of lake trout seemed to show temporal or habitat segregation according to whether they spawned in river, shore, or shoal areas, windward or leeward zones, bay or mainshore areas, and deep or shallow waters. Lake Superior river-running stocks, for example, often spawned somewhat earlier than those along adjacent main shores. Stocks frequenting the warmer waters of a bay (such as Nipigon Bay) might ripen more slowly and so be reproductively isolated from those of the main lake.

The earlier reports of intraspecific differentiation among Great Lakes *S. namaycush* date from the 17th century and the Jesuit Relations (1670–71). Later historical documents pertaining to the Upper Great Lakes fisheries often noted two visibly distinct runs of lake trout: one spawning inshore and another frequenting offshore shoals (United States House of Representatives 1897; Cook 1929). The spawning scenario of Lake Superior could be considerably complicated, however, by the multiple use of grounds by more than one apparently distinct breeding group. In certain areas this resulted in a rather extended spawning period (as was the case among the islands south of Nipigon Bay). Successive runs showed definite peak concentrations of individuals separated in time by up to 2 wk or more. Despite some intermingling of different runs, patterns seem to have remained consistent through many years. In addition, the close proximity of certain breeding grounds, characterized by different spawning periods, suggests the sympatric association of different groups of trout varying in their responses to spawning stimuli.

Body Weight and Form

As a general rule, seasonally later runs were composed of larger and heavier fish. Several factors might account for these interrun size variations: (1) differences in age composition (perhaps younger fish spawned earlier); (2) differences in growth rates (perhaps the early spawners had slower growth rates or more precocious maturation rates); (3) differences in percentage sex composition; (4) the occurrence of fishing-up phenomena, whereby large individuals were selectively cropped from more heavily exploited fish groups. Obviously these factors can be interrelated, and growth and maturation rates may be influenced by a variety of environmental factors, including water temperature, diet, and fishing pressure. Nevertheless, consistencies were found in the modal weights fishermen reported for each run. It seems that there were not merely intergradations of sizes arriving on the grounds, but actual pulses of different size-classes, an annual stability in composition which may, in some cases, have been linked to local racial differences, (Weight summaries are provided in Table 3.)

Reported variations in body form between lake trout of different grounds, or between different runs on the same grounds, are discussed in later sections. Variations in body form between segments of a population can relate to different rates of growth (Martin 1949).

Flesh Coloration

Although the role of carotenoids in coloring Salmoninae flesh has been known for years (Stevens 1948; Goodwin 1954), the relative importance of various factors determining the intensity of coloration remains in question. Whereas some

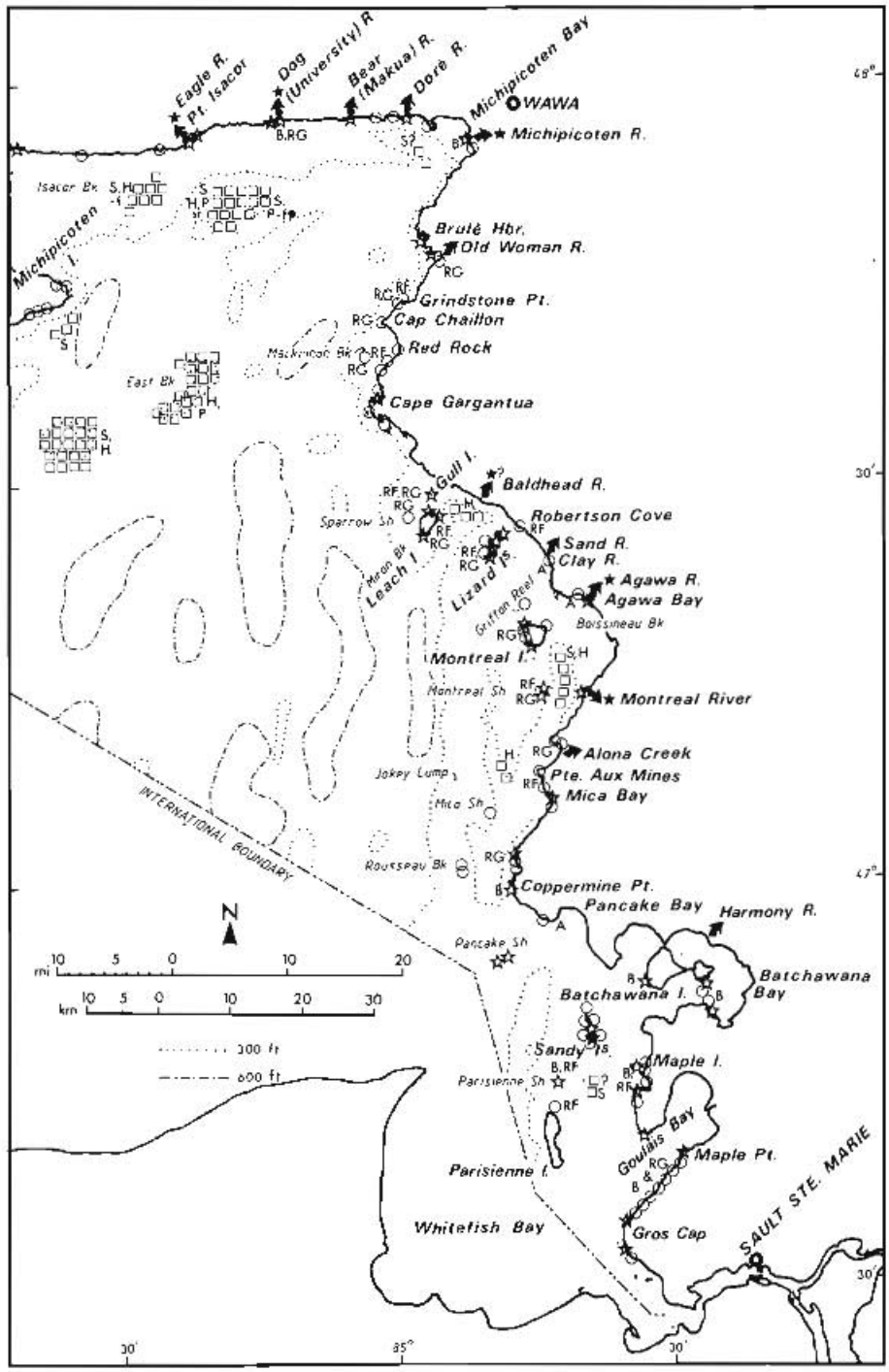

FIG. 1. Sault Ste. Marie to Michipicoten Island. Fishing grounds (nonlean fish only) and spawning grounds of native lake trout. Varieties of native lake trout (names are those employed by fishermen). Leans: RG, regular; B, black; RF, redfin; RD, red; Y, yellowfin; G, grey; ST, Salmon-trout; A, Sand trout. Spawning grounds for lean lake trout. Shore or shoal: ☆, major; ○, average (or of unknown importance); ms, "moss" areas (see text). Rivers: ★, major; ◆, minor (or of unknown importance). Nonleans: S, siscowet (or fat); H, half-breed; P, paperbelly (or humper); □, fishing grounds for nonlean lake trout; ●, spawning reported for nonleans. Spawning location or variety uncertain indicated by question mark (?). Fishing season: sp, spring (April–June); sr, summer (July–Aug.); f, fall (Sept.–Nov.). Fishing gear: gn, gill nets; tr, trolling; pn, pound nets.

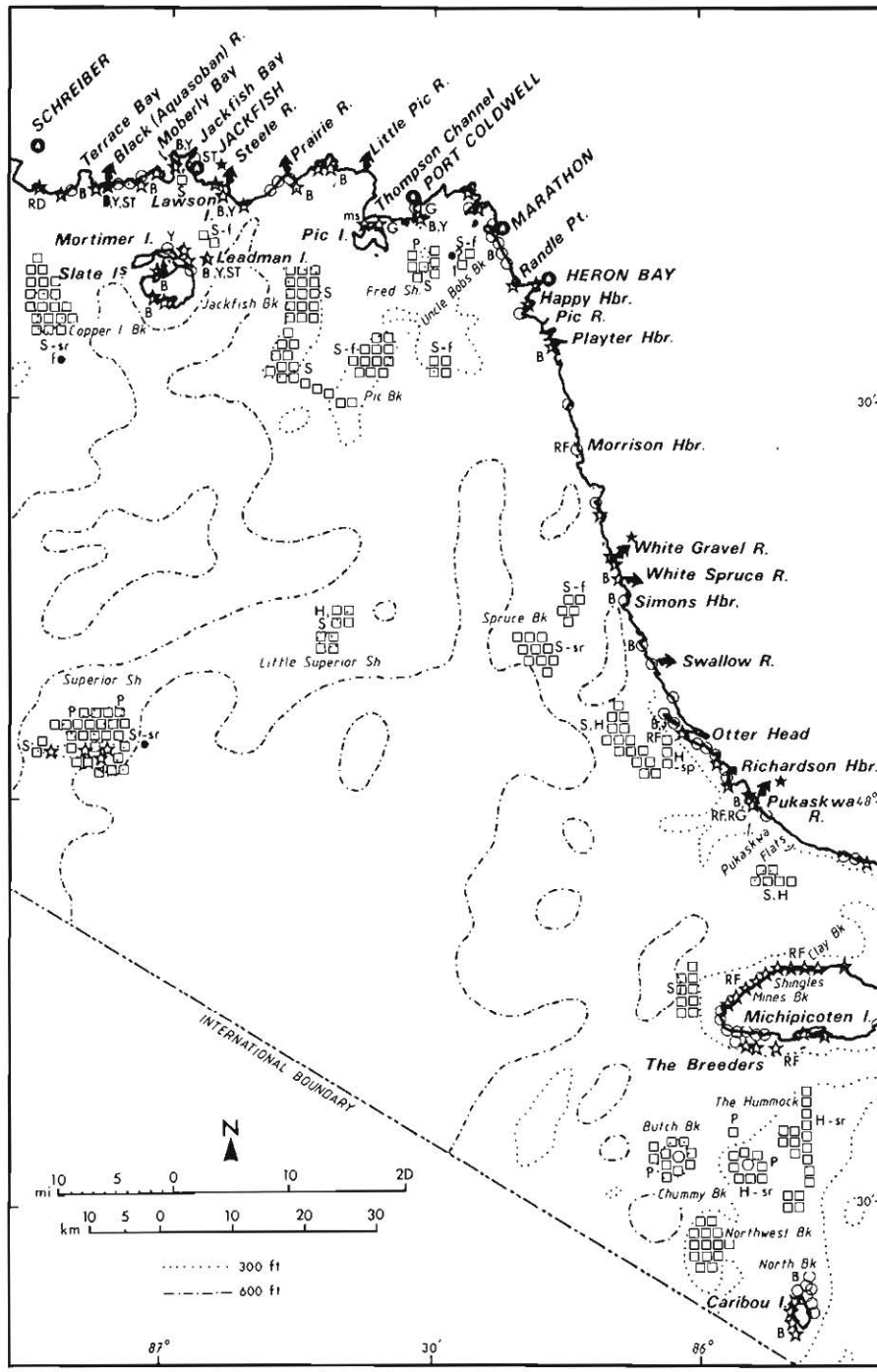

FIG. 2. Michipicoten Island to Schreiber. For explanation of abbreviations, see legend to Fig. 1.

researchers have stressed genetic controls (Prince 1916), others have outlined the significance of environmental determinants such as diet (Hacker 1962; Peterson et al. 1966), age and size (Nilsson and Andersson 1967), or sexual condition (Miller and Kennedy 1948; Rawson 1961). Thus one might regard flesh coloration as an unreliable stock indicator due to the interaction of environmental and physiological factors in masking its genotypic expression. In Lake Superior, however, visible flesh differences existed between the trout of certain spawning runs and/or shoals and remained consistent from year to year. The persistence of different flesh forms may relate to the operation of mechanisms ecologically

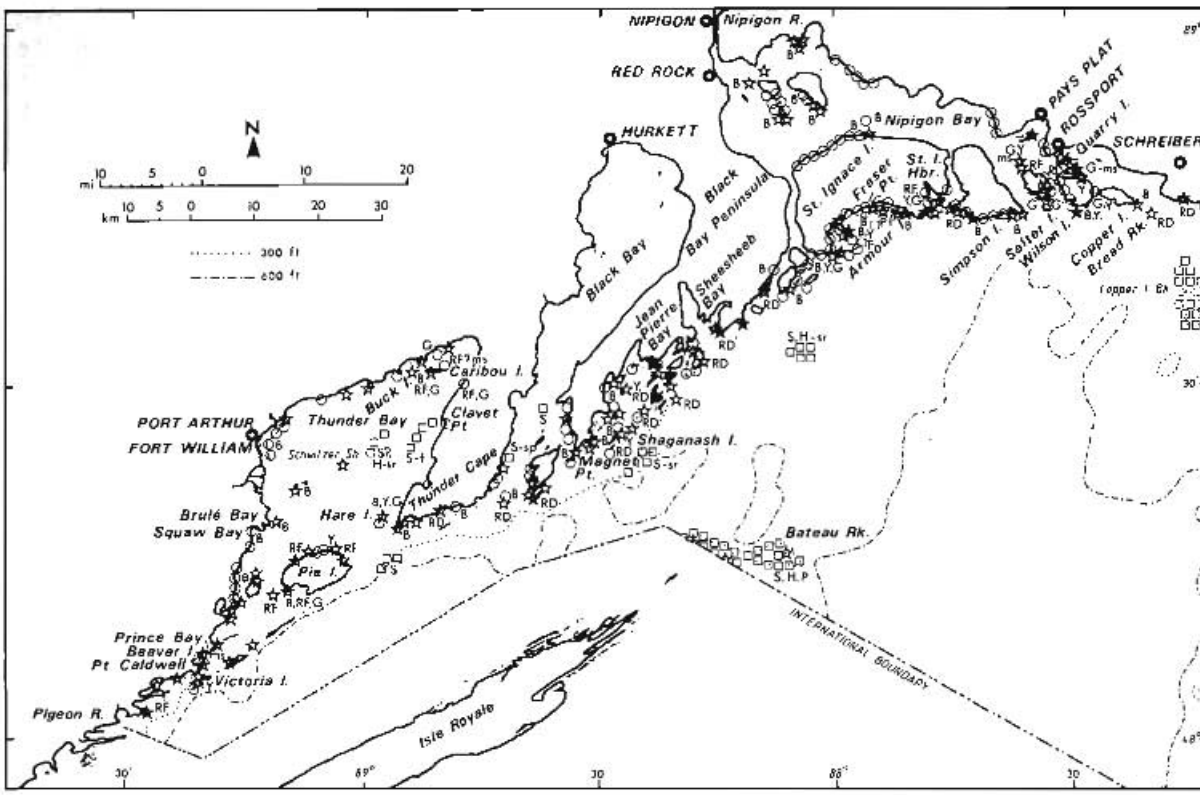

FIG. 3. Schreiber to Pigeon River. For explanation of abbreviations, see legend to Fig. 1.

TABLE 2. Spawning grounds and periods for Lake Superior lean lake trout. For explanation of abbreviations, see legend to Fig. 1.

Location	Approx. spawning period: Start	Approx. spawning period: Finish	Dominat variety	Comment
		A) Shore, shoal, and bank areas		
Sault Ste. Marie to Michipicoten Island (Fig. 1)				
Gros Cap to Maple Point	1st wk Oct.		B, RG	
Maple Island	Oct. 5–10	For 7–10 d	B	Spawning heavier than along main shore
	Oct. 15	End of Oct	RF	2 distinct runs
Parisienne shoal	Oct. 15–20	For 7–10 d	B	Offshore stocks, spawning later than those near shore
			RF	2 distinct runs
East Batchawana Bay	Oct. 10		B	Small B, probably a discrete stock
Outside Batchawana Island	Oct. 10–15		B	
South Sandy Island	Oct. 15–20			
Pancake Bay Flats			A	Observed in summer and fall (see text)
Mica Bay, Pte. Aux Mines	Oct. 1	Oct. 15 (?)	RF	Run unique to this area
Montreal Shoal	Sept. 28–Oct. 1	Early Oct.	RG	Possible stock of large RF
	Oct. 10–25	Nov. or early Dec.	RF	
Montreal Island	Oct. 5–10	Oct. 25	RG	
Boissineau Bank			See comment	Unique form to this area (deeper body, thinner ventral region, color differences from other leans) taken in late summer. Spawning location unknown
Agawa Bay	Late Sept.		RG, A	
Clay River and Sand River area			A	
Lizard Island	Oct. 5–10	Oct. 25 or later	RG, RF	
Robertson Cove			RF	Possible stock
Leach Island	Oct. 5–10	Oct. 25 (?)		

TABLE 2. (*Continued*)

Location	Approx. spawning period		Dominant variety	Comment
	Start	Finish		
Sparrow Shoal	Oct. 5–10	Oct. 25	RG	Especially large trout
Gull Island	Oct. 10–25	1st wk Nov.	RG, RF, see comment	In addition to RG and RF, form having unique skin coloration (silver green body with large darker spots)
Mackinnon Bank	Oct. 15	Up to 1st wk Nov.	RF	Possible offshore spawning stock
Red Rock	1st wk Oct.		RG, see comment	In addition to RG, spawning form known as "half-dollar trout" (colored fins, pink flesh, coin-sized markings on silver–gray bodies)
North point of Old Woman Bay	Late Sept.		RG	
Brulé Harbor	3 days after Old Woman Bay		RG	
	Nov.		See comment	Large late spawners at 18 m (60 ft); deeper than RG
Michipicoten Bay	3rd wk Sept.		B, RG, RF	
Michipicoten Island to Schreiber (Fig. 2)				
Pukaskwa Flats	Early Sept.		B, RG, RF	
Richardson Harbor	Sept. 10			
Otter Head		After Oct. 15	B, RF	Possible stocks of B
Clay Banks, The Shingles, Mines Bank (Michipicoten Island)	Early Oct.	3rd wk Nov.	RF	Probable stocks of RF
Chummy, Northwest, The Hummock Banks				Stocks of leans Spawning habits not known
Butch Bank				Stock of leans smaller than those of the above banks
Caribou Island	Oct. 1	Oct. 22	B	Probable stock
Simons Harbor			B	Possible stock
White Gravel River area	Sept. 7		B	Stock of late-spawning RF?
	Nov. 1		RF	
Playter Harbor, Happy Harbor, Randle Point	After Sept. 7		B	
Port Coldwell area			Y, G (ST)?	Probable stocks
Thompson Channel	Nov.		G	Spawning in "moss" areas (see text)
Lawson Island	Sept.	Nov.	B, Y	
Leadman Island			B, Y, ST	Probable stocks Large trout more abundant than at Slate Islands
Slate Island	Sept. 20–25	For 2 wk (longer in sheltered areas)	B	Stocks probably discrete from those of mainland
North Mortimer Island (Slate Islands)			Y	
Jackfish Bay area	Sept. 20–25	For 10 d–2 wk	B	
Moberly Bay, Cody Island (Jackfish Bay)	Oct. 1 or later		Y	Possible stock Racer form also reported
East arm of Jackfish Bay			ST	Possible minor stock
Superior Shoal	July? Sept.?		See text	Discrete stocks, possibly associated with particular banks Numerous instances of deformity and cannibalism
Schreiber to Pigeon River (Fig. 3)				
Among islands south of Rossport and Nipigon Bay	Sept. 22	Oct. 10	B	
Bread Rock, Quarry Island	Oct. 5	Oct. 15	RD	Possible stocks? (see text)
Quarry Island, Rolette Shoal (North Salter Island)	Nov.	Dec.	Y, G	Spawning in "moss" areas (see text)
West Wilson Island, Salter Island, St. Ignace Harbor	Mid Nov.	Dec.	G	Probable stocks of late spawners
Nipigon Bay	Sept. 30		B, silver-colored trout	Probably discrete stocks

TABLE 2. (*Concluded*)

Location	Approx. spawning period: Start	Approx. spawning period: Finish	Dominant variety	Comment
Armour Island, Fraser Point	Oct. 5	Oct. 15	RD	Possible stocks?
Sheesheeb Bay area	Sept. 17		B	
Sheesheeb Bay			See comment	Small trout in June distinct in appearance from those of main shore (stockier, coloration differences)
				Spawning habits not known
Shaganash Island	Sept. 20	Mid Oct.	B	Possible stock of Y
	Late Oct.		Y	
Magnet Point	Sept. 20		B	
Black Bay				Spawning stocks move only to south portion
Thunder Cape	Sept. 30		B	
Blateau Rock			See text	Probable discrete stocks of leans
Hare Island Reef	Sept. 30–early Oct.	Nov.	B, Y, G	
6.5 km (4 mi) north of Clavet Point		Nov.		Possible stock of late spawners
South shore of Caribou Island	1st wk Oct.		B	
	3rd wk Oct.		RF	
North shore Caribou Island			RF(?), G	Spawning in "moss" areas
North end Thunder Bay		Dec		Unusually late spawners
Buck Island			G (?)	Large, late spawners
Breakwall at Port Arthur and Fort William	Late Sept.–early Oct.		B	
Schwitzer Shoal				Probable stock
Grand Reef (Brulé Bay)	Sept. 25	Oct. 2	B	
South of Squaw Bay	Mid. Sept.		B, "little grays"	
Pie Island	Sept. 15	Late Sept.	B	
	Oct. 20		RF	
	After Oct. 20		Large RF	
Northwest shore Victoria Island	Nov.		Y	Probable stock
Beaver Island			G (?)	Spawning in "moss" areas"
Caldwell Shoal (Point Caldwell)	1st half Nov.		Large spawners	Possible stock
		B) Major spawning rivers		
Montreal River	Sept. 20–25	Oct. 10–15		
Michipicoten River	Sept. 17	Sept. 27–Oct. 8		
Dog River	Sept. 17	Sept. 30 (Loftus 1958)		
Eagle River	Before Dog River			
Pukaskwa River	Sept. 1–5	Late Sept.		
Steele River	Sept.			

separating groups of lake trout during some portion of their lives. For example, to the extent that flesh color is diet related, one might posit the existence of dissimilar feeding niches.

SKIN COLORATION

Agassiz (1850) noted several local color variants in Lake Superior lake trout and believed these to be dependent on habitat bottom. As discussed below, more recent fishermen also recognized an assortment of comparable color types. The frequent heterogeneity of type at a single spawning location suggests the influence of other factors in addition to local substrate. On the basis of behavioral and spawning patterns described by fishermen, it is probable that coloration represented the natural spawning period responses of certain groups of Lake Superior lake trout and could be used to distinguish them at this time. Precedents exist for the use of skin coloration as partial criterion for salmonid stock identification (Ricker 1959; Bulkley 1963; Nilsson and Filipsson 1971).

NONSPAWNING MOVEMENTS

Distinct groups of lake trout were less obvious at times other than the spawning season. However, fishermen frequently reported both vertical and horizontal segregation of large and small trout. Those caught in bottom nets set at 55 m (180 ft) to 75 m (245 ft) in the spring were usually of smaller size. As the weeks progressed many lake trout migrated into shallower zones along both offshore shoals and shore banks. In June or July larger (and older) fish tended to become

TABLE 3. Weight summaries of lake trout varieties reported by Lake Superior fishermen. For explanation of abbreviations, see legend to Fig. 1.

Location	Variety season, gear	Weight range (kg(lb)) Min.	Max.	Avg.
	Leans			
Sault Ste. Marie to Michipicoten Island (Fig. 1)				
East Batchewana Bay	B, f, gn			0.9(2)–1.4(3)
Pancake Point to Coppermine Point	B, f, gn	1.1(2.5)	2.7(6)	1.8(4)
Montreal Shoal	sr, tr		9(20)	1.4(3)–1.8(4)
Jokey Lump	sr, tr	3.6(8)	8(18)–11(24)	
Miron Bank	sr, tr	2.3(5)	25(55)	
Mackinnon Bank	sr, tr		14(30)	
Red Rock	"Half-dollar trout," f, gn			7(15)
(River spawners)				
Montreal River	f		9(20)–16(35)	3.6(8)–4.5(10)
Dog River	f		6.4(14)	1.8(4)–3.2(7)
Michipicoten Island to Schreiber (Fig. 2)				
Michipicoten Island	sr, tr		6.8(15)–14(30)	
Butch Bank	sr, f			0.68(1.5)–0.91(2)
Caribou Island	B, sr, f		4.5(10)	2.7(6)
Steel River mouth	sr, tr		14(30)	2.3(5)–4.5(10)
Jackfish Bay area	B, f, gn		3.6(8)	2.7(6)
Jackfish Bay area	Y, f, gn	5.4(12)	11(25)	
Jackfish area (main shore)	sp, gn			1.1(2.5)–1.4(3)
Slate Island (River spawners)	B, f, gn		2(4.5)	1.4(3)
Pukaskwa River	f	1.4(3)–1.8(4)	>8.2(18)	
Schreiber to Pigeon River (Fig. 3)				
Among islands south of Rossport and Nipigon Bay	B, f, gn		4.5(10)	1.4(3)–2.3(5)
	Y, f, gn	5.4(12)	9.1(20)–23(50)	
	July, gn		4.5(10)–6.4(14)	
Armour Island, Fraser Point	RD, f, gn		6.8(15)	
Nipigon Bay			2.3(5)	
Black Bay Peninsula	B, f, gn		3.2(7)	0.9(2)–2.3(5)
Sheesheeb Bay	June		2(4.5)	0.9(2)–1.4(3)
Jean Pierre Bay area	RD, f, gn	2.3(5)	6.8(15)	
Bateau Rock		1.1(2.5)	3.2(7)	
Harc Island	Y, f, gn		23(50)	
Buck Island	RF, G f, gn		24(54)	
Grand Reef (Brulé Bay)	B, f, gn		3.6(8)	
South of Squaw Bay	"Little grays," f, gn			1.8(4)

TABLE 3. *(Concluded)*

Location	Variety season	Weight range (kg(lb)) Min.	Max.	Avg.
Pic Island	RF, f, gn		11.3(25)–13.6(30)	6.8(15)
	Nonleans			
Between Montreal Shoal and Montreal Island	H, gn	0.7(1.5)	2.7(6)	
	S, gn	2.7(6)	5.5(12)	
Port Coldwell vicinity	P, June, gn			1.8(4)–2.7(6)
Pic Bank	S, Aug., f, gn	4.5(10)	9.1(20) 11(25)	
Copper Island Bank	S, Aug., f, gn		11(25)	
(Historical references)				
Lake Superior (Herbert 1851)			7.7(17)	1.8(4)–2.3(5)
Lake Superior (Lanman 1847)			5.4(12)	
Lake Superior (Sweeny 1880)			14(30)–41(90)	

pelagic, at which time fishermen knew them to feed on cisco stocks or insects at the surface (see also Lawrie and Rahrer 1973). Nearshore movements might be referred to as "summer runs," which continued for several weeks in certain areas. Their availability was under the strong influence of wind and temperature. Dates for the commencement of movements to shallow waters also varied with location in any particular year. In Michipicoten Bay, for example, trout moved into shallow waters in late June, earlier than in the vicinity of the Montreal River. In the vicinity of St. Ignace Island (south of Nipigon Bay) lake trout would appear in pound nets during the 1st wk in June and remain until mid-July; the peak period for large individuals was around July 1 (see Table 3).

At scattered locations (such as in the vicinity of Thunder Cape) large lake trout would again move into shallow waters in mid-August. This second "summer run" was of neither the magnitude nor duration of the first.

During spring and summer, different size-classes of trout might characterize shoals in the same general area, diversity sometimes not easily attributed to the effects of differential fishing pressures alone. Fishermen claimed an ability to recognize different resident groups among the banks extending from Rousseau Bank (off Coppermine Point) to MacKinnon Bank (north of Cape Gargantua), and among the shoal complex between Michipicoten and Caribou Islands.

Native Lean Lake Trout Varieties Described by Fishermen

THE EARLY SPAWNERS

The small, early spawners tended to move to inshore waters in September or early October. On certain grounds these were typically gray or silver–gray, with lighter gray spots and light ventral surface; various fishermen knew them simply as "regular trout" or "little grays." At many locations in both eastern and western waters, however, the early trout were called "blacks." These were often described as having been robust and stocky, with brown–green, dark brown, or black backs, becoming somewhat lighter toward the ventral surface. Flesh coloration varied: blacks south of Coppermine Point showed reddish tones, whereas those spawning among the islands south of Nipigon Bay and on grounds about Jackfish and Port Coldwell tended to be much paler. In general, the small blacks would spawn in waters of 4.5 m (15 ft) or less. Among the islands of the Black Bay Peninsula they sought sheltered areas away from exposed lake shores.

Average weights cited for early spawners ranged from 1 kg (2.2 lb) to 2.7 kg (6 lb). Blacks frequenting inner Batchawana Bay, the Slate Islands (south of Jackfish), and Nipigon Bay tended to be smaller in size than those found along adjacent areas of the lake's main shore. Fishermen believed them to be discrete breeding groups. Native Nipigon Bay trout spawned 8–10 d later than those of the main lake, were brighter in color, and showed a greater tendency to develop fat.

River spawners composed the most obvious stocks of dark-colored trout. These were most prevalent south of the Pic River on the eastern shore, whereas none are known to have existed west of Nipigon Bay or along the American shore. Certain streams received a wide range of fish sizes. Dog River lake trout were, on the average, smaller than Montreal River trout (also noted by Loftus 1958), and Pukaskwa River fish could range to 9 kg (20 lb).

Although there is no evidence that more than one stock visited a single stream, streams might contain a number of separate spawning sites. The Michipicoten River, for example, showed extensive lake trout movements, occasionally extending as far as Scott Falls, 16 km (10 mi) upstream.

There is some evidence that certain river-spawning stocks (such as those of the Steel, Black or Aquasoban, and Little Pic rivers) were depleted prior to the advent of the sea lamprey (Goodier 1981). Excessive poaching was the most likely

cause, although log rafting and channel modification by storms may have had minor impacts.

Redfins and Yellowfins

In general, any lake trout possessing brightly colored fins was liable to be designated "redfin." But the name was also employed by many Lake Superior fishermen to define a specific run which followed that of the earliest spawners. It is possible that falling water temperatures could trigger fin coloration in certain fish, thus creating the illusion of a new run. However, although blacks (or "regular trout") and redfins might spawn on the same grounds, the two forms generally were not found spawning at the same time. At certain locations the retreat of the black trout would precede the arrival of redfins. The classification "redfin" has also been employed by fishermen of Isle Royale (Rakestraw 1968) and the Keweenaw Peninsula (Organ et al. 1978). Fishermen of Georgian Bay identified redfins as their second run of lake trout (Kerr 1886; Loftus 1980).

Redfins were a heavier fish than the earliest spawners. South of Michipicoten Bay redfins were reported to be paler and more elongated than blacks. Between Coppermine Point and Cape Gargantua most grounds were situated on offshore shoals, although north and south of this region many main shore grounds existed. At the Clay Banks and Shingles of Michipicoten Island, large redfins were especially abundant and fishermen believed these to remain in this vicinity all year long.

Former fishermen of the Jackfish and Port Coldwell areas tended to refer to the fish of the second run as yellowfins rather than redfins. Flesh colors were variously reddish or pale. (One fisherman reported a yellow-finned "racer" form (see section on Caribou Island and Superior Shoal lake trout) in the Jackfish Bay area.) Likewise, fishermen of the Black Bay Peninsula–Thunder Bay area would not distinguish redfins and yellowfins as different spawning classes. However, certain grounds, particularly along windward island shores, were frequented predominantly by lake trout with yellow fins. (Large colorful trout might also be described simply as "big blacks.")

Two fishermen familiar with the island shores south of Nipigon Bay and Rossport believed yellowfins to be a unique run at certain sites. Reportedly, these fish were elongated like redfins, but proportionately deeper of body, with yellow–white or white rather than red flesh. Spawning depths varied but often exceeded those of earlier-spawning lake trout.

The Late Spawners

Fishermen west of Marathon tended to perceive a greater number of discrete trout runs than fishermen to the east. Former residents of Jackfish and Port Coldwell refer to "salmon-trout," the large fish arriving after the second run. These commenced spawning in late October and in certain years continued through the month of November and into December. One interviewee described them as "... Streamlined with a small head like a West Coast salmon. The tail was not too big, and all possessed red flesh. They did not have colored fins, and they had a silvery body, not as dark as the blacks and yellowfins. Salmon-trout were taken in a little deeper water at 5 or 6 fathoms."

Fishermen of the Black Bay Peninsula knew large, red-fleshed trout as "red trout," a general category probably including a number of stocks and size-classes more or less intermingling on their grounds during the second half of the fall.

Rossport fishermen applied the name red trout to a seemingly discrete stock. Thomson (1883) also refers to this fish the Indians knew as "Pugwashooaneg, that is Pays-platt District fish, as it is taken only in this locality, and only in the fall of the year as a rule." Red trout would first appear in nets set around August 15 in 18 m (60 ft) to 36 m (120 ft) of water, thus preceding black trout into shallow waters (but actually spawning at a later date, somewhat prior to redfins and yellowfins). Although the variety could be seen on the same grounds as the blacks, their spawning sites, as indicated by fishermen, tended to be smaller in area and less numerous. Red trout were paler and heavier, and typified by red flesh.

West of Schreiber the latest spawners ran to large sizes and were known to some fishermen as gray trout. Rossport fishermen would occasionally set gill nets of 23-cm (9-in) or 25-cm (10-in) mesh for those fish of truly massive proportions (McNab 1922). Grays tended to spawn at 9 m (30 ft) to 20 m (65 ft), relatively greater depths than those preferred by most other forms of lean lake trout. It was the habit of certain stocks of grays (and less frequently yellowfins) to spawn over beds of filamentous green algae, designated "moss" by local fishermen (and identified in Lake George, New York, by Needham et al. (1922) as *Dichtomosiphon tuberosus*, with best development at an average of 14 m). Moss spawners were present at Prince Bay (south of Thunder Bay), north of Caribou Island (in Thunder Bay), near Rossport, and in Thompson Channel (north of Pic Island). At the last location, grays were abundant but absent from neighboring sites. In Michigan State waters "channel salmon" selected similar substrates in harbor areas of Isle Royale and so earned the additional nickname "moss trout." In the Michigan State waters of Lake Michigan, Organ et al. (1978) report an even greater prevalence of moss trout than in Lake Superior.

Caribou Island and Superior Shoal Lake Trout

In addition to the inshore trout runs discussed above, mid-lake shoal zones also supported apparently discrete stocks (whose members were often dark and frequently large). The native leans of Caribou Island, for example, possessed white flesh, a dark brown–green back, gray ventral region, numerous dark spots, and usually lacked colored fins. Spawning in October, they tended to be somewhat heavier than the inshore black trout. Among these Caribou Island "blacks," fishing tugs would net perhaps 2–3% gray (or silver–gray) trout with red or pink flesh, possibly individuals which had strayed from outside areas. There existed recognizable differences between the native lake trout of Michipicoten Island, Caribou Island, and the shoals and banks between these two islands.

In general, the lean lake trout of both Superior Shoal and the Bateau Rock shoals tended to have dark brown backs, mottled appearance, red-colored fins, and deep red flesh. At the former location, a number of banks rise like pinnacle mountains from the lake bottom. It is the opinion of fishermen that specific trout stocks were associated with the different

banks, effectively separated from each other by deep ditches in between. When commercial fishing developed here in the 1920s and 1930s, the individuals of some (but not all) banks were of poor condition and afflicted by a high incidence of deformities. Such fish were known as "racers." Overcrowding and a poor forage base may have been their causes. By the 1960s the frequency of deformities was considerably less; possibly population pressures had been alleviated by the fishery. (A comparable improvement in the condition of Lake Nipigon lake trout also occurred during the early decades of that lake's fishery (King, undated).)

Sand Trout

In the southeastern portion of the lake, some fishermen recognized not only two major spawning runs but also another group named "sand trout." Also designated "silver trout," this fish was slender and small, with red meat and light silvery coloration marked by darker blotches on the dorsal surface. According to two sources, the sand trout was a shoal fish, usually taken over sandy bottom depths of ~55 m (180 ft). Others knew the form to move to inshore flats in June and July. It was possibly analogous to the variety known to Lake Huron fishermen as "summer trout," which Kennedy (1941) describes as "... lighter in colour than the Winter Trout (fall-spawners). Fishermen say they have taken them with spawn running in summer. These fish "disappear" in autumn or winter." Summer trout and sand trout may have represented young age-classes (Canada Department of Marine and Fisheries 1904) and should not be regarded as stocks. Dryer (1966) located the greatest spring and summer concentrations of small lake trout in the Apostle Island region of Lake Superior between 49 m (160 ft) and 71 m (234 ft). On the other hand, sand trout may have been a seasonal phenotypic variation in certain groups of small, early spawners. Only a few sand trout spawning sites were reported by fishermen (Fig. 1). Loftus (1952) reported spawning at the Pukaskwa Flats area between October 20 and November 30, a late run for that area.

Siscowets, Half-breeds, and Paperbellies

Lake trout of high fat content were first described by the Jesuits at their Michilimackinac outpost on Lake Huron (Jesuit Relations 1670–71). Fat trout in Lake Superior were also known as siscowets, a name deriving from an Ojibway Indian word meaning "cooks itself" (Goode 1884). Inconclusive evidence exists to suggest that phenotypically distinct stocks of siscowets flourished within the lake. It was common in the early days of the fishery to distinguish two forms based on differences in skin and flesh coloration (Kingston 1853; Sweeny 1890). Barnston (1874) describes a fish known as "bear trout," fatter than siscowet with white meat of inferior quality. Isle Royale fishermen netted both black and white siscowets. "Black generally run almost three times as large as white. Spawn in up to 100 fathoms of water" (Rakestraw 1968). Fishermen interviewed usually described a single general phenotypic form, with pale pink or white flesh and body lighter in appearance than the lean lake trout. The body below the lateral line was yellowish, fading to grayish-white on the ventral surface; above it was a pale brownish-gray or greenish-brown. Spotting varied but was usually less distinct than that of leans. Authors have recorded a large range of observed body weights (Table 3). Fishermen have long noted that the deeper they fished the fatter lake trout became, and some truth undoubtedly lies in the statement of Eddy and Surber (1960) that "all sorts of gradations in body forms occur."

Only a minority of interviewees actively sought the nonlean categories of lake trout, and even these men were generally unaware of spawning locations and times. Spawning tended to occur at great depths and at times of the year when inclement weather would discourage open-lake fishing. In consequence, only general fishing areas and seasons are outlined in Fig. 1–3. Any known spawning activities are explicitly noted. A short regional summary of grounds follows.

In August siscowets spawned on the offshore banks between Coppermine Point and Cape Gargantua at 46 m (150 ft). To the north large siscowets moved onto Isacor and East Banks by mid-October and dominated the catches. Fat trout grounds also existed closer to Michipicoten Bay, but their exact location is not known (Landon 1973). In former years it was not unusual to capture fat trout in June or early July in waters less than 10 m (33 ft) near the Michipicoten River. But spring abundances were never as great here as off the Pic River, where, in the first half of the 19th century, siscowets outnumbered lean trout in the seines and shallow gill nets of the Hudson's Bay Company's Pic Post. (Several old-timers interviewed at Heron Bay and Marathon had no experience of this annual inshore movement, however.)

Close to the fishing village of Port Coldwell, Uncle Bobs Bank and banks in the vicinity of Fred Shoal were considered among the best grounds in the region. Siscowets were fished in water greater than 110 m (360 ft) until August, when nets were moved to the edges of the various banks. Purvis (1977) was informed by local fishermen that fats came to the banks east of Pic Island to spawn at this time. However, in years past, the Nicoll Brothers Fishery of Port Coldwell was unable to procure fat trout spawn for the Port Arthur Hatchery until November and December (Nicoll 1917, 1920).

Large siscowets ranged along the length of Pic Bank. Reportedly, spawning occurred on the Copper Island Bank from September 1 to early November. In July pound nets set at certain points along the outside island shores south of Rossport would take fats, while occasionally trolling would also prove successful. To the west, along the Black Bay Peninsula, nets could be sunk at various locations on the dropoff of the island shoals to capture siscowets and half-breeds (although nonleans were never intensively fished in this region). In Thunder Bay itself siscowets were occasionally sought in the central basin in November or off Clavet Bay in August.

It is thought that half-breeds are immature fat trout (Khan and Qadri 1970), although some fishermen refute this and claim to have found them in spawning condition. Half-breeds were fished at shallower depths than fats, and there existed certain popular grounds where they were netted in greatest abundance. For smoking purposes this variant was usually preferred over siscowets.

Paperbellies, known to American fishermen as humpers, have been described by Eschmeyer and Phillips (1965), Rahrer (1965), and Patriarche and Peck (1970). They are

unique in having a very white ventral region, sometimes distended, with abnormally thin skin. Paperbellies are a lighter gray than the deep-water siscowets. It has been suggested by Lawrie and Rahrer (1973) that the variant derives from wandering lean lake trout, which colonized the offshore banks and underwent subsequent polymorphic development. Paperbellies were reported to have existed on all the banks between Caribou and Michipicoten Islands and were especially abundant on the flat, northernmost bank of Superior Shoal. According to one fisherman, around June 1 of each year there occurred inshore movements of paperbellies to the vicinity of Port Coldwell harbor.

Conclusion

The criteria employed by fishermen in recognizing "breeds" of lake trout can provide useful background information for researchers interested in stock identification. Prior to 1955, there existed in Lake Superior visibly different spawning groups or runs of lean lake trout, apparently separable in terms of time and/or space. Regional trends in spawning periods evident on a large scale were no doubt partly related to water temperature differences. Local variations, however, suggest the sympatric association of various breeding stocks. It is probable that the sedentary nature of certain lake trout groups, both lean and nonlean, encouraged stock formation, especially on offshore shoals. Other groups, although highly migratory at spawning time, probably maintained strong homing tendencies which could encourage segregation (see review in Lawrie 1978; Martin and Olver 1980). This was most apparent among the river-spawning lake trout populations of the east and northeast shores. In addition, certain groups, although mixing more or less freely on the shore or shoal grounds, evidently remained semidiscrete, for they were seen year after year at the same locations.

It is the nature of the sources used in an historical approach such as this that an abundance of clues for mapping former fish stocks is generated: unfortunately, many must also remain speculative and inconclusive. Further analyses (including electrophoretic techniques) of stock remnants would prove valuable in both verifying fishermen's impressions and determining degrees of stock discreteness (see, for example, Dehring et al. 1981). Surviving stocks of native lean lake trout have been reported at the Slate Islands, Bateau Rock, and Pie Island. In addition, genetic strains of Lake Superior trout have been maintained for many years in a number of Ontario's inland lakes (such as Killala and Mishibishu lakes), as well as in the breeding tanks of several Ontario fish hatcheries. In fact, during the past 100 yr Lake Superior has been a popular source of transplants, which have been scattered widely about North America.

The havoc wrought by the sea lamprey on the salmonid stocks of the Great Lakes has been well documented. It has been suggested by Lawrie and Rahrer (1973) that a sequential fishing-up process of lake trout stocks was occurring within Lake Superior waters prior to the advent of *P. marinus*. The opportunistic development of the commercial industry created conditions in which this would be likely to occur. On the basis of both the interviews and preliminary examination of government reports prior to 1940, the contention of the above authors seems to be valid for some regions. (The apparent depletion of river-spawning stocks is mentioned above, for example.)

Reviewing the processes of stock transformation and loss within the lake should be the next step for continued research. Again, the primary and most valuable sources of information are the "old-timers" themselves, fishermen who have repeatedly demonstrated an intimate awareness of lake conditions and fish habitats. Such knowledge develops only from years of observation, from the certainty that economic and physical security depends on its accurateness, and from a respect for, and desire to conserve, the environment which has lent them a livelihood.

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