LAKE SUPERIOR NOTES

BOOK II

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Habitat

1. ① alevins, fry → slow-running streams, litteral, some pelagic, semi-pelagic
② adults → to more pelagic habitat.

In Lindsey & Woods Biology of Coregenid Fishes

T. Lindström Habitats of whitefish in some north Swedish lakes at different stages of life history.

p 465 - species lengths at maturity important for choice of spawning sites

STAGES

*Habitat during egg stage

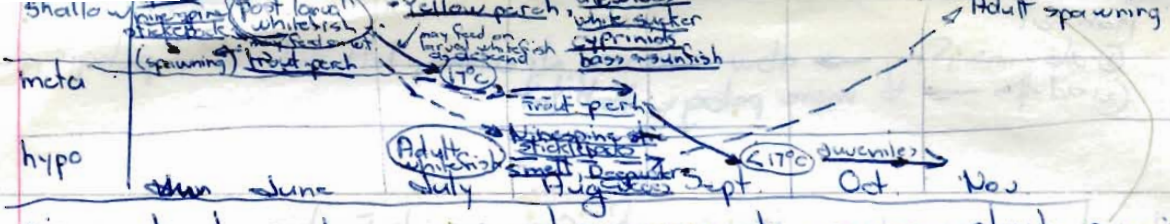
p 467 - Stream spawners
- offspring may leave streams as eggs but may also do so as alevins or later in life cycle
- drift of eggs most hazardous because ↑ risk of oxygen deficiency + predators
- Pelagic spawners
- Burbot potential egg predator in deep parts
- Lawler (1965) suggests deep basins in a lake can maintain residual popn of whitefish when the other parts are too warm in winter for embryonic development.

p 472 - minnows suspected to be an important predator on whitefish frey

p 474 - schooling behaviour
- change in behaviour when pass certain length (arbitrarily 15 mm)
- react upon other school members, move in a very uniform way. Keep regular mutual distances

475 - pelagic popns characterized by low individual size and high no of gillrakers
- also spawn pelagically or semipelagically and later than other cohabiting whitefish species
- popn spawning in running water larger individual size and spawns early
- However Fenderson (1966) reports in Maine U.S.A. dwarfs with ↑ higher no. of gillrakers spawn late in running water
Lindsey (1963) reports whitefish with modal value of 25 gillrakers living more pelagically than whitefish with 23 gillrakers but spawning in running water and probably earlier
- ∴ habitat choice can perhaps vary for a species
- when occurring in same habitat fry & different species show different food choices (Lindström and Nilsson, 1962) - but interactive aggregation may depend much on habitat choice

2.



- in early stages large percentage seem to occupy slowly running waters close to late + littoral areas
- after first stages all whitefish move to a more pelagic life

South Bay L. Huron — J.R. Reckahn. Ecology of young lake whitefish (Coregonus clupeaformis) in South Bay, Manitoulin Island, Lake Huron.

p 440 - bay consists of two basins = outer basin flat and shallow, inner basin deeper and larger.
- two basins separated by narrow, and bay separated from L Huron by an even narrower channel.
- adult whitefish in inner basin form resident popn which do not leave
- spring pound net fishery conducted in outer basin from mid-May to early July each year since 1947
- Not - American smelt (Osmerus mordax) not adequately sampled by spring pound net fishery in shallow water
- used small bottom trawls and stratified gill netting series (1965)

p 442 - ~~Depth~~ distribution
- post larval whitefish in shallowest waters of South Bay in late June
p 444 - in early July near emergent vegetation in close proximity of 17°C water.
- leave shallows early July and migrate 4km towards deeper water
- descent of fish closely associated with narrow stratum of 17°C water near upper boundary of metalimnion
- near end of August ~~descent~~ young whitefish descend to colder and deeper waters for uncertain reasons
- changes in temp., light, pressure might be involved.
- acclimatization to colder waters might stimulate descent and subsurface seiches may be imp. in initiating descent
p 445 - involves also lateral movement
p. 446 - reduced rate of growth
- probably colder water temperatures which regulate metabolism are directly resp.

p 447 - Coinhabitants
① Gill net sampled

- Epilimnion - yellow perch (Perca flavescens) most abundant
  - Alewives (Alosa pseudoharengus) and white suckers (Catostomus commersoni) equally abundant

p. 449 - Deeper Waters - American smelt (Osmerus mordax) most abundant (however smelt exceptionally vulnerable to gill nets as most frequently caught by single strand jammed into angle of recurved teeth on their tongue + upper maxillae
  - Adult and immature whitefish moderately abundant (abundance in South Bay much higher than elsewhere studied in L. Huron)
  - Burbot (Lota lota) in small numbers

- low abundance of fish in metalimnion
- young whitefish inhabiting area during July + August in region of low potential predation and competition from larger fish

② Bottom trawls

p. 450 - warmest, shallow waters - johnny darters (Etheostoma olmstedi), young alewives, several species of cyprinids, young trout-perch (Percopsis omiscomaycus), young rock bass (Ambloplites rupestris), pumpkinseed sunfish (Lepomis gibbosus), bluegill sunfish (Lepomis macrochirus), young smallmouth black bass (Micropterus dolimieui) - in July + August
  - ~~young~~ spottail shiners occupied shallowest waters, but adults following spawning activities caught most abundantly in waters 6-14 m. deep
  - white suckers, yellow perch, adult alewives in waters 1-14 m. deep
  - adult trout-perch in large spawning aggregates in shallow water in June and early July - most abundant within metalimnion during July and August.
  - N.B - differences in food habits of trout-perch and whitefish sufficient to reduce potential competition (seems to be no decline in growth rate of whitefish which would indicate competition)
  - young spottail shiners along with young whitefish in shallow waters - hazard to whitefish which ~~are eaten~~ by spottails and ninespine sticklebacks (abundant in shallower waters in June and early July during spawning season when associated with aquatic vegetation in which males construct nests.

p. 451

hypolimnion - ninespine sticklebacks dominant

p. 453 Food habits see Table 5, Table 7
- initially feed on copepods which dominate at time of ice out
- with spring plankton growth cladocerans dominate
- when leave shallows in early July begin to feed on bottom organisms
- however cladocerans, esp Bosmina, still dominant food
p 454 - as descend to metalimnion further orientation to bottom foods
- ostracods in greater nos but dipteran larvae dominate
- dipterans increase in nos until early August when sharp decline
p 455 (may coincide with time of pupation)
- replaced by water mites (Hydrachnidae) and more significantly small Pelecypods, eg Pisidium
- late Sept and Oct dipterans again significant - Pelecypods + Gastropods also increase
p 456 - Conc.
- young whitefish feed on planktonic organisms when gill rakers few and small in size, but switch to benthic diet by time gill rakers well developed in late fall (occupy adult niche by this time)
- intraspecific competition reduced
- adults in deepest waters during July + August and ascend to shallower water during Sept. and Oct. prior to spawning in Nov.
- thus occupy shallower depths in fall when young whitefish adapting to adult fare in deeper waters ~~(utilize similar foods amph~~
- juvenile whitefish much of hypolimnial region betw 20 m (utilize similiar foods ie amphipods, isopods, ostracods, pelecypods, gastropods, some planktonic crustacea)
- in following spring when both juveniles + adults in shallow water some segregation of food habits to reduce competition eg size differences of amphipods
- interspecific comp also reduced in deeper waters - ciscoes different diet

Faber, Daniel J. Ecological observations on newly hatched lake whitefish in South Bay, Lake Huron.
(collected with tow nets)
p 455 - spawning during mid November, hatching during late April.
p. 456 - other species in order of abundance (newly hatched)

5, Faber
-compares coregonid larvae. -spawning mid Nov, hatching late April.

① Rainbow smelt, Osmerus mordax
p. 457 -not appear until ~~late~~ early may
-most smelt spawn in streams thus env. cond. in streams (not bay) probably responsible for delay in appearance
② Burbot, ~~lota lota~~ - not large popn. in South Bay
③ Shallow-water cisco, Coregonus artedi -declined during last 20 years to very small nos.
④ ~~Myoxocephalus~~ Deepwater sculpin, Myoxocephalus quadricornis
p. 489 Note - not newly hatched ~~cisco~~ whitefish aggregated - this should be taken account of in sampling technique
-comparison of coregonid larvae

Berg. A. A comparative study of food and growth, and competition between two species of coregonids introduced into Lake Maggiore, Italy

p. 315 -coregonids microphagic typically
-may distinguish between pelagic coregonids, which are mostly planktophagic and bottom-dwelling coregonids which are mostly benthophagic
316 -winter food typically quite different from food consumed in growth period
320 -annual variations in diet function of active selection and interrelationship of vertical emigration of fish and zooplankton
-fish feed within a thermically well defined ~~lay~~ water layer — consequence of typical stenothermy
-plankton species which is not distributed in that particular water layer cannot be exploited
p. 327 -growth determining factors of fish are temperature and food availability
-coregonids ~~many~~ able to compensate for temp. by vertical movement
-food availability may be very important — eg. Svardson (1953) great acceleration of growth in transfer expts. of coregonids in Scandanavian virgin lakes.
may complicate cond. made re concerning effect of artificial fishing mortality and natural mortality
-increased growth ~~cond~~ result in earlier sexual maturity, shorter life span
-thus - contrary to cond. of Wagler (1941, Die hochsartige (Salmonidae). II Teil Coregonen. Handbuch der Binnenfischerei Mitteleuropas 3, 6: 371-494, Schweizerbart'sche Verlagsbuchhandlung: Stuttgart.) food of alpine lakes can not always be considered to be in excess — may be an important limiting factor to growth.

Berg. A - noted depth dist. of Keckahn paper 11 C
- food availability may be limiting - linked to vertical migration of zooplankton
6. - two species do not show typical food segregation of sympatric coregonids (Nilsson, 1963) (may be due to infertility of profundal bottom) ∠ intraspecific comp. probably important
p. 9.

p. 341 - seasonal growth of two species limited to short period (May - Oct) characterized by a high production of cladocerans
- for oligostenothermal species (ie coregonids) temp play only indirect role by regulating rate of plankton production.
- <u>interactions between bondella (Coregonus macropthalmus) and laverello</u>
p. ① typically sympatric species show food segregation
- generally coregonid with smaller no. of gillrakers consumes bigger sized food (benthos) while coregonid with higher no. of gill rakers feeds upon organisms of smaller size (plankton) (Lindsey, 1963)
- not evident in two species of Lake Maggiore
p342 - may be because while littoral zone many organisms profundal zone poor in benthos (because of lack of organic sediments)
- precluded from littoral zone during most of growth period because of high temp. (will also depend on plankton of pelagic zone)
p 343 ② no efficient spatial segregation
∴ intraspecific competition for food
- however interspecific competition between coregonids and another planktophagic species (<u>shad agone; Alosa fista lacustris</u>) reduced — differentiation in food spectrum, spatial segregation, physiological differentiation, separation of reproductive periods
- competition favours bondella
① fecundity higher
② deep water spawning areas less subject to adverse conditions
③ reproduction period (end of Jan) better for fry survival than lavarello (Dec) because allows hatching at end of winter when food more available
④ effect of fishing affect bigger form (lavarello) more - eliminate more immature young fish

Spangler, George R. Factors of mortality in an exploited population of whitefish, <u>Coregonus clupeaformis</u> in northern Lake Huron.

p. 520 - relationship between survival and instantaneous fishing + natural mortality rates:

$$S_i = e^{-(M_i + F_i)(T_i - T_{i-1})} \quad (1 \le i \le n)$$

n = no. of time intervals during the study

7.

Spangler - Mark-recapture data analysis to determine natural and fishing mortality
- Natural causes (probably lamprey major) more significant than fishing in whitefish mortality near Burnt Island.

M_i - instantaneous natural mortality rate during the $i-1$th interval
F_i = instantaneous rate of fishing during the $i-1$th interval
T_i = beginning of the ith interval
S_i = probability of escaping capture and surviving to time T_i for a fish alive at time T_{i-1}

Let Z_i = total instantaneous mortality rate = $(M_i + F_i)$
probability that a fish alive at time T_{i-1} will be captured by the fishery is

$$P_i = \frac{F_i}{Z_i}(1 - S_i)$$

- Jolly (1965) presents estimator for no. of tagged fish extant at the beginning of successive time intervals (modified to estimate only no. of tagged fish alive + free)

$$\hat{A}_i = \frac{N_i \cdot U_i}{R_i} \quad (i = 2, 3, \ldots, n-1)$$

$\hat{A}_i$ - estimated no. of tagged fish alive and free immediately prior to lifting the gear at time T_i (this excludes fish in the gear about to be lifted).
N_i = number of fish bearing tags which were released at time T_i
R_i = no. from N_i which were recaptured subsequent to time T_i
p. 521 U_i = no. of fish recaptured after T_i which were tagged prior to T_i and not caught at T_i

$$\text{So } \hat{S}_i = \frac{\hat{A}_i}{\hat{A}_{i-1} + N_{i-1}}$$

$$\hat{Z}_i = \frac{\log_e(1/\hat{S}_i)}{T_i - T_{i-1}} \quad (i = 2, 3, \ldots, n-1;\ 0 < \hat{S}_i \leq 1)$$

Actual no. of tag recaptures (C_i) in the gear at time T_i permits estimate of P_i

$$\hat{P}_i = \frac{C_i}{\hat{A}_{i-1} + N_{i-1}} \quad (i = 2, 3, \ldots, n-1)$$

$$\text{thus } \hat{F}_i = \frac{\hat{Z}_i \cdot \hat{P}_i}{1 - \hat{S}_i}$$

$$\hat{M}_i = \hat{Z}_i - \hat{F}_i \quad (i = 1, 2, \ldots n-1;\ 0 \leq \hat{S}_i < 1)$$

p. 522 - important assumption is that N_i animals released from ith sample ~~as~~ dist at time t_{i+1} that each same probability of being caught
- no theoretical restriction on length of time between samples (after "mixing" time" for released fish allowed)
- in practice must choose time interval short enough so that mortality can be considered constant within the interval.
- estimation of A_i requires fish to be released alive
- mortality estimates cannot be made by this method unless live-capture gear used
- ~~a~~ survival between pound net seasons estimated by

$$\hat{S}_i = \frac{\hat{A}_5}{\hat{A}_5}$$

where $\hat{A}_5$ = the mean of the first three $\hat{A}_i$ of an age-group in the spring and
$\hat{A}_5$ = mean of the last three $\hat{A}_i$ for that age group the preceding fall

p. 523 Discussion
- total mortality rate of Burnt Island whitefish increases with age
- greatest mortality during months June - Oct for all age class
- 525 - largest component due to causes other than fishing
- fishing in period becomes sign. for age IV whitefish but does not contribute to mortality of younger age groups
- Nov. - May - 2 + 3 year olds low mortality from natural causes
- 4-yr. great losses from this source
- III increased mortality due to fishing as become vulnerable to 114 mm gill nets
- total annual mortality rates high for stock
- approaches 100 % at onset of age V
- non-fishing sources major factor although fishing must also be considered
- 2 years-olds fully vulnerable to 76 mm pound net mesh late in season
- sea lamprey predation seems to be major ~~cause~~ of mortality.

Nümann, W. The "Blaufelchen of Lake Constance (~~Coregonus Wartmanni~~) under negative and positive influences of man.

9. Niimann -while eutrophication stimulates growth, overfishing tends to reduce size of stock → smaller stock grows faster → ~~[illegible]~~ loss of older fish and fishery increasingly removes younger (faster growing but pre-spawning age fish. Note also eggs of older spawners more chance of survival

p 537 -before eutrophication a small year class grew faster than a large year class with no other factors operating (density dependency)
-However good or bad growth may be simulated by fishery (in a good year only a few fish ever size limit survive, while in a bad year fishing effort is decreased and more fish survive)

p 539 -warm fall favourable to growth

p. 540 -eutrophication increased growth rate by increasing available plankton food (1956-1963 decline)
-overfishing took place because size limits did not correspond to changes in growth

p 541 -younger year classes being taken (size limit remained at 30" or 31 cm) even before had chance to spawn once
-older fish disappeared and younger fish not formerly seen (age II) appeared in catches

546 -absolute number of eggs necessary condition for large year class
-eggs of first spawners of poorer quality - need older fish spawning to expect high yield
-egg loss may be 70 to 90% before fry appear
-predators - esp. burbot (Lota lubaris)
-also deep form of char (Salmo salvelinus)

547 -egg loss and deformities may result from lowering bottom oxygen concentrations

perch predator

548 -with eutrophication perch (Perca fluviatilis) and cyprinids no longer stay only in littoral regions but penetrate into pelagic also
-potential predators on whitefish fry
-in turn adult whitefish eating very small perch
-parasites may influence strength of year class

551 Note - maturing process quicker at low temperatures and slower at high temperatures for fry

Nilson, Nils-Arvid Interaction between trout and char in Scandanavia Trans. Amer Fish Soc. v. 92, No. 3, July 1963 pp 276-285

p 282 ⊕ ~~Salmo trutta~~ trout are territorial and Salvelinus alpinus char more roaming in general behaviour
⊖ when abundant food two species have similar preferences, when

Nilson (1963) - demonstrated food segregation in sympatric trout (Salmo trutta) and char (Salvelinus alpinus) in Scandinavian lakes.

Note ① introduction of char into trout waters adversely affects trout

② introduction of whitefish into char waters may adversely affect char (Ekman, S. 1910 om mannikans ardel i fiskfaunans sprindring till def inre Norrlands vatten, Amer 30, 133-170)

sparse, different in feeding habits

- trout more ecologically "rigid" — char, more pelagic and roaming, and better able to change from one feeding behaviour to another

p. 277 - when allopatric species both prefer Gammarus, Limnaea, ephemerid nymphs and terrestrial insects (char preference for chironomids not as striking for trout - no sign. difference in consumption of small crustaceans nor of Trichoptera larvae.

p 279 - in sympatric cases char feed on small crustaceans (copepods and Cladocera), trout on Trichoptera larvae + terrestrial insects

p. 280 - large char more planktonic feeders to a greater extent when living with trout

282 ③ Under experimental conditions trout > char fight interspecifically with trout in general being the more aggressive species

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SUPERIOR Laurie [A.H.], & F. Rahrer Lake Superior A Case History of the lake and its Fisheries Great Lakes Fishery Commission Technical Report No. 19.

p. 34 LAKE TROUT

- almost universally distributed from the littoral to over 183 m (100 fath)
- deep every offshore shoal arising from deep water and isolated from the littoral
- as spawner in tributary waters
- local and discrete populations may be recognized

VARIANTS - lean + fat trout clearly distinct

Present ① Lean ~~S. h namaycush~~

- depths less than 73 m (40 fath)
- mode in region of 37 m (20 fath)
- salmon-like in appearance
- 6.6 - 52.3 % fat in tissues
- spawn between late Sept. and early Nov. on gravelly beaches and rocky shoals in shallow waters 2 - 37 m (1 - 20 fath) (Eschmeyer 1955).

11. LAKE TROUTS

VARIANTS ① LEAN - shallower, spawn Sept - Nov on shoals reefs } distinctive stocks
- less migratory
② FAT - deeper, spawn July - Nov. in deep water
③ HALFBREED - hybrid of LEAN + FAT but closer to FAT
④ HUMPERS - live on offshore isolated reefs, shallower water than FATS
- little movement
- some resemblance to FATS but closer to LEANS in fat content, bathymetric dist, spawning depth

- some pops, now extinct, ascended lower reaches of certain north shore tributaries for as much as two miles in order to spawn (Loftus 1958)

② Fat trout S. n. siscowet
- depths below 91 m (mode in region of 128 m - 70 fath)
- deep, stout body and small head giving a dumpy appearance
- 32.5 to 88.8 % fat in tissues
- adaptive for buoyancy regulation (Crawford, 1966.)
- spawn over longer season and much deeper, from at least July to November depending on geographic location in, 91 - 146 m (50 to 80 fath) (Eschmeyer, 1955)

p. 36 ③ Half breeds
- cross between fat and lean
- regression of fat content on length for halfbreed trout from the lake not significicantly different from fat trout
- Khan and Quadri (1970) - no significant difference in morphometry of fats and halfbreed trout
- no significant differences in meristic counts except for those of branchiostegal and anal fin rays
- Halfbreed trout smaller than fats
- taken from depths which lie within deeper part of lean trout ranger close to upper limit
- may be considered to be small fats not yet large enough for their divergence in morphometry to make them readily distinguishable (see Eschmeyer + Phillips (1965), Khan and Quadri (1970) p 34-35

④ Humpers
- deep-bodied, with thin abdominal wall, short head, convex snout (Rahrer, 1965)
- tops of offshore banks (shoals) separated from one another and from inshore bank by deep water usually of 90 m (50 fath) or more
- some taken as deep as 110 m (60 fath) but must taken in depths less than 73 m (40 fath) - like lean trout
- like lean trout spawn on isolated reefs in water as shallow as 18m (10 fath)
- largely segrated from deeper fat trout pops
- on average small, slow-growing trout (Rahrer 1967)
- tendency to early maturity & reproduce at smaller sizes than other populations
- passing resemblance to small fat trout or halfbreed
- closer to lean trout in fat content, bathymetric dist, spawning depth

-small size may be result of invertebrate diet (~~Mysis relicta~~ L gammarids) -forage fish scarce on ground
-similar slow growth and early maturity in planktivorous lake trout of certain Algonquin Park lakes (Martin, 1966, 1970)
-older lean trout tend to become pelagic, particularly during summer months
-may be taken by use of floating gill nets and hook lines as well as by trolling (Roosevelt, 1865; Milner, 1874; Eschmeyer 1957a, Dryer et al., 1965; Rahrer, 1967)
-~~are~~ wander quite extensively

p. 37 -also lean trout taken ~~on~~ offshore banks in small nos.
-offshore banks ~~may have~~ may historically have been colonized by wandering lean trout
-resulting pops reproductively isolated, and phenotypically altered by direct influence of food supply to yield humper variant

Movements
- 0 - 483 km (300 mi)
-variability associated with - differences between variants
- differences between mature and immature fish
- in case of hatchery-reared fish, differences in time since release
- location of planting site, esp. in relation to prevailing currents, and trout densities already prevailing

-~~Humpers~~ -move little
-tagging -Isle Royale, Caribou Island, Superior Shoal

p. 38 ~~lean~~
-most live within 81 km (50 mi) of points of release or planting
-Apostle Island tagging 1951-1952 (Eschmeyer, Daly, Erkkila, 1953)
-Loftus (1958) recaptures in lake of river spawning trout mostly within 48 km (30 mi) of spawning river
-see Buettner (1961), Pycha, Dryer & King (1965)
-"homing" for mature trout suggested (Eschmeyer, Daly & Erkkila, 1953; Eschmeyer, 1955, Loftus, 1958, Rahrer, 1968)
-seems only evident from observations of hatchery-reared planted

p. 39 trout, which have a tendency to return to beach planting sites

- decline after 1953 under effect of sea lamprey,
- increase in 1960s with sea lamprey control + stocking programme

13

to spawn even though many better sites (rock reefs) in vicinity
--much circumstantial evidence that lake trout ~~will return~~ once having
p 39 spawned at a particular ground will return in subsequent years

YIELDS.

p 40 - statistics irregular prior to 1913
- entire lake yield data only available for 8 of 28 yrs 1885 to 1912 inclusive
- max. recorded yield 3,334,811 kg (7,532,000 lb) in 1903
- no sign. ~~decli~~ long term trend in yields until 1953
- steep exponential decline of 27% a year until 1962
- constant yields from 1962 - 1966 + sharp increase in 1967 - from statistics taken after fisheries sharply restricted in 1962 and yields controlled by application of de facto quotas
- most imp. species until collapse
- long maintainance of high yields probably due to species widespread distribution in multitude of quasi-discrete stocks - lent themselves to sequential fishing-up process during development of the fishery
- Hile, Eschmeyer and Lunger (1951b) document increase in effective fishing effort over large part of lake during 1930s + 40s
p 41 - evidence avg. stock densities falling despite constant yields
- though irregular or even cyclic approximated negative exponential with rate of 2% per year

dev. & commercial angling fishery in second quarter of this century
- early accounts of easy of taking lake trout with baited hook or artificial lure (Agassiz, 1850; Herbert 1851; Roosevelt, 1865; Brown, 1876)
p 42 ~~no~~ records available of purely sporting catch
- in 1950 estimated 47 part-time and 10 full-time charter boat operations in Canadian waters

EFFECTS OF SEA LAMPREY PREDATION
- evidence selects larger + hence older lake trout (Fry 1953, Fry + Budd 1958; Budd and Fry, 1960).
- decline characterized by progressive truncation of upper end of both size and age dist. and ~~by~~ ultimately by loss of spawners
- as control achieved distributions extended upward again and spawning resumed (Dryer + King, 1968)

14. PLANTINGS

- large numbers planted in lake (Table 9) in program complementing that of lamprey contol
- during 1960's increasingly dominated inshore lake trout catches until by middle of decade contributed up to 95% of catch
- 48 fish per 3,048 m (10,000 ft) of gill net in 1962 → 140 per 3,048 m (10,000 ft) in 1969

Great Lakes ~~Commission~~ Fishery Commission Annual Report
Ann Arbor, Michigan.

1974

Superior p 12
- decline of lake herring - only one of Great Lakes that still supports significant population
- 1972 - establishment of Lake Superior Lake Herring Subcommittee (LSLHS)

13
- continued abundance of planted lake trout
- percentage of native lake trout continues to increase esp in Wisconsin waters
- tend to return to planting site to spawn
- many of sites along shorelines unsuitable for spawning or egg incubation
- recommends continued effort to planting in areas suitable for successful reproduction

Whitefish Bay
- In Whitefish Bay mortality of "legal size" lake trout higher than in other inshore areas in Michigan waters - 25 in and longer lake trout relatively scarce
- due to factors other than sea lamprey
- Michigan and Wisconsin good results with plants of brook trout x lake trout hybrids (splake)
- grew rapidly and tend to remain in planting area
- both states use F, splake in programmes

Huron 15
- rehabilitation not as far advanced
- full-scale lamprey control not initiated until 1966. (Lake Superior - 1958; Lake Michigan - 1960) - Ontario included 1971

- delayed intensive fish stocking programme
- 1966 - Commission decided planting of trout be restricted to hybrids of fast growing fish similar to lake trout in behaviour and appearance and brook trout in fast growth and early maturity
  - no of splake limited by shortage of brood stock
  - backcrosses produced (1971) & and planted in 1973 (splake × lake trout)
  - in 1972 decided must continue with annual plants of one million lake trout, splake, or splake × lake trout backcross in Michigan waters until selected splake came available
- intensive planting programme in operation for shorter time and amounted to only 9.5 million large salmonids (3.3 million in L. Superior and 4.9 million in L. Michigan - recreational fishery has not developed to same extent
- effects of alewives and sea lampreys started sooner in L. Huron than in L. Michigan and Superior
- Herring virtually disappeared, chubs have reduced to insignificance, whitefish stocks not shown same resurgence as in L. Michigan

PLANTINGS
- planted annually in L. Superior since 1958
- nearly all trout reared to yearlings (ca 30/pound) & planted during spring and early summer
- since fall of 1971 experimental planting of fall fingerlings (regular size approx 80/lb)
- expts with accelerated growth fingerlings (approx 30/lb) - through diet and use of heated water
- comparison after two years in lake show less advantage for accelerated growth fish but being larger they have dispersed farther or may be less vulnerable to the gear

1970

Superior
- increasing mortality beyond age V and a length of 20 - size rather than age main consideration
- sea lampreys contribute significantly to mortality of larger older trout
- offshore stocks in Michigan waters around Caribou Island examined
- catch per unit effort in 1970 improved by 17 % over 1969.
- bulk was 'humper' trout (75 % by no, 57 % by weight)

- Lot trout (siscowets) did not seem to be increasing

10 - Sea lamprey
- In Superior annual counts taken at assessment barriers indicate abundance has been reduced 80-90 %.
- In Michigan and Huron success judged by indirect means such as lamprey wounding rates + response of fish stocks
  - survival and growth of planted salmonids excellent
  - stocks of whitefish and steelhead (rainbow) trout marked recovery
- Percentage of juvenile, unmarked (wild) lake trout in sample catches increased, but remains low except in few areas
  - numbers of 24-30 in class increased but not yet abundant
- lampreys exhibit some biological response to programme
  1. faster growth
  2. higher survival
  3. higher percentage of females in spawning run
  4. accelerated metamorphosis in certain streams

12 - lake whitefish
- not reduced to same extent as lake trout under pressure of lamprey
- declined especially in Lakes Michigan and Huron
- differing characteristics among various discrete stocks in upper Great Lakes makes generalization difficult

- Lake herring
- only in L. Superior have herring continued to support a significant commercial fishery
- catch has declined from 13.6 million pounds in 1961 to 4.2 million in 1970
  - 98 % of entire herring catch came from Lake Superior during period.
  - L. Superior herring exhibit all classic symptoms of biological stress - increased growth rates, early maturity, abnormal sex ratios

13 - Chubs and ciscoes
- with loss of lake trout from commercial fishery and decline of lake herring, chubs became more important
- avg annual production 1961-1970 - 12.6 million lbs (11.4 from US waters, 1.2 from Canadian)
- most of US catch from Lakes Michigan and Superior, + major portion of Canadian catch from Lake Huron
- since turn of century (particularly over last 20 yr) the large deep-

17.

water ciscoes have virtually disappeared - 99 percent of chub catch made up of bloater (C. hoyi)

- Yellow perch
- most valuble in commercial catch of Gt. Lakes
  - 1961-70 avg prod. 28.1 million lbs with 85 % from L. Erie.
  - perch popns have declined in lakes Michigan + Huron
  - probably from competition from alewives and exploitation

15 - Splake
- investigations in 1970 of selected splake in L. Huron
  1. Habitats formerly occupied by lake trout selected
  2. Excellent growth
  3. Sexual maturity reached at early age
  4. Food of Age I splake - fish, small quantities of invertebrates
     Age II splake - mainly smelt, alewives, trout-perch, sticklebacks.

David E. Craigie. the Geographical distribution and spatial associations of fishes in Georgian Bay, Ontario 1958-1963 - Phd thesis 1971 U. of T.

p.6 - three exotics introduced to Georgian Bay
1. ~~Sea lamprey (Petromyzon marinus)~~ } entered upper lakes during 1920's + 1930
2. Alewife (Alosa pseudoharengus) } via Welland Canal around Niagara Falls, or possibly via Erie Canal from Hudson River
3. Rainbow Smelt - (Osmerus mordax) - originally introduced into Crystal Lake, Michigan, in 1912 intended as a forage species for land locked salmon

7. - smelt and alewife may affect whitefish by preying on and competing with its young - lamprey probably not to blame for decline

- Techniques

p. 29. - program for plotting distribution of mean catch on coordinate system corresponding to Georgian Bay.

p30 - plotted by years - indicated little variation in dist. by year
- also consistency of geographical distribution and relative catch size among the mesh sizes taking a given species showed by plots of each species in each mesh size

Craigie p. 73 "The broad outlines of summer species association in Georgian Bay, which are not immediately evident from inspection of catch records or distribution maps, are clarified by analysis of spatial associates pp. 37-52, supported and supplemented by principal-components analysis pp 64-76 and to some extent explained by canonical correlations analysis."

- program for computer mapping

p. 32 Coefficient of spatial association

$$(x_i - x_j)^2 + (y_i - y_j)^2 = d_{ij}^2 \quad (1)$$

i, j = geographical location defined by pair of x and y coordinates

d^2_{ij} = squared distance from location i to j

Sum of squared distances from each fish of species m to every other fish of species m:

$$2d_{ij}^2 m_i m_j \quad (2)$$

m_i, m_j = nos captured at locations i + j

and for species n

$$2d^2_{ij} n_i n_j \quad (3)$$

∴ geometric mean "dispersion within species":

$$\sqrt{(2d^2_{ij} m_i m_j)(2d^2_{ij} n_i n_j)} \quad (4)$$

or

$$2\sqrt{(d^2_{ij} m_i m_j)(d^2_{ij} n_i n_j)} \quad (5)$$

~~But squared distance from~~ a

and "dispersion between between species" (total squared dist from each fish of species m to every fish of species n)

p 33 $$(d^2_{ij} m_i n_j) + (d^2_{ij} m_j n_i) \quad (6)$$

or

$$d_{ij}^2 (m_i n_j + m_j n_i)$$

If fish distributed between two locations in same proportion ie. $n_i = cm_i$ and $n_j = cm_j$, the ratio of the geometric mean dispersion between species will equal 1.0

If

$$A = \frac{2\sqrt{(d^2_{ij} m_i m_j)(d^2_{ij} n_i n_j)}}{d^2_{ij}(m_i n_j + m_j n_i)} = \frac{2\sqrt{(d^2_{ij} m_i m_j)(d^2_{ij} c m_i c m_j)}}{d^2_{ij}(m_i c m_j + m_j c m_i)}$$

then $$A = \frac{2\sqrt{(d^2_{ij} m_i m_j)(d^2_{ij} c^2 m_i m_j)}}{d^2_{ij} m_i c m_j + d^2_{ij} m_j c m_i}$$

$$= \frac{2\sqrt{c^2 (d^2_{ij} m_i m_j)^2}}{2c d^2_{ij} m_i m_j}$$

p37 $= \frac{2\sum d^2_{ij} m_i m_j}{2\sum d^2_{ij} m_i m_j}$

$= 1.0$

- to use with fishing locations, the dispersion values are summed for all possible pairs of locations
- discrepancies among proportions taken at various locations and increase of sum of d^2_{ij} in the denominator (occurring with species less and less similarly distributed or found at greater + greater distances from one another) will cause value to be decrease < 1.
- to correct for exaggered effect of distance caused by use of square distances

coefficient of spatial association, $J = \sqrt{\frac{2\sqrt{(\sum_{i<j} d^2_{ij} m_i m_j)(\sum_{i<j} d^2_{ij} n_i n_j)}}{\sum_{i<j} d^2_{ij}(m_i n_j + m_j n_i)}}$

p.37 - values of J for species differing considerably in abundance cannot be compared See p 35-37
- may be used as rank variable

Rank correlation of spatial associates

- compare ranked lists of two species (putting species as first on their respective lists.

p50 - carried out for all combinations of two species providing criterion for grouping species in terms of the intercorrelations of their spatial associates
- intercorrelations summarized in association matrix (p 51

Principal Components Analysis pp 52-60

p.61 ## Canonical Correlations Analysis pp 61-70 VERY NEAT!

- extension of multiple regression from case of multiple independent variables and a single dependent variable to situation of multiple independent variables (or predictors) and multiple dependent variables (or criteria
- analysed variables of year, distance from shore, depth, temperature, number of nights nets were set (for any residual effect after correction), x and y coordinates of the location with the species at the 260 sample points

p 70-72 - used to interpret vector weightings of principal component analysis

73 Discussion

- most important factor affecting dist in Georgian Bay is depth
  - Wells (1968) concluded that in southern L. Michigan most imp factor affecting dist and movements of major fish species was temp.

74 - depth perhaps less correlated with temp in Georgian Bay because of influences of wind drift, upwellings, thick metalimnion, complex temp profile (Fry, 1956).
- chubs are only species however strongly differentiated from others by depth

75. - lake whitefish, common white sucker, alewife, yellow perch tend toward southern and eastern halves of the bay, in warmer + shallower waters
- Exceptions ① concentration of yellow perch in extreme north
② area immediately east of Manitoulin Island with large catches of lake whitefish, common white sucker, alewife — Fry (1956) identifies it as an area of persistent upwelling (food species may be exceptionally rich).
- great similiarity of env correlations of lake whitefish and common white sucker

76 - evidence supports obs. of Regier + Cusin (1965) that in recent years whitefish tended to shallower water (0-46m, 0-25 fath) — Craige found whitefish dominant in 5-25 fath

77 - similiarity of distribution and feeding habits gives possibility of competition
  - both bottom feeders, utilizing chironomids, molluscs, amphipods, other benthos (Carlander, 1969)
  - Scott and Crossman (in press) regard common white sucker as probably serious competitor for all browsing, shallow water bottom feeders
  - Regier (pers comm) suggests comp might be less serious if common white sucker mainly, skim the surface of the substrate taking algae, detritus + other surface organisms — lake whitefish actively root + probe for food.

78 - yellow perch
  - strong association with shallow depths in cooler waters of north.
  - Scott + Crossman (in press) — yellow perch able to utilize wide

range of warm to cooler habitats but usually considered shallow water fish - seldom > 30 ft

(2) burbot, chub

51 - probably predator prey relationship
- also probably prey on other smaller fish - perch, other chubs, whitefish, smaller burbot, sculpin, alewife
- catches of sculpin increased as burbot catches declined
- Christie (1963) - obs. burbot appns in L. Ontario to vary synchronously with lake whitefish and lake trout
- chubs complex of species and hybrid forms making identification difficult
- mainly zooplankton feeders
- Scott + Crossman (in press) relate loss of original species (Coregonus alpenae, C. zenithicus, C. johannae, C. kiyi in Georgian Bay).
* - by 1960 pricipal remaining species was C. hoyi
- however breeding of remnants of first four species with C. hoyi produce variety of deeper bodied more robust forms

2
83 (1) smelt, cisco, longnose sucker, round whitefish, lake chub, sculpin
- characteristic of northern + western halves of bay, primarily in cooler waters

cisco northern dist. (coldwater fish)

84 - catches declined sharply in 1961 and declined again in 1962 + 1963 almost to absence.
- Scott (1963) reported simultaneous increase in alewife abundance and suggests comp. responsible for decline
- however in Georgian Bay in simple period dissimilarity of dist. of alewife and cisco
- smelt most similar dist. + feeding habits to cisco (may have contributed to decline but smelt populations, while numerous, remained quite stable during period of study - showed no resp. to decline of cisco).

Tomkins, F.T. The life history and reproduction of Georgian Bay lake trout, with some notes on the commercial fishery. MSc thesis University of Toronto 1951

- evidence of two distinct popns in Georgian Bay
  - 1949 - taken in 50 fathoms of water north of Surprise Shoal
  - 1950 - 16-35 fathoms from Owen Sound to Western Islands
22. - differences in feeding habits - insects dominant invertebrates of surface catch and not present in bottom catch

9 - captured in almost every part of Georgian Bay, with exception of very shallow southeast end of the Bay
- taken during summer in water of 20-30 fathoms generally close to an island or reef (Fig 1)
- in autumn at spawning time captured in large nos on many shoals + reefs
- smaller trout ~~captured~~ in (less than 15 ins. in length) captured mainly in tullibee nets - 45-60 fathoms
- small trout feed on deep-water food forms
- deeper dist than larger + older trout
- legal-size trout taken in 20-25 fathoms

p. 14 - two years taken from statistically different popns
- 1949 sample largely from tullibee gill nets which caught smaller fish of the same age
- 1950 largely from hook lines and large-mesh gill nets which caught larger fish
- Mean Fork Length for age II and age III same for both years
- mesh selection produced variance of means of groups IV, V, VI - from different sections of popn.
- variance in size more pronounced from age VII and up

16 - Fish from two years taken from different locations
sixes? - 24 out of 25 1949 sample taken in 50 fathoms of water north of Surprise Shoal.
lean? - only three of 1950 sample caught north of Surprise Shoal
- only four in 50 fathoms
- remainder caught in 16 to 35 fathoms from Owen Sound to the Western Islands
- Van Oosten (1950) notes same phenomenon in L. Michigan lake trout
- monthly avg lengths of 1945 year-class consistently higher for fish caught off Michigan than those of same age caught off Wisconsin

✱ - commercial fishing returns for different areas of Bay also suggest more than one discrete popn. in Georgian Bay
- 1950 - good catch in north end of Bay; very poor catch in south

17 - great variability in lengths of larger late trout of same age (Table IV)
- Van Oosten (1944) associates variability in size of larger lake trout

with tendency for larger specimens to travel alone + feed by themselves

19 -Table II - no regular difference between growth rate of males and growth rate of females - evidence presented for and against differential growth of sexes by Surber 1933, Fry 1949, Martin 1949.

22 -Georgian Bay lake trout appear to grow at a faster rate than some other papers - notably those of some of inland lakes (Louise, and Redrock lakes - Martin 1949, Lake Opeongo - Fry 1950) (see Fig 4.)
-greater growth rate becomes more obvious at about size at which become piscivorous

23 Year Classes
-Because of size selectivity of gear + small no. of specimens obtained from large-mesh gill nets, no good indications of year class strength (Fig 5)
-in each year age VI largest year class of catch on floating hook line
-1950 - age VI high percentage of large-mesh gill net catch
-also in 1950 age V fish most of bottom hook line catch (had dominated fullibee net catch at age IV in 1949

26 Age at maturity
-one male of 88 examined of age II mature - all other mature fish VII or older (Table VI - 1950
-mature fish designated as such when gonads appeared in such a condition that fish would have spawned in autumn
-males begin to mature at earlier age than females
25 -one male mature at age II - all mature by age VIII
no females mature at age II - some at age VII still immature
(pattern reported by Fry (1950) for L. Opeongo)
-with limit of two lbs round weight become vulnerable to commercial fishery between age V and VI
-since maturing begins at age VI + VII catch largely made up of fish which have never spawned.

29 REPRODUCTION

Sex Ratio
-during summer fishing season ratio almost 50:50 - slightly more males
-male trout reported by authors to appear on spawning grounds before females and to stay longer (catch of 89 fish males outnumbered females 3:1)

- -immature females more vulnerable to capture than males since mature at an older age + larger size than males

35 FEEDING HABITS
-~~Leucichthys spp~~ important as trout become larger
- ~~Triglopsis thompsoni~~ imp. to smaller trout becomes less imp.
(deep-water species - smaller trout deeper distribution than larger.)
36 -Smelt in stomachs of trout of intermediate size
38 - ~~The~~ Yellow perch found to be of little importance - form substantial part of ~~food~~ & trout of some inland lakes (Fry + Kennedy 1937, Martin 1949)
-alewives not present
-Dymond (1928) - sites ~~three~~ alewives as "favourite food of the lake trout in Lake Ontario in summer"
-may not have been present in Georgian Bay although were present in L. Huron (Hubbs + Lagler, 1947)
39 - Table ~~XII~~ contrast between surface + bottom feeding fish
-insects ~~make up all~~ of invertebrate diet of surface-caught fish
-fish were mostly large (<15 in) and older than fish caught at bottom
-almost complete absence of insects from trout taken at bottom
~~24~~ * -fishermen claim that two groups of trout quite distinct, even in flavour, but no visible taxonomic difference
-feeding habits seem to point to two distinct feeding groups
-mysids most common invertebrates in trout under 15 inches
41 -indications that trout of ~~Lake~~ Georgian Bay feed sparsely if at all during spawning period (Martin (1949) found food in stomachs of spawning trout of Lake Huron)

42 The Lake Trout Fishery
-in early days second in importance to whitefish in L. Huron + Georgian Bay
-since 1894 - catch of lake trout exceeded whitefish in G. Bay
-since 1869 Georgian Bay highest producer until Lake Superior in 1920
-fishery in expansion until turn of century
-from 1885 production high with minor fluctuations until early in W.W. I
-stable from 1922 - 1941
- 1941 - 1949 - production dropped - Table ~~XIII~~

Van Oosten (1944) – Dr. E.E. Prince considered color of flesh of lake trout to be genetically determined – correlated with colored material of egg yolk and not food or env. conditions

* See Xerox for history of the fishery and data sources

Van Oosten, John Lake Trout. U.S. Dept. Int. Fishery Leaflet 15: 1-8 (1944)

2 – in Great Lakes most of lake trout live in waters less than 60 fathoms (360 feet) – can penetrate to depths greater than can be fished with nets (750 ft)
– "siscowet" or fat trout of L. Superior seldom less than 40 fathoms deep – occurs most abundantly in 80 – 100 fathoms

Huron – in southern L. Huron, lake trout usually scarce in summer in water less than 100 ft. deep
– in East Tawas–Oscoda (Michigan) area scarce in summer in less than 100 ft. of water
– inshore popn. appears to shift to progressively deeper water as from July to Oct.
– in Alpena–Ossineke (Michigan) region and perhaps farther north inshore trout appear to move from >100 ft in May to 40–70 ft depth range in June
– return to progressively deeper water in July (beyond 70 ft.), August (beyond 90 ft.) and September (beyond 120 ft.)

Superior – L. Superior around Apostle Islands – in early summer (June) on shallower reefs in 15 to 30 ft. of water
– move to 60–120 ft in July, Aug., Sept.
– in spring or early summer and fall, many trout rise off bottom
– taken by certain commercial fishermen with floated hooks
– also in fall general movement toward shallower water for spawning
– after spawning move back to deeper water

– tagging expts in L. Michigan
– adults roam throughout lake
– vast majority of young fish (under 1½ lbs) remain within 25 mi. of home waters
– few tagged fish in L. Superior noted to travel gt. distance – one migrated from Michigan to Minnesota – 236 mi.

genetics 3. – both white-meated and red-meated lake trout often in same waters and schools
– color of flesh considered by late Dr. E.E. Prince to be genetically determined
– correlated with colored material in egg yolk, and not, as popularly believed,

associated with food or env. conditions. (Red-meated trout develop from red- or orange-colored eggs and white-meated from pale or white eggs.)

See p. 80

6. - growth of adult lake trout of same age varies greatly with individuals
- perhaps associated with tendencies of fish to travel alone and feed by themselves - differences among schooling individuals would be much less pronounced
- large size of individual is not always indicative of old age

Table 3. Estimated lengths, weights + growth rates of lake trout from L. Mich for each year of life (cont see p. 47)

N.A Martin The bionomics of the lake trout Cristivomer Namaycush Namaycush (Walbaum) of two Algonquin Park Lakes (1949)

4 Historical review
- Walbaum (1792) - gave name Salmo namaycush
- Dr. S.L Mitchell (1818) - gave new name amaythytus
derived from amaythytine appearance of the teeth

5 - Kirtland (1838)
- described one species as characteristic of the state of Ohio, Salmo namaycush, or the mackinaw trout
- DKay (1842) (New York naturalist) identified two species of trout
- Salmo ~~salar~~ - the lake trout
- Salmo amaythytus - the mackinaw trout
(former common form of New York state, amaythytus characteristic of large lakes between the United States and the Arctic circle)
- Cuvier and Valenciennes (1848) - History of Fishes
- next known description of lake trout - described as Salmo ~~salar~~
- account based largely on writings of other authors
- Agassiz (1850)
- described species again as namaycush
- in obs. of L. Superior lake trout further describes the siscowet - classed as separated species (Salmo siscowet)

6 - Hamlin (1874) - described lake trout characteristic of Maine lakes as the togue, Salmo tomo, Hamlin
- Suckley (1874) - described six species of lake trout of the North American genus Salmo
① Salmo namaycush, Pennant

② Salmo confinis, Detray
③ Salmo siscowet, Agassiz
④ Salmo hoodii, Richardson
⑤ Salmo newberryi, Girard
⑥ Salmo symmetricus, Prescott

-Fullest account published to its date was Milner (1874) - report on fisheries of the Great lakes
- describes two species
① Salmo namaycush - salmon or mackinaw trout
② Salmo siscowet, the siscowet
- Adams (1874)
- suggests namaycush, confinis and siscowet may be "only varieties of seasonal or sexual conditions of one gray-spotted lake-trout, common to the boreal regions of the continent."

7. -general tendency to reduce no. of species of trout towards end of last century
-descriptions primarily taxonomic and little for life history contributions
-Jordan and Evermann (1896) described lake trout as one form Cristivomer namaycush - suggest siscowet. Cristivomer namaycush siscowet, was a local variety.
(Gill and Jordan (1878) first proposed generic name, Cristivomer, separating lake trouts from the charrs, genus Salvelinus and the salmons, Salmo.)
-one of most complete descriptions written to that time was Kendall (1914)
-disagrees with Gill and Jordan's use of Cristivomer as a generic name and re-groups the lake trout with the charrs, Salvelinus
-describes one lake trout as characteristic of New England lakes but admits to local variations
- Titcomb (1922) - notes on habitat, abundance, feeding habits, spawning habits, restocking of lake trout of lake George, New York.

Gill Net Selectivity

Table V

Length group (in)	1½	2½	3½
	Size of gill-net mesh (stretched)		
4-9	91 (Louise)	9	0
10	62 (Redtrack)	38	0
10-14	44	55	1
	2	87	12
15-19	39	49	12
	40	54	6
20 + over	0	91	9

19 - min and max sizes taken
$1\frac{1}{2}$ stretched mesh - 4 - 21 in.
$2\frac{1}{2}$ " " - 6 - 31 in
$3\frac{1}{2}$ " " - 13 - 31 in
- $3\frac{1}{2}$ ~~mesh~~ in mesh captured few trout of any size

22 - evidence that lake trout make nocturnal excursions into shallower water to feed

Dec. 1/77 STOCK CONCEPTS -Wed./MAPLE
- Milton Troutman - percids
- Atlantic salmon stocks - Greenland stocks
  - Dick Saunders (genetic makeup)
- herring stocks - Selgeby + Macallum
- whitefish C. clupeaformis → Bruce Swanson (Bayfield, Wisconsin)
- chubs.
  - Commission - taxonomic problems
  - expts with hatchery reared - Tom?
- Ross Herrington - imprinting, genetics. - Great Lakes
- whitefish expts at South Bay
- Percids work at Green Bay.
- trout stocks - acid stress lks from mine tailings - Madison
- Eosen (Commission labs) - hybrids, l. trout brook trout
  - electrophoretic treatment expts for ident. of stocks.
- Allendorf - University of Montana. — Northwest salmonids.
- Sewell Wright - pioneering geneticist (1930's).
  - developed techniques
  - see stock concept kept by Booke
- Nick Martin - plantings in Opeongo
  - differential fitness of two stocks
- Webster - Adirondack strain, Finger Lakes strain (which perish in Adirondacks)
- Berst - lake trout, backcross, F, splake.
  - also in brook trout lakes
- Swardson - Drottingholm lab.
- Kincaid - fish pop geneticist
- Graham - Coast - California - marine. - fish pop genetics
- Fred Utter - biochemical genetic / genetic salmonids
- countries of Sweden, Japan, Isreal

Martin -found piscivorous fish of Redrock to be faster growing than planktivorous fish (during summer months) of Lake Louisa (compares to Tomkins (1951)) findings on Georgian Bay fish
-males matured more rapidly than females (Tomkins (1951) found no obvious differential in maturing rate (p. 22)
29. -older trout at more shallow depths in summer months

-Peter Ihssen - geneticist - selective breeding
-John Buch - culturist. - MNR in Toronto
-Christie synthesis for mgt. - sel breeding
-Wright - stocks.

Martin (cont.)

35 -Lake Louisa
-older ind. tend to conc. above 50 ft contour in summer months while smaller fish below it
-8°c isotherm generally separates these zones
-no great difference in dist. of size + age groups above 12-13 in and age V levels
-observed that smaller lake trout often concentrated in certain areas
-Miller and Kennedy (1948) - noted in first four summers of life Great Bear lake trout spent time in boulder habitat
-for shelter

45 -Diet
-highly varied diet in spring months
-insects taken from bottom fauna
-surface feeding for short period
-fed on on plankton to considerable extent
-fish imp particularly in May - as insects eaten more frequently became less piscivorous
-difference in summer feeding habits associated with availability of forage fish to them
-cessation of bottom + surf. feeding corresponds with movement of fish to deeper water
-Lake Louisa - large no of forage fish probably taken by short incursions to warmer strata (10-15% of food)
-plankton basic summer food
-Redrock - plankton less imp
-fish 850-910 % - almost exclusively perch/overlap of depth ranges during thermal strat in 12°c to 18°c zone
-High percentage of non feeding fish in fall
-decline in feeding after peak in early fall
-begin to feed more actively in late fall

Hubbs - species of lake trout confined to deep water trough of Rush Lake, Michigan
RUSH LAKE TROUT - Salvelinus namaycush hubbsi (Hubbs)

30

-fed to great extent on fish during winter
56 -older lake trout at larger food items than did younger

Growth Rates
-little difference in early growth rate of two popns
-after III year Louisa lake trout grew more slowly than Redrock popn which continued to grow rapidly
-associated with feeding habits and perhaps colder water temp
-non matured before sixth year
-males matured earlier than females

Hubbs, Carl L. and Karl F. Lagler (1958) Fishes of the Great Lakes Region. Cranbrook Institute of Science Bulletin No. 26.

Caudal fin rather strongly forked; body spotted with gray, without bright colours; lower fins without a black stripe; gill rakers 12 to 14; precaudal vertebrae 38 to 41; mandibular pores (see Fig 40 p. 94) usually 9 or 10; pylonic caeca more than 95; vomer with a raised crest extending backward from the head of the bone and free from the shaft; this crest armed with strong teeth (Subgenus - Cristivomer; Salvelinus namaycush) ——— 8

8 { Head nearly U-shaped as seen from above; fins rather short
COMMON LAKE TROUT - Salvelinus namaycush namaycush (Walbaum)

Head rather broadly U-shaped as seen from above; fins larger ——— 9

9. { Size small; thin; confined to Rush Lake, Marquette County, northern Michigan.
RUSH LAKE TROUT - Salvelinus namaycush hubbsi (Hubbs)
(confined to very deep trough)

Size large; excessively fat; deep waters of Great Lakes
SISCOWET - Salvelinus namaycush siscowet (Agassiz)

The Fishermen (1933) - anecdotes of different shapes + colours of lake Michigan trout (red trout, white-meated trout, buckskin trout, ~~etc~~ silver trout)

31 - suggests difference in habitat may determine trout markings

Smith, Lester. Are There Different Kinds of Lake Trout. The Fisherman v. 2 no. 4. p. 9-11 1933

9. - according to Dr. John Van Oosten, the record weight for a lake trout, no doubt the siscowet, is given at 80 lbs - caught 1878 at Mackinaw, Mich

Superior siscowet - in late years very few of these trout (siscowet) have been caught in Lake Michigan and Lake Huron, but apparently they are holding their own in numbers in Lake Superior, although some fishermen lately report smaller lifts of the larger sized siscowets

10 - environment or different race

- "The thought might be injected here that whitefish caught in lower lake Michigan often differ in appearance from those caught near the Manitous in the northern section.

red trout - "While it is well known that the Jewish trade prefers white meated trout, many other consumers want the red trout. The "red meated" trout, known to almost all commercial fishermen, is found in lake Superior, Michigan, and Huron.

- "In the Saginaw Bay region of Lake Huron, the fishermen also report a "different" trout. It is called locally the "buckskin" trout and is caught in large numbers by commercial fishermen there after the closed season for trout. These trout appear regularly each year at a definite time and move southward along the shore almost on schedule.

"buckskin" trout?

- N.B reported by G. Brown-Goode (1884) (obs. of Mr Kumlien) in Thunder Bay, Region of Lake Huron. (Book 1)

- caught in 4½" gill net, but are comparatively small in size averaging from 2-2½ lbs.

- differ from "regular" trout in markings and in the "feel" of the skin, hence the name "buckskin"

- The fact that these trout are caught during the spawning season and are of adult size (even though they have never been found with eggs or roe, or spent after spawning) form a basis for the claim by fishermen in that section that these fish are a "different" trout"

- "Years ago fishermen, in going over their lifts, often picked out certain fish as 'pound net trout', 'hook trout', or 'gill net trout' according to certain markings and supposed characteristics. This theory, however, has been exploded by finding

11 a trout with hooks in their mouths caught in gill nets, trout with gill net marks on them caught in pound nets, and also by the fish tagging operations carried on by our firm the last few years. Some of these trout were marked with dark spots, some with dark wavy markings, like those on

Solomon (1977) - role of pheromones in homing behaviour and shoaling behaviour of different stocks

32

watermarks, and some had a uniform silvery shade." There is no doubt, therefore, that in going over a lift of fish one can find differences in the shape and colorings of the Lake Michigan trout."
- "silver trout" - trout with lighter colored skin, somewhat silvery, instead of the darker, speckled skinned trout.

Solomon, D.J. A review of chemical communication in fish.
J. Fish Biol (1977) 11, 363-376

364 -Shoaling behaviour - olfaction appears to play role in preventing break up of the shoal at night.
-many species of fish appear capable of conditioning the surrounding water to produce an effect on other individuals.
- effect can be harmful or inhibitory (crowding factor) or advantageous
- McCauley (1968) found some factor in water which had previously held other individuals conferred an advantage on rainbow trout (Salmo gairdneri)

367 -HOMING OF MIGRATORY FISH
- pheromones appear to play a role in homing behaviour
- presence of young fish in stream renders it attractive to adult fish (White 1934 b)
- Nordeng (1971) - suggested that a race-specific emanation from young migratory char (Salvelinus alpinus (L.)) attracted adults of that race
366 - Doving et al (1973) examined the mechanism of race discrimination in the char populations studied by Nordeng (loc. cit) - recorded electrical activity of olfactory bulp and telencephalon of fish experiencing the odours of various races.
- found the smell of conspecifics caused a definite response, but were unable to demonstrate the fish's ability to discriminate between races
- later expts (Doving et al (1974) involving recordings from single cells in the olfactory bulb - indicated ability to distinguish between fish from different areas
- mucus appeared to provide the information

374 Management
- manipulation of stocks of migratory or shoaling species is likely to be influenced by pheromones.
- re-stocking with eggs of young of a distant race of fish which home by

33 Ihssen + Tait (1974) - ~~differ~~ genetic differences in ability to retain swimbladder gas between lake Simcoe and lake Louisa lake trout. (see also Crawford (1966 MSc U. of T. - his study of differences of avg flotation pressure of Siscowet and Lean Trout) (reference p. 35 in Khan + Qadri (1970).)

rare - specific pheromones may be useless, or even positively damaging to the homing of native individuals

- poor productivity as a result of chemically depressed growth in stunted popns is unlikely to be improved by increasing stock density, which has in the past often been a quickly adopted panacea for poor angling
- reduction in stock may be a better course of action

R. W McCauley 1956. Thermal Relations of Geographic Races of Salvelinus MSc thesis U of T

p. 27. - Hart (1952) concluded in his study of geographic variations in freshwater fish that there was no strong indication of the existence of physiological races within species
- any physiological differences that be uncovered correlated with morphological characteristics that gave each group concerned the rante of a subspecies.
- this thesis supports Harts hypothesis
- geographic groups of S. fontinalis which are considered to be morphologically similar do not display any significant difference in the lethal temp. or cruising speed - temperature relations
- geographic groups of S. alpinus are considered to be distinct subspecies — difference in lethal temp. relations

Ihssen, P. and J.S Tait. Genetic differences in retention of swimbladder gas between two populations of Lake Trout (Salvelinus namaycush) (1974) J Fish Res Bd vol. 31(8)

1353 - difference in ability to retain swimbladder gas between lake Simcoe and lake Louisa fish
- as measured by their bouyancy after exposure to hydrostatic press. = 2.8 cm Hg
- total range found within genus Salvelinus is about 23 cm Hg — represented by difference between brook trout + lake trout (Tait 1970)
- ~~∴~~ intraspecific stock difference quite substantial

Khan and Qadri (1970)
① Agassiz (1850), Slastenko (1958) considered siscowet as separate species
② Jordan + Gilbert (1883), Eddy and Surber (1947) considered siscowet and lean trout as subspecies.
- suggest subspecific ranks C.n. namaycush and C.n. siscowet be retained
- Halfbreeds should be considered of same form as siscowet
- See Lawrie + Rahrer (G.L.F.C Tech Rept No. 19) (p. 0)

- stocks raised under identical environmental conditions and also since this effect was seen in interpopulation as well as interspecific hybrids, it must be concluded that it is genetic
- the interpopulation lake trout crosses were intermediate
- flotation pressure correlated with depth distribution
- thermocline much deeper in L. Simcoe than L. Louise
- during summer lake trout distributed below thermocline 25-35 m or more
- Martin (1951) - Lake Louisa - distribution of lake trout is widespread with a concentration between the 8 and 10C isotherms at about 10-20 m deep

p. 1354 - "Valuable distinct genetic stocks may be lost by not recognizing that a species, even within a relatively small geographic area, can be represented by several specially adapted stocks."

N.Y. Khan + S.U. Qadri - Morphological Differences in Lake Superior Lake Char J. Fish Res. Bd. Canada 27: 161-167 (1970)

161 - four forms of Lake Superior lake char Cristivomer namaycush
① the lean char ② siscowet ③ halfbreed ④ Humper
- Agassiz (1850), Slastenko (1958) considered siscowet as a species
Jordan and Gilbert (1883), Eddy and Surber (1947) considered it and lean lake trout as subspecies

166 - on the basis of the morphological differences L. Superior lake char forms three groups.
① lean lake char
② siscowet and halfbreed
③ humper

Morphometric - lean lake char higher regression coefficients than the siscowet, halfbred, and humper for all head characters except eye ball diameter
- lean longer predorsal length than halfbreed and humper
- lean deeper caudal peduncle than humper
- humper higher regression coefficients than siscowet and half-breed in head length, diameter of the eyeball, length of lower jaw
- humper higher regression coeff. than siscowet in postorbital distance
- siscowet and humper did not differ
- ventral-anal distance, length of caudal peduncle, dorsal-adipose

Khan & Qadri (1970) + A. heuri (personal comm Dec DC/77) - uncertain as to value of study. While old lean and fats are easy to distinguish (even visually the younger smaller ones are much harder. Also Qadri did not do his own sampling but received specimens from the commercial fishermen (see FRB tech rept ~~by~~ by Lee for further stat analysis of fats & lean)

35

also. Ihssen (personal comm, Dec 20/77) - many of morphological differences are environmentally influenced (eg no. of gill rakers) - refer to N. Martin re distance, pectoral - ventral distance, ~~height~~ heights of dorsal and anal fins similiar for all four forms

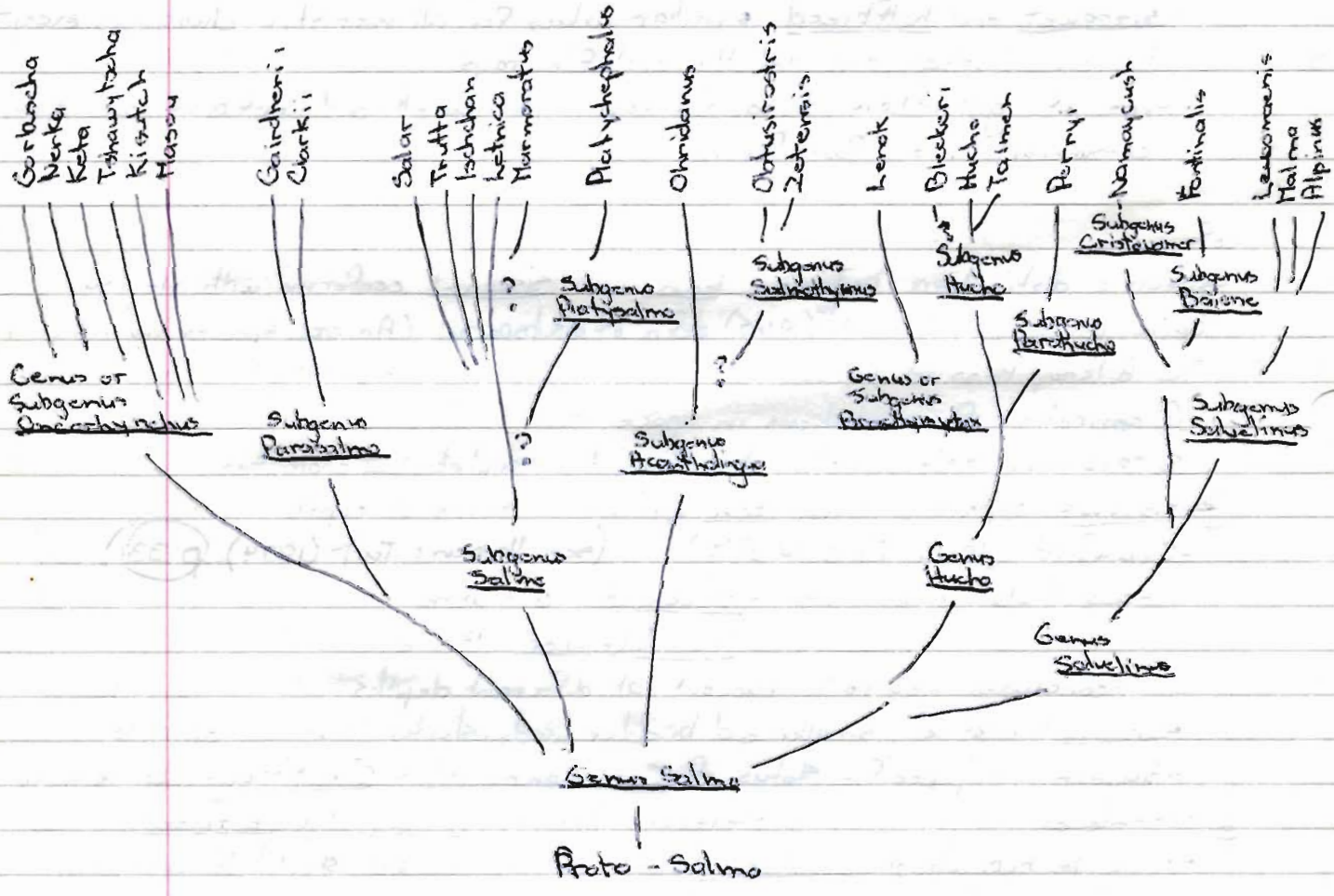
Meristic - humper greater mean number of branchiostegal rays than the siscowet, lean, and halfbreed

- mean no. of anal fin rays in halfbreed and siscowet different from each other and from those for the humper and lean lake chub
- lean lower mean no. of rib than humper, siscowet, halfbreed
- siscowet and halfbreed similiar values for all meristic characters except the branchiostegal rays and the anal fin rays.
- nos of gill rakers, dorsal fin rays, interneurals, and vertebrae overlapped considerably in all four forms

- specific distinction between lean and siscowet conforms with the two basic points in Mayer's (1945) defn of a subspecies (Animal species and evolution. The Belknap Press of Harvard Univ. Press, Cambridge, Mass 797 p)
  1. separation of populations in space
  2. taxonomic differentiation by diagnostic morphological characters.
- (1) siscowet separated from lean spatially in terms of depth
  - Crawford (1966, MSc U of T) (see Ihssen & Tait (1974) p 33)
    - avg flotation pressure - siscowet 6.3 atm
      lean lake chub 3.8 atm
    - concluded neutrally buoyant at different depths
  - siscowets relatively smaller and broader heads, shorter jaws and operckes
  - suggest subspecific status of C.n. nanaycush & C.n. siscowet be retained
- (2) Absence of morphological differences between siscowet & Halfbreed
  - could be hybrids of lean lake chub & siscowets but should be considered as of same form as siscowet
- (3) Little known of biology & dist of humper in relation to other forms

Behnke, Robert. J. 1968. A new subgenus and species of trout, Salmo (Platysalmo) platycephalus, from south central Turkey, with comments on the classification of the sub family Salmoninae Mitt. Hamburg Zool Mus Inst. Band. 66 pp 1-15

11. A suggested phylogeny of the subfamily Salmoninae



Twentieth Conference on Great Lakes Research Abstracts 1977
Int. Association for Great Lakes Research

Letter sent Dec. 18, 79
Replied.
Thank you sent Jan 18

Fred W. Allendorf, University of Montana, Missoula, Montana
→ Genetic Variation in Populations of Fish

Kjell, A. Johansen and John A. Robbins, Gt. Lakes Research Division, University of Michigan, Ann. Arbor, MI

37 - Fallout Cesium 137 in sediments of Southern L. Huron + Saginaw Bay
also J.R. Krezoski and J.A. Robbins, Gt. Lakes Research Division, U. of Mich
- Radioactivity in Sediments of the Gt. Lakes; Postdepositional redistribution by deposit-feeding organisms

- detection of genetic variation using electrophoretic separation of proteins
- electrophoresis can provide the following info
  1) the identification of discrete stocks
  2) the relative degree of genetic similarity among separate stocks
  3) the amt of genetic variation within individual stocks
  4) the relative contribution of individual stocks to mixed groupings of fish

② Hugh F.H. Dobson, Canada Centre for Inland Waters, Burlington, Ontario.
Dec 18 → Great Lakes water quality trends in relation to fish stocks
letter sent - coincidence of central Erie's oxygen decline and changes in species
Replied Jan 5 composition of the commercial fishery is illustrated graphically
- trend has been found in Lake Superior, where nitrate is increasing rapidly

③ Ross. M. Horrall, Laboratory of Limnology, University of Wisconsin, Madison, WI.
Dec 18 → Historical Spawning sites and their Importance to Great Lakes Rehabilitation
letter sent Programs
- ex. presented which describes the availability of information on the locations of former (historic) lake trout spawning sites in the Upper Great Lakes
- ex describing lake trout rehab prog on L. Mich. mid-lake Milwaukee-Sheboygan reef complex

Spoken ④ P. Ihssen, Fish + Wildlife Research Branch, OMNR, Maple, Ont.
to at Maple → Physiological Genetics and the Stock Concept: implications to fish management
Dec 20/77

⑤ Jochim T. Moenig, Environmental Control Branch, MIREM, Winnipeg, Man
→ The decline of the lake trout, Salvelinus namaycush (Walbaum) in Lake Erie.
- frequented deeper eastern basin of L. Erie until mid fifties, notwithstanding that it was inhabiting a lake at the edge of its zoogeographic limit.

38

Population genetics of fishes
Yu. P. Altukhov. Fisheries + Marine Trans. Series No. 3548. Dept of Env

Atlantic Fisherman 1952 (8) p. 19, 37 Lake Superior's Troll Fishery Now Big Business

start of trolling on Sup.
- reported start 1924 William Brown, a former West Coast comm. fisherman
- Wood Island Reef of Munising, Mich.
- with two lines in little under 5 hrs took 1,430 lbs of lk. trout

Not true See mention of trolling on L. Sup. Marine + Fisheries Dept (1879) Book I p. 61
- boats fitted with cross arm over cabin to which are attached two poles
- keep lines clear of the boat
- trolling lines usually of 1/16" stainless steel or bronze twisted wire - 0.024 - 0.032, from 100 to 150 fathoms, wound on gurdy or deep-sea trolling reels
- few commercial trollers make use of power reels
- white fishing poles are fixed at angle of approx 50 deg. to the mast
- fishing lines carry weights from 10 to 20 lbs depending upon level at which ~~trout~~ wishes to troll
- usual practice for commercial fishermen is to watch for schools of chub, herring, smelt, etc. on which trout feed

do not feed in Oct - Nov best time
- during spawning season in Oct seldom hit trolling lure
- feed voraciously after spawning - best catches in Nov.

L. Superior Michigan waters decline
Hile, Ralph 1952 Changes in the lk trout fishery in the three Upper Gt. Lks The fisherman 20(6), 5, 8

- Michigan waters
  - downward trend in abundance
    - 1944 - 107% of 1929-1943 mean abundance
    - 1949 - 65% " " " " "
  - high level of fishing pressure during years of decreasing availability
  - mean fishing intensity 1944-1949 - 142% of 1929-1943 avg.
    1946-1949 - 151% of " " "

- statistics - Comparison of 1949, - 1950 statistics in Michigan waters for lk tr.
- some encouragement
  - production improved in four of six statistical districts
  - for combined districts output rose from 2,181,000 in 1949 to 2,400,000 in 1950 - increase of 219,000 lbs
  - rise in the take came about through an upturn in the catch per unit of fishing effort (reflected in the abundance index) rather than from more intensive fishing

- rise in cpe. 1949-1950

-abundance increased in every district and for the combined areas rose from 65 in 1949 to 80 in 1950

-at the same time the index of fishing intensity decreased in four of the six districts and for the combined districts fell from 162 in 1949 - 146 in 1950

-<u>however</u> -availability in Michigan waters still 20% below 1929-1943 "normal" and fishing pressure still 46 % above mean for 1929-1943

District	Item	Year 1949	1950	Change from 1949 - 1950
S1	Production	333,605	384,946	51,341
(Isle Royale)	Abundance	81	104	23
	Intensity	115	104	-11
S-2	P	170,411	130,642	39,769
(Black River-	A	86	97	11
Ontonagon)	I	141	96	-45
S-3	P	728,313	874,025	145,712
(Keweenaw	A	66	78	12
Area)	I	214	218	4
S-4	P	431,566	467,816	36,250
(Marquette-	A	60	69	9
Munising)	I	180	169	-11
S-5	P	386,672	370,455	-16,217
(Grand Marais)	A	46	60	14
	I	158	117	-41
S-6	P	130,647	171,892	41,245
(Whitefish Bay)	A	82	101	19
	I	92	98	6
All Districts	P	2,181,214	2,399,776	218,562
	A	65	80	15
	I	162	146	-16

gill nets bottom nylon

-much of increase in abundance index in 1950 can be traced to improvement in the catch / lift of gill nets

-estimates of abundance made for different gears, individually and in combination

Gear	Abundance index
Gill Nets, Pound Nets, Set Hooks	80

Pound Nets, Set Hooks	78
Gill Nets	81
Pound Nets	78
Set Hooks	79

pgs - estimates of abundance are so nearly the same as to lead to the conclusion that the change to nylon gill nets had not yet in 1950 exerted any substantial bias on the estimation of the abundance of lake trout." (p. 5)

Van Oosten, John 1939 Great Lakes Fisheries for Anglers & Fishers
Mich Game Trails 1 (5): 1 p. June 9, 1939

Species	Lake	Periods "Normal"	Compared → Recent	% Decrease from Normal
Whitefish	Sup. (Mich)	1885 - 1897	1926 - 1937	88
Whitefish	Michigan	1893 - 1908	1935 - 1937	47
Lake trout	"	1885 - 1908	1935 - 1937	41
Herring	"	1913 - 1920	1927 - 1937	40
Perch	"	1890 - 1908	1935 - 1937	26
walleyedpike	"	1899 - 1917	1932 - 1937	30
Perch	Huron	1890 - 1919	1930 - 1937	41
Chubs	"	1913 - 1924	1935 - 1937	43

- production of Lake trout in L. Sup maintained
  ① by going to more distant fishing grounds
  ② development of a new smoking for siscowet - virtually without a market until the last few years

new smoking process for siscowet ~ 1939 bring them more into production

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Ibid 1939 Migratory Fish, a problem of interstate cooperation?
Repr. Trans Fourth North Amer Wildlife Conference: 26-38

p. 27 - Commercially extinct:
  ① sturgeon

② bloater - L. Ont.
③ blackfin - L. Mich
- L. Huron
④ bluefin - L. Superior
⑤ longjaw - L. Superior
⑥ cisco - L. Erie.
- decline. from 19 million to 68 lbs
- reappeared in 1938 in east end of lake Erie - fisherman caught most (although against law in one state no record of prosecutions
- Van Oosten regards major causes of declines as subordinate to or outgrowths of "divided control of the fisheries and the resulting lack of uniformity in the laws and in the method of enforcement of laws applicable to different regions of a single lake."

p. 29 - recommends central administrative agency independent of political pressure and state boundaries
- most promising attempt was Toronto Agreement - signed by the conservation officials of Ontario and the four states bordering on L. Erie.
- contained 5 basic regulations for the control of L. Erie fisheries - became effective April 24, 1933
- Fall of 1933 - New York, primarily because of political pressure, found it impossible to enforce the regulation on the closed season
- lead to infractions by other signees and finally to complete abrogation of the agreement

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Van Oosten, John. ~~Aug 28~~, 1949. Condensed transcript of proceedings of the conference on nylon fish netting held at Erie, Pennsylvania. July 28, mimeo. 1-30.

~~p. 6 - as of July 15, 1949 no commercial fishermen using nylon on L. Sup~~
p. 7 - in Canada only being used experimentally in L. Erie waters
p. - Dr. Hartness - "several of my reports indicate that nylon twine is as much as two times up to five times as efficient as cotton twine."
- none used in L. Ont.
- ~~used on~~ had been used on west end of L. Superior
- ~~one~~ fisherman reported that some had been used in Thunder Bay on an experimental basis
p 11 - deep trap net

42 deep trap nets in American waters of L. Sup outlawed June 30, 1936 by Michigan

deep trap nets
- was abolished in Lakes Michigan and Superior
- in L Huron was limited to 80 ft
- bill introduced to increase depth to 100 ft - vetoed by the governor
- Van Oosten regarded this as a prime ex. of the need for early information on gear efficiency (fishermen had already invested much many when the nets were banned

p. 22 - Captain Hoskins (Fish Tug Captn, Erie, Penn)
- mentions bullnet in the herring fishery years befor
- after 5 or 6 years herring gone and larger companies folded
- nylon breaks up quicker, harder to handle, harder to get the fish out
- however - "some days it fishes 5-1, sometimes 10-1 or even 50-1."

p. 25 - nylon takes fewer small fish and more large fish of the same species
- nylon more easily stretched

p. 28 - fished better partly because linen and cotton covered with slime and the nylon did not. -

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gill net selectivity

Van Oosten, John. 1935 logically justified deductions concerning the Great Lakes fisheries exploded by scientific research. Trans. Amer Fish Soc. 65, 72-75

p. 71 Selective Action of Fishing Gear

ie "will an increase in the size of mesh gill nets and impounding nets always reduce the number of small fish taken in the catch."

- yellow perch in L. Erie.
- decrease in number taken with meshes from $2\frac{3}{4}$ to $3\frac{1}{8}$"

72 - when mesh increased to $3\frac{1}{4}$ and $3\frac{1}{2}$"
- avg no. of undersized perch taken increased
- more readily entangled by teeth in large mesh than in small mesh nets

- selective action of chub gill nets on baby lake trout in L. Michigan
- gill nets - meshes from $2\frac{3}{8}$" to 3"
- smallest mesh net instead of taking greatest no. of trout took the fewest
- no. of trout in $2\frac{1}{2}$, $2\frac{5}{8}$, $2\frac{3}{4}$" showed neither a progressive increase or decrease - no selective action
- slight decrease in no. taken in 3" gill net
- trout of sizes covered by the experimental meshes (except $2\frac{3}{8}$ + 3") apparently equally abundant in the lake.

-Pound nets
-expts with herring pound nets in Saginaw Bay
-smaller herring escaped through the larger meshes in the spring of the year but not in the fall (probable that advent of spawning accounted for this behaviour

p. 78 *Statistics
-writes of percentage decrease in catch with time that nets are left in the water

Table 1. Effect of fishing time on size of lift (all species combined) in different impounding nets. The data for the average lift at different fishing times for all types of nets have been presented on the percentage basis, with the catch of nets one night out set arbitrarily at 100 pounds or 100 per cent. Based on state of Michigan statistics.

Number of Nights Out	1	2	3	4	5	6	7
Theoretical catch	100	200	300	400	500	600	700
Catch in pound nets (Green Bay)	100	117	126	137	114*	-	-
Catch in fyke nets (Lake Erie)	100	116	131	149	131*	-	-
Catch in shallow trap nets (Saginaw Bay)	100	120	130	139	163	170	187
Average of pound, fyke, shallow trap nets	100	118	128	139	142	-	-
Catch in deep trap nets (Harbour Beach)	100	130	152	161	151*	-	-
Avg. in impounding nets	100	122	136	146	142*	-	-

* Less than preceding lift

Table 2. Effect of fishing time on the average lift of chub gill nets (The lift of a gang four nights out is set arbitrarily at 400 pounds; consequently each additional night out should theoretically add 100 lbs to the lift) Based on Michigan's Fishery in northern L. Huron (District I) for the years 1930-1933 inclusive.

Fishing time (nights out)	4	5	6	7	8	9	10	11
Theoretical lift	400	500	600	700	800	900	1000	1100
Actual lift	400	446	510	547	583	626	622	542

Van Oosten, John 1937 The Great Lakes fisheries: their proper management for sustained yields. Trans Amer Fish Soc., (1936). 66: 131 - 138

p. 134 - interstate and international conferences held on the Gt. Lks in.

1883	1927 (two)
1884	1928 (two)
1891 (two)	1929
1892	1931
1897	1932 (two) - meetings of Lake Erie Advisory Comm.
1904	1933
1905 (two)	1934
	1936 (three

make fisheries conf. dates

Van Oosten, John 1935. Lake states change fishery regulations. The Fisherman, 4: (10): 1, 2.

→ applying to L. Superior lk trout:

1 Michigan
- outlawed use of deep trap net on Superior effective June 30, 1936

2 Wisconsin
① adoption of size limits for Lk Superior fish (were none before)
- limit for lk trout and whitefish 15 in

② closed seasons

long jaws (a chub)	- Nov. 5 - Dec 5
perch	- April 15 - June 1
lake trout	- Sept. 25 - Nov. 5 (change from Sept. 10. - Nov. 1.)
whitefish	- Sept. 25 - Nov. 15 (from Oct. 20 - Dec. 1)
perch-pike + pickerel	- April 1 - May 10 (from March 10 - May 1)

③ gear
Gill nets
- max. quantity - 150,000 ft per boat
  - set in not more than 6 gangs
  - each gang not to exceed 25,000 ft. in length
- prohibit use of any gill nets with meshes between $2\frac{7}{8}$ & $4\frac{1}{2}$" after July 1, 1937

- max depth 11 ft. whether barged or not
- increase in quantity of bait nets allowed each licensee from 2000 - 5000 ft.
- change in mesh from $1\frac{3}{8}$" to $1\frac{3}{8} - 1\frac{1}{2}$"
- all fish taken in bait nets must be used as bait for set hooks and may not be sold as was done formerly

Set hooks
- max quantity - 3 gangs not to exceed 3000 hooks per gang

Minnow seine
- decrease in max length of in L. Superior from 100 ft. to 50.

Pound nets
- elimination of all references to the size of mesh in pound nets

Fyke and drop nets
- restriction of max. size - diameter of pot not to exceed 5 ft.
  - hearts to be covered for a length not to exceed 6 feet
  - length of outside tunnel of drop nets not to exceed 15 ft.
- minimum size of fyke + drop nets $2\frac{1}{4}$" (no ref. to size in previous statutes)
- provision that boats used to lift fyke or drop nets must have a false bottom at least 4 in. from the main bottom, except in L. Superior (?)

- decrease in size limits of trout and whitefish taken in small mesh gill nets in L. Sup. from 17 and 16" respectively to 15 in., with reference to the "10 per cent by weight" clause
- all undersized trout, whitefish, wall-eyed pike and pickerel taken in any gear in L. Superior, must be turned over to the Conservation Commission, instead of only those taken in excess of 10 per cent. as formerly.

Van Oosten, John. 1933. Preliminary report on investigation of chub mesh in Lake Michigan. The Fisherman, 2 (4): 3, 4, 8.

p. 4
- number and weight of chubs taken decrease with each progressive increase in the size of mesh.
- number of baby lake trout remains nearly constant, especially in the case of the $2\frac{1}{2}$", $2\frac{5}{8}$", $2\frac{3}{4}$" mesh.
- % amount of destruction of baby lake trout by chubnets cannot be reduced by changing the mesh in these nets to a size still desirable for taking chubs
- may be reduced by preventing setting of chub nets on shoals occupied by trout or in waters with dense trout pops

→ 958.209.6 ca 1700 Planisphaerium Caelest. Opera G.C

Six insets maps showing
Beautiful → 1) Tychonica hypothesis
2) Ptolemaic "
3) Copernican "
4) Phases of the moon of earth's rotation around sun
5) Ph. Lansbergii scheme
6) Tides affected by moon

46

Van Oosten, John 1940 Fishing industry of the Great lakes. U.S. Dep interior, Fish. Wildl. Serv., Memorandum 1-63., 1-15.

→ Fishing Methods and Fishing Gear

Gill Net fishing

- said to have been used by the Indians on the upper lakes as early as 1781
- not in common use until after 1830
- early nets all made by hand
- stones attached to sink the twine.

See xerox.

① Gill net fishing
② Pound net fishing
③ Trap net fishing
④ Fyke nets
⑤ Hooks
⑥ Seines and dip nets
⑦ Trammel nets

MAPS AT THE CANADIANA LIBRARY

① 958.255 b published many times from 1683-1791
Popple, Henry (?); Halley, Edmund.
Coloured engraving 56.7 × 52
Detailed map showing Hudson Bay, Gt Lks area, the regions inhabited by the Kilistenos and Illinois, source of Mississippi

② 955.47.3, 1720 - Nou France showing Gt. Lakes
(Lac de Tracy & ou Lac Superieur et Lac de Conde)

③ 956.106.4 map of eastern North America 1722 (watermark)

④ 962.110.2, 1755 Partie de l'Amérique Septent?
- St. Lawrence R. & Gt. lakes

⑤ 947.75.2 1757 Karte von Der Seen in Canada Zur allegemeinen.
- partly topographical of Gt. Lks.

⑥ 953.134 1761. An Accurate Map of Canada
-map of Gt. Lks area during English-French war (Seven Year's War)

⑦ 956.53.4 Eng. map ... Straits of St. Mary + Michilimakinac c 1800
(on loan to upper lakes)

⑧ 958.143 British Dominions in N.A., 1823, Russel
(on loan to upper lakes)

⑨ 406.154 1834. New Travelling and Commercial Map of the Canadas From the Sault of St. Marie to the River Saguenay. And a large section of the United States of America - Rare Book Cupboard

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Van Oosten, John. 1944 Lake Trout. US Dept. Int. Fishery Leaflet 15 1-8 (cont. From p.25

p.3 Places and Seasons Spawning

Spawning times

- late Sept - ends from early Oct. to late Nov. or early Dec. varying with the latitudes, the lakes, and the races of fish
- length of spawning season varies from about 10 days in small lakes to 40 days or more in large lake
- successful spawning occurs normally at a falling water temp of about 40°F

p.4 - wide variety of spawning grounds + depths
- open reefs or around islands, in channels or bays with mossy bottoms, in deep water on clay bottoms, or along open shore.
- may spawn in water as shallow as 2 or 3 ft. and as deep as 60 fathoms (360ft)
- occurs most commonly on reefs often with "honey comb" rock bottom in water from 6 - 120 ft.
- female trout when spawning produces about 750 eggs per pound of body weight
- no. deposited perhaps avg. approximately 6000 eggs per female.
- in hatcheries, lake trout eggs may hatch as early as Jan. and as late as March or April - incubation period varies with water temp.
- approximate length of incubation period may range from 75 - 100 days at water temperatures varying from 45° to 36° F

in 200 Lib.

TABLE 1 - Length-weight relationship of lk. tr. from L. Mich
TABLE 2 - Length-weight-girth relationships of certain lk. tr. from ~~L. Superior~~

Table 3. Estimated lengths, weights, and growth rates of lake trout from Lake Michigan for each year of life

Table 4. Ages and weights of certain lake trout from various localities

7 Trolling

- Charles Hallock 1873 "The Fishing Tourist" - reported none of the various species of lake trout were considered game fish as they seldom rose to the fly, although they afforded good sport for trolling
- In early days, many commercial fishermen of the Gt. Lakes trolled for lake trout for the market
- recent comm. trolling initiated in 1926 at Munising, Mich. on L. Superior

8. Bobbing

- "Bobbing or fishing for trout through the ice has perhaps reached its greatest development on Lake Superior."
- fisherman has a hand sled, a canvas or burlap windbreak, one or two poles, a small stool or box, an ice chisel, a heavy bobbing line (breaking strength from 60 to 90 pounds) treated with pine tar, coal tar, and paraffine, and then stretched, a flat 8-ounce sinker, heavy hooks (size 8-0 or 10-0) with a wide band, and bait or "bobber" which consists of flat elongated pieces of herring.
  - hook attached to a leather trace which is strong through the two eyes of the sinker
  - bait attached to hook in such a manner to simulat a live fish when the line is jerked or bobbed up and down
- in L. Sup. usually done in 75 - 100 ft. of water
- Begins in protected waters about mid-Jan. and on the open waters early in February and continues into April.
- careful watch must be kept of the offshore winds which move the ice fields away from shore

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Meth, Fred 1970 Saturation in Gill Nets MSc Thesis U. of Toronto

p. 26 Ways in which fish can exert an influence on other fish approaching the net

① Spatial elimination

Kennedy, W.A. (1951) The relationship of fishing effort by gill nets to the interval between lifts. Jour. Fish Res Bd. Can. 8 (4): 264-274

see Kennedy (1951)

-varies with species behaviour
-longnose sucker and common white sucker thresh about and gather many adjacent meshes about their bodies
-chub, round whitefish, alewife, lake northern chub rarely entangle more than one mesh

② Visual stimulus
-may act as ~~both~~ avoidance or attraction stimulus

27 ③ Vibrations
-sound, low frequency water vibrations may complement visual & tactile stimuli in fish

④ Alarm substance
-von Frish (1941) discovered an alarm substance secreted by specialized epidermal cells in the skin of some Ostariophysii released upon injury to the skin.
-perceived by olfactory organ and initiates alarm reaction in other fish or closely related species resulting -reaction may be transmitted visibly
-fishermen's contentions that fish avoid areas where there are dead fish

33 Summary

① Gill nets of four mesh sizes fished for 2 and three ~~weight~~ intervals, and the catches compared with summed concurrent nightly catches (as a measure of availability) to determine whether they became saturated

② Least squares polynomials were fitted to these 58 comparisons for each net
- 1¾" and 2" - linear equations
- 1½", 2½" - curvilinear eqns in form of parabolas

③ Curve for 1¾" in straight line with slope of one
-expected if densities of catches were below that level at which the deterrent effect of captured fish became significant (mesh caught nothing but a few large alewives
Curve for 2½" net straight line but with slope less than one
-harder to explain but may be biased by one sample of high catch

④ The maxima for the parabolas were taken as saturation levels for these mesh sizes

⑤ At saturation the net is partitioned into "areas of influence" by ind. fish about their point of capture. The radius of this area is proportional to the length of the fish. (Almost identical effect in the two meshes)
-this assumes an even distribution which is not always the case

⑥ A correction factor for size is developed by which net areas in expt. gangs can be adjusted to offer equal fishing intensity over all fish sizes

L.R. Wilson (1931) Evidence of a lower level of Lake Superior Science vol 73 no 1885 p 185

- sample of peat dredged from depth of 54 ft - one ½ mile west of Sand Island, Bayfield County, Wisconsin
  - deposit was in 40 ft of water under 14 ft. of lake sand
  - pollens were well preserved and of plants found in or near a typical peat bog
  - another deposit reported between Cat Island and North Twin Island 23 miles east northeast of Sand Island
  - unaltered state of peat suggests not of interglacial age, but postglacial and probably associated with the Nipissing Stage of the Gt. Lks
  - lake level at least 54 ft. below present "not in accordance with our present ideas concerning the postglacial history of the region" (Frank Leverett, "Moraines and shore lines of the Lake Superior Region" U.S. Geol. Sur. Prof. Paper 154-A (1929))

Marjory A. Ford (1943) Annual Landings of Fish on the Canadian Side of the Great Lakes from 1867 to 1939. International Bd. of Inquiry for the Great Lakes Fisheries. Ottawa.

Data

1867 - 1908 - Annual Repts of the Dept of Marine and Fisheries (or the Dept. of Fisheries) of Canada.

1909 - 1937 - Annual Repts. of the Game and Fisheries Dept. of Ontario

Conversion Factors.

1 barrel fish = 2 cwt. see a) 10th Rept (Fed) 1877, p. 273, Fresh Whitefish for 1876 and 1877

cont.

51 Pycha (1962) -found nylon gill nets 2.25 times more efficient than cotton for legal-sized trout (2.8 times as efficient for undersized trout)

Pycha, Richard L. (1962) The Relative efficiency of nylon and cotton gill nets for taking lake trout in L. Superior. ~~Wood~~ J. Fish. Res Bd. vol. 10 no. 6

1085 -early gill nets — see xerox
- relatively coarse twine
- crude wooden floats
- lifted by hand into open rowboats or sailboats

- improvements
- power boats (first steam, then gas and diesel) - enclosed and heated with hulls capable of breaking through ice, have increased the length of season and the range of operation
- power lifters - increased amount of gear that could be handled
- ~~monofilament~~ fathometers - some fisherman lift as much as 10 mi (16 km) of net in a day!
- recently fathometers and automatic pilots have assisted in location of suitable grounds and have reduced the need for manpower - can find net buoys in fog or snow as far as 60 mi (96 km) from shore
- in gill nets
- structure and preparation of wooden floats has improved
- since 1925 aluminum floats have eliminated any depth limitation on fishing (nets commonly fished in L. Sup. at depths down to 120 fathoms (220 m) and have been set in at least 150 fathoms (275 m). Usually few fish are taken below 120 fathoms)
- increases in twine efficiency
- twine became finer and more pliable

1086 - 1930's softer, more elastic cotton thread replaced linen in most major fisheries
- 1949-52 (L. Superior American waters) - conversion from cotton to nylon twine in large-mesh gill nets. - principally 1950 + 1951.
- greatest single increase in efficiency
- efficiency change with change from linen to cotton much smaller (lack quantitative data.)

- states did not require fishermen to record kind of gill-net twine used in their monthly reports - "It would have been highly indiscreet to solicit this information at a time when pressures existed for legal restrictions on use of nylon twine.

- most studies have indicated advantages for nylon over cotton ranging from a little less than two times to slightly more than three times

p. 1093 Results
- gill nets 2.25 times as efficient as cotton nets for taking legal-sized lake trout
- Erktikis earlier observation of 2.5 fold advantage of nylon over linen twine in agreement

1094 "may be used as valid correction for early 1950's
- other biases have developed since then
- trend to concentration of effort on better grounds in the best seasons.
- poorer fishermen forced to cease operations altogether and better fishermen turned to fishing other species during stock period
- trend continued until by 1959 lake trout fishery was a part-time operation limited to winter and spring months for all but a few fishermen (In 1960 + 1961 only one fisherman on entire U.S. shore fished for lake trout steadily through all the summer and fall months).
- would bias average annual catch per unit effort
- "therefore, even though we can now feel confidence in a value for the efficiency ratio of nylon and cotton gill nets fished for lake trout, correction of recent lake trout statistics still would yield undependable figures

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Christie, W.J. (1965) Angling-Commercial Fishing Relationships in the Great Lakes. Dept of Lands & Forests, Fish & Wildlife Branch

p. 2 "Where a large angler catch is prevented for example by a lower value commercial gill net catch in the same area, the angler catch should have precedence" - fish have a much higher dollar value for anglers

5 -striking trend among the anglers towards larger and more sea-worthy boats

Nute, Grace Lee (1944) Lake Superior Bobbs-Merill Co. (Pub) Indianapolis, N.Y.

Early History

19 -First explorers Etienne Brulé and Grenoble
- Brulé one of Samuel de Champlains interpreters, whom he sent to live among the Indians
- L. Sup. with shown on Champlain's published map of 1632
- Brulé + Grenoble visited a place from which the Indians were taking copper— Historians think it was Isle Royale, but perhaps they went only to the copper mines of the south shore
- rapids at the Soo called Sault de Gaston (name of the king's brother)

20 -1641 - two Jesuit missionaries, Charles Raymbault and Isaac Jogues, visited rapids and changed name to Sault de Ste Marie
- learned of new tribe of Indians who dwelt at the western end of Superior

21 -map sometime before 1958 delineating the entire lake fairly accurately - author not known - now in Paris archives

D -lake first mentioned as "Supérieur" or "Superior" in Jesuit Relation of 1647-48
- First travellers in lake to have recorded travels in any detail were Médard Chouart, Sieur des Groseilliers, Pierre Esprit Radisson - 1660

22 -Radisson's narrative preserved by the famous diarist Samuel Pepys - bay unknown to historians till almost the end of the 19th c.
- describes the Sault de Ste Marie, and its fisheries, southern shore
- Built first known dwelling of white men on the lake at Chequamegon Bay - after winter crossed to north shore, and probably explored the age-old trail to the interior which begins at the mouth of the Pigeon R.

23 -Jesuit missionaries (Father René Ménard + his lay assistant, Jean Guérin) + seven traders returned in 1660 with Radisson's + Des Groseilliers' recent Indian companions - neither Jesuit survived the trip
- seven traders returned to Quebec in 1663
- ~~when the two Indians~~ Father Claude Jean Allouez - 1664
- built a chapel at Chequamegon Bay
- spring 1667 - decided to visit the Nipissing tribe, then in the area north of lake Nipigon - skirted entire shore of Lake Superior in a small bark canoe with two Indian guides

- later with help of Father Marquette, he prepared one of the most accurate maps drawn until recent times - published in Relation of 1670-71 - Marquette left post at Sault in 1669

27 - Marquette remained at Chequamegon Bay until summer of 1671
- fled to Mackinac when attacked by the Sault

- 1669 - Father Claude Dablon replaced Marquette at the Sault - succeeded by Father Gabriel Dreuillettes in 1670

- June 14, 1671, at the Sault - Francois Daumont, Sieur de Sainte Lusson, took possession of all interior North America, including the L. Sup basin for France & Louis XIV.

- Daniel Greysolon, Sieur du Lhut (Sieur Duluth) - lat seventies & early eighties
- 1683 built a supply post at Ft. William
- made an alliance with the Assiniboin & Cree with the help of his younger brother, Claude Greysolon, Sieur de la Tourette (who established his post on lake Nipigon)

- Pierre Le Sueur - 1693 - built post on the south shore of Madeline Island at Chequamegon Bay (close to spot believed to the site of Radisson's and Des Groseilliers' cabin of 1660)
- 1694 - established post at mouth of St Croix R.

- Prices of furs dropped because of oversupply - 1696 Louis XIV of France revoked all fur-trade licenses and prohibited all colonists from taking any goods to the western country - Indians obliged to bring all their furs to Canada to trade
- Upper country deserted for over a decade
- age of French exploration almost at end

- 1713 - Treaty of Utrecht between Great Britain & France - trade of Hudson Bay yielded by France to the Hudson's Bay Co

- France realized need of maintaining French posts on L. Superior in order to hold on the trade of the interior, recognizing their mistake of 1696
- 1717 Sieur de la Noue re-established Fort Kaministikwia at mouth of river
- in 1721 place taken by Captain Deschaillons
- 1718 - La Pointe ~~re~~-established (Chequamegon Bay)
- command to grandson of Jean Nicolet - Paul Le Gardeur, Sieur de St. Pierre
- 1720 taken over by René Godefroy, Sieur de Linctot (Linctot in many documents)

(CONT

McAllister, D.E and S.U. Qadri (1965) Fish remains from a 2,500-year-old Lake Superior Archaeological Site, with Notes on Previous Sites National Museum of Canada Natural History Papers. No. 29. 8p.

- Fish remains, bones and scales, discovered during the 1960, 1961, 1963 investigations of a Laurel Tradition, Middle Woodland Site by Dr. J.V. Wright
- site at Heron Bay near the bank of the Pic River up from its mouth on northern Lake Superior, near the town of Marathon, Ont.
- a seriational estimate of the date of the site places it at about 500 B.C, ie. 2500 years old.
- Fish specimens obtained from a depth of 9 inches. The bones are tinged brown, a few are burnt. An indication of how the fish were caught is given by the presence of gill net sinkers and copper gorges.
- * specimens catalogued under N.M.C. 64-30 of the fish collection of the National Museum of Canada (see bulletin of the National Museum of Canada for description of the site.
- Salvelinus namaycush (Walbaum) - The lake charr was represented by a small anterior portion of the dentary. The size and shape of the dentary alveoles in the lake charr are different from those of the brook charr, with which it might be confused

  A small and broken piece of the frontal bone may be attributed to the subgenus Cristivomer or to Salvelinus. However, the massiveness of the bone points to the fact that it probably belongs to Cristivomer. (~~is~~ Qadri completing study to bring forth evidence for a generic recognition of Cristivomer)
- climate no warmer then than now - none of the warmwater species found at other Ontario archaeological sites were found at the Pic site. (longnose gar, freshwater drum, yellow perch, catfishes, black~~s~~ basses)
- found Acipenser fulvescens (lake sturgeon), lake trout, Coregonus (subgenus Leucichthys, sp.) (whitefish or cisco), Prosopium cylindraceum (round whitefish), Esox lucius (northern pike), Catostomus catostomus (longnose sucker), Stizostedion vitreum (walleye)
- that these seven forms were present there as long ago as 2,500 years B.P. makes it more likely that they dispersed from a nearby southern refugium following the Wisconsin glaciation, than the they dispersed from the distant Bering or Pacific refugia.

Grace Nute (cont.)

-third post successor of Duluth's and La Jaucette's post on Lake Nipigon -Pierre Gautier de Varennes, Sieur de la Vérendrye learned of routes to the Sea of the West here in 1736

-from 1763 to 1783 lake was wholly British

-fur trade on the lake reached its peak -almost entirely British (mostly Scotsmen or colonials until 1817

-then John Jacob Astor (head of the American Fur Company from 1808 to 1834) arrived

-under influence American Congress passed act in 1816 prohibiting foreigners from trading in American territory

-last quarter of the 18th and first quarter of the 19th c formed the heyday of the Northwest Co.

-chief competitor of Hudson's Bay Co.

-from conquest until 1767 British Government's policy to restrict trade to a few larger posts

-for Superior was the fort at Mackinac

-1765 Alexander Henry (British colonial) given by commandant at Mackinac exclusive right to trade about L. Superior (pp 33-34)

-built a post on Chequamegon Bay in fall 1765

-second winter spent at Sault

-third and fourth spent at Michipicoten

-1775 skirted north shore of Lake Superior to the Grand Portage

-Carver - Massachusetts colonial (p. 27)

-spring 1767 - north shore of lake from Fond du Lac to Grand Portage

-reinforcement and provisions did not arrive for the western trip so Carver and others returned along the north shore to the Sault and Mackinac.

-by 1770 four partnerships in the trade centering at Mackinac; in 1773 there were six; 1775 there were seven

-included the men whose names are most famous in the later North West Company: Benjamin and Joseph Frobisher, Todd and McNeall, Henry and Cadotte, James and John McGill, Paterson and McKay, Finlay and Gregory, and Dunn Grant and Porteous

-Northwest Co became a loose grouping of partners and firms rather than a corporation like the Hudson's Bay Co.

-established posts

- Canadian - at Sault Ste Marie, Michipicoten, the Pic, the Pays Plat, the Nipigon country and Fort William
American - Grand Portage, Grand Marais, Fond du Lac, La Pointe, Ontonagan, L'Anse,
- some of famous men and factors
  - ~~Dr. John Mcloughlin~~ - Grand Portage
  - Charles Oaks Ermatinger at the Canadian Sault
  - ~~John Johnston~~ at the American Sault
  - Jean Bte. Perrault and William Morrison at the Fond du Lac post
  - Duncan Cameron in the Nipigon country
  - David Thompson - Company's surveyor and map maker
  - John Macdonell - passed through lake in 1793 (one of best accounts of the lake.
  - Daniel Harmon - Vermont trader (A Journal of Voyages and Travels in the Interior of North America (Toronto 1911).
  - Alexander Henry, Jr - nephew of first English trader on the lake, diary telling of visits to Grand Portage and of life at posts dependent upon it.
  - ~~Alexander Mackenzie~~
  - Roderick Mackenzie
- in 1790's Bay Co. began to build a post in the Rainy Lake Country
- two companies combined in 1821 and thereafter posts on the Canadian shore of the lake belonged to the Hudson's Bay Co.
- also operated along the American North Shore between 1833 and 1847 by special agreement between Ramsay Crooks, president of the American Fur Company, and George Simpson, governor of the Hudson's Bay Territories
- 1822 David Thompson (map maker first of the Hudson's Bay Co., then of the Northwest Company) - member of the British part of the international commission set up under the Convention of 1818 to settle the boundary disput between Gt. Br. + the US
  - along south shore to Grand Portage (1822)
  - 1823 returned with ~~John J. Bigsby~~ (Shoe and Canoe) (p. 55)
  - along north shore from Sault to Grand Portage
- 1823 Major Stephen H. Long sent by the War Dept. to determine, among other things, the exact location of the recently established boundary (arranged by the Convention of 1818 and related to the area west of the lake of the Woods and as far as the crest of the Rocky Mountains. East

of that lake the line was not established)
-From Rainy Lake took the Kaministikwia canoe route instead of the Grand Portage way, and arrived at Fort William
-proceed by boat along north shore to the Sault (pp. 53-55)
-Major Joseph Delafield (1823) June 23 left Sault and travelled north shore (papers published in The Unfortified Boundary. (Robert McElroy + Thomas Riggs, eds, 1943)
-Lieutenant Henry Wolsey Bayfield - sailed from Sault June 22 1823 in the Recovery carrying out his British Admiralty orders to survey lake Superior - most detailed maps of period
-Nicolas Garry - deputy governor of Hudson Bay Co.
- 1821 travelled from London to Hudson Bay via lake Superior
-diary published in Ottawa by the Royal Society of Canada in 1900
-George Simpson
-first trip on lake 1820, many times between 1826 - 1850, touched at the Sault each year from 1853 - 1859
-diaries and papers in Hudson Bay archives
-Paul Kane accompanied Simpson on his trip of 1846 (Canadian artist) - Wanderings of An Artist (Toronto, 1925)
-Frederic Ulric Graham - with Simpson in 1847
-diary privately printed by his family in London in 1898
-Louis Agassiz (1849) - from Sault to Fort William (pp. 9-11)
-account of trip written by J. Elliot Cabot

p. 87 Hudson Bay Co. Posts

- "In the minutes of council of the Southern Department of the Hudson's Bay Company in London are the lists of appointments of the Lake Superior District and two posts, as well as the Sault Ste Marie District and its posts, all for the period 1822 - 1863."
- under the Lake Superior District were Michipicoten, Pic and Fort William - chief factors post usually Mich., in 1833 it was Ft. William
- under the Sault St Marie District were the Sault St Marie Depot and Batchewana - headquarters at Sault St. Marie post till 1851; thereafter it is called the Depot (The chief officer was usually a factor
- Batchewana post was a small establishment as a mere clerk, or even a man of lesser rank, a postmaster, was in charge.
- Pic Post usually in charge of a chief trader or clerk - after 1851 descended in rank (postmaster directed its affairs until 1863 when a clerk again took over)

-James Evans - Wesleyan missionary from Canada
-in 1838 left Sault to go by canoe to trading posts on the northeast

59 Frank Prothero. The good years 1973
HD 9464 C23 E77 (Hums)

side of the lake
- unpublished diary - after reaching post at Michipicoten Bay and staying there for a short time, Evans decided he must go back to the Sault to get permission from the Indian chief to establish his mission
- trip to Sault and back to Michipicoten made late in October (p 50-51)

p. 101 - Missionaries' diaries + letters
- Jeremiah Porter at the Sault, and his letters to the American Home Missionary Society,
- Sherman Hall at La Pointe.
- James Peet at Superior, Bayfield and Oneota (now a part of Duluth)
- John H. Pitezel and associates along the south shore
- Franz Pierz at Grand Portage
- Otto Skolla at La Pointe, Duluth and Grand Portage
* - James Evans along the Canadian shore + his associates:
  - William Mason at Rainy Lake
  - Thomas Hulburt at Fort William
- Abel Bingham and William MacMurray at the Sault
- the native missionaries, Peter Marksman, George Copway, Peter Jacobs and others at various places on the lake
* - the Jesuits Pierre Chone (Chonné), August Kohler, M.S.V. Hanipaux, Nicholas M.J. Fremiot and Dominic Durargnet, at the Fort William mission
- Edmund F. Ely and Samuel Spates at Fond du Lac.

Prothero, Frank (197?) Men N' Boats The Great Lakes Fisherman, Port Stanley.

105 Lake Superior Shoreline.
- some of the smaller boats in the fishing industry are operated in Lake Superior
- Much of Lake Superior is too deep to be very productive and fishermen must search out the small reefs and use the shallows close to shore (large vessel would be a nuisance)

109 Thunder Bay
- Kemp Fisheries - one of larger fish processing plants on the Gt Lks.
- under direction of George Humby
- active almost all year long - ~~handles much of north shore prod, incl trout,~~
- handle much of the production of the north shore - incl trout, herring, other species

- Ontario govt. program designed to encourage the exploitation of a growing sucker population
  - subsidies to ~~to~~ aid with transportation costs to encourage the development of markets
  - so successful to date that quota had to be imposed to keep the quantities down to the point where the production could be handled
- Kemp Fisheries also handles landing from northern inland lakes
  - a number of Lake Superior fishermen, such as Tom Chevrier of Hurkett, are licensed to fish one or more of the inland lakes, an activity that forms an important supplement to their normal fishing business

110. Mamainse Harbour
- in recent decades revival of the fishery - due largely to two injections of talent from other lakes
- in the late sixties Lionel Hurley and son-in-law, Jim Macdonald moved their Ferrocbad Fishery from Lake Erie to Mamainse, buying out the interests of the Gauthier Fishery
  - much of the fishing activity of the Ferrocbad Fishery is centered at the Michipicoten Island, but have built a large packing, freezing ~~island~~ processing plant in Mamainse
  - fleet of refrigerated trucks allows them to serve fisheries as far away as Thunder Bay
  - large gill net tug the JAMES D, constructed by Ralph Hurley at Port Burwell - has been the model for several ~~the~~ later vessels such as the ~~[redacted]~~ DORRETTA L and the MARVEL ANN
- also, Emerald LaBlance and his sons moved their operations from Tawas City on Saginaw Bay to ~~nearby~~ Goulais River - since that time the local fishery has grown substantially
  - small fleet of vessels used primarily in the harvest of chub
    - LEON J is a traditional Upper Lakes style vessel
    - MANVILLE L belongs to LaFond family of Two Rivers

113 - Mamainse is favourite visiting spot for fishermen from both Lake Erie and Lake Huron, and not infrequently a number of them stay on for a period of time to augment the local labour force and gain some experience in the L. Sup. fishery
  - several fishermen who normally fish out of Sault St Marie have moved north to be nearer the increased activity in the area
- Peter Robinson - over thirty years experience
  - operated the LORRAINE out of Mamainse

-also at tiny harbour the VERNA JANE, the LENORE, and the MARIE M
-fishermen include Doug Vokes, Gerald Jones, Louis Neveau, Olaf Bjarnes

Nipigon-Hurkett

-major operation is trawling for herring in Black Bay and Nipigon Bay
-in the shallow waters of the bays the yearly quota of herring is usually filled in a matter of a few weeks
-most economical to harvest them in the Fall (when they have formed)

Nipigon
-boats are mostly Lake Erie style and are rigged with the usual winches and A frames to allow them to utilize this technology
-Elvin, Gordon, Harold and Henry Dampier all operate vessels at Nipigon
-some are rigged for gill netting as well but the major activity is trawling. -Gordon Dampier's SEAGULL III, also Dampiers operate the PELICAN
-the SEABIRD II and the PENGUIN are typical
-other species include whitefish, trout, smelt, perch and a growing number of suckers

-Hurkett (formerly the F.T. JONES)
-sister trawling vessels DONNA (belonging to Tom Chevrier) and OTTER II both constructed in the Bronte yard on Lake Ontario about thirty years ago
-large vessels and well suited to the job of landing tons of herring per day
-James Handy, James Nuttall, Thomas Chevrier

133 Gill Netting

-as many fish in the Great Lakes are bottom feeders, nets are set at that depth, but they can be "canned" up or suspended from cans that act as floats to catch fish that are at a level closer to the surface
-a net is 30-50 ft long and a number of them tied together form a 'strap'
-several straps in a general location are called a 'gang'
-the mesh are constantly becoming tangled in underwater debris and require constant attention. During the winter months when the fisheries may be less active the nets are replaced by cutting away the torn mesh and putting in new material made of nylon or monofilament
-method
-when gill net boat reaches fishing grounds, stern doors are opened and an anchor and buoy thrown overboard with the nets attached
-nets are fed out over a wheel which separates the top and bottom lines so that they settle to the bottom in their proper position
-trays or steel boxes hold the nets until such time as they are set, a fisherman

setting several boxes of nets depending on whether he is expecting a light or a heavy concentration of fish
-nets may be retrieved the same day, a practice known as 'daylighting' but will more commonly be left in the water for several days
-nets are pulled by lifting the buoy and anchor line and attaching the sideline of the net to the net puller, a device located at the forward part of the boat. A revolving drum mounted horizontally winches the nets aboard as the boat proceeds forward at a slow pace
-fish may be removed as the net is brought aboard, as is the practice
134 in some L. Mich + L Sup fisheries. Elsewhere the nets are piled back in trays as the come from the puller and are then dragged to the stern deck where they are picked
-before the introduction of nylon and monofilament nets, it was common practice to dry nets on large outdoor reels. In some of the L. Ont fisheries small reels were used and when the nets were ready for setting the reel would be positioned in the stern of the boat and the nets set directly from the reel
-Some fishermen still dry nets out on reels, particularly if the nets have become covered with slime or algae. When the nets are removed from the reel, the dried algae flakes off leaving the net clean
-disadvantages
-require high degree of labour to make, maintain and use
-a pool of labour with these skills is becoming increasingly difficult to maintain,

Trawling -see p 134

p 136 Winter work
-major task is the overhaul of his nets and manufacture of new ones, particularly if he uses trap nets or gill nets
-buy their own web and lines from wholesalers and spend long hours stringing new nets, and repairing old ones by cutting out and replacing torn mesh
-custom in some fisheries for one man to work each side of the line while in other cases a single worker will do each side by himself
-plastic needle must be threaded skillfully through the mesh and knotted correctly at the right point so that both sides of the net are kept even
-shanty work lasts for a number of weeks, often depending on the probability of a late or early spring

-ice fishing prevalent on Lake Michigan, Superior and Ontario.
-at first when ice is relatively thin, snowmobiles are used for transportation but as the temperature drops, trucks may be substituted for the snowmobile, particularly on protected waters where the dangers of shifting ice are not present
- Method - done almost exclusively with gill nets
-drill holes through ice with a power auger at intervals of about a hundred feet.
-The nets are then attached to a device called a "jigger" which is essentially a board with a hole in the center in which a steel bar connected to a rope is hinged. when the rope is pulled the steel bar acts as a lever, pulling at the surface of the ice from underneath,
140 and propelling itself forward. when it comes to rest the rope is yanked again. The device can be seen through the ice, or, if there is too much of a snow cover, it can be heard.
-An alternate method of setting nets under the ice is to use long sections of one inch by two inch lumber nailed together, and pushed under the ice from hole to hole.
-for protection, small sheds constructed with a hut of clear plastic on them which creates a light and effective windbreak that can be hauled from hole to hole by hand by or snowmobile
-catch, deposited in a wooden packer, will be taken away by a snowmobile or truck when filled.

141 BOATS
-steel almost universally the material of hull and superstructure construction, the major exception being the American ports on L. Mich and L. Sup. where the tradition of building wooden boats lasted much longer - long durability
-Lake Erie style tug found all over the GL. Its ~~name~~ name more a matter of convenience than accuracy
-varies from other styles in several essentials
-closed deck with engine located below decks
-water that comes aboard merely washes overboard through the scuppers located along the rail like where the deck and superstructure meet
-wheelhouse located over the engine about amidship - relatively large with space provided over the rear deck for sleeping
-some of larger boats ever have dinette facilities, complete with small stove and refrigerator
-most of tugs presently in service on L Erie were built during the thirties and forties

-a length of fifty or sixty feet and a beam of fourteen feet, was, at the time, considered practical
-all have diesel power, most equipped with marine engines of one hundred and fifty to two hundred H.P., the ed.c tugs that have been converted to trawlers often having larger power plants to meet the rigorous demands of that type of fishing
-Lake Erie tugs constructed in the past decade tend to be larger and more powerful
-total length now in area of 74 ft and beams are in excess of 20 ft.
-gives more spacious deck space and making for a more stable working platform, some of the earlier models having a tendency to roll rather violently
-power increased with diesels ranging from 200 - 400 H.P.
143 -Lake Erie gill net tugs invariably have their net pullers on the port bow, a tradition that is not true on some of the other lakes
-trawlers are identified by the A-frame welded to the superstructure at the stern side door.
-Upper Lake boats, particularly on Lakes Michigan and Superior tend to be quite different in layout from the Lake Erie style
-open decks rather than closed decks
-water that comes aboard is pumped out of the bilge rather than flowing out through scuppers.
-very seldom as big as the lower lakes tug and have narrow beams but are almost always of heavier construction, having their frames closer together and a plating of all quarter-inch steel or heavier
-very seaworthy and very steady sailers
-good boats in ice (slice through six inches of ice or more) almost without effort
-engine located amidships where it tends to take up valuable space since it is not located below decks
-diesel power nearly universal but there is the odd gas installation
-in the traditional model the wheelhouse was elevated and located at the stern of the boat. This allowed for a single man to steer the boat and set nets and provided a degree of visibility aft that is not present in other designs. Since Upper Lakes fishing boats were often landing more valuable species of fish, they were not
194 dealing with the large crews or huge quantities of fish that were customary on Lake Erie.

-tendency in recent years to move the wheelhouse to a position over the engine, thus creating more deck space, but the large wheelhouses with sleeping facilities have not yet been provided.
- Net pullers may be on either port or starboard bow. - customary for the nets to be picked as they are pulled so that fish do not become damaged and they can be put on ice more quickly. Frequently this work is performed on a table that extends from the puller aft toward the engine area
- with decline of the fisheries many of the smaller boat yards serving the upper lakes have closed
- many of stout steel vessels presently in service on both L. Sup & L. Mich are from the Burger yard, Company, Green Bay
- Curt Folstad of Menominee, Michigan provides sixteen to thirty foot boats for fishermen on both Lake Mich. and L. Sup
- as trawling has gained in popularity on the upper lakes, a no. of Lake Erie vessels from both the Canadian and American side have found their way north
- when wood construction abandoned, boat building primarily left to professionals
- traditionally constructed by the fishermen themselves - dated back to the earliest pioneers
145 - the lower turnover in upper lakes craft and the present unsettled ~~condition~~ situation in some of the fisheries there has meant that boatbuilding has declined and older boats are kept in service longer

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Wohlgemuth, O.D (1969) Fisheries management program, Eastern Lake Superior, Sault Ste Marie District, 1969 Unpublished Report, 11 pp.

* - lake trout fishing in the inshore areas of Eastern L. Sup. permitted only for assessment purposes.
- much supervision by Department personnel required in order to control and keep established quota system functional - during open lake trout season surveillance of the catch was continuous
- although the inshore waters were divided into six sectors for recording purposes only two, sectors 3 and 5, provided meaningful data (Batchawana Bay (5) and Goulais Bay (3) most of angling)

- it appears that the offshore areas provide little or no recreation to the majority of anglers who possess only small type watercraft.
- interest in lake trout in this district appears to have declined - 337 licences in 1969, 729 in 1968 - decrease of 54 %
- Perch dominant in anglers creel (79 % of total catch) ② yellow pickerel, ③ rock bass, ④ northern pike, ⑤ small mouth bass and ⑥ rainbow trout

QUOTA AREAS - see xerox for catch nos. (Commercial

① Area 4 Spring May 5 - May 15
Fall Sept 10 - Oct 1

② Area 14 - Whitefish Bay - S. May 16 to May 30
F Oct 1 - Nov. 6
- open immediately after closure of area 4

③ Area 9 - fished by six licensees under a special permit.
④ Area 7 - thriving fishery at Quebec Harbour, Michipicoten Is.
⑤ Area 6 - fished under special permit

- commercial fishing in quota areas 4 and 14 primarily for sampling purposes
- there are, however, several areas in the central portion of the lake where natural stocks appear to be already abundant (quota areas 9, 7 and 6). These are fished under a management quota rather than for assessment purposes

* - "It appears that the lake trout quota system as established is less than appropriate. Because of the commercial fishing practices employed in this district, it is exceedingly difficult to control the harvest of lake trout on a quota basis in some areas. It is recommended that the lake trout quota system be reviewed and new guidelines be established."

Kerr, S.J. (1977) Observations and data concerning the lake trout spawning run at the University (Dog) River September 1977 Unpublished report.

- University River lake trout popn. displays an early spawning trait, as compared to lake trout in other areas of eastern L. Superior
- usually between Sept. 17 and Sept. 30 with peak centred around Sept. 24 (Loftus, 1958)
- normal peak spawning time for lake trout of other origins in this

locality generally considered to be near Oct. 21
- early spawning characteristic believed to be fixed by heredity rather than under the influence of environmental conditions
- sea lamprey believed responsible for drastic decline of this popn to point of being "apparently extinct" (Lawrie and Rahrer, 1973)
- led to series of lake trout plantings totalling nearly 400,000 fish (TABLE 2),
- in 1972 commercial fisherman reported ripe adult males present at the mouth of the Dog River (MNR correspondence, 1973) - first reported catch of this location for at least ten years
- lake trout spawning act takes place after dark and most movement occurs between 1900 hours and 2300 hours (Scott + Crossman, 1973)
- no sightings made in evening observations
- only 15 lake trout caught during four day sampling period.
- 5 of 10 fish positively sexed were ripe (4 ♂, 1, ♀)
- remainder "hard" - presence of "hard" fish in the river would not be unexpected if a river spawning popn did exist. Loftus (1958) noted that lake trout may enter the river in a "hard" state, a few nights prior to actually spawning.
- none captured native in origin - all hatchery reared and planted in 1973 (probably spawning for first time at age of 5+ years)
- impossible to conclude that a river spawning lake trout popn still exists
- all trout planted
- cannot not conclude that these planted fish had developed into river spawners since no fish were actually observed in act of spawning
- all captured near mouth of river and not well upstream
- indicate that either just beginning to move into river prior to spawning or else merely present at mouth of river and not heading upstream at all

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Wohlgemuth, O.D (1968) Investigation of spawning lake trout in eastern Lake Superior, Vicinity of Montreal R., Sault Ste Marie District, 1968 Unpub rept. 4pp and appendices.

- one of most common spawning grounds during pre-lamprey era
- assumption that 90% of total lake trout in Eastern Lake Superior is hatchery planted
- gill nets set in vicinity of Montreal River.
- found peak spawning did not occur until after Oct. 31st

~~increase~~ not as early in season as in pre-lamprey period.
- Loftus (1958) from data collected during the 1951-54 period stated spawning period at Montreal River to be from Sept. 25 to Oct. 10
- percentage ratio of males to females 62:32 possibly indicate that males are sexually mature at an earlier age than females.
- 6 year old ♀ absent from spawning grounds while males present some ♀ sexually mature at age 7, but not until age 8 is the ratio of males to females relatively equal.
- as in 1967 survey 1960 and 1961 year class represented greatest portion of trout captured (ie. those of spawning age)

Cook, C.F. (1966) Decline of Lake Trout angling eastern Lake Superior late 1940's early 1950's & unpublished reports

- information from the log book and diary of the cruiser "Carol K" which was in operation as a charter boat out of Montreal River during the period 1946-1962 inclusive
- Michael Krezak, owner-operator of Trail's End Lodge during 1940's and 1950's - operated two cruisers "The Carol K" and "The Ollie K"
- 1946-1959 - approximately 20 cruisers and guide boats operating out of Montreal R.
- most out of business by 1958-59
- M. Krezak disposed of his two boats in 1960 and 1964
- in addition to aforementioned boats, each year during the months of July and August the Chicago, Detroit and Grand Haven Yacht Clubs maintained a Commodore at this port to take care of the requirements of their 3 to 5 yachts per day (or approximately 188 to 200 for the season) that were coming and going for lake trout angling
- also large fleet of small outboard boats (res. + non-res)
- marine gasoline pump at this Port - pumped avg of 60,000 to 65,000 gallons of gas per annum, plus oil, repairs, etc.
- ice house - filled each winter with approx. 15,000 cubic ft. of ice which was used up by Sept. 10
- accomodation and restaurant service much in demand
- during the latter half of the 1940's and first half of the 1950's the lake trout spawning popn. in the Montreal R provided Hatchery at Sault

Ste Marie with approximately two million lake trout eggs each year
-during 1949 spawning operation 1,726 lake trout spawned and released-
during 1955 spawning operation only 40 lake trout could be procured
for spawning purposes

Canada.
Commission of Conservation
Report of the first annual meeting, 1910

p. 109 -non-resident anglers tax introduced 1907 - 2$
-originally at suggestion of Ontario Forest, Fish and Game Protective Association

Lands, Fisheries and Game, Minerals, 1911, Ottawa

p. 38 SUMMARY OF PRINCIPAL LAWS AND REGULATIONS - The Fisheries Act.
(R.S., Canada, Chapt. 45)

Leases and Licenses - Minister of Marine and Fisheries may issue leases or licenses to fish for a period not exceeding nine years. If a lease or license for more than nine years is required, it may be issued only under authority of the Governor in Council

Trout Close Season -Ontario Speckled trout, Sept 15 - May 1
Salmon trout, Nov 1 to 30
lake trout, Oct. 15 to Dec 1

Anglers' Permits - ~~permit required costing $5~~
-allows fishing line having no more than 3 hooks to be used
-trout limit 6 inches
-permit issued by provincial authority
-good for three months on payment of an individual fee of $2, or $5 per rod when those fishing live on their own yachts.
-guides licenses $2 each
- For ONTARIO see Ontario Statutes, 7 Ed. VII chapt 49

-Ontario Hatcheries at ① Ottawa
② Newcastle
③ Sandwich
④ Wiarton
⑤ Sarnia

Proceedings at a Meeting of the Committee, Nov. 1 & 2, 1915
Fielding, J. B. Conservation of Canada's Inland Fisheries pp 81-92

p. 83 - "It is not fully appreciated that, taking the same species of fish as an example, the natural periods of gravidity vary under different local influences, such as temperature, food supply and environment. Thus it is surely improper to enact legislation enforcing an artificial so-called close season without due consideration of these factors. The remedy is not far to find. Would it be possible to divide our country, so far as fishery administration is concerned, into watersheds where conditions are nearly akin? This would surely be more advantageous to the fish than the present method of having a universal close time over a whole province.

L. Huron. Georgian Bay — Let me give as examples only two instances of these varying periods in the province of Ontario. On the west shore of the Saugeen or Bruce peninsula the lake trout (Cristivomer) comes on the "redds" a fortnight earlier than it does on the southeast shores of Georgian Bay. Again, in lake Nipigon, the speckled trout becomes gravid nearly a month later than it does in the river flowing out of it."

Werner, W.H.R. (July 26, 1960) Memorandum Re: Lake Trout — Lake Superior. 9pp

- sampling of Commercial catches indicate a rising percentage of planted stock in the commercial catches
  - eg. 1959 Wisconsin Commercial catch 38% hatchery planted fish. - "This percentage was apparently higher in Wisconsin than in some other waters of Lake Superior but it does illustrate the growing dependence of the fishery upon planted fish and the decline of native fish in spawning stocks."
- Report of the Ad Hoc Committee on Regulation of the Lake Superior Lake Trout Fishery (Excerpt from G.L.F.C. Interim Meeting, Ann Arbor, Mich, June 14 & 15, 1960)
  - Committee on Lake Trout Rehabilitation - Mr. Saalfeld as chairman did not believe that this committee's terms of reference were

conducive to proper consideration of the subject of regulations.
-called senior representatives of agencies concerned to form an ad hoc committee.
- Ontario government had maintained total number of licences issued at approximately same level over last 15 years in spite of requests for new ones
- Report on Ad Hoc Committee on Regulation of Lake Superior Lake Trout Fishery (recommendations)
-met May 18, 1960 - senior administrators from the fisheries agencies of Ontario, Michigan, Wisconsin, and Minnesota
-recommended management be based on an annual quota for the lake
-distribution of the quota may vary - this distribution should be reconsidered at intervals of not less than five years, or on the request of any agency concerned.

Ryder, R.A. (?) Dynamics and exploitation of mature walleyes, Stizostedion v. vitreum (Mitchell), in the Nipigon Bay region of Lake Superior. 36 p.

p. 12 -Nipigon Bay pound-nets
-were traditionally set between the mouth of the Nipigon River and the Clay Banks (Fig 1) and cropped the spawning stock [of walleyes] as they descended southward in Nipigon Bay along the west shore
-there has been relatively little movement of pound nets over the years (Ryder shows data from 1945-65)
p. 13 -Black Bay is shallow with a mean depth of about 20 feet, whereas Nipigon Bay is more typically lake trout habitat with a mean depth of about 90 ft.
p26 -POLLUTION
-artificial eutrophication caused from the effluent outfall of the Kraft mill at Red Rock (Fig 12)
-this mill achieved prominence in the late 1930's as a sulphite mill with a capacity of 60 tons/day production
-changeover in 1950 for kraft production at the rate of 390 tons/day
-1955 - old kraft machines were partially converted to a semi-chemical plant
-1958 - bleach plant and new chemical recovery unit were installed in the mill

- Effluent outfall has increased over the years but not necessarily proportional to the increase in production rates.
  - 1960 - average of 67 tons of suspended solids per day was dumped in to Nipigon Bay at Red Rock (E. W. C. Turner, personal communication)
  - 1958 - 1962 - noted increase in both suspended and dissolved solids in the effluent outflow occurred between 1958 and 1962 corresponding with the increased production rates during this period.
  - of critical concern are the high levels of phenols found both in the effluent and throughout the west portion of Nipigon Bay
    - O.W.R.C. effluent objective for phenols was exceeded by 55 ppb at a station located 100 ft downstream from the effluent outflow (German, M.S. 1966)
      - a surface water objective for phenols was exceeded by an average of 5 ppb at eleven stations in the western portion of Nipigon Bay, an indication that phenols and possibly other waste components are retained and concentrated within the bay
    - while the conc. of phenols generally sub-toxic to fish (American Public Health Association, 1960) can be responsible for imparting an unpleasant and obnoxious taste, thereby making fish unpalatable and consequently unmarketable
      - 1961 - Gordon Dampier - took loss of $2500 when an American buyer rejected a shipment of lake whitefish
      - fish buyers have rejected other shipments from Nipigon Bay, both lake whitefish and walleyes.
      - flavour evaluations carried out by Ontario W.R.C. on fish taken from the vicinity of the mill
        - 80% possessed an objectionable flavour (German, personal communication)

p. 30

- "Wood fibre accumulations, concentrations of sludge worms, the absence of mayfly nymphs and amphipods in the vicinity of and downstream from the effluent outflow, and the reduction in the number of species of midge larvae in the same area demonstrate severe organic pollution in the water between the effluent outflow and Five Mile Point and moderate pollution within a 1½ mile radius west and

Preliminary report on the biological survey of Nipigon Bay, 1966, Ont water Resources comm. 19pp

southwest of the discharge ditch (German, MS. 1966)

p 32 - the sport fishery has been virtually nonexistent since 1963

- "The importance of olfaction in certain salmonids in locating their spawning tributaries and individual spawning grounds is well documented (Hasler, Arthur D. (1966) Underwater guideposts. Univ. Wis. Press., Madison. 155 pp.)

p 34 - If olfaction also necessary for walleyes to locate their spawning grounds then dissolved foreign matter below spawning grounds may result in complete olfactory disorientation.

- ~~may~~ might result in spawning on unsuitable substrate (one possibility) or a complete lack of spawning with the coincident reabsoption of eggs

- Walleye exploitation increased with decline of trout due to sea lamprey predation in the 1950's — see graph of decline of lake trout in Nipigon Bay (1945-1965)

Martin, N.V. (1978) The Lake Charr unpub. manu.

① Introduction

② Description

③ Distribution

- found almost entirely within extent of Pleistocene glaciation
- talks of glacial refugia and process of recolonization after glaciation
- Hussakof (1916) - fossil specimen in Wisconsin at a point corresponding to the maximum extent of the ice sheet

④ Life History

A. Reproduction

a) Sexual Dimorphism
b) Maturity
c) Gonads
d) Spawning
- intermittent spawning not uncommon.
  - Due to (maybe)
    ① Latitude - different pattern of light + dark in high lat. lakes
    ② Unproductive nature of far northern lakes
- spawning times vary between populations
  - Lake Superior
    - Leano - early Oct - late Oct to mid Nov (Eschmeyer, 1955
      - peak late Oct to mid-Nov. (Duration 6 weeks)
    - Siscowet - June 8 - Nov. 22 (6 months Duration) (Eschmeyer, 1955)
    - "Humpero" - mid-Sept. - (Rahrer, 1965
    - River lake trout - Sept. 5 - Oct. 10 (Duration 8-15 days) (Loftus, 1958)
  - Nipigon
    - "Lake trout" - Oct. 1 - Oct 30 (Duration 1 month)
      "Deepwater trout" - Oct. 20 - Nov. 10 (D. mond. 1956)
- spawning times may vary between years
  - may be due to
    ① quantity of sunlight
    ② temperature
    ③ quantity of wind
- most spawning from dusk to 11 pm
- depth of spawning may range from 15 cm, as in Squam Lake, New Hampshire (Merriman, 1935), Lake Louise, Ont. (Martin, 1957), and in Cold Stream Pond, Maine (DeRoche, 1969), up to 61 m in Seneca Lake, New York (Royce 1951) with siscowets spawning at depths of over 91m in L. Superior (Eschmeyer, 1964)
- river runs in L. Superior showed homing tendencies (Loftus, 1958)
  - in three of streams distances of spawning areas from the lake were approximately 160 m, 0.8 km and 3.2 km and necessitated the charr traversing a no. of steep rapids
- males usually precede females to the spawning beds each year and also each evening
- in Green lake there was a complete failure in reproduction because the trout spawned over unsuitable substrate in deep water and there was no adequate protection for the eggs

effect of imprudent stocking

Thacker, 1957) This situation arose since the charr planted in this lake originated from deep-spawning stock obtained from Lake Michigan.

~~[redacted]~~

⑤ ~~[redacted]~~ Distribution and Movement

p.45 - large lake charr in Lake Superior may be fished by drift nets in open water at certain times of the year. (Lawrie, pers. comm.)

⑥ ~~[redacted]~~ Food and Feeding

⑦ ~~[redacted]~~ Growth

-(Mokane, 1951) -28.6 kg lake charr from Lake Superior taken by angling

p.76 ⑧ ~~[redacted]~~ Diseases Parasites and Predators

⑨ Population Structure

a) Sex Ratio

b) Age Composition

-sports fisheries - lake charr begin to appear in numbers in the catch at 4 or 5 years of age

commercial fisheries - at 7 or 8 yrs

winter sports fisheries through the ice - first harvested at younger age groups than is case in summer, because of the type of gear in use (Martin 1954, Schumacher 1961, Jorgensen, unpub.)

c) Size Composition

⑩ Abundance

a) Absolute Abundance

b) Relative Abundance

-Relative population size has been calculated by the use of commercial catch statistics. Hile (1949) and Hile et al. (1951a, 1951b) used catch per unit-of-effort of various fishing gears in Lake Huron, Lake Michigan and Lake Superior to estimate the relative abundance of the lake charr in these lakes over a period of years. Although abundance and production figures were similar, production statistics did not allow reliable measures of the extent of changes in abundance.

-catch-per-unit effort data of limited value in indicating abundance (the FS index) - Martin cites references for and against CPE

c) Changes in Abundance

f) Yield

(11) Recruitment
  a) Age and Size
  b) Reproduction Rates
  c) Year-class strength
(12) Mortality
  a) Mortality Rates
(13) The Lake Charr and the Ecosystem

Great Lakes Fishery Commission (1974) Lake Superior Committee, 1974 Annual Meeting, Milwaukee, Wisconsin, March 26, 1974. Minutes (with appendices) 125 pp

p.7 III Status of management of major species (excluding lake herring)

Michigan

Spawning of planted trout

-Mr. Wright reported that studies on lake trout spawning in Lake Superior suggest that lake trout home to sandy shore planting sites, but do not spawn there. They mill around and many attempt to spawn on small patches of unsuitable gravel. It is apparent, however, some fish from beach plantings move to suitable spawning locations, but the fate of most fish is unknown. In several instances, spawning lake trout have been observed to be very selective in their choice of spawning sites, avoiding areas that appeared identical to those in use. In the future, Michigan would be placing greater emphasis on offshore plants by selecting suitable reefs near shore that can be stocked from small boats

V. Status reports on contaminants

p.8 Ontario

-1971 - Fishing for lake trout in Thunder Bay prohibited due to mercury contamination (closure still in force)
  -Ministry's survey program was initiated in 1970
  -more than 150 individual fish samples (primarily lake trout) have been taken from L. Superior and tested by the Inspection Service, Environment Canada

IX. Special research projects,

p 12 - Mr. George King - described Wisconsin expts to induce homing in both native and hatchery reared rainbow trout by imprinting them with morphaline

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Minnesota Appendix III. Minnesota Department of Natural Resources, Fish and Wildlife Division, Section of Fisheries. Report of the Lake Superior Committee.

24 - wounding rates highest in Minnesota waters
- native lake trout have comprised a small portion of the assessment samples in recent years (4 to 8 percent) although reproduction appears to be occurring and these fish are slowly contributing to legal-sized stocks
- Breakdown of the native catches in the assessment samples since 1970 indicates small but continued improvements in abundance of native trout - Grand Portage area has highest ~~[illegible]~~ abundance of native trout

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Appendix IV ~~[illegible]~~ - George R King. Wisconsin Department of Natural Resources, Bayfield. Progress Report of Fish Management on Lake Superior, 1973

p. 31. - ~~research~~ intensive sampling of the lake trout population carried on each year since ~~1950~~ 1959
- "A very successful program of stocking hatchery reared trout and control of the sea lamprey has brought the lake trout population back to a very high level of abundance. This high level of abundance appears to be decreasing, mainly because of the reduction in stocking rates since 1967. lamprey predation on the larger trout, plus the ineffectiveness of shore stocked lake trout to rejuvenate historic lake trout spawning areas is preventing effective rehabilitation."

p. 34 - hatchery lake trout have been stocked annually in the Apostle Islands since 1952
- Since 1962, nearly all stocking has been from mainland shore sites, however the results of special plants off-shore in 1965 and 1967 lead to a decision to increase off-shore plants. Returning mature fish from the 1965 plant of 100,000 yearlings on Gull Island Shoal showed a large percentage spawned where they were stocked."

35 -slow but improving contribution of natural reproduction from 1965
-numerical abundance of lake trout was lowest in 1960 and has shown steady improvement through 1970
-the present rate of recruitment is not sufficient to maintain the lake trout population at the high level of abundance reached in 1970
-analyses of C.P.E (no. of fish / 100,000 yds nets) by age group and sex of lake trout for major spawning shoals in Wisconsin waters (see XEROX)

p. 71 Appendix V(a) see XEROX
Wohlgemuth, O. Exploratory Gill Net Fishing for Deep Water Cisco (Chub-Coregonus spp.) Eastern Lake Superior

p. 74 -"The future of the (cisco) chub fishery is largely dependent upon the ability of the fishermen to harvest this species without adversely affecting sub-legal lake trout. Lake trout abundances changes with location and time of year. If patterns can be established, the chub fishery could be manipulated to fish only at locations and times of low abundance of lake trout. (Table 2-Temporal Distribution)"
shoal area ? at Parisiennels
-Lake trout appeared more abundant in sector VII -29 during April through June period and November and December
-at sector VII -11 (one of the two more heavily fished areas) the C.P.E. remained fairly constant throughout the season
75 -quantity of lean trout (planted fish) taken in addition to the fat trout and halfbreeds
-majority from VII -29 during the April through May period (Table 3)
-"This unusual occurrence (planted trout in 50 fathoms plus) may be significant when drafting future management plans for a chub fishery
-The experimental fishery was an economic success. There is every indication that Eastern Lake Superior chub could become one of the more important species in the commercial catch."

p. 81 Appendix V(b) SEE XEROX
Wohlgemuth, O. Hatchery-reared Lake Trout Survival Batchewana Bay, Lake Superior.
-Anglers catch few lake trout on the Canadian side of the eastern Lake Superior

- majority of the eastern shore is exposed to the prevailing westerly winds and most boats used by anglers are unsuited for these rough waters
- Since most of the hatchery-reared trout in the rehabilitation program have been planted along this exposed shoreline, the opportunities for anglers to catch the planted trout were very limited.
- 1971 - Batchewana Bay chosen as sheltered bay where a lake trout sports fishery might be re-established (max depth 45 m)
  Since
  - 1971 40,000 yearling lake trout planted annually
  - experimental gill-netting in 1973 showed that planted lake trout are surviving in the deeper waters of Batchewana Bay
  - trout were only caught below 30 m

p.85 APPENDIX VI(a) SEE XEROX
Status of the lake trout population in Michigan inshore waters of Lake Superior, 1973

p.88 - It seems reasonable to believe that the lack or weakness of reproduction of planted fish is a result of their failure to spawn on traditional spawning grounds.
- Substantial numbers of planted lake trout have matured and spawned in Michigan waters of Lake Superior for at least the past two years. . . . the spawning runs of planted fish have tended to be in inshore areas not formerly known as spawning sites of native fish. Whether reproduction has been successful in any of these areas is unknown. The apparent lack of successful reproduction in similar areas of Lake Michigan is certainly not encouraging.
- only 10% of the undersize fish taken in Michigan L. Superior waters in 1973 were native trout as compared with 26% in Wisconsin

* - The evidence at present favors the view that native lake trout reproduce much more successfully than planted fish
- If planted lake trout fail to reproduce adequately, we are faced with a considerable delay in reestablishment of self sustaining stocks
- In view of the long time required for lake trout to mature in Lake Superior (7 years minimum), we believe it would be prudent to attempt to "seed" some major spawning areas with eggs in 1974, if practical. Although the evidence from the one planting of lake trout on Gull Island Shoal, Wisconsin, indicated that planted fish can be induced to spawn on a traditional spawning ground by stocking that ground, seeding eggs should be a more certain way to induce homing to suitable sites."

Prince, Edward E (1916) On the red color of the Flesh in the Salmon and Trouts. Trans. Am. Fish. Soc, v 46 : 50-61

Current Views

- Is Color due to Food? - No
  - however most popular and widespread view
- Is Color due to Vascularity? - view that the vascularity of the muscles, the rich blood-supply, explains the color
  - is the case in such Scomberoids as the Tuna (Thynnus)
- Does Color signify Health-energy?
  - white flesh is regarded by some as having a pathological significance
    - others regard pale colour as being due not to sickness or ill-health, but to poor feed
  - many people regard the color as intimately related to flavor and a highly-colored salmon or trout must, in their opinion, have a superior flavour
- Is Color due to Sexual Ripeness?
  - up to the commencement of spawning it is asserted, salmon and trout accumulate fat, especially the red, oily matter, which during the breeding season is transferred from the muscles to the ovaries and spermaries
    - does not appear however to be building up the white testes; though such might be the explanation of the brilliant red contents of the ovaries

Current Views Erroneous

- "The lake trout, gray trout or Toque, exhibit great variation even in the same lakes and on the same fishing grounds, but some waters are characterized by white-fleshed trout; these latter being as healthy, well-fed and well-flavoured as the fish from lakes in which the trout are uniformly tinted pink or red."
- Undoubtedly the red oily matter, abundant in the flesh, does pass to the ovaries of the female, and the eggs are brilliantly tinted by these abundant red globules in the yolk-matter
  - red eggs product of red-fleshed fish, and the white or colorless eggs being the product of pale-fleshed females pale eggs of white-fleshed salmon and trout almost as colorless as the eggs of the whitefish
- Prince believes colour is a hereditary feature - due almost certainly to the colored material in the yolk of the egg from which the fish

81 Is there enough food in waters where trout are planted?
- what are depths, currents like?

developed
- colored material unessential
- persists as "oil drops" until a late stage in the early life of the fish and is not used up, as the other contents of the egg are; but finally it passes into the body-tissues and is found in the form of very minute bright red bodies, seated in the cement substance of the individual fibrillae of the great lateral muscles

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(Superintendent U.S. Fisheries Station, Duluth, Minn.)

Cook, W.A. (1929) A brief summary of work of the Bureau of Fisheries in the Lake Superior region. American Fisheries Society, Transactions, v. 29 pp. 56

Spawning in U.S. waters p56 - spawning season of lake trout
- early run starts the very last of September at Isle Royale followed shortly by another run off the northern tip of Keweenaw County, Mich. (approx fifty miles from Isle Royale)
- next run usually appears at Portage Lake, Ship Canal, Gay, Big Traverse Bay, and Rabbit Bay which are a little farther south, being followed by a run at Huron Island
- by 17th or 18th Oct. run is usually swinging at all collecting stations
- most distant station only about eighty miles west of Sault Ste. Marie

egg color p. 57 - large variety of egg color - greenish cast, light cream, salmon pink and amber shades, besides several variations of these colors
- often eggs of various colors are taken from fish caught on the same shoals
- scientif branch says various colorations may be caused by environment
* - eggs of pink salmon color produce fry with reddish cast to body (see Price (1916) p. 80)
- fish planted back in localities from which the eggs are obtained

p. 58 - produce eggs of variable size.
- some nearly as small as good sized brook trout eggs while others run 3½ to the inch.
- "These facts would lead one to think that there must be several distinct families or sub-species of these fish and possibly the propagation of certain ones would be to better advantage than others."

comm. 1929 trolling - in some localities commercial trolling is practised and this is rapidly depleting the run of the large spawning lake trout. It is the claim of some of the men using this rig that 90% of the fish caught by this method are

female fish and practically all are large ones. This method of fishing must prove detrimental to fish of this species. (introduced in in 1924 - See Atlantic Fisherman (1952) p. 38)

herring - herring propagation has been attempted at various times, but not very successful

due to conditions under which eggs are secured

- spawn-takers are aboard commercial tugs fishing during spawning time (no closed season)
  - The tugs set all the nets they can handle and when lifting have a large crew passing nets back from the lifter and piling them up fish and all. They run under good speed while doing this and even with spawn-takers aboard there is but little chance to get eggs as fish can only be secured while they are passing by * in the nets. . . Eggs which we took off from small skiffs where the spawn-taker was given chance to take the eggs properly proved to be of very good quality.
- because of bad weather conditions during the spawning season (late Nov.) difficult to interest smaller fishermen in the work of collecting eggs.

p. 59 DISCUSSION

Dr. Metzelaar (Michigan)

- Dr. C.L. Hubbs of the University of Michigan commenced a study of the sub-species of l.t. found in the lakes of the Huron Mountain Club, near Big Bay in Marquette County, Mich.
  - different forms cannot be classed as sub-species he decided
  - believes they represent relics of various Lake Superior forms which flourished at some time in the history of these lakes

pre-glacial ??

Dr. Van Oosten (Michigan)

- Fatness of the siscowet may be due to environmental conditions rather than biogenetic differences

Dr. H.S. Davis (Washington, D.C.)

- some Europeans investigating differences in sizes of eggs in fish of the same size
  - usually the fish with the fewer eggs will produce the larger size
  - "Mr. Dinsmore told me a year or so ago that he was quite certain that the size of the eggs of some of his fish had been influenced by feeding. If he started feeding heavily late in the spring, he got larger but fewer eggs, while if he started feeding heavily after the

spawning season he got more but smaller eggs from the same fish. Similar conclusions have been reached by Dahl, in Europe.

- Mr. Cook
  - principal variations takes place in the eggs which are secured around Isle Royale and Keweenaw Point
    - at Marquette the first run or "shoal" trout, considered a smaller fish, produces a fair percentage of the pink eggs
- Mr. BO. Webster (Wisc.)
  - northern L. Michigan ~ large lake trout
    - produces large eggs
    - rocky reefs in northern part

vs

  - southern part of fishing area of L. Mich - fish smaller in size generally
    - majority of small eggs come from the small fish
    - around Waukegan, Racine and Kenosha fish spawn on clay beds
  - in Green Bay - lake trout which is strictly a bay trout and is not found anywhere else on the shores of Wisconsin, either in L. Sup. or in L. Michigan
    - produces a red egg, like a wild brook trout, but of smaller size
    - "It has always seemed to me that the difference in colour is largely due to differences of environment and to the kind of food eaten previous to spawning."

Dr. Davis
- expts. conclude that "Unquestionably there is a marked difference in the rate of growth of fish from different parents, which persists for several years in succession in the same fish." (kept under identical env. conditions)

Dr. C. M. McCay (New York.)
- Gray of Cambridge has shown that the size of fish produced from eggs is affected merely by altering the temperature at which the eggs are held during the period of incubation. If he keeps his eggs very cold, and thus extends the period of incubation in the end he gets larger fish, if he hatches rapidly he gets smaller fish. He correlates this result with the egg content consumed during this period and its later effect in restricting the development of the embryo."

Tyers, Burton J. (1978) Muskoka River Lakers, Ontario Out of Doors Vol 10, No. 4 pp 14-17

"Muskoka lakers tend to be a bit darker than those of either Simcoe or Temagami. The contrasting white spotting on the sides appears almost snow

white. Whether this is due to the slightly darker coloration of the water flowing from the Muskoka River or is characteristic of all Muskoka lakers I'm not sure, but the lakers I've taken elsewhere seem sombre by comparison."
- at mouth of Muskoka river in spring until warmer weather drives them into deeper water
- follow spawning schools of smelt to warmer run-off water

From Dick Crewe June 14/78

— Dr. Tibbles – Sault Ste. Marie – will have data
Sea Lamprey Control Unit (1958) – left Huron Queen.

— Ivan Purvis - Quebec Harbour – 86. – steam tugs of
see ~~son Jack Purvis~~ – Sault Ste. Marie. – bring ship to Ivan
Mort Purvis – MVR at Soo / Pim + Queen – Salvage + Towing Co.

– Mich Mission Rd. – Wawa
– left at end of Mission Rd.
– Lyman Buck – 70 yrs. – original fisherman

– Ed Mitchell – 15 Blake St, Soo.

– Doug Vokes – fishing ~~Harold Dunlop~~
– Mamainse.

– Orville Uehlgemuth

Jim Cullen – officer Thunder Bay

Jack Corbett – fishing lodge in Pancake Bay.
– 62 yrs. – 66 Princess St., Soo.
(sheet metal worker) – owns a licence but does little fishing

RG 23 v. 215 no 1149 vol. 1. Part 1.

~~[illegible]~~ 1885 Northville, Mich.
Frank Clark, Sup't Mich Stations U.S Fish Commission to
Major T.H. Elliott, Fishery Inspector, Soo, Sept 17, 1895
A short time ago I wrote you in reference to a permit to be used by the U.S Fish commission employees in connection with gathering eggs of the lake trout at Caribou island and on the North Shore with Ainsworth + Conley. I have not heard from you in reference thereto

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re Lake Manitou pp 4596-~~[illegible]~~ 4606

A.G Duncan, Inspector, Marksville to R.N Venning, Ass't comm of Fisheries Ottawa Nov 14, 1905 p. 286

. Alexander Purvis was fishing with his tug for the (Manitou Fish) company near the Duck Islands for trout [for ova] - also w.f.
- intended stocking L. Manitou (~~[illegible]~~ (Sandfield Hatchery)

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* S.F Bastedo, Deputy Commissioner, Toronto to F. Gourdeau, Dept. Min M + F, Sept 12, 1901

lake trout

I am in receipt of a communication from Fort William, stating that the Duluth Fish Commissioners have had a man at Rossport for some time collecting spawn for the Duluth Fish Hatchery, and that he left Duluth on the 9th September presumably with all the spawn he required. It is further pointed out that the Department should establish a hatchery at this point and utilize the spawn, instead of its being permitted to be taken out of the country. It is further suggested that the Duluth Commissioners' obtaining spawn at this season of the year emphasizes the statements which are from time to time being received that the close season in Lake Superior for trout is largely inapplicable

RG 23 v. 253 no. 1646

Letter from Acting Deputy Min M+F to Hayter Reed Dept^{y} Sup^{t} of Gen^{l} of Indian Affairs Nov 9th, 1894 (re petition of Fort Wm Band of Indians to be allowed to fish in closed season)

"It is not true that the fish remain in deep water until the 15th October. Information has reached the Department that in many cases the large lake trout and whitefish are in shallow water in September, and certainly in early October, and there is no real necessity for any fishing in November.

Further, this privilege of fishing in the close season was most seriously abused. It was shown that United States' buyers encouraged the extensive destruction, by the Indians, of breeding fish when crowded together on the spawning beds in shallow water. The disturbance and capture of these thickly massed schools of spawning fish means extermination, and a total dearth of fish food in the future.

The Department of Indian Affairs favoured this Department with certain information recently upon this subject, supplied by Dr. Walton and referring to Georgian Bay. "It is suspected that unscrupulous". Dr Walton says "whitemen have supplied some of the members of this Band with trap and pound nets, and that, instead of launching out boldly into deep lake fishing, they have in many cases confined their efforts to illegal inshore work.

RG 23 v 263 No 1782 part I

Letter from A.G Duncan, Inspector Mattawa to E.E.P. Dominion Commissioner Jan 12/1903

- Hugh Armstrong is manager of the Dominion Fish Company Rat Portage and Ainsworth and Manley represents the Buffalo Fish Co at Sault Ste Marie U.S.A.

RG 23 v. 323 v. 2753 v. 1.

J. W. Cross, Overseer Port Arthur to Dep Min of MF
Sept 14 / 1895.
"Joseph Conley of Sault Ste Marie connected with the Georgian Bay Fish Co. was up here and took stock of all the Fishing property and Boats and supplies owned and controlled by the Booth Co. And there is no doubt but there is a syndicate formed to controll the Fishermen if everything is satisfactory
[previous scheme for encouraging such a monopoly ~~was~~ -
Somer overseer Macdonell was involved in it

"A. Johnston Dep. Min MF to Messrs Thornton & Chancellor Barristers, Chicago Oct 11 / 1911.
I beg to acknowledge your communication of the 9th instant, requesting to be informed whether there is a corporation organized under the laws of Canada called the Booth Fisheries Company, and if so if you could be given the cost of a certified copy ~~thereof~~ of its last annual report and original papers of incorporation on file in this office
In reply I may say that so far as this Department is aware the Booth Fisheries Company has not been incorporated in any part of Canada, though it is understood that it has been buying fish in very considerable quantities on the Great Lakes and in Manitoba through Agents and Companies which were possible associated with that Company.
If, however, the Company is incorporated in Canada, it would appear necessary for it to have its place of business registered with the Registrars of the Joint stock companies, and if such is done, you would be able to ascertain the fact by communicating with the Secretary of State for Canada here and with the Provincial Secretaries for Ontario and Manitoba, at Toronto and Winnipeg respectively

Fort Wm Fur Trade

Lumby (1974) Historic Fort William F 5547 F7 5L84 ROBT

Macgillivray, G.B (n.d) Our Heritage F5547 F7 5M34 ROBT

Fort William, Hinge of a Nation F5547 F75F67 ROBT

PAC MAB

F/410 - (Lake) Superior - 1905 North shore of Lake Ontario from Dog R to Imogen R.
Dr J. M Bell Jan 1905

① shows Pilot or Ganley Hbr (Shown as Pilot Hbr on 2300 Hydrographic)

② what is shown as Ganley Hbr on 2300 is called Red Sucker Hbr (just to immediate w of Pipe River)

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— & J.C. MacLeod. MS 1973. Fish toxicity survey of four prairie province pulp mill effluents. Resource Management Branch. Fisheries and Marine Service, Environment Canada. Tech. Dept. No. CEN/T-73-4 14p.

PAC. Lake Sup

① Pic Fort or Lefroy, Letters from the N.W p 48 MG 24 I 25
② 1687-1740 - C11E vol 3, 13
③ exploration 1723-1730 explor. MG 1 Depot des Fortifications
④ Quebec Mining Co Comm. of Crown Lands Canada East RG 1 L7 vol 103

⑤ L. Sup can Mining Co See W.H Merritt Subject Index

⑥ Michipicoten Is Petitions re mining at Canada Land Petitions B, Bundle 7 853

XX ⑥ Thunder Bay - Surveying See MURDIE, William Campbell MG30 B101
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End Williams

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Channing E. "Story of the Great Lakes"

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Great Lakes, 10th. Rept. Stat Bd. Fish. Comm. Lansing Mich; 172-181

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Ottawa, Ontario
K1A 0E6

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(Suggestions E.J. Crossman. April 7/78
Jim Tibbles. Sault Ste Marie - lamprey

A.E Allin. - Medical Officer of Health - Port Arthur
- Thunder Bay Natural Society
- Historical Society. Thunder Bay.

John. Casselman - Thunder Bay
- at Maple. -

Ontario Council Commercial Fishermen. - Secretary.

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(12) Fish Stocking Records
- a record of all lakes and streams currently stocked with hatchery reared fish

Licensee Data - location of license
1925 - present - Whitney Block
1890 - 1912 - National Archives (Ontario Game and Fisheries Commission)

From the Catalogue of Statistical Files in the Ontario Government 1976

① Commercial Fisheries (Equipment, Boats, and Shore Installations)

② Commercial Fishing Annual Report (Form CF&A)
- reports received annually from each licensee- showing species, quantity and value of fish caught, type, quantity and value of fishing equipment used; and money spent on the purchase of fishing equipment
- paper file, confidential, approx 1200 sheets / year.

③ Commercial Fishing Liscensee Mailing List
- licensee name, types of license and type of gear, alphabetically by district

④ Lake Record Cards
- cards showing lake name and location, licensee names, license numbers, and gear licensed eac year
- card file, kept 15 yrs after each card is superceded

⑤ Landing and equipment ledgers
- ledgers showing annual quantities and value of fish landed by commercial fishermen, and the type of equipment used in each body of water

* ⑥ License and catch Report Record Cards
- electrofile cards showing licensee's name, license number, type of gear, fishing location, and whether reports have been received

* ⑦ Creel census interview (Form SF 150)
- information describing the activities of fishing parties such as number hours fished, bait used, fishing method, weather, visitor type, origin, type of fishing, number of lines, species ~~sought~~ caught, and number released

⑧ Fish culture Production and Costing System
- a monthly inventory of each lot of fish in each hatchery including number, weight and size of fish, amount of food fed, mortality, growth + food conversion

⑨ Lake Survey Summary - Aquatic Habitat Inventory Form SF 133
- a collection of physical, chemical + biological data of lakes in Ont.

⑩ Toxic metals
- information on the length, weight and amt of contaminant in fish as well as references to the original sample, detailing the form analysed, lab doing the analysis, their sample no., capture date + location of capture

⑪ Hunting and Angling License Files

(Bald Head Is. fishing rights MSS Stevenson Papers 1850

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Ontario Archives

① Filing Cabinet
- ✓ A) Diaries collection finding list
- B) Fur Trade (Check listing of correspondences from forts)
- c) Lands + Forests - Crown Lands
- D) Lands + Forests Survey records
  - Appendix F - Guide to Surveyor's Accounts (partly checked Tech)
- ✓ - Diaries, Field Notes ; + Reports
- ✓ - Preliminary Inventory of the Records . . .
- E) Mines, Dept. of

② Books, Phamplets, period articles card cat
- ✓ A) Fish, Fisheries, Fishing (Subj)
- ✓ B) CAN., Dept of Marine + Fisheries
- ✓ C) Lake Sup
- ✓ D) THUNDER BAY DIST
- ✓ E) Michipicoten
- ✓ F) Algoma DIST
- G) Natural Resources

cont ① Filing Cabinet
- ✓ F) THE MERRIT PAPERS (Nothing on Sup. but accounts of Huron
- ✓ G) SIR A CAMPBELL PAPERS Fishery Co 1838-42)

③ Manuscripts card cat
- ✓ A) Fisheries
- ✓ B) Lake Superior

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Old Class GUoy P ROBTS
115 New documents by Lahontan concerning Can & Newf. 1940.
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La Hontan - Nouveaux voyages dans l'Amerique septentrionale
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Diary Book 1918

Salter, A.P & R. Gilmour. (37757, Stak 9-1) Plan of Western end of exploratory line from Michipicoten Bay on L. Sup - east towards the Montreal River and exploration from Mississagi R. and L. Huron (1887
Field Note Book 1923

120

Township

John Mezaks, 4th Floor LANDS + FORESTS, 965-6882

Ontario Archives.

Public Archives Canada
Res. Inquiry
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Blake V.— Survey by Wilson, 1872, Report
Ontario Archives Survey Diaries, Shelf 72 Box 2

- A sketch of the North Shore of L Sup collected from the Journal of a Coasting Survey and remarks made by Lieut Bennett of the 8th Reg. (no field notes, photocopy in Sur. original in Archives)
- Plan of part of the strait, and the fall of St Maries, situated between L Sup & Lake Huron, Twps of Awenge 1796
No field notes - Theodor Depincier original in archives

up to ~~1797~~

- A Plan ✱ L showing L. Sup Mining Locations along the Coast from the Mouth of the Michipicoten R. to Sault Ste Marie, showing Batchewaung Bay, Goulais Bay and also Mining Claims in the Twps. of Herrick, Ryan, Palmer, Tilley, Archibald, Haulland, Tupper. District of Algoma
-no information 6564 P 14-21

- Plan of the North Shore of L Sup from Township of Pic to the Pipigan in the District of Township of Thunder Bay showing islands & mining loc. (1894
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- Survey and exploration of the region U.S Bdy to Seine R.E. shore of Thunder Bay to City of Ft. Frances. Twps McIntyre, Neebing, Fowler, Ware, Oliver, Paipoonge, McIrvine 8073 R29-13

- Plan of Thunder Bay, L. Sup, showing mining locations twps. Neebing, McIntyre, MacGregor, and Sibley (1869) 4713 - M19 4

- Plan of mining locations at Thunder Bay (1865) 6413 - P8-2

- Parke Twp F.N. Bk 1641 (1849

X ✓ - Survey Notes, Forneri, 1873 Ontario Archives Survey Diaries, Shelf 72, Box 6 March, 1873

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✓ ✓ * Canadian Archives Report, 1888, p. 64 - letter written by in 1784 by Benjamen Frobister. (talks of Alexander Baxters residence at Point aux Pins) Not at U of T?

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* ~~Canadian Archives, 1888 p. 64. Benjamin Frobister writing to Governor in 1784 recommends est. of post at Point aux Pins to command entrance to Superior."~~

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F5604 M3 1971 ROBT., SIGS

X ^ M. Smith 1813 "A Geographical View of the Province of Upper Canada... pp. 118. Old Class ARC XIV Rare Books *

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Conv. Jan 9/77 - Lawrie published map of fishing grounds (FRB in 200 LIB)
- Data from approx 2000 lk trout (morphological from Michipicoten area)
- re mapping of C.P.E
- has in storage age length key data for plantings

- see F.R.B Technical rept. by Lee - makes statistical comparison of fat trout and lean trout characteristics
- ~~gray trout~~ are of inland lakes not Superior
- frequently fishermen would trim fat from siscowets and record (sell) them as lean trout which brought a higher price
  - fishermen might also not record catch each day but only work it out at the end of the month
    - instead of recording from ~~buyer~~ log book might record from their buyers' receipts which would exclude fish caught but too small for sale and other fish not acceptable by the time they reached the market
- might like to look at CF-1 forms for only spawning months to cut down on work.
- much of the data has been summarised on tape

Dr. Ihssen (personal communication, Dec. 10/77)
- working with electrophoresis studies of trout populations
  - has found allele difference in three lake pops - Opeongo
    - Mishimashi
    - ?
  - L. Mishimashi (Nipigon) allele corresponds to allele found in Dog River population (may be a population transplanted from L. Superior)
- doubts value of Godri's work
- Stock concepts papers presented at 1977 Great Lakes Res Conf are being issued for circulation to attendees
- Read in Ottawa. Yu. P. Altukhov. Population genetics of fishes. Fisheries & Marine, Dept of Environment Trans. Series No. 3548

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check

135

- stunghens - german hermit living in cabin at Prairie R. (Rossport area)
  - still alive? - stroke in 1977 - old folks home Terrace Bay

- see Don Storms - hatchery man for MNR
  Joseph Atkinson - MNR hatcher at Dorian

- Fishing Companies - Dagle's - at Gros Cap (east of the Soo)
  - Kemp Fisheries - at Thunder Bay
    - run by George Humby

- Indian fisheries at Gros Cap, Goulet Bay, Batchewana Bay
  - Angus Kakapeobe - band leader
  - Indian's info frequently unreliable

NOTE

- fishermen of L. Sup will distinguish Black Trout from Red Trout
  - differ in time and location of spawning
- western Superior more conducive to growth of private fishermen and small enterprises
  - more bays, less wind, more sheltered
    - fishermen may be more apt to be conversational
  - eastern Lake necessitated growth of larger companies (the harsher conditions and more exposed water necessitated larger inputs of capital for equipment)
- underwater topography of L. Sup very hilly (as on land)
  - trout live on sides of inclines and are fished at these points
  - Cats live deep on inclines
  - sheals not very far from shore on L. Superior
- check out Rossport Fishing Derby
  - until (1954?) and then begun again for while in sixties when MNR started stocking area
- Laurie has data (measurements) on approx 2000 lake trout specimens which he will make available
- sports fishermen fish only close to shore so only limited data value
  - Superior Shoal (major ground) 70 mi south of coast
- Laurie suggests approaching fishermen with bottle of whisky, tape recorder and navigational maps of the region.

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D I Johnson + R.W Clemens
Box 326
Schreiber, Ont.

CONVERSATION A. LAWRIE (DEC. 20/77)

East Superior

① Mr. Jack Corbett, Manager
Ont. Council of Commercial Fisheries
Box 355
Sault Ste Marie, Ont. P6A 5L8

② Jim Macdonald - Feroclad Fisheries
Mamainse - 60 mi north of Sault Ste Marie

③ Horst Anderson - Fisherman Michipicoten Harbor. ~~Michipicoten~~

④ For info. on Michipicoten fishery
wd.
~~see~~ Ivan Pervis - winters at Gore Bay
Gore Bay Ont - summers at Quebec Harbour (would have to fly in)

⑤ For addresses of fisherman + info:
Orville Wohlgmuth - Fisheries officer Sault Ste Marie

West Superior - ROSSPORT

- Kenney - fisherman
- William Shelling - retired commercial fisherman
- Mrs Esther Seppela - runs Rossport Inn.
  - ~~may~~ have catch records of her father (dead)
  - will probably be very unorganized
- Albert Rouble - fisherman Rossport, Ont
- Legault family - may have useful knowledge of spawning sites
  - two brothers (one named Felix, Wm L. Rossport
- Adolf King - old man, roots in Rossport, comm. fisherman
  - may be in old age home at Soo
  - son Peter King - works for MNR
    Field Services + Parks PO 1340
    Espanola.
    POP 1C0
- Oscar Nordlander - Thunder Bay
  - has talked about black trout

- Peter Dahl - used to fish Jackfish Bay (Ashburton Bay to the east used to be very good)

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TORONTO ANGLER'S + HUNTERS.

ONTARIO FED. OF ANGLER'S → P.O. Box 28 Peterborough
ED. CROSSMAN - ROM 705-748-3115
Rick Morgan

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- Peterborough 1-705-748-3115
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- check spawning areas - shoals - size changes of fish with time
  - streams

Regier Nov 11 ① Synthesis on lake trout [N.V. Martin Maple 832-2761 ~~2261~~

② SCOL on Superior - A.H. Lawrie Maple 832-2761 ~~2261~~ changed

③ SCOL on Huron A.H. Berst + G.R. Spangler 832-2761 ~~2261~~

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⑤ L. Huron history D. Lofts OMNR, Owen Sound

⑥ Hudson's Bay records

⑦ L. Superior spawning stocks - K. H. Lofts 965-7883

⑧ Stock concept symposium - A. H. Berst.

⑨ L. Superior assessment unit W.A. MacCallum OMNR S.S. Marie

⑩ Interviews with fisherm. R Harrall, Limnology Univ. of Wisconsin, Madison.

⑪ Indian middens, Inverhuron - Howard Savage

Age length keys
Lawrie - planting / Whitney Block / 1625 / 9:00 am

from K. Lofts Nov. 14 ① Bill Saunders - Sault Ste Marie
- stalking 'memories' - moved from L. Huron to L. Superior

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④ Wayne Macallum - Regier's PHd student for Char Lake
Charlton 363-6961 Rm 1903
Inn.

- possibilities of computer mapping techniques of fish distribution patterns (utilizing a coordinate system) - see PHd thesis by David E Craigie 1971 and notes from Computer Programming for spatial distributions?

Spangler + Berst Nov. 15

L. Huron / South Bay
- Fry; ① Bensely 1915 - See Spangler's paper
② Bernie Noble + Prince, 1908, Dominion Fish. Commiss.
- Presence of ciscowet (possibly discrete) in Georgian Bay
- later decline in Owen Sound, Parry Sound, MacGregor Bay stocks.

Great Fisher

- Parry Sound, Espanola

Atlas

Bill Haxell — Don Hughson 705-869-1330

MacGregor Bay

Fry taken this past fall.

Huntsville 789-9611

Andy Laverie - director. Maple branch

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