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CONFIDENTIAL

FISHERIES RESEARCH BOARD OF CANADA

ANNUAL REPORT

of the

CENTRAL FISHERIES RESEARCH STATION

for

1948

With Investigator's Summaries as Appendices

by

K. H. Doan, Acting Director

WINNIPEG, MAN.

DECEMBER, 1948

Fisheries Research Board of Canada
Report of the
Central Fisheries Research Station
Winnipeg, Man.

by K. H. Doan, Acting Director

A major proportion of the work of the Central Station has continued on the problem of the infestation of whitefish, Coregonus clupeaformis, with the second intermediate stage of the tapeworm Triaenophorus crassus. Most of this effort has been in the field of application--reduction of abundance of jackfish or pike, Esox lucius, which carries the adult stage of the worm, and statistical analysis of infestation in whitefish. The jackfish demonstration at Heming lake, Manitoba, has been conducted for four summers and it may now be concluded that a point has been reached where no further improvement in whitefish quality can be made by a small crew operating nets each spring. The catch of jackfish has approximated two pounds per acre, and enough of these fish still survive to propagate the tapeworm quite successfully. About one-half of the small water fleas, Cyclops bicuspidatus, which serve as the first intermediate host for the worm and may later be swallowed by whitefish or tullibee, Leucichthys spp., carry tapeworms in early June, so that the chances of fish to become infested are still high. Emphasis will be shifted to other tools of management for this problem, besides ordinary netting.

Estimation of quality of whitefish in lakes or in shipments has been facilitated by a statistical study of the distribution of tapeworm cysts in samples, and sequential analysis

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of sampling data has proven of great value in determining the quality of fish for export with a minimum of time and samples and a maximum of confidence in the inspection.

Three fisheries were followed intensively as to rate and composition of catch. Only adequate catch information can assist in placing a fishery at its optimum yield. Great Slave lake, brought into production following a biological survey begun by the Board in 1944, produced almost 2½ million pounds in 1947, 61 per cent of which were lake trout, Cristivomer namaycush, and 36 per cent whitefish. The data indicate that a further expansion of this fishery could be permitted. The new fishery at Lake Claire, Wood Buffalo National Park, Alberta, marketed 65,000 pounds of goldeye, Amphiodon alosoides, equal to the former total Canadian catch of this popular fish, but only one-quarter of the recommended quota for the lake. Collection was made of catch statistics on Lake Winnipeg, but results are not yet available.

Study of the biology and management of the goldeye was begun in 1945, and field work is now about complete. Very young fry were taken at Lake Claire, but artificial propagation of adults suffered ill effects from the weather. Young goldeye were abundant in the South Saskatchewan and Red Deer rivers, indicating no harm to upriver reproduction by the dam at Saskatoon. The extensive work on this species will be brought together in a final report.

The differentiation of various species and races of tullibee has been proceeding on Lake Winnipeg, and it has been concluded that L. zenithicus and L. nipigon cannot invariably be distinguished by colour alone. A clue as to some separation of species of tullibee according to depth of water has been found,

An unsuccessful attempt to mark white whales, Delphinapterus leucas, alive was made at Churchill, Manitoba, in order to trace their movements and to obtain some measure of future exploitation. Aerial counts showed a progressive decline in their numbers in this area from August through September, and from Churchill northwards, probably associated with their migrations.

Along the coast of Hudson Bay in the vicinity of Term Point, Northwest Territories, about 250 miles north of Churchill, a preliminary study of Arctic char, Salvelinus alpinus, was begun. Both sea-run and landlocked char were examined, the former being much larger in size. Char apparently run into freshwater lakes for spawning in early autumn, but a crate of eggs sent out to a hatchery by air suffered ill fate in shipment. Special equipment, transportation, and supply of provisions are required for a continuation of this research in the Barren Lands.

South of Churchill brief observations of the spawning of speckled trout, Salvelinus fontinalis, were made in the Nelson river region. These fish were first investigated in 1946, and some study of their management has been undertaken by the Manitoba Government with a tagging programme to determine their movements and exploitation.

A survey showed that a fishery for "rough" fish for mink feed at Hay river on Great Slave lake would take mostly commercial fish of greater value as food for man. On the other hand, whitefish from Yellowknife bay on the north side of the lake were of poor general quality for the export market, but might possibly meet the requirements after most rigid sorting. Other surveys are being contemplated, one of which may be the determination of the kinds, quantity, and quality of commercial fish available in Nueltin lake,

one of the larger lakes in extreme northern Manitoba.

Although an extended study of Lake Winnipeg was begun, few of the results of work on catch statistics, variation in whitefish infestation, and measurement of basic factors affecting fish production are yet comprehensive enough. Lake Winnipeg is being used as a special study lake, the same as Great Slave lake.

STAFF

Mr. L. C. Hewson, who graduated in biology from the University of Saskatchewan and was employed as a Junior Research Assistant during the summer, was appointed as a Junior Biologist from November 1. He is working in the field of catch statistics and general whitefish research on Great Slave lake and Lake Winnipeg.

BUILDINGS

During the latter part of the year alterations in the internal arrangement of the Winnipeg office were begun, with the construction of two small darkrooms to house scale reading and photographic equipment, and the replacement of some shelving and cupboards.

A storage warehouse in The Pas was used through the courtesy of the Manitoba Government, and another at Gimli.

A small cabin was built at Big Black river on Lake Winnipeg, to serve as a shore station for work in that portion of the lake. The Board's building at Fort Chipewyan on western Lake Athabasca was again used during the goldeye work.

EQUIPMENT

The gas boat "Investigator", used for 4 years on Great Slave lake, was transferred to Lake Winnipeg, and put in operation at the end of the summer. A marine toilet was installed and minor repairs made. The boat has been hauled out for the winter by the Dominion Department of Public Works at Selkirk.

An 18-foot freight canoe reached the end of its usefulness after 4 seasons on Heming lake and the Saskatchewan river. A 16-foot skiff was purchased and later was lost during a storm on Lake Winnipeg. A 5 h.p. Johnson outboard engine was purchased, and the other engines given overhauls and repairs as required.

The 1941 Ford station wagon has travelled nearly 35,000 miles since March, 1947, and has been a very suitable type of vehicle for our needs. However, with much of the travel having been over prairie roads in various stages of improvement, repairs have been extensive. A later model car, with more frequent replacement, would obviate much of the repair bills.

A portable generator to be used for the electrical shocking of fish has been given preliminary tests.

Additional field equipment included air mattresses, sleeping robe, parka, rubber clothing, ground sheets, tent, gasoline lamps and stoves, and nets. Scientific equipment included a plankton bucket and an analytical balance. The outstanding item still on order is the microprojection apparatus for scale reading.

PUBLIC RELATIONS

Several members of the Fisheries Research Board, its staff, and the Department of Fisheries visited the Station during

the year. It is unfortunate that most of the field work, from one thousand miles north to the same distance west, cannot be appreciated fully from the Winnipeg office.

Dr. Kennedy attended meetings of the Limnological Society in Maryland, the American Fisheries Society in New Jersey, and with Dr. Doan gave papers before the meeting of the American Society of Ichthyologists and Herpetologists in Louisiana, and also visited a new fisheries research station at Rockport, Texas. Dr. Doan assumed chairmanship of the fish committees of the Greater Winnipeg Game and Fish Association and of the Manitoba Federation of Game and Fish Associations.

A list of available publications by members of the staff was sent to fisheries biologists, and our revised mailing list for the exchange of publications now totals about 175 names.

This Station cooperated with Defense Research Board in suggesting that the effect upon fish of poisoning aquatic insects in the Churchill region be measured, and recommended a man for the work.

ACKNOWLEDGEMENTS

We are indebted to Chief Inspector H. V. Dempsey of the Dominion Department of Fisheries for assistance in many matters. A wide variety of courtesies were extended by the University of Alberta, the Manitoba Department of Mines and Natural Resources, McInnes Products Corporation Ltd., Booth Fisheries Canadian Co. Ltd., Keystone Fisheries Ltd., Armstrong Gimli Fisheries Ltd., Hallgrimson Fisheries Ltd., Mr. Oscar Hjordleifson of the New Fish Co., the Royal Canadian Mounted Police, Canadian National Railways, Mr. Fred Martin, Mr. Oscar Sigurdson, Mr. Sam Voisey, Mr. Angus

Boag, personnel of other stations of the Fisheries Research Board, and by many fishermen, particularly on Great Slave lake and Lake Winnipeg. We take great pleasure in expressing our thanks to all.

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Jackfish control and whitefish quality

Since 1945 jackfish or pike, Esox lucius, have been netted in Heming lake, 18 miles south of Sherridon, Manitoba, to reduce their abundance. Jackfish carry the adult stage of the tapeworm, Trienophorus crassus, an intermediate stage of which may occur in the flesh of whitefish, Coregonus clupeaformis, and affect their market quality. It was hoped to demonstrate an improvement in quality of whitefish concurrent with a reduction in the numbers of jackfish. A summary of results is presented:

	1945	1946	1947	1948
No. jackfish caught	563	571	931	705
Pounds jackfish caught per acre	2.25	1.8	2.31	1.95
Per cent jackfish 18" and over	82	58	48	53
No. whitefish examined (13" and over)	273	125	161	278
No. cysts per 100 whitefish	528	327	322	353
No. cysts per 100 pounds whitefish	290	156	168	196
Greatest No. cysts in one whitefish	99	33	17	32

It has now become apparent that even in a small lake of 588 acres that, after the initial catch of larger jackfish has been made, continued fishing for them with nets cannot reduce their abundance to significantly lower levels. Similarly, whitefish quality showed considerable initial improvement which has not continued; in fact it may be getting worse.

In Heming lake jackfish mature at 12 inches, and these fish are too small and live in such secluded and inaccessible locations that they are relatively free from the action of ordinary hoop and gill nets and serve to propagate their kind.

Although no appreciable numbers of whitefish or tullibee, Leucichthys sp., (an alternative intermediate host for the tapeworm) has been found in jackfish stomachs, yet the reduced numbers of jackfish must consume enough of them to produce a heavy spring crop of larval tapeworms which infest at least one-half of the Cyclops bicuspidatus, which is the worm's first intermediate host.

It may be concluded that netting of jackfish is not enough, and more attention will have to be directed towards local or total poisoning of jackfish, of larval stages of the tapeworm, of the microcrustacean host, and towards the control of tullibee which has shown such promising results in Alberta.

K. H. Doan

Appendix No. 2

White whale investigation, Hudson Bay

A small field party was located at Churchill, Manitoba, from August 11 to September 16 to attempt to mark white whales, Delphinapterus leucas, alive to trace their movements and to estimate their abundance in the region. Marking was to be done by a tattoo of needles bearing indelible ink and thrown at the animals as in harpooning. Unfortunately the weather was so stormy for nearly the whole period that the venture was unsuccessful, and even netting gave no results.

Whales were counted, however, both from shore and from the air. On August 12 there were about 200 in the river mouth at Churchill, 165 within 50 miles north along the shore, 125 at

Nunulla, and very few north as far as Tavani. They decreased steadily in abundance, presumably moving southward, until there were none at Churchill on September 13 and only very few 100 miles north.

There seemed to be no local worry over possible commercial exploitation of the whales, and a company was already engaged in building a processing plant for operation in 1949. Local catch ordinarily amounted to about two dozen animals per year but commercial use will probably result in a catch of several hundreds.

Dr. Sprules examined the stomach contents of five white whales from nets at Term Point, Northwest Territories. One was empty, two contained remains of a large sea crab, and two contained remains of crabs and fish, probably Arctic char, Salvelinus alpinus.

K. H. Doan

Appendix No. 3

Observations on speckled trout in Nelson river

region, Manitoba

Between September 17 and 22, 36 speckled trout, Salvelinus fontinalis, were taken from rivers and creeks in the Nelson river drainage near mile 352 on the Hudson Bay Railway. Some observations made in this region in 1946 were confirmed; (a) some trout apparently stayed in the rearing streams, grew slowly, and matured at lengths from about 9 inches in males and 11 inches in females, (b) other trout spent much of their life in the large rivers, grew more rapidly, but did not come into the small streams for spawning until reaching lengths of about 13 inches in both sexes and a few were still immature up to 14 inches, (c) trout do not necessarily spawn every year, and nearly all large trout from the Nelson river

itself showed no indication of going to spawn at this season.

On September 20, ripe, spawning, and spent trout were taken, and spawning was observed on a gravel bed at the head of a shallow pool with some current from the rapids above. Both spawning fish were about four pounds in weight, and the male was very active in digging and sweeping gravel; the female rested against some submerged twigs when not engaged in laying eggs. A smaller male of about three-quarter pounds made persistent attempts to join in the spawning and apparently caused the large male much concern. Trout eggs were taken from the stomachs of small immature trout in the vicinity.

The Manitoba Department of Mines and Natural Resources operated a pound net in a stream at mile 338 on the railway, and tagged and liberated 141 speckled trout as the initial step in tracing their movements in the Nelson river system.

W. A. Kennedy

Appendix No. 4.

Study of the Great Slave lake fishery in 1947

The statistics collected on the Great Slave lake fishery in the summer of 1947 have been analysed. An estimated 2,368,000 pounds round weight of commercial fish were taken by the fishermen, of which 61 per cent were lake trout, Cristivomer namaycush, 36 per cent whitefish, Coregonus clupeaformis, and 3 per cent inconnu, Stenodus leucichthys. Only about 1 per cent of the fish caught were unfit for sale--a considerable improvement over 1946.

The availability of lake trout increased from west to east, while the average size decreased from west to east. These facts strengthen Dr. D. S. Rawson's theory that most lake trout

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The availability of lake trout increased from west to east, while the average size decreased from west to east. These facts strengthen Dr. D. S. Rawson's theory that most lake trout

originate in the eastern part of the lake, and that those found in the western part have migrated there.

The availability of whitefish increased from east to west and the average size decreased. These facts indicate that probably most whitefish originate in the western part of the lake.

Up until the end of the 1947 season there had been no change in the average size of fish taken, and practically no change in availability. On each of the grounds catch per net dropped about 25 per cent from the virgin condition during the first few days, then dropped no further even where there was steady fishing for two seasons. Because of this obvious lack of effect on the fish population by a fishery which was concentrated in approximately one-quarter of the total area of the lake, we recently recommended that consideration be given to increasing the annual quota of commercial fish.

Statistics were collected in 1948 but have not yet been analysed.

W. A. Kennedy

Appendix No. 5

Fish for mink feed

Mr. H. V. Dempsey requested information on the advisability of allowing mink ranchers to take "rough" fish for mink feed from Great Slave lake at Hay river, Northwest Territories. Gill nets of various mesh size were fished in the vicinity of Hay river during June, July, and August, 1948. It is obvious from the catches made that "rough" fish were comparatively scarce and that any nets set in this vicinity would take mostly commercial fish. We are recommending that no fishery for mink feed be allowed.

Yellowknife bay whitefish

Dr. Rawson found in his preliminary survey of Great Slave lake that the infestation rate of Yellowknife bay whitefish, Coregonus clupeaformis, was high. In view of agitation to have commercial fishing allowed in the neighbourhood of the town of Yellowknife, a further sample was taken in 1948. The sample contained twice as many "black" whitefish as other whitefish. The "black" whitefish had an average of 73.9 cysts per hundred pounds and a maximum of 42 in one fish. The others had an average of 22.8 cysts per hundred pounds and a maximum of 3 in one fish.

Unless fish taken from Yellowknife bay are rigidly sorted to eliminate "black" whitefish, there is considerable probability that they will not meet export requirements.

Lake Winnipeg studies

The boat "Investigator" was moved from Great Slave lake to Lake Winnipeg to be used in four separate but integrated studies:

1. Collection of catch statistics of the commercial fishery was initiated in 1948. These data have not yet been analysed.

2. The tullibee study is reported elsewhere by J. J. Keleher.

3. A study of the variation in infestation of whitefish with T. crassus with time and place was initiated in 1948. Wide variations were found in rates of infestation among small samples of whitefish caught on successive days at one spot.

4. A general study of basic factors affecting fish production was begun.

W. A. Kennedy

Appendix No. 8

Nueltin lake

Some interest has been shown in the commercial fishery possibilities of Nueltin lake, which lies across the Manitoba-Northwest Territories boundary. We are making enquiries of various people known to have visited the lake to see whether a biological survey is advisable.

W. A. Kennedy and K. H. Doan

Appendix No. 9

Edible weights of some fish

Economic, statistical, administrative, and biological practices sometimes have need for figures on the edible proportion of fish, and the various percentages of round or whole weight that are discarded with each step in processing. Some progress has been made in obtaining these proportions by actual test for a few fresh-water fish. Boneless and skinless fillets of whitefish, Coregonus clupeaformis, constitute 42 per cent of the round weight, 42 per cent for lake trout, Cristivomer namaycush, 36 per cent for northern suckers, Catostomus catostomus, 39 per cent for burbot or maria, Lota l. maculosa, and 38 per cent for small pike, Esox lucius. Percentages of other parts are listed in the following table. This Station's report for 1947 showed that a smoked gold-eye as marketed, represented 65 per cent of the fresh round weight. Progress will be continued with additional species.

	Whitefish	Lake trout	Northern suckers	Burbot	Pike
When cut	7/30/47	8/15-17/47	8/18/47	8/16/47	6/7-12/48
Where	Great Slave l.	Great Slave l.	Great Slave l.	Great Slave l.	Heming l. Manitoba
No. of fish	45	23	22	21	74
Round weight, pounds	130	164	100	103 $\frac{1}{2}$	113 $\frac{1}{4}$
Per cent of round weight					
Viscera (incl. gills)	14	17	15	20	
Heads and viscera					25
Heads	5	11	11	12	
Ribs and backbones	14	10	18	10	20
Fins and skins	20	11	17	14	12
Fluids, etc.	5	9	3	5	5
Filletts	42	42	36	39	38
Totals	100	100	100	100	100

The goldeye fishery of Lake Claire, Alberta

A commercial license was granted to McInnes Products Corporation Limited, following the fisheries survey of 1947 and subsequent recommendation that the area be opened to commercial fishing, permitting the removal of 250,000 pounds (round weight) of goldeye, Amphiodon alosoides, from Lake Claire, Wood Buffalo Park, Alberta.

From 10 to 15 skiffs of native fishermen participated in the fishery from June 5 to 29, inclusive, and marketed approximately 65,000 pounds of goldeye, 14,000 pounds of pickerel, Stizostedion vitreum, and 8,000 pounds of jackfish, Esox lucius, (dressed weights). Other species obtained were used for dog feed and local consumption. The native fishermen, although inexperienced in commercial methods, worked diligently and handled the fish well in general.

.. Although the limit for the lake was not approached during the brief fishing period, statistics of the daily catch and analysis of the fish population showed that goldeye were present in sufficient quantity to supply the limit, if the full fishing season had been utilized and if the nets recommended in the original report had been available. Adverse weather conditions during the first weeks of fishing, coupled with light net anchors and the abnormal high water which flooded the low-lying banks and allowed the goldeye to travel in areas which could not be fished, were the main factors contributing to the relatively small catch.

Other minor difficulties were encountered, for the most part pertaining to the handling of the product, but it is felt that the experience gained during the first year's fishing will

permit the operation of a more efficient fishery in subsequent years.

Wm. M. Sprules

Appendix No. 11

Goldeye investigation in 1948

A second survey of Lake Claire, Alberta, was made during the latter part of May, to be compared with the results obtained during the 1947 survey. In every instance the average catch of goldeye, Amphiodon alosoides, per net night was greater in the 1948 survey.

An attempt was made to artificially propagate goldeye eggs, but unfortunately a strong onshore wind which lasted for several days flooded the hatching containers and destroyed the eggs. When conditions for this work were suitable again the spawning was all but completed, and ripe males and females could not be obtained in quantity.

Goldeye fry at a much earlier stage in development than had been obtained previously were captured in a specially constructed drag net made of fine mesh screening. The first of these were obtained on June 11, about three weeks after the ice left Lake Claire, and measured 10 millimeters in length and averaged 0.01 grams in weight.

Wm. M. Sprules and K. H. Doan

Appendix No. 12

Natural propagation of goldeye in the
South Saskatchewan river system

A series of seine hauls was made in mid-July along 130 miles of the South Saskatchewan and Red Deer rivers from Atlee Ferry, Alberta, to Pennant Ferry, Saskatchewan, to determine

whether or not goldeye, Amphiodon alosoides, were spawning successfully in this region.

A total of 14 species of fish was obtained during the survey, including many goldeye fry which had developed from spawn deposited in the early spring. The goldeye averaged 36.4 millimeters in length and 0.4 grams in weight, and were available more readily in every instance than in parts of the Saskatchewan river near The Pas, Manitoba, where a small commercial fishery is sustained. Thus, from a comparison of the availability of small goldeye in these two areas, it would seem that the species is successfully propagating itself in the upper reaches of the South Saskatchewan river system and should be present in sufficient numbers to support adequately local sport fisheries in the area.

It was found that goldeye show a distinct habitat preference for very turbid water, since they were obtained in each seine haul made in the muddy Red Deer river, while no specimens were obtained in hauls made in the relatively clear South Saskatchewan river above its junction with the Red Deer river. In addition, just below the junction where the muddy Red Deer water maintained its identity along the north shore and the clear South Saskatchewan water along the south shore, goldeye were only obtained in the seine hauls made on the north shore. Farther downstream, where the waters were completely mixed, goldeye were obtained on the south shore.

Wm. M. Sprules

Appendix No. 13

A preliminary investigation of the Arctic char

A brief survey of the Arctic char, Salvelinus alpinus, was carried out between August 12 and September 12 in the vicinity

of Term Point, Northwest Territories, situated on the west coast of Hudson Bay approximately 250 miles north of Churchill, Manitoba.

A total of 98 sea-run char were examined from salt, brackish, and fresh water in the Wilson river system, and 61 landlocked char from a small fresh water lake above tide level at the coast. Grayling, Thymallus signifer, tullibee, Leucichthys sp., round whitefish, Prosopium cylindraceum, and lake trout, Cristivomer namaycush, also were netted in the Wilson river, while sculpins, Arctic cod, Boreogadus saida, and lake trout were obtained in the salt water sets. White whales, Delphinapterus leucas, and seals, Erignatus barbatus, were netted by the Eskimos in whale nets set along the coast.

The landlocked char ranged from $6\frac{1}{4}$ to $15\frac{1}{2}$ inches in fork length and from 1 to 20 ounces in weight, while the sea-run char ranged from $12\frac{1}{2}$ to $32\frac{1}{2}$ inches and from three-quarters to $12\frac{3}{4}$ pounds. Char obtained from salt water were feeding exclusively on sand lance, Ammodytes americanus, and sculpins, while all the stomachs examined from sea-run char in fresh water were empty. The landlocked char were feeding on sticklebacks, Gasterosteus aculeatus, and small mollusks.

Although the survey terminated just prior to the spawning period of the char, a considerable amount of information relative to the spawning habits was obtained from the few residents in the area whose observations coincided in every instance. Several large males with hooked lower jaws, brilliant body coloration and ripe gonads were obtained in fresh water in early September.

Nine char were caught, tagged, and released in salt water approximately 30 miles from the head of tide in the Wilson

river estuary, but no returns were obtained during the investigation.

If it is deemed advisable to continue research on the char in this area, larger equipment must be obtained for sea travel. In addition, a field party of not less than four men should carry out the research, and contact must be made with a plane carrying provisions at least every second week. This could be reduced somewhat if suitable radio equipment was carried by the party. Lack of natural resources, ruggedness of terrain, and the sparse population found in this part of the Barren Lands makes it inadvisable for a small, poorly-equipped party to carry on without suitable outside contact.

G. B. Oakland

Appendix No. 14

Statistical studies of whitefish infestation

A mathematical study was made from June to September of the infestation of whitefish, Coregonus clupeaformis, with cysts of the tapeworm Triaenophorus crassus. The main problem was to work out the most satisfactory sampling method for the programme of pre-inspection of whitefish for export. Sequential analysis proved satisfactory, and required the least fish for any particular degree of accuracy. Sequential analysis had never been applied to this type of problem, and development of formulae was necessary. It was found that the Negative Binomial fits the frequency distribution of number of cysts per fish in a large random sample.

Using the formulae, tables were prepared showing a list of acceptance numbers (i.e. numbers of cysts which, if they exceed the number in the sample after a given number of fish are cut,

indicate that a shipment is acceptable), and a list of rejection numbers (i.e. numbers of cysts which, if exceeded by the number in the sample after a given number of fish are cut, indicate that the shipment is not acceptable). To cover all the different combinations of size of fish, size of shipment, and form of product, 62 tables had to be made.

It was also shown that there was no consistent tendency for the various parts of Lake Winnipeg to differ in rates of infestation, and that the sexes of whitefish were infested at the same rate.

J. J. Keleher

Appendix No. 15

The 1948 tullibee investigation on Lake Winnipeg

Data were collected on 223 specimens of the tullibee, Leucichthys spp., taken at Big Black river from June 13 to July 3, and at Black Bear island from August 29 to September 10. Scale samples, body measurements and counts have not been analyzed but preliminary observations are reported.

The following species of tullibee have been reported as occurring in Lake Winnipeg: L. zenithicus, L. nipigon, L. artedi, L. nigripinnis, L. tullibee and L. hoyi. As can be seen from the tables, only L. zenithicus and L. nipigon are identified.

Table I gives the percentage composition, by species, of the net sets in the two localities. The specimens on June 15 and 19 were taken in 5 fathoms of water, 2 and 4 miles, respectively, west from Big Black river. The June 18 net set was 8 miles west of Big Black river, the depth being 8 fathoms. At Black Bear island, in depths from 3 to 12 fathoms, $1\frac{1}{2}$ - and 3-inch mesh were fished continuously resulting in only 27 tullibee. Fishermen

explained that the tullibee had not "moved in" prior to their spawning.

From the limited information available it appears that L. nipigon is more abundant in shallow water than the other species of tullibee in early spring. It also is absent from the Black Bear island area in the early fall. As this is the first indication of differential depth distribution by the various species of tullibee, this phase of the work should be expanded. Particularly important is spring and fall sampling of the deep water, mud-bottom areas of the northern half of the lake.

Fishermen recognize in their catches a light-backed and dark-backed tullibee. This distinction is based almost exclusively on the dorsal coloration of the fresh fish. A record of this characteristic in each specimen was kept, the results being tabulated in Table II. It appears that although there is a significant association between the species and colour, coloration is not a reliable criterion for the identification of L. zenithicus and L. nipigon.

Table I. Percentage composition of tullibee, Leucichthys spp. taken in Lake Winnipeg during 1948.

(For locality and depth refer to text. Number of individuals in paren.)

	<u>L. zenithicus</u>	<u>L. nipigon</u>	Unidentified as to species
June 15	12 (5)	66 (27)	22 (9)
June 19	9 (2)	66 (16)	25 (6)
June 28	43 (57)	17 (22)	40 (52)
Aug. 30-Sept. 12	33 (9)	0.0 (0)	67 (18)

Table II. Dorsal coloration related to species of Leucichthys taken in Lake Winnipeg in 1948.

(First figures show percentages. Number of individuals in paren.)

	<u>L. zenithicus</u>	<u>L. nipigon</u>	Unidentified as to species
Light-backed tullibee	31 (23)	15 (10)	24 (20)
Dark-backed tullibee	62 (45)	85 (55)	67 (57)
Undecided	7 (5)	0.0 (0)	9 (8)

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Appendix No. 16

Infestation of Cyclops bicuspidatus with
Triaenophorus at Heming lake, Manitoba,

during the summer of 1948

Other studies by the author have shown that where Cyclops bicuspidatus occurs in surface waters it is usually more abundant at depths of 12 to 15 feet, the maximum depth of Heming lake. A Clarke and Bumpus plankton sampler was used to collect semi-weekly surface samples of plankton from Heming lake from June to August. All samples contained C. bicuspidatus, the first intermediate host of Triaenophorus crassus, T. nodulosus and T. stizostedionis. Dissection of Cyclops revealed the Triaenophorus.

	27 June							July		
	4	7	15	18	22	25	28	4	6	8
No. of <u>C. bicuspidatus</u> examined	47	18	7	6	5	8	20	8	30	4
No. with <u>Triaenophorus</u>	20	3	0	3	0	0	1	0	0	0
Per cent infestation	43	17	0	50	0	0	5	0	0	0
Total No. of proceroids	23	3	0	3	0	0	1	0	0	0
No. of proceroids per infested <u>Cyclops</u>	1.2	1	0	1	0	0	1	0	0	0
Estim. No. <u>C. bicuspidatus</u> per cu. m.	6398	1764	432	102	787	906	741	1553	1800	244

Negative infestation continued throughout July and August. If the first two samples taken in June be considered together and the subsequent samples be grouped by threes, there appears to be an almost linear decline in infestation, reaching the vanishing point in early July. Based on individual samples, the infestation was insignificant by the end of the third week in June. This is probably the first quantitative measurement of the infestation of C. bicuspidatus with proceroids of Triaenophorus and strongly confirms the findings of Dr. R. B. Miller that (1) C. bicuspidatus is the first intermediate host of Triaenophorus, since examination of other planktonts in Heming lake did not reveal its presence in any of them, and (2) that the duration of Triaenophorus proceroids within C. bicuspidatus is generally one month or less.



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