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SPECKLED TROUT IN THE LOWER NELSON RIVER REGION, MANITOBA

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INTRODUCTION

In Manitoba, the speckled trout, *Salvelinus fontinalis*, is native in the coastal streams and rivers flowing into Hudson bay as far north as about 58° N. lat. It is replaced northwards by the Arctic char, *S. alpinus*, which occupies a similar ecological niche. Several features of the biology of speckled trout in the northwest extremity of its natural range are worthy of record. Nelson river is within 60 miles of the northern limit of this trout's distribution, and is farther north than Nain which is said to be its northerly limit on the Labrador coast (*Dymond, J. R. A list of the freshwater fishes of Canada east of the rocky mountains. Ont. Mus. Zool., Misc. Pub. 1, 1-36, 1947.*)

Nelson river and its tributaries are inhabited by speckled trout as far up as Kettle rapids, about 85 miles inland from the head of tide. Although the route from Hudson bay to lake Winnipeg, using portions of the Nelson river, has been travelled by explorers and traders for about 275 years, no extensive investigations or reports on the speckled trout have been made.

NELSON RIVER AND TRIBUTARIES

The lower portion of the Nelson river is accessible today by way of the Hudson bay railway, which extends from The Pas to Churchill, and travellers may venture upon the river at Mile 352 from The Pas. From here to Port Nelson, an abandoned port at the mouth of the river, is a distance of about 70 miles by canoe and a drop of about 200 feet to sea level. The river carries the drainage from the southern and central portions of the three Prairie Provinces, and the flow is large. The Nelson flows up to about 10 miles per hour, has many rapids, and is from one-half to two miles in width, broadening extensively and becoming very shallow in the estuary. The banks are about 100 feet high, and to the east of the limestone outcroppings along the eastern edge of the Precambrian Shield they are of clay. The water of the main river is cold and muddy, but tributary streams from frozen muskegs are cold and clear with a brownish stain. The country surrounding the lower Nelson supports a sparse growth of stunted tamarack and spruce, especially in the valleys of the streams, but this almost disappears near the coast of Hudson bay.

Speckled trout were taken from the Nelson river itself and the following tributaries: Kettle river, stream at Mile 329 on the Hudson bay railway, Limestone river, stream north of the gravel pit at Mile 352, stream at Mile 353½, Sky Pilot creek, Angling river, Wier river, Head of Navigation creek, Deer (Roblin) river, Seal river, Wilson creek, and the second stream east of Port Nelson.

HAYES RIVER AND TRIBUTARIES

The Hayes river carries water from Gods, Island and Oxford lakes in northeastern Manitoba, and flows into Hudson bay 5 miles southeast of Nelson river. York Factory is located at the mouth of Hayes river. This river is smaller than the Nelson, but is swift and not as turbid. Tributaries of both rivers have similar characteristics. Speckled trout were taken from Ten Shilling creek, near York Factory.

GEOLOGY AND DISTRIBUTION OF TROUT

The Precambrian Shield crosses Manitoba as a wide strip, bounded on the west by a line running through Flin Flon, Herb lake, and the north end of lake Winnipeg and south to the Winnipeg river and the international boundary. The eastern limit of the Shield extends to the sea in the extreme north of Manitoba, but from Churchill it goes inland west and southwards to the Nelson river, then southeast to the Ontario boundary. This strip of coastal plain in northeastern Manitoba is about 100 miles in width and consists of palaeozoic sediments of Ordovician and Silurian origin, mostly the former.

The shore of Hudson bay in the vicinity of the Nelson and Hayes rivers is quite low-lying and flat, with mud, sand, and marshy flats alternately covered and exposed by a six-foot tide. The water is not noticeably salty, and is shallow for many miles from shore.

Circumstantial evidence leads to the belief (*Radforth, Isobel. Some considerations on the distribution of fishes in Ontario. Contrib. Royal Ont. Mus. Zool., 25, 1-116, 1944*) that following the periods of glaciation the speckled trout extended its range northwestward from Atlantic coast regions, rather than from the Mississippi valley, and reached the Nelson river by travelling up the coast of Hudson bay. Where a river passes, on its way to Hudson bay, from the Precambrian Shield to the region of newer sediments it drops considerably in elevation. The drop is extreme enough to give, in nearly all the rivers, a falls or violent rapids; it has been suggested that these offer impassable barriers to upstream migration of fish. It might be thought that the recognized ability of the speckled trout to ascend fast water and surmount moderate obstructions would lead to further penetration of inland waters.

MATERIALS AND METHODS

A field party consisting of the author, Dr. W. M. Sprules and L. F. Knoll travelled from the lower Nelson river to Hayes river by canoe and outboard engine for one month from August 13, 1946, visiting most of the tributary streams.

A total of 109 speckled trout were retained for study, and angling was the most practical method of capture in the fast water. Fish were measured in inches to the centre of the fork of the tail, weighed in ounces, and sexed; the stomachs were examined, their contents were recorded qualitatively, and samples of scales were preserved for age study. These scales have been examined dry and unmounted, using a compound binocular microscope at a magnification of 50 diameters.

Dr. Sprules and the author were at Sky Pilot creek, a tributary of the Nelson river, for the last week of August, 1947. Speckled trout were caught, tagged, and released as the first step in a programme to determine the extent of their migrations.

RESULTS

Size Range of Trout

Small fish were taken in small streams and creeks and large fish in the main Nelson river and in large streams. Lengths ranged from 7 to 21 inches in 1946, and the most frequent was 16 inches. Their frequency distribution is given in table I. Even though every effort was made to take trout of all sizes, only 10 per cent of those caught were below the Manitoba minimum legal length of 11 inches. The maximum size attained by speckled trout in this region is reported as 7 pounds (*Hinks, D. The fishes of Manitoba. Man. Dept. Mines and Nat. Res., 1-102, 1943*). An adult male 22½ inches in length and weighing about 5 pounds was taken during the tagging operations in 1947.

Age and Growth

Speckled trout were from 1 to 6 years old when taken, the most common age group being 3 years (table II). These fish, showing 3 annuli or winter-marks on their scales, were actually nearing completion of their 4th summer's growth when caught in August and September.

Average total lengths of trout, according to age, varied in the different rivers, but, except for the small streams (Gravel Pit cr. and Mile 353½ cr.) did not differ too greatly (table II). In the smaller streams the younger fish were smaller than fish of the same age in larger rivers, but were of comparable lengths at greater ages.

Age-weight relationships have also been calculated (table II); fish from smaller streams weighed less than fish from larger streams, at the same ages.

Maturity

Trout whose ovaries contained large, well-formed eggs were mature, and those with small, undeveloped gonads were regarded as immature. In table I the number of mature fish is shown in relation to the total number of specimens examined of all lengths, and the mature fish constituted 24 per cent of the total; mature fish composed 23 per cent of the total number of trout 11 inches or more in length. All mature fish under 14 inches in length were from the smaller streams

TABLE I. Length frequency distribution of speckled trout taken in Nelson and Hayes rivers and tributaries from August 17 to September 10, 1946, showing the number of male, female, and mature fish.

Length (in.)	Where taken								Totals	No. mature fish	No. males	No. females
	Nelson r.	Limestone r.	Gravel Pit cr.	Mile 353½ cr.	Angling r.	Seal r.	Second cr. east Port Nelson	Ten Shilling cr.				
7	..	..	1	2	..	..	..	..	3	0	1	2
8	..	..	1	5	..	..	..	..	6	0	5	1
9	..	..	..	1	..	..	..	..	1	0	1	0
10	..	..	..	1	..	..	..	..	1	1	1	0
11	..	..	1	2	..	..	..	1	4	1	2	2
12	..	1	..	2	..	..	..	1	4	2	1	3
13	..	..	2	..	..	..	..	3	5	2	2	3
14	1	1	..	1	..	1	..	6	10	1	3	7
15	..	..	..	..	1	2	..	8	11	1	6	5
16	1	..	1	..	1	5	2	20	30	3	17	13
17	..	..	..	..	..	2	1	11	14	2	7	7
18	2	2	..	..	..	5	..	3	12	7	6	6
19	..	..	..	..	..	1	..	1	2	1	2	0
20	2	..	1	..	..	..	..	1	4	3	2	2
21	2	..	..	..	..	..	..	..	2	2	2	0
Total	8	4	7	14	2	16	3	55	109	26	58	51

(Gravel Pit cr. and Mile 353½ cr.). Most of the larger fish were mature, namely 65 per cent of all fish 18 inches or more in length.

Maturity has also been considered in relation to the age of trout. Fish from the larger rivers became mature at the end of their fourth summer; in the smaller streams sexual maturity was attained not only at smaller lengths but by the third summer.

SEX RATIO

Of the 109 specimens examined, 58, or 53 per cent, were males and the remainder females. There were no outstanding deviations from this ratio in any length or age groups.

SPAWNING

Often male fish become ready for spawning, or ripe, before females. Speckled trout proved no exception in this investigation, and the first ripe fish was a male

TABLE II. Age-frequency distribution of speckled trout taken in Nelson and Hayes rivers and tributaries from August 17 to September 10, 1946, with average lengths in inches and weights in ounces.

	Number of annuli (age)					
	1	2	3	4	5	6
Larger rivers:						
Nelson r.						
Number	...	....	1	1	3	3
Length	...	....	14.8	16.8	19.3	20.9
Weight	...	....	17.0	27.0	45.3	57.0
Limestone r.						
Number	...	....	2	....	2	....
Length	...	....	13.6	....	18.5	....
Weight	...	....	15.0	....	38.5	....
Angling r.						
Number	...	....	2	....	....	....
Length	...	....	15.9	....	....	....
Weight	...	....	26.0	....	....	....
Seal r.						
Number	...	....	7	8	1	....
Length	...	....	15.7	17.8	19.3	....
Weight	...	....	21.6	33.0	48.0	....
Second cr. east Port Nelson						
Number	...	....	1	2	....	....
Length	...	....	16.0	17.1	....	....
Weight	...	....	22.0	29.0	....	....
Ten Shilling cr.						
Number	...	2	32	18	3	....
Length	...	11.6	15.4	17.3	19.3	....
Weight	...	7.5	21.3	30.4	42.7	....
Average						
Length	...	11.6	15.2	17.3	19.1	20.9
Weight	...	7.5	20.5	29.9	43.6	57.0
Smaller streams:						
Gravel Pit cr.						
Number	...	2	3	1	1	....
Length	...	7.6	12.7	16.8	20.0	....
Weight	...	2.3	12.0	27.0	33.0	....
Mile 353½ cr.						
Number	7	6	1	....	....	....
Length	8.0	11.1	14.5	....	....	....
Weight	2.5	7.7	16.0	....	....	....
Average						
Length	8.0	9.4	13.6	16.8	20.0	....
Weight	2.5	5.0	14.0	27.0	33.0	....

taken from Ten Shilling creek on August 27. Two ripe males, resplendent in vivid colours and with a markedly hooked lower jaw, were taken from Seal river

on August 30. A ripe male was taken from the Nelson river off the mouth of Wilson creek on September 7. Two spent female trout were caught on September 8 in Gravel Pit creek, where a ripe male was taken on September 10.

It is not known what maximum summer temperature the water of the Nelson river may attain, but it is evidently a few degrees warmer than tributary streams. For instance, the stream which crossed the railway at Mile 353½ had its origin in muskeg and where it flowed into the Nelson it was 54° F. and the Nelson river itself at that point was 60° F. on August 18. Trout seemed to favour places in a river where smaller and colder streams flowed in. Here they lived, presumably for days or weeks, until lowering temperatures or freshets prompted them to enter the small tributary for spawning purposes.

The Gravel Pit creek was only about 6 inches in depth and 6 feet in width, with varying rapids and pools. Speckled trout were present in the Limestone off the mouth of this creek, and the spent trout present in the creek had apparently only entered temporarily for spawning. A fish of large size was observed on gravel bottom in shallow, rapid water at the head of a pool in the creek, but freshly worked gravel was not noticeable even though the fish returned from the pool to the same spot upon several occasions after being frightened away. The spent fish taken in the creek were lying at the bottom of a pool, and had not yet returned to the Limestone river.

The banks of the Nelson river to a height of 50 feet above the water in August, were clear of trees and shrubbery, but were covered with grass. Tributary streams also had clear banks until far enough upstream to be uninfluenced by the Nelson. It is believed that this scouring of banks occurs when ice jams, said to be 50 feet high, dam up the water and later release it. It is suspected that very little success would come from the spawning of trout in the main river or the lower tributaries where ice pressure and scraping would disturb the bottom. Up the small tributaries above the action of the ice of the main river, however, there would be no such disturbance as shown by the fact that the water and gravel were clean, and the eggs or fry would not be swept away.

Rearing streams, where small trout were observed, were small creeks with pools, rapids, and beds of black muck with rooted aquatic vegetation. More trout were seen where the streams were bordered by shrubs and trees than where they were open owing to recent burning. There were fewer trout in the fast-flowing gravelled sections than in quieter waters.

Migrations

Residents at the mouth of the Hayes river, at York Factory, do not catch trout there in the late summer. The fish come downriver in the autumn and can be taken by sweep seine or through the ice early in November. In the winter, trout can be taken by hook and line through the ice at a distance of about 7 or 8 miles out from the shore of Hudson bay. Apparently they spend the winter in the estuaries of the large rivers and cruise along the coast. In the spring and summer the trout travel up the Nelson and Hayes and it is said that they arrive

at each tributary river according to a schedule. They enter the smaller rivers and go further upstream until late in the summer when they lie off the mouths of small, cold creeks or actually run into them for spawning. Late in the summer the temperature of tributary rivers such as the Deer (Roblin) and Wier is up to 60° F. at the mouth, the same as the main Nelson, and trout are not to be found in such locations. At this time they do occur in the Nelson at points where small, cold streams flow in—the same as farther up in tributary rivers—but it is not known whether these fish are late arrivals or have lived in the vicinity of such junctions since earlier in the summer.

The main Nelson is not uninhabitable for trout late in the summer, since specimens were taken from it rather far from a stream mouth. One such location was the violently fast water of the Limestone rapids about one-quarter mile above the mouth of the Limestone river.

That the Nelson may not be an ideal trout habitat late in the summer was evident from the association of pike-perch (*Stizostedion vitreum*), jackfish (*Esox lucius*), and sturgeon (*Acipenser fulvescens*) with the trout. In the tributary rivers where most trout were to be found there were only occasional jackfish, and this in the quietest water.

After spawning, the trout drop back into the tributary rivers, then into the main Nelson, and so on down to Hudson bay for the winter.

Some speckled trout taken in tributaries of the Nelson closer to Hudson bay (Seal and Angling rivers) were of a bluish silvery colour, with pink and blue spots and dorsal vermiculations not very evident. Presumably, these fish had recently

TABLE III. Food of 87 speckled trout taken from larger rivers—Nelson r., Limestone r., Angling r., second creek east of Port Nelson, Ten Shilling cr.—between August 17 and September 10, 1946, by length groups. The percentage frequency of each food item in the stomachs is shown as percentage only of stomachs containing food.

Lengths in inches	10-13¾	14-17¾	18-21¾
Number of trout examined	6	62	19
Number containing food	3	20	8
Food items:			
Invertebrates			
Dragonflies (nymphs)	33	20	38
Stoneflies (nymphs)	33	15	50
Water bugs	..	20	..
Aquatic beetles	..	25	..
Caddis flies (larvae and pupae)	..	10	..
Aquatic moths (larvae)	..	10	..
Wasps	..	10	..
Insect remains	33	10	..
Vertebrates			
Fish remains	67	..	..
Debris			
Plants and stones	33	5	38

run in from the sea. The most highly coloured and beautiful fish were those in spawning condition at greater distances from the sea.

FOOD (BY DR. W. M. SPRULES)

The stomachs of all the specimens were examined. The types of food were utilized and the percentage frequency of occurrence of each are shown in tables III and IV. When all the localities from which specimens were obtained were considered it was found that aquatic invertebrates (mostly immature stages of aquatic insects) formed the most important group of food items. Terrestial insects were found in only 17 per cent of the stomachs which shows that these fish were not feeding at the surface to any great extent. Fish remains were found in 16 per cent of the stomachs that contained food, and in every instance insects

TABLE IV. Food of 21 speckled trout taken from smaller streams—Gravel Pit cr. and Mile 353½ cr.—between August 17 and September 10, 1946, by length groups. Percentages as in table III.

Lengths in inches	6-9¾	10-13¾	14-17¾	18-21¾
Number of trout examined	10	8	2	1
Number containing food	10	8	2	0
Food items:				
Invertebrates				
Leeches	..	..	50	..
Millipedes	..	13	..	..
Mayflies (nymphs)	10	..	..	..
Dragonflies (nymphs)	80	50	50	..
Stoneflies (nymphs)	..	25	..	..
Water bugs	20	..	50	..
Aquatic beetles	20	..	50	..
Caddis flies (larvae and pupae)	80	75	50	..
Blackflies (larvae)	20	..	..	..
Ants	30	13	100	..
Insect remains	..	13	..	..
Snails	10	..	50	..
Vertebrates				
Brook stickleback (*E. inconstans*)	10	..	..	..
Fish remains	30	38	..	..

were present also. Thus it is improbable that vertebrates form an important staple in the diet of these fish. An interesting point regarding the utilization of fish as food is that fish were taken only by trout between 7 and 13¼ inches in length and not by the larger specimens.

Trout from Nelson river and its larger tributaries (table III) showed a greater frequency of empty stomachs than specimens obtained from the smaller streams (table IV). Sixty-four per cent of the first group were empty and only 5 per cent of the second group. Along with this fact it was found that the fish

from the small streams showed a more varied diet in general, with this condition most pronounced in small specimens. In the large streams stonefly nymphs, consisting of *Pteronarcys dorsata* and *Claassenia sabulosa*, were the most important single food item, with dragonfly nymphs coming next, both from the standpoint of frequency of occurrence in stomachs and volume. In the smaller streams caddis fly larvae and pupae replaced the stoneflies as the most frequently occurring single food item, with dragonfly nymphs in second place. However, the dragonflies were of greater importance than the caddis flies when the volume of food utilized was considered.

Availability

Availability means the ease or difficulty with which trout may be taken. This bears some relationship to their absolute abundance, but availability is modified by kind of gear and skill in its use, the weather, and other factors affecting the movement or feeding of the fish. Availability is usually expressed in number or pounds of fish caught per unit of effort.

Between August 17 and September 11, 111 speckled trout were taken in 89 rod-hours, or 1.3 fish per rod per hour. This was equal to 1.9 pounds per rod per hour. Several efforts yielded no fish, and the best catches were made in Ten Shilling creek, where 55 trout were taken at the rate of 2.5 fish or 3.9 pounds per rod per hour.

DISCUSSION

It has become evident from the foregoing that two types of trout waters are present in the lower Nelson river region. The first, which is the greatest in extent and volume, consists of the coastal waters of Hudson bay, the Nelson and Hayes rivers and their larger tributaries, and is occupied by a majority of the trout throughout most of a year. The second consists of small creeks less than 6 or 8 feet in width which arise from the surrounding muskeg areas and flow both into tributaries of the Nelson and into the main Nelson itself. This type is occupied temporarily by large spawning trout which enter from the larger rivers, and by a permanent population of smaller trout.

It is suggested that of a given lot of eggs deposited, fertilized, and hatched in a small creek, most of the resultant fingerlings soon leave the creek and enter the larger rivers where they grow rapidly and range over extensive distances. These fish travel to the sea in late autumn, coming back up the rivers in succeeding summers. By their third summer they have attained lengths of upwards of 11 inches, and at the end of their fourth summer many have become mature and are ready to spawn at a length of about 15 inches. The balance of the young trout hatched in the small creek do not immediately seek the larger rivers, but remain and feed and grow in the creek. These fish, although they take a wide variety of insect food during the summer, grow more slowly than do those that sought the larger waters, and become mature at lengths upwards from 9 inches at the end of their third summer of life. It is not known exactly how long they

continue to live in the small creeks, winter and summer, but the data suggest that by the time they have reached a length of 14 inches they too move out into larger rivers. The larger rivers provide greater facilities for better growth than do the creeks, because they provide, in addition to an increased "space" factor, higher water temperatures in summer and better supplies of small food fishes and larger insects such as the stonefly.

Even though speckled trout in the larger rivers may become mature at lengths upwards from 15 inches, only at lengths of 18 inches and greater is there any considerable proportion of the population that spawns. Even among the larger specimens, not all the fish spawn in any one year. Large fish with underdeveloped gonads were examined for traces of previous spawning, but no evidence was found that indicated they had ever spawned.

The importance of the small creeks as spawning areas is strengthened by an interpretation of the evidence of severe ice jamming and scouring in the main Nelson and lower portions of its larger tributaries. Although no spawning was in evidence in the rivers, if such occurs the eggs and fry would be threatened with destruction during winter and spring. Only eggs deposited in small, protected, elevated creeks would have much chance of survival. It is these small nursery creeks which supply the big rivers with seed stock.

As the adult trout, about ready for spawning in early September, lie off the mouths of small creeks, they are presumably awaiting a temperature urge to bring about their quick entry into the creek. They would be vulnerable to attack from predators if they attempted to live in the creek any considerable length of time, but are presumably willing to risk a short venture of a few hours or days into the creek in order to spawn. Most of the small creeks have created a wide outwash valley where they join a larger river, and at the point of junction a flat, fan-shaped accumulation of stones and gravel has been pushed out. In a very small creek where few pools and rapids suitable for spawning exist, the stream flows so widely and is so shallow where it enters the river that large trout would find it impossible to gain entrance. Only a temporary rainfall with its resultant freshet would enable the waiting spawners to surmount the barrier at the mouth of the stream. Without the coincidence of a freshet, the stream above would remain unused.

A very fine example of a suitable stream which was blocked at its mouth is that which crosses the railway at Mile 352½. It is very similar to the stream at Mile 353½, both in temperature of the water, volume of flow, and other physical characteristics. The Mile 353½ creek supported a population of small trout, but the other stream did not. But the creek at 352½ was quite impassable from the Nelson owing to an extensive accumulation of stones and gravel, while the other creek was open to passage of fish from the Nelson. Full utilization of all spawning and nursery areas would involve some plan of management to see that all streams had an adequately cleared channel to the main Nelson.

The account of the annual travels of speckled trout in the lower Nelson region told how the fish left the rivers and streams to which they had penetrated

in the summer, went to sea, and came inland the next summer. It has not been suggested that a trout returned to the same stream annually. Certainly some trout come to a given stream, but not necessarily the same individuals. Fears have been expressed that trout would be depleted in some streams that are easily accessible and heavily fished by anglers, such as Sky Pilot creek, 6 miles east of the Kettle rapids bridge. If a specific migratory stock of fish used this stream, and no other fish of different origin entered, then the stock could be depleted under intensive exploitation. If, however, Sky Pilot creek attracted a mixed and varying run of fish each summer, which may have originated in many and widely separated streams along the Nelson, even though the fish were quickly and completely removed each season there need be no great concern felt over the intensity of fishing. Streams in remote areas along the Nelson, where anglers rarely or never visit, would act as undisturbed sources of supply for trout moving into a stream which is heavily fished.

The Nelson river drains surface water from lake Winnipeg, and its maximum summer temperature where it leaves the lake is not known. As it moves northeasterly across the Precambrian Shield it undergoes many expansions and presumably becomes even warmer under the summer sun. Eastwards from Kettle rapids the river cuts deeper into the sediments, and flows rapidly without any lake expansions towards the sea. This 100-mile coastal plain is perpetually frozen, and thaws only to a shallow depth in summer. The high banks of the lower Nelson are moist with seepage of cold water, and all tributary streams have a low temperature. It is believed that the main river actually becomes cooler as it approaches Hudson bay, and this is the region inhabited by speckled trout. Perhaps, instead of the physical barrier of change in elevation at the east side of the Shield there is the physiological barrier of higher summer water temperatures in the highlands which deters trout from penetrating farther inland. If there was a series of deep, thermally stratified lakes in the Nelson river system to which trout could retire during the summer, using connecting rivers only during cooler periods of the year, then it would be expected that over the past centuries trout would have gone farther inland. The presence or absence of such cool, summer retreats could be established by surveys. If absent, there would be little hope of acclimating speckled trout in the interior of Manitoba's Precambrian Shield.

SUMMARY

A survey of some features of the biology of speckled trout was made in the region of the lower Nelson river, Manitoba, from August 13 to September 13, 1946.

Study of 109 specimens showed average lengths of 11.6, 15.2, 17.3, 19.1 and 20.9 inches in the third to seventh years of life. Growth was slower in small creeks.

Maturity was attained at lengths upwards from 15 inches in the fourth summer in the rivers, and from 9 inches in the third summer in creeks. The

sexes were nearly evenly divided. The first ripe fish was taken on August 27, and the first spent trout on September 8. Spawning had not yet become general at the conclusion of observations, but appeared to take place in small creeks on gravel bottom, in rapidly flowing water at the head of pools. Extensive ice scouring indicated unfavourable conditions for survival of eggs and fry in the larger rivers. Some creeks were inaccessible to spawners because of fanwise gravel and stone outwashings at their mouths.

It is believed that most trout make an annual trip from the estuaries of the river and the sea, where they spend the winter, inland to small creeks where they spawn in September, but some live the first few years of their life in creeks without seeking larger rivers.

Aquatic invertebrates formed most of the trout food and they consumed a wider variety of items in small creeks than in the larger rivers.

In addition to the physical barrier of change of elevation at the eastern edge of the Precambrian Shield there may be a physiological barrier owing to higher water temperatures upriver in the Nelson system, which prevent speckled trout from becoming established farther westward in the interior of Manitoba.

The degree to which speckled trout travel from one stream to another has a direct bearing upon the question of whether or not they can be seriously depleted under heavy exploitation at any one place. A tagging programme has been inaugurated to explore this possibility.