University of Alberta Library

0 1620 3674549 3

For Reference

NOT TO BE TAKEN FROM THIS ROOM

Library of the University of Alberta, Edmonton, Alberta

Gilmour, William McMullen
A study of the lower Bow
River trout with special
reference to taxonomy.

Ex LIBRIS
UNIVERSITATIS
ALBERTAENSIS

THE UNIVERSITY OF ALBERTA

A Study of the Lower Bow River Trout
with Special Reference to Taxonomy

A DISSERTATION
SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF SCIENCE

FACULTY OF ARTS AND SCIENCE

by

William McMullen Gilmour

EDMONTON, ALBERTA

April 13th, 1950.

Digitized by the Internet Archive
in 2018 with funding from
University of Alberta Libraries

<https://archive.org/details/studyoflowerbowr00gilm>

TABLE OF CONTENTS

INTRODUCTION	1
THE POSITION OF THE BOW RIVER TROUT WITH RESPECT TO OTHER TROUT SPECIES	7
A Study of Relative-Growth Curves	11
Comparison of Proportionate Measurements of Bow River Trout with Other Trouts	19
The Frequency Distribution of Proportionate Measurements of Body Parts	24
Discussion of Taxonomic Status	26
GENERAL BIOLOGY OF BOW RIVER TROUT	28
Growth Rate	29
Spawning Behaviour	32
Tagging Operations	37
Management	39
CONCLUSION	44
ACKNOWLEDGMENTS	46
REFERENCES	47
APPENDIX	49

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

A STUDY OF THE LOWER BOW RIVER TROUT
WITH SPECIAL REFERENCE TO TAXONOMY

INTRODUCTION

For the past number of years the Bow River has been building up a reputation as an anglers' paradise. The fighting quality of the trout, caught by either fly or casting rod, has made this part of the Bow River around Carseland an irresistable attraction to the keen angler. The accessibility of this area and consistent good catches have not only attracted sportsmen from Calgary and the surrounding districts, but its fame has spread and American tourists visit this area in increasing numbers each year.

It is impossible to estimate the total catch in one year from the area in and around the Carseland Dam. Some idea of the number of fish taken may be obtained from the fact that the writer caught, and took taxonomic measurements of, 139 trout as well as tagging and releasing 100 more. The average weight of the 139 fish examined was 29.9 ounces. These fish were all taken by angling from

FIGURE 1.

SKETCH of Bow River
near
CARSELAND DAM

heavily wooded, low lying land

spawning beds

potential spawning beds

fish ladder

point from which anglers were counted

May 10 to September 15. The writer personally knows one or two ardent anglers who caught an equal number, if not more, within the angling season. On one Sunday, the author saw from the middle of the river (marked O on sketch, figure I) thirty-seven anglers at one time. All these were in the area below the dam.

Despite the many trout taken from this area, and the rest of the Bow River from Calgary to Carseland, their identity has remained a mystery. There are many problems relating to this trout which must be solved in the future but it seems imperative that the taxonomic aspects be tackled first. It is for this reason that the present study has been mainly an attempt to establish the identity of these fish. Other biological factors, observed while gathering data for the taxonomic study, will also be discussed.

The Bow River trout, as they will be called in the following pages, have been variously called rainbow, steelhead and cutthroat trout. As we shall see, none of these names is entirely correct.

According to Neave (1943) there is a significant difference between the average scale counts of anadromous and non-sea-going rainbow trout (Salmo gairdneri). The sea-going type is known as the steelhead. Since there is no direct drainage of the Bow River to the sea, the name steelhead is entirely incorrect and can be eliminated from further discussion.

... ..
... ..
... ..
... ..
... ..

... ..
... ..
... ..
... ..
... ..
... ..
... ..
... ..
... ..

... ..
... ..
... ..
... ..

... ..
... ..
... ..
... ..
... ..
... ..

It has long been known that the cutthroat (Salmo clarkii) is the native trout in our East slope streams (Jordan and Evermann, 1896). We know that the rainbow (Salmo gairdneri) has been introduced into the Bow River and its tributaries for a number of years. It would be reasonable to assume that these species would both be present in the Bow River. However, neither of them seems to be present as a true species and this leads to the supposition that the Bow River trout is a hybrid between the rainbow and the cutthroat.

The history of the plantings of trout in the Bow River and its tributaries gives considerable support to the "hybrid" theory. The planting history as far back as records could be found is given in table I.

Table I.

Record of trout plantings in the Bow River, its lower tributaries and Kananaskis Lakes

(No records available for plantings up to 1933)

Bow River and Lower Tributaries

Year	Species	Advanced Fry	Fingerlings	Yearlings
1933	Cutthroat Rainbow	318,000 79,380		
1934	Cutthroat Rainbow	50,000 143,795	173,000 201,400	
1935	Cutthroat Rainbow	210,000	190,425 399,340	

Bow River and Lower Tributaries (cont.)

Year	Species	Advanced Fry	Fingerlings	Yearlings
1936	Cutthroat Rainbow	221,000	425,200 151,520	
1937	Cutthroat Rainbow	207,800 427,100		
1938	Cutthroat Rainbow	349,150		
1941	Cutthroat Rainbow		453,700	2,000

Bow River (no tributary plantings included)

1942	Cutthroat Rainbow		52,000	
1943	Cutthroat Rainbow		160,000	43,000
1944	Cutthroat Rainbow		50,000	16,400
1947	Cutthroat Rainbow			21,000

Kananaskis Lakes and Tributaries

1936	Cutthroat Rainbow	150,000 95,590	75,000	
1941	Cutthroat Rainbow		40,000	6,000
1944	Cutthroat Rainbow			30,000

It may be seen from this table that both rainbow and cutthroat have been planted in colossal numbers in the past. Since the cutthroat is the native trout, it would seem reasonable they would be ^{re}most likely to survive. It

may also be observed from table I that the total rainbow plantings far outnumber the cutthroat. This has probably led to a great deal of competition for food and spawning beds. Especially in regard to spawning beds it seems likely that natural hybridization might have taken place since both trout spawn at the same time of year and on the same type of bed.

To go a little further in support of the "hybrid" theory, it seems quite possible that the rainbow being planted from the Calgary hatchery are themselves not a true species.

During the past summer, it was drawn to the writer's attention that the "spawn-takers" for the hatchery were unknowingly creating a hybrid.

Kananaskis Lake, where the cutthroat is the native trout, was planted with rainbow in 1936. These rainbow, although planted in the Upper lake, soon worked down into Lower Kananaskis Lake (Rawson, 1936). These fish have survived and flourished, and have been used as a "brood stock" for the Calgary hatchery. With the cutthroats already established, it would seem to be a very simple error to fertilize a "batch" of rainbow eggs with the milt from a cutthroat, or vice versa. These eggs have been hatched and the fingerlings planted in numerous lakes and streams throughout the province. Many of these "hybrid" fingerlings have been replanted in Kananaskis Lake (table I).

The extent of this suspected hybridization is beyond the scope of this thesis but the present indications are that it is widespread throughout the province. It is highly probable that the Calgary hatchery has no true species of rainbow and those so-called are probably hybrids.

The Bow River trout seem to combine the sporting qualities of both the cutthroat and the rainbow. At certain times they will take the lure and break water in a typical rainbow fashion; alternately "running up the line", breaking water and shaking their heads in an attempt to get rid of the hook. At other times this trout will not break water but heads directly for the bottom. In fast water, a run downstream to the end of the line proves a very effective means of gaining their freedom with or without "hook, line and sinker".

The most outstanding characteristics of the Bow River trout are its variations in colour, markings and shape. The general colour may vary from a light shiny silver on sides and belly to a greenish-black colouration. The back is generally dark, varying from green to almost black. A large number of the trout examined were silvery in colour with an indistinct "rainbow stripe" even in spawning season. The "cutthroat mark" may be present or absent. If present, it may extend the whole length of the lower jaw or may be confined to a small area. The colour of this "cut-mark" varies from a blood red to an almost yellow colour. The

fins may be light or dark, spotted or unspotted. The spots on the fins and body may be round or cross-shaped. The body may be flat on the dorsal surface, sloping gently upwards to the dorsal fin, or it may project upwards abruptly immediately behind the head and extend backwards flatly to the dorsal fin. The presence or absence of this abrupt upward projection behind the head seemed to be a conspicuous difference in these trout. However, no correlation between this character and the assumed rainbow or cutthroat parentage could be found.

THE POSITION OF THE BOW RIVER TROUT WITH RESPECT TO OTHER TROUT SPECIES

The introductory remarks on colour characteristics of these Bow River trout serve to indicate the futility of identification based on colour characters. Accordingly, it was necessary to attempt to define the fish largely from morphological characters. This is done by catching and measuring while fresh, as large a number of specimens as possible. The measurements are taken in the manner described by Hubbs and Lagler (1947). On each fish 25 measurements were made; the parts measured are shown in the column headings in table VIII (appendix). Then by determining the proportion that each part bears to the whole length of

the fish, it is possible to compare fish of different sizes and to pick out those which differ significantly. For example, length of head, length of upper jaw, diameter of eye, etc., tend to bear a constant proportion to body length in fish of the same species; in fish of different species the proportions are apt to be different.

The most convenient method of making these comparisons is to plot the logarithm of the size of each body part against the logarithm of the standard length of the fish. Rather than calculate the logarithm, it is simpler to plot the arithmetic measurements on log-log paper. The curves obtained in this way are called relative-growth curves and were first used and explained by Huxley (1932). This procedure was used in a preliminary treatment of the data. It was found that some of the measurements showed no variability and these were left out of further considerations. The measurements which showed some promise of taxonomic significance were given more intensive study; log-log plots of these are shown as black dots on figure 2.

A careful study of the distribution of the black dots on figure 2 shows that they tend to fall into straight lines. Now, if the Bow River trout represent a mixed population of two species of fish, one would expect the dots to be distributed so as to fall into at least two straight lines for each character. The inescapable conclusion is that these Bow River fish form a reasonably homogeneous

Figure 2.

A comparison of various body measurements of Bow River trout with rainbow trout (light line) and cutthroat trout (heavy line)

LOG. BODY MEASUREMENTS
DIFFERENT ORIGIN FOR EACH CHARACTER

LOG. STANDARD LENGTH

population. The question again arises, what are they, then? Are they cutthroat or rainbow or a hybrid between these species? To solve this question it is necessary to compare their measurements with similar measurements of bona fide rainbow and cutthroat. A search of the literature on the taxonomy of trout was made; the pertinent data have been extracted and assembled in table II.

This table also contains measurements of Spray Lakes cutthroat (column II) taken by the author. For various reasons, to be discussed later, the Spray Lakes cutthroats were used as cutthroat standards. Bajkov's (1925-26) measurements of the Kamloops trout of Jasper Park (column IV) were used as rainbow standards. The heavy lines on figure 2 represent the log-log plots of the cutthroats and the lighter lines the log-log plots of the rainbows. The detailed taxonomic discussion which follows is based primarily on these curves. To expand and corroborate the evidence given by these curves, there is also a discussion of the comparative measurements of various trouts in table II. Finally the frequency distribution of these measurements of body parts of the Bow River trout and other trouts is described.

Table II.

Proportionate measurements of body parts of Bow River trout, rainbow and cutthroat trout of various localities

Figures give percentage of standard length

	I	II	III	IV	V	VI	VII	VIII
	Bow	Spray	Gorge	Irideus	Clarkii	Alpestris	Whitehousei	Kamloops
	♂	♂(♂+♀)	♂+♀	♂	♂	♂(♀)	♂(♀)	♂
Head Length	22.9	22.2(21.7)	23.6	24.2	25.0	23.2(21.3)	26.9(24.9)	28.5
Inter-orbital W.	7.9	6.9(6.7)	6.6	8.5	7.5	6.7(6.5)	7.8(7.1)	9.8
Maxillary Length	13.3	13.0(12.6)	13.7	10.4	14.5	13.4(11.4)	13.8(12.3)	18.8
Snout Length	5.9	4.9(4.5)	6.3	6.2	7.0	6.5(5.5)	6.6(5.9)	11.0
Lateral Line Scales	128.5	124.1	143.4	115-130	150-158	200-230	139-164	135-153

Column numbers with abbreviations followed by identification.

- I. Bow - Bow River trout
- II. Spray - Spray Lakes cutthroat (Salmo clarkii)
- III. Gorge - Andrekson's (1949) cutthroat (Salmo clarkii)
- IV. Irideus - Bajkov (1926) (Salmo irideus Gibbons)
- V. Clarkii - Dymond (1932) (Salmo clarkii)
- VI. Alpestris - Dymond (1931) (Salmo clarkii alpestris)
- VII. Whitehousei - Dymond (1931) (Salmo kamloops whitehousei)
- VIII. Kamloops - Dymond (1932) (Salmo kamloops Jordan)

Table 1

Table 1 shows the results of the analysis of variance for the effect of the treatment on the response variable. The results are presented in the following table.

Treatment	Control	Low	High	Very High	Extremely High	Total
Mean	11.20	11.20	11.20	11.20	11.20	11.20
Standard Error	0.10	0.10	0.10	0.10	0.10	0.10
Sum of Squares	11.20	11.20	11.20	11.20	11.20	11.20
Mean Square	11.20	11.20	11.20	11.20	11.20	11.20
F-Value	11.20	11.20	11.20	11.20	11.20	11.20
Probability	11.20	11.20	11.20	11.20	11.20	11.20
Significance	11.20	11.20	11.20	11.20	11.20	11.20
Correlation	11.20	11.20	11.20	11.20	11.20	11.20
Regression	11.20	11.20	11.20	11.20	11.20	11.20
Residual	11.20	11.20	11.20	11.20	11.20	11.20
Total	11.20	11.20	11.20	11.20	11.20	11.20

The results of the analysis of variance are presented in the following table. The results are presented in the following table.

A Study of Relative-growth Curves

In order to understand the purpose of the graphs in figure 2, the methods used, and the difficulties encountered, will be discussed. Bajkov's rainbow data will then be examined and interpreted. The cutthroats will be treated in the same manner as the rainbow. Next, the Bow River fish will be compared to the other trouts. Finally, the characteristics used will be treated individually in their relationship to all three types of trout.

The logarithms of the measurements plotted against the logarithm^s of the standard length^s of the fish gives a straight line graph. Dymond (1932) has pointed out that there is an increase in the relative magnitude of the four measurements (head length, maxillary length, inter-orbital width and snout length) with an increase in the standard length. The advantage of using the logarithm of these measurements is that the error, introduced by using fish of different lengths, is eliminated. It is to be noted that snout length is not used in the graphs in figure 2. Dymond (1932) also states that there is a sexual difference for the above mentioned four characteristics. This is borne out by graphs in figure 2. The sex^{es} of the Bow River fish are indicated by the usual symbols. This appears to apply particularly for the trout in which maturity has been attained.

As discussed in the following pages, not all of the characteristics listed at the top of the columns in table VIII (appendix) were used. For some of them, no similar data were available from Bajkov's rainbow investigations. Only those characteristics were used which, from a preliminary examination, showed a significant variability.

In compiling the rainbow data, it was necessary to make some adjustments in order to use some of the measurements taken by Bajkov in his investigations. He gives no standard length in his tables and this was calculated by plotting the total length against standard length for the Bow River fish. The rainbow standard length was interpolated from this graph.

It was planned to use all of the significant characteristics shown at the top of the columns of table VIII (appendix). This was impossible for some of these measurements as there was no comparable information available from Bajkov's data. This was the case for the following characteristics: head depth, body width, adipose length, pelvic to anal length and length of the anal base. In regard to snout length, Bajkov's fish were measured to the anterior surface of the eye ball. The writer's measurements were taken to the anterior bony margin of the orbital rim (Hubbs and Lagler, 1947). This difference is small but nevertheless this characteristic was omitted from these log-log graphs. This measurement was used previously in

table II and is used again in the frequency curves, figures 3 to 6.

In order to use the snout to dorsal length measurement, it was necessary to add together the two characteristics, snout to occiput and occiput to dorsal. This was done for the Bow River trout and the cutthroats as Bajkov did not give these measurements independently. Undoubtedly this has introduced a small error in the curves for this characteristic.

The rainbow curves are shown as a fine line in figure 2. Each line represents the average change of the character for a change in the standard length of the rainbow trout. Log-log plots were used to give a straight line. The fish were selected without consideration of the sex. They represent a selection of trout picked from Bajkov's data with size being the only factor involved. These fish were plotted for the various characteristics and the best fitting straight line was obtained. It is this line which is represented in figure 2 by the fine line.

The cutthroat trout were treated in a similar manner. The heavy lines in figure 2 represent these trout. These fish represent all of the cutthroats taken by the writer from the Spray Lakes near Banff, Alberta.

Andrekson's (1949) cutthroat from Gorge Creek could have been used. There is no appreciable difference between the average proportionate measurements (table II,

columns II and III) of the two populations. The Spray Lakes fish were chosen for two reasons. Firstly, both these fish and the Bow River trout were measured by the writer and any errors in taking these measurements would be the same for both. Secondly, the Spray Lakes trout were, on the average, larger than those from Gorge Creek. Consequently, they were considered to be more suitable for making a comparison with the larger Bow River trout.

The Bow River fish are shown on the graphs in figure 2 as squares and circles with the usual symbol for the sex. Only the mature fish in which there was no doubt of the sex are shown with the sexes distinguished.

Included with the Bow River fish are a number of trout from the Willow Creek drainage. There were no fish taken in the smaller size range from the Bow River. The trout in Willow Creek and its tributaries are very similar in colour characteristics to those from the Bow River. Since they fall along the same straight line as the Bow River trout for all of the taxonomic measurements, they are considered to be identical with them.

The Bow River fish (the Willow Creek trout will be included in this heading in the following pages) were picked at random with the size being the only consideration. After these fish were chosen, the sex and 'cut mark' were noted (table VIII appendix). Those shown as circles in figure 2 are the fish in which the 'cut mark' was absent. The

squares represent all the fish showing the 'cut mark' in any degree.

In none of the characteristics shown in figure 2 is there any appreciable difference between the trout in which the 'cut mark' is present and those in which it is absent.

There is a different series of fish used for the Bow River trout in the body depth measurement. This was necessary as fish taken after spawning had a noticeably lesser depth than those which were immature or unripe. In order to eliminate this obvious error, only trout which were in normal condition were used.

Each of the twelve taxonomic measurements shown in figure 2 will now be discussed individually. Each characteristic will be dealt with in regard to the rainbow, cutthroat and Bow River fish.

Length of Head. For this characteristic, the graphs for the rainbow and cutthroat are nearly parallel, the rainbow having a slightly longer head than the cutthroat. The Bow River trout tends to be scattered over the range of both. There is a definite sexual difference; the males having a longer head than the females especially in the larger mature fish.

Inter-orbital Width. The rainbow and cutthroat graphs are parallel in this character indicating a similar change in inter-orbital width with a change in standard

length. The rainbow has a greater inter-orbital width than the cutthroat. The Bow River trout are intermediate in size but tend to fall along the cutthroat curve. A sexual difference is apparent, with the males again being the larger.

Maxillary Length. The rainbow and cutthroat show a distinct difference in maxillary length. The increase in maxillary length with an increase in standard length is the same, i.e., the lines are parallel. The Bow River fish follow the cutthroat line and would appear to be very similar to them in this characteristic. A very definite sexual difference is present with the larger males having a much longer maxillary than the cutthroat. This variation can probably be explained by the fact that the cutthroats were relatively small fish and that both sexes were included in the graph.

Eye Diameter. The cutthroat and rainbow lines cross for this characteristic indicating a different rate of growth in the two species. The Bow River fish are somewhat intermediate between the two. They tend to follow the cutthroat line for the smaller fish but follow the rainbow for the greater part of the series. There is no apparent sexual difference.

Snout to Dorsal Length. Since the cutthroat and rainbow curves intersect at a small acute angle, there must be a slight difference in the relative magnitude of this

measurement in the two species. For the smaller fish the rainbow tends to be slightly larger; for the longer fish the cutthroat has a slightly greater length. The Bow River fish are intermediate but tend to follow the cutthroat a little more closely.

Body Depth. The rainbow and cutthroat show the same change in body depth with an increase in standard length. The rainbow are very slightly (probably not significantly) deeper in the body. The Bow River fish tend to be a little larger than either of the two species but are closer in size to the rainbow.

Anal Length. For this characteristic there is no marked difference in length in the two species. They show the same change in anal length with an increase in size of the fish. The cutthroat has a greater anal length than the rainbow. The Bow River fish are again intermediate and tend to be scattered over the range of both species. They are like the cutthroat especially in the larger specimens.

Caudal Peduncle Length. There is a very noticeable difference in the caudal peduncle length with a proportionate increase in standard length of the two trout. The rainbow increases at a considerably greater rate than the cutthroat and their caudal peduncles are longer over almost the entire range of sizes. The Bow River fish are very similar to the cutthroat, following this line quite precisely.

Caudal Peduncle Depth. The intersecting of the

rainbow and cutthroat curves for this characteristic indicates a widely different increase in depth with length for the two species. For the smaller fish the rainbow has a greater caudal peduncle depth; for the intermediate and larger fish the cutthroat has the greater depth. The Bow River fish tend, as for the other characteristics, to be intermediate between the suggested parental stock. For the larger fish there is a slightly greater tendency to be like the cutthroat.

Pectoral and Pelvic Length. These two characteristics are dealt with together as they have very similar curves. The best fitting straight lines for both the cutthroat and rainbow were identical and are shown on the graph as one line. There is no significant difference between the two species for these two characteristics. The Bow River fish follow the general trend of the common curve for both characteristics. They have a slightly greater relative length in the smaller fish and a slightly shorter relative length in the larger specimens.

Pectoral to Pelvic Length. There is a very slight difference in the distance between the pectoral and pelvic fins for the two species. The cutthroat is the longer for the greater part of the range. The Bow River trout are intermediate in size but tend to be more like the cutthroat.

The conclusions from figure 1 will now be summed up briefly. In some characters the Bow River trout are intermediate in proportions between the rainbow and the

cutthroat. In all but two of the characteristics (eye diameter and body depth) the Bow River fish show a greater tendency to resemble cutthroats than rainbow.

Comparison of Proportionate Measurements of Bow River Trout with Other Trouts

As mentioned in the introduction, the literature on the proportionate measurements of various body parts of the trout has been searched and the data found are compiled in table II. Included in the table are comparable measurements of Bow River trout and the writer's measurements of cutthroat trout from the Spray Lakes. These data (table II) are presented in order to corroborate and expand the findings of the log-log graphs, just described. This table will be repeated here for convenience and a full explanation will follow in the text.

In this table the characteristics used are the four on which Dymond (1931-32) bases his taxonomic findings. The measurements are the proportionate measurements; the numbers given being the percentages of the standard length which the different body parts comprise. The lateral line scales are the number of scales counted along the lateral line from the posterior margin of the head to the caudal fin. In some of the columns the range of these counts, rather than the average, is given.

Table II.

Proportionate measurements of body parts of Bow River trout, rainbow and cutthroat trout of various localities

Figures give percentage of standard length

	I	II	III	IV	V	VI	VII	VIII
	Bow ♂	Spray ♂(♂+♀)	Gorge ♂ + ♀	Iri- deus ♂	Clar- kii ♂	Alpestris ♂(♀)	White- housei ♂(♀)	Kam- loops ♂
Head Length	22.9	22.2(21.7)	23.6	24.2	25.0	23.2(21.3)	26.9(24.9)	28.5
Inter-orbital W.	7.9	6.9(6.7)	6.6	8.5	7.5	6.7(6.5)	7.8(7.1)	9.8
Maxillary Length	13.3	13.0(12.6)	13.7	10.4	14.5	13.4(11.4)	13.8(12.3)	18.8
Snout Length	5.9	4.9(4.5)	6.3	6.2	7.0	6.5(5.5)	6.6(5.9)	11.0
Lateral Line Scales	128.5	124.1	143.4	115- 130	150- 158	200- 230	139- 164	135- 153

The various abbreviations at the top of the columns, numbered I to VIII, represent the following fish.

Column I Bow: The numbers in this column are the average proportionate measurements of 66 male Bow River fish. These figures represent all the male trout taken below the Carseland dam.

Column II Spray: These numbers are the average proportionate measurements of four male native cutthroats

from Spray Lakes; in parentheses are the average proportionate measurements of 11 trout, male and female. These represent all the trout taken by the writer from this area. Both sexes were used (in parenthesis) in order to have comparable figures with Andrekson's (1949) unsexed cutthroats (column III).

Column III Gorge: The numbers in this column are the average proportionate measurements of 101 native cutthroats taken from Gorge Creek in the Sheep drainage (Andrekson, 1949). As no sexual differentiation was given in Andrekson's data, both sexes are included in these figures.

Column IV Irideus: These figures are the average proportionate measurements of 17 male rainbow trout, (Salmo irideus Gibbons, Bajkov, 1927). (The standard lengths of Bajkov's trout were derived in the same manner as described previously).

Column V Clarkii: The numbers in this column are the proportionate measurements of one 12 inch male cutthroat, (Salmo clarkii, Dymond, 1932).

Column VI Alpestris: These figures are the proportionate measurements of Salmo clarkii alpestris (Dymond, 1931). The average of the paratypes, five males, is given first; the type species (one female) being in parenthesis. This trout inhabits a somewhat similar environment to the cutthroats in Columns II and III but are from the western slopes of the Rocky Mountains.

Column VII Whitehousei: The numbers given in this column are the average proportionate measurements for 10 male paratypes, and, in parenthesis, 9 female paratypes of Salmo kamloops whitehousei (Dymond, 1931).

Column VIII Kamloops: This column gives the proportionate measurements of one 29 inch male trout, Salmo kamloops Jordan (Dymond, 1932).

Table II is used here in deciding the possible parental stock of the Bow River trout.

In comparing the various cutthroats, columns II, III, V and VI the following observations are noted. Columns II, III and VI are very similar in these four characteristics. There is, however, a very wide variation in the lateral line scales. As mentioned previously, these three cutthroats inhabit a somewhat similar environment. The one fish used in Column V is definitely larger, in the four characteristics, than the other three types of trout.

In comparing the rainbow data, columns IV, VII and VIII, both the kamloops (VIII) and kamloops whitehousei (VII) have decidedly greater proportionate measurements than irideus (IV). The former two trouts are from the western slopes; the latter one is from the eastern slopes of the Rocky Mountains.

Comparing the Bow River trout, in light of the above, they appear to fall in the general range of columns II, III and VI for the cutthroats and column IV for the

rainbow. On the basis of scale count, column VI, alpestris, is eliminated from this comparison. Accordingly, columns II and III are used as the basis for the cutthroat and column IV as the basis for the rainbow. It will be noted that the Bow River trout are intermediate in the four characteristics shown. The scale count for these trout is within the range of the others but does not indicate any definite relationship to either of them.

It was observed from the log-log plots that the Bow River trout tend to be more like the cutthroats for most of the characteristics studied. Using only males to eliminate the error introduced by the sexes, a comparison of column I with column II (males only) and column IV shows the above statement to apply in two of the four characteristics. In inter-orbital width and snout length, the Bow River trout are more similar to the rainbow than the cutthroat. It must be borne in mind, however, that any definite conclusions are obscured by using fish of different lengths. No means of compensation are used in this direct comparison. Despite this obvious error, the fact that the Bow River trout do take up an intermediate position does substantiate the findings of the log-log plots.

The Frequency Distribution of Proportionate Measurements of Body Parts

A third way of comparing the Bow River fish with trout of other areas is to plot frequency curves of the measurements of various parts of the different trouts. Accordingly, frequency tables of the proportionate measurements of head length, inter-orbital width, maxillary length and snout length were constructed using the following trout: 17 male rainbow (Bajkov, 1927), 19 Gorge Creek cutthroat, mixed males and females with a strong cut mark, (Andrekson, 1949) and 66 male Bow River trout taken from below the Carseland dam. The other cutthroat in table II (column II, Spray) could not be used in the frequency distribution because their numbers were too few. The four characters chosen for comparison are those favoured by Dymond (1931-32). The frequencies in the tables were converted to percentages to make the comparisons easier. These percentages have been plotted and are shown as figures 3 to 6.

Snout Length. The graphs for all three types of trout show almost the same distribution for this characteristic. All three curves approximate normal frequency curves. The Bow River trout show a larger number of fish in the two extremes than do the cutthroat and rainbow.

~~delete~~ (This is probably attributable to the larger number of fish used.)

Figure 3

Figure 4

Figure 5

Figure 6

Maxillary Length. The distribution curve for the rainbow shows a definitely shorter maxillary than the others. The largest number of fish fall in the 9.1 to 10.0 interval in contrast with the cutthroat and Bow River maxima which fall into the 13.1 to 14.0 and 14.1 to 15.0 intervals respectively. It is noted that the Bow River fish have a much flatter and wider distribution curve. This curve overlaps the larger rainbow and coincides fairly closely with the range of the cutthroats. A wide flattened curve with a tendency towards a bimodal shape is what might be expected from a hybrid.

Head Length. The curves for this characteristic show a fairly typical unimodal shape for the cutthroat and the rainbow. The largest number of fish fall into the 23.1 to 24.0 interval for both species. The Bow River fish show a bimodal distribution which could be reasonably interpreted as a hybrid tendency. The range overlaps that of both the cutthroats and rainbows. The largest number of both these species falls between the two maxima of the Bow River fish.

Inter-orbital Width. The largest number of cutthroats show a narrower inter-orbital width. The Bow River fish tend to be intermediate between the two suggested parental stocks but are more like the rainbow than the cutthroat.

In conclusion, it is observed that these frequency distribution curves corroborate the findings ~~of~~ derived from table II and the log-log graphs.

Discussion of Taxonomic Status

Taking into consideration all the errors which could not be avoided, the following conclusions may be drawn.

The Bow River trout tend to be intermediate in proportions for all of the taxonomic characteristics, but, in the majority of these characteristics, they resemble the cutthroat more closely than the rainbow.

A brief resume of the conclusions from the log-log graphs, table II and the frequency distribution curves is now useful. From the head length and inter-orbital measurements, the only conclusion substantiated by all three approaches to the problem is the intermediate position, assumed by the Bow River trout. In regard to maxillary length, the intermediate position and the tendency to be more similar to the cutthroat is borne out by all three methods used. From the table and frequency curves, there is no significant difference for the snout length for the three trouts.

From all these considerations it is concluded that the Bow River trout originated as a hybrid between the native cutthroat and the introduced rainbow.

In choosing Bow River fish for these computations the only consideration was to select a representative size range. The fish were then checked for the presence or absence of the 'cut mark' (table ~~III~~^{VIII}, appendix). Of the 25 fish used, only nine had a 'cut mark' and yet the comparisons show a general tendency to resemble the cutthroat more closely than the rainbow. The logical conclusion that may be drawn is that these cutthroat characteristics have a survival value. The cutthroat is the native trout in these waters and no doubt has developed certain characteristics which have led to their survival. Over the short period of time in which this suggested hybrid has arisen, those fish tending to be similar to the native cutthroats may have survived and reproduced their kind. Those which are more like the rainbow may have proven less able to survive and thus have disappeared. The cutthroat mark either has no survival value or, being a recessive character, has begun to disappear from the hybrid. It is admitted that the survival value of some, or all, of these taxonomic characteristics is unknown, but the tendency of the Bow River trout to retain their cutthroat characteristics does suggest that cutthroat properties may have a survival value.

Table III.

Record of collections of minnows and small fishes in the lower Bow River

Sample number	Location	Date	Notropis hudsonius	Catostomus commersonii	Rhinichthys cataractae	Percopsis omiscomaycus	Couesius plumbeus
1	Below sluice gates at Bassano dam	June 7	3	1			
2	$\frac{1}{2}$ mile below Carseland dam	June 8		3	7		
3	Immediately below Carseland dam	June 12		3	10	1	
4	Immediately below Carseland dam	June 17		1	6		
5	Immediately below Carseland dam	June 23			5	1	
6	Above highway bridge $1\frac{1}{2}$ miles below Carseland dam	July 16		2	29		
7	Immediately below Carseland dam	Aug. 17		2	13		1
8	Immediately below Carseland dam	Aug. 27			6		2

GENERAL BIOLOGY OF BOW RIVER TROUT

Some of the biological factors which are related to these trout will now be discussed. This is not to be considered a complete investigation of all the factors involved; only the main features which were observed while collecting data for the taxonomic treatment will be mentioned. These include growth rate, spawning behaviour and seasonal movements, each of which will be discussed. Finally, a few of the management problems will be examined.

Environmental conditions such as temperature and pH were observed periodically throughout the investigation. The temperature of the Bow River in the area of the Carseland dam varied from a minimum of 46° F. on May 23 to a maximum of 68° F. on August 1. The pH remained fairly constant throughout the summer, the variations being from 7.7 to 8.2

A series of samples of small fishes taken throughout this period are given in table III (opposite page 28). The minnow population appeared to be confined mainly to a few species. The total population during the late spring and summer was extremely large. The area immediately below the control gates of the dam was black with minnows and young suckers for the greater part of the season.

Growth Rate

As this area of the Bow River was fairly heavily populated with good sized trout, it was decided that a growth rate calculation would be of considerable value from the point of view of management. Consequently, this was done and two populations seemed to be indicated: one above the dam and another below. The procedure and observations were as follows.

Scale samples were taken from each fish that was measured taxonomically. These scales were cleaned and mounted in glycerine jelly. For study they were projected to a magnification of 55 diameters. On these magnified images the diameter of each scale and the diameter at the end of each preceding year of life was measured with a ruler. These measurements were possible because of the presence of annuli on the scales, each annulus being a mark on the scale caused by the cessation of growth in the fall followed by its resumption in the spring.

The scales from these fish, as from all other trout, were very difficult to interpret accurately. A length-frequency and an age-frequency curve both had the typical unimodal distribution indicating that all the trout scales were read consistently.

The data obtained from this scale study were used to determine not only the age of each fish, but also to calculate, by proportions, the length of the fish at the

end of each preceding year of its life. A summary of these calculations is shown in tables IV and V. The fish were divided into two groups, those taken below Carse-land dam and those above, and the two tables show these treated as separate populations.

The data of tables IV and V have been used to plot the two growth curves shown in figure 7.

Table IV.

Calculated rate of growth in length for trout taken below Carseland dam
(lengths in mm.)

Age	No. of fish	Average length at capture	Average calculated length								
			1 yr.	2 yr.	3 yr.	4 yr.	5 yr.	6 yr.	7 yr.	8 yr.	9 yr.
2	6	282.2	106.3	205.8							
3	18	333.5	94.1	209.4	303.3						
4	21	379.6	98.9	188.3	302.2	359.2					
5	30	418.7	87.3	166.7	254.1	342.3	395.5				
6	8	448.3	64.2	134.5	219.1	307.1	384.3	432.6			
7	8	477.3	66.6	133.3	220.7	304.2	383.1	431.2	462.6		
8	6	499.6	51.5	101.5	171.3	243.3	357.5	419.5	458.1	484.1	
9	<u>4</u>	536.2	58.0	110.2	190.7	260.5	334.0	398.7	449.5	498.5	524.0
	101										
Average		403.8	85.3	169.9	260.3	327.4	383.7	423.9	458.2	489.9	524.0

Table V.

Calculated rate of growth in length of trout taken above

Carseland dam

(lengths in mm.)

Age fish	No. of at capture	Average length	Average calculated length								
			1 yr.	2 yr.	3 yr.	4 yr.	5 yr.	6 yr.	7 yr.	8 yr.	9 yr.
2	14	296.0	96.4	193.2							
5	6	401.8	63.4	134.8	219.0	300.3	380.5				
6	6	450.5	65.9	131.2	208.1	311.0	384.6	438.3			
7	4	507.2	66.8	119.7	200.5	304.5	396.7	451.2	486.0		
9	<u>1</u>	604.0	62.5	132.0	234.0	355.0	452.0	501.0	561.0	569.0	589.0
	31										
Average		383.6	79.2	158.5	211.7	308.3	390.0	448.7	501.0	569.0	589.0

As only 31 trout were available for the above-dam population, compared to 101 from below the dam, a less regular curve was obtained for the former.

In considering both the curves of figure 7, it may be observed that the growth at the end of the first and second years is almost the same. In the third and fourth years, the above-dam population growth slows down while the below-dam population increases gradually. Between the fourth and fifth year of growth, the above-dam population

TABLE I

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

Summary of the results of the investigation

FIGURE 7

Growth curves showing rate of growth in length
of Bow River trout from above and below the
Canseland dam.

above dam -----
below dam —————

overtakes the below-dam population and continues at a greater rate for the remaining age groups.

The upper limits of the curves should not be interpreted as being entirely correct. The difficulty in reading scales of such age groups, together with the small number of fish in these groups does not give a sufficiently accurate result. This applies particularly to the above-dam population where the number of fish is fairly small for all age groups. For the below-dam population, a typical growth curve is obtained.

In a consideration of these growth rates, it must be borne in mind that tackle selectivity has influenced the size of the fish obtained. The majority of these trout was taken with casting tackle using a Len Thompson spoon or a flatfish. Such tackle tends to take the largest fish of the year classes and only fish which have actually entered the fishery will be taken at all. A large number of the smallest fish, taken below Carseland dam, were caught on flies. These would be the smallest fish that have entered the fishery. Taking into consideration these factors, it is apparent that the growth curves of figure 7 represent maximum rates.

Spawning Behaviour

The next factor to be discussed in the general biology of these trout is the interesting spawning behaviour.

The trout were observed by the writer on their spawning beds from the middle of May to the middle of June. None of these fish could be enticed to strike at any kind of lure or bait; consequently none of the actual spawners was collected and examined. The locations of the spawning beds are marked + on the sketch map, figure 1. They were found in fast moving water on fine gravel and sand. The area in which the beds were located had apparently been cleaned of algae and slime as they showed up as bright patches of gravel about six feet square. Each bed was hollowed out somewhat with a deep pool immediately below. Presumably the area was picked out and cleaned by the spawning pair of fish. When the female is ripe, both fish stay side by side, facing upstream, with just sufficient movement to maintain a stationary position against the action of the current. The female, when laying her eggs, moves her body violently. By flipping over on her side and thrashing about with her tail, she raises a cloud of sand. This action lasts about five to ten seconds. The male then proceeds in a similar manner but somewhat less violently and for a shorter period of time. The female repeats her activity every two or three minutes.

If another trout, probably another male, attempts to enter this area, it is violently attacked and chased away by the male. The female remains on the spawning bed while the male is thus engaged.

It appears highly probable that each bed is used by more than one pair of trout. Over a period of several days fish were observed on the same spawning bed. Only one pair used these beds at the same time but, from the difference in sizes, it was apparent that it was not the same pair over the entire period.

Eggs were recovered beneath the fine gravel on these beds. This was accomplished by kicking up the bottom and catching the material swept down below the bed in a net. Sucker eggs were also recovered from the material caught below the bed. These fish were not observed on the bed but had evidently spawned there sometime before the trout were observed.

All the above information was obtained from areas below Carseland dam. At the time these trout were spawning, the area above the dam was unsuitable for boating due to the large amount of submerged debris and hidden sand bars. The water was high and dirty so it was impossible to locate any likely spawning areas at this time. Later in the summer, this area was investigated and a number of potential spawning beds were located. The area had been cleaned and conditions similar to the established beds prevailed. These potential beds are indicated by ⊕ on sketch map, figure 1.

Table VI.

Record of Bow River trout tagged in the vicinity of Carseland
dam

Tag no.	Date	Location
100	Aug. 14	6 miles above dam
101	" 14	5 $\frac{1}{2}$ " " "
102	" 14	5 $\frac{1}{2}$ " " "
103	" 14	4 " " "
104	" 14	3 $\frac{1}{2}$ " " "
105	" 14	3 $\frac{1}{2}$ " " "
106	" 14	3 " " "
107	" 14	3 " " "
108	" 14	3 " " "
109	" 14	2 $\frac{1}{2}$ " " "
110	" 14	2 $\frac{1}{2}$ " " "
111	" 10	5 " " "
112	" 25	2 $\frac{1}{2}$ " " "
113	" 7	2 $\frac{1}{2}$ " " "
114	" 14	2 " " "
115	" 21	2 " " "
116	" 21	2 " " "
117	" 21	2 " " "
118	" 21	2 " " "
119	" 28	2 " " "
120	" 28	2 " " "
121	" 14	2 " " "
122	" 14	1 $\frac{3}{4}$ " " "
123	" 16	Below small dam
124	" 17	1 $\frac{1}{4}$ miles above dam
125	" 17	1 $\frac{1}{4}$ " " "
126	" 18	1 " " "
127	" 18	1 $\frac{1}{2}$ " " "
128	" 18	1 $\frac{1}{2}$ " " "
129	" 18	1 $\frac{3}{4}$ " " "
130	" 19	1 $\frac{3}{4}$ " " "
131	" 19	1 " " "
132	" 19	1 $\frac{3}{4}$ " " "
133	" 21	2 $\frac{1}{2}$ " " "
134	" 21	2 $\frac{1}{2}$ " " "
135	" 21	1 " " "
136	" 21	1 " " "
137	" 26	1 $\frac{1}{4}$ " " "
138	" 26	1 $\frac{1}{4}$ " " "
139	" 26	1 $\frac{3}{4}$ " " "
140	" 26	1 $\frac{3}{4}$ " " "

Table VI. (cont.)

Tag no.	Date	Location
141	Aug. 26	3 miles above dam
142	" 26	4 " " "
143	" 28	4 Below big dam
144	" 28	" " "
145	" 28	" " "
146	" 28	" " "
147	" 28	" " "
148	" 28	" " "
149	" 28	" " "
150	" 28	" " "
151	" 28	" " "
152	" 29	" " "
153	" 29	" " "
154	" 29	" " "
155	" 30	" " "
156	" 30	" " "
157	" 31	" " "
158	" 31	" " "
159	" 31	" " "
160	" 31	" " "
161	Sept. 1	" " "
162	" 1	" " "
163	" 1	" " "
164	" 1	" " "
165	" 1	" " "
166	" 1	" " "
167	" 1	" " "
168	" 2	" " "
169	" 2	" " "
170	" 2	" " "
171	" 2	" " "
172	" 2	" " "
173	" 2	" " "
174	" 2	" " "
175	" 2	" " "
176	" 3	" " "
177	" 3	" " "
178	" 3	" " "
179	" 3	" " "
180	" 3	" " "
181	" 3	" " "
182	" 3	" " "
183	" 3	" " "
184	" 3	" " "
185	" 3	" " "
186	" 4	3 miles above dam
187	" 4	4 " " "
188	" 4	1 " " "
189	" 4	3 " " "
190	" 4	4 " " "

Table VI. (cont.)

Tag no.	Date	Location
191	Sept. 4	3 miles above dam
192	" 5	" " "
193	" 5	" " "
194	" 4	" " "
195	" 5	" " "
196	" 5	" " "
197	" 5	" " "
198	" 5	" " "
199	" 5	" " "
200	" 9	" " "

Tagging Operations

In order to gain more information of possible movements of these Bow River trout, a hundred of them were tagged during the latter part of August and the first part of September. Forty-four trout were tagged above the dam and 56 below. Table VI gives the complete record of the trout tagged in this area. The type of tag used was a body tag. A nickel pin was inserted through the muscle of the back below the dorsal fin. A red disk was attached on one side and a white one on the other. Such tags should be very successful as they are very conspicuous and readily observed by any angler.

The purpose of this tagging operation was twofold. Firstly, to observe any migrations and to see what effect the dam had on these migrations. Secondly, to estimate the percentage of the population taken by angling

THE UNIVERSITY OF CHICAGO

 

THE UNIVERSITY OF CHICAGO

every year. The results of this operation will not become apparent until, and unless, tags are returned during the angling season next year.

In considering the first purpose of this tagging operation, it is apparent that there is no obstacle to prevent the free movement of the above-dam population. It is the opinion of the writer that the dam affords a complete block to any of the below-dam population attempting to move upstream. The dam has a fish ladder installed (see figure 1), but it appears to be ineffective in allowing fish to move upstream over the dam. The writer watched trout jumping up into the waterfall over this dam for many hours. At no time were any fish observed getting into the ladder. Certainly very few, if any, could make the ascent if they were fortunate enough to get into the lower step.

According to Miller and Macdonald (1950) it would appear that the native cutthroat is non-migratory. It would seem reasonable from the foregoing taxonomic findings that these trout would tend to be non-migratory. If this is so, the blocking of movement by the dam is of no importance from a management point of view. In support of the non-migratory theory, it was observed that these trout jumped continually, long after the usual spawning period was over. Also, fish were observed spawning below the dam and it would appear that the migratory urge was

insufficiently strong to prevent normal spawning when their migration was blocked.

The jumping of these trout was confined almost entirely to a period of an hour or so in the evening. This would indicate that the waterfall is more of a challenge to the trout than a biological drive induced by some reproductive hormone. The confirmation of these observations will have to await further investigation.

The second purpose of this tagging is to obtain an estimate of the population taken by angling during the season. The percentage of the tagged fish taken will indicate the percentage of the total population being caught by anglers. The results of this part of the investigation should appear after the close of the angling season next year.

Management

In the preceding sections some biological factors were discussed briefly in their relationship to management. The management problems with which this section is concerned are angling regulations, natural reproduction and pollution.

The per diem limit for trout in this area is 15 and the size limit is eight inches, measured from the snout to the centre of the tail. The effect of these regulations from a management point of view is beyond the

scope of this thesis. However, something may be said regarding regulations governing the opening and closing dates of the angling season.

All fish taken in this study were sexed and the condition of the sex organs recorded (table VIII in appendix). These observations are presented in table VII, where they are arranged into three groups according to date. The first group consists of fish taken prior to the opening day of angling, i.e., May 10 to June 16. The second group consists of the fish taken from opening day in Alberta (June 16) to opening day in the National parks (July 1). The third group contains the fish taken after July 1.

In the first group, 68.7% of the fish were ripe and only 3.1% had already spawned (spent). 9.4% were not yet in spawning condition.

In Group II, 34.0% were ripe in comparison with 68.7% in the first group. There were no unripe fish and 44% had spawned in comparison with 3.1% in the first group.

In the third group, only 7.7% of the fish taken were ripe and 48.7% had finished spawning.

Table VII.

Sexual condition of Bow River trout during three periods
of the season

Group I. May 11 to June 16			
Sexual condition	No. of fish	Percentage	Total no.
Ripe	22	68.7	33
Unripe	3	9.4	
Spent	1	3.1	
Immature	6	18.8	
Group II. June 16 to July 1			
Ripe	17	34.0	50
Unripe	0	0.0	
Spent	22	44.0	
Immature	11	22.0	
Group III. July 1 to August 4			
Ripe	3	7.7	39
Unripe	0	0.0	
Spent	19	48.7	
Immature	17	43.6	

From the above data, it would appear that to allow complete spawning of the trout in this area, July 1 should be the opening day for angling. It should be noted that probably the water temperature in this area reaches a suitable spawning level before areas further north in the province. The later spring in the northern waters probably retards spawning even more than in this area.

It must be pointed out that the above findings are only applicable if closed season regulations are an important factor in the management of fisheries. The necessity of a closed season has never been substantiated. It has been only a general assumption since fisheries conservation regulations began. Eschmeyer (1947) in his investigations in the Tennessee Valley drainage has shown that a closed season during spawning is unnecessary in the maintenance of a good fishing population. No such investigations have been carried out in this province. A closed season may have no value for the management of sport fishing in Alberta.

The next management problem to be discussed is that of natural reproduction. Of the 138 trout caught and measured, above and below the Carseland dam, 65 were males, 62 were females and 11 were doubtful or immature. This being a random sampling of the population over a four months' period indicates a very even distribution of the sexes. An examination of table VIII in appendix shows that maturity generally occurs in the fourth year. A few of the trout did not mature until the fifth year and a few reached maturity in their third year. Providing water, food and spawning conditions are favourable, and this would appear to be so, natural reproduction should be good.

During the late summer and early fall very great variations in the volume of water were observed.

 

These extreme variations are due to the control of the water at the Ghost River dam. Such a variation during spawning season would drastically reduce natural reproduction. All the spawning beds observed were uncovered at times with the change in water level. Fortunately, these water level variations were very small during the entire spawning season and had no noticeable effect on natural reproduction.

The very contentious question of pollution in the lower Bow River has been a problem of great concern to sportsmen for a number of years. The investigation of such a problem is beyond the scope of this thesis but cannot be altogether ignored in any studies related to the Bow River. It is the opinion of the author that to whatever the pollution may be attributed, it is not toxic to the trout. It is the edibility that is affected and to which the anglers object so strongly. During the season a goodly number of these fish were eaten by the writer and very few had the reported "oily" taste. It was noted, however, that during the hottest part of the summer when the temperature of the water reached 60° F. to 68° F. (the maximum), the flesh became soft and unappetizing. Whether this was due to the warm water, or to a combination of warm water and pollution, the writer is unqualified to say. The above statements apply only to the area in and around the Carseland dam. Fifteen to twenty miles upstream towards

Calgary, fish were reported "oily" for a good part of the season. In this area, in some of the backwaters, an oily scum was observed on the surface of the water. When the soft bottom was walked on, the oil oozed up to the surface and spread out. A particularly disagreeable odour was present at this time. There seems to be no doubt that there is some pollution present but the extent and the cause of this pollution is unknown. That it is non-toxic to trout seems ^{is indicated by} (reasonably certain due to) the excellent angling prevailing in the Bow River.

CONCLUSION

The main purpose of this investigation has been to establish the identity of the Bow River trout, wrongly called 'steelhead' by the anglers who catch them. The principal conclusion is that they are actually hybrids between the introduced rainbow and the native cutthroat (Salmo gairdnerii x Salmo clarkii).

It has been difficult to reach this conclusion. The literature contains only a very few statements of the specific characteristics of the two parent stocks, and these few statements are not wholly satisfactory for comparison with the Bow River data. However, every effort has been made to render the data comparable, and, although

some errors have doubtless persisted to obscure the picture, it is felt that the evidence is strongly in support of the hybrid theory.

The hybrid tends to be more similar to the cutthroat parent than to the rainbow. It is not a sterile hybrid as these fish are able to reproduce. Apparently they are non-migratory and their growth rate in the present environment is good. The distribution of a similar trout throughout the Old Man and Sheep drainages indicates that they will survive under the colder, less productive conditions that prevail in these waters.

The hybrids combine the sporting qualities of the rainbow and the cutthroat and are proving to be a real attraction to even the most ardent anglers.

ACKNOWLEDGMENTS

The author wishes to express his appreciation to the Alberta Government, Department of Lands and Forests, Fisheries Branch for financial assistance in carrying out this investigation; to Mr. W. H. Macdonald, Inspector of Fisheries and to Mr. W. Bell, Fisheries Officer for their assistance while collecting the data; and to Mrs. L. Morris, for her aid in typing the manuscript.

The author is sincerely grateful to Dr. R. B. Miller, University of Alberta, for his constant encouragement, patient direction and for his supervision in the planning, interpretation and presentation of the results.

REFERENCES

- Andrekson, A. (1949) A Study of the Biology of the Cutthroat Trout in the Sheep River with Special Reference to Gorge Creek. M.Sc., University of Alberta.
- Bajkov, A. (1927) Reports of the Jasper Park Lakes Investigations 1925-26. I. The Fishes. Reprinted from Contributions to Canadian Biology & Fisheries, being studies from Biological Stations of Canada, N. S., Vol. III, No. 16, 1927.
- Dymond, J. R. (1931) Description of Two New Forms of British Columbia Trout. Reprinted from Contributions to Canadian Biology & Fisheries, being studies from the Biological Stations of Canada, N. S., Vol. VI, No. 16, 1931.
- Dymond, J. R. (1932) The Trout and Other Game Fishes of British Columbia. Published by the Dept. of Fisheries.
- Eschmeyer, R. W. (1947) T. V. A. (Tennessee Valley Authority) "Year-Round Fishing" Experiments. Mimeographed, 12 pp.
- Hubbs, Carl L. and Lagler, Karl F. (1947) Fishes of the Great Lakes Region. Cranbrook Institute of Science, Oct. 1947.
- Huxley, J. S. (1932) Problems of Relative Growth. Methuen, London.

- Jordan, D. S. and Evermann, B. W. (1896) The Fishes of North and Middle America. Washington: Gov't Printing Office, 1898.
- Miller, R. B. and Macdonald, W. H. (1950) Preliminary Biological Surveys of Alberta Watersheds 1947-1949. Dept. of Lands and Forests, Gov't of Alberta. pp. 139.
- Neave, Ferris (1943) Racial Characteristics and Migratory Habits in Salmo gairdneri. J. Fish. Res. Bd. Can. 6 (3) 1944: pp. 245-251.
- Rawson, D. S. (1936) Report on the Biological Examination of the Kananaskis Lakes, Alberta. (mimeographed).

APPENDIX

Table VIII.

Measurements of trout from the Bow River, Willow Creek,
Kananaskis Lake and Spray Lakes (mm.)

Key

No. - the number of the individual fish; TL - total length of the fish; SL - standard length; HL - head length; HD - head depth; S - snout; IO - inter-orbital width; M - maxillary length; ED - eye diameter; S to O - snout to occiput length; O to D - occiput to dorsal length; BW - body width; BD - body depth; CPL - caudal peduncle length; CPD - caudal peduncle depth; DL - dorsal fin length; AL - adipose fin length; P₁ - pectoral fin length; P₂ - pelvic fin length; An L - anal fin length; An R - number of anal fin rays; GR - total number of gill rakers; LLS - the number of lateral line scales; P₁P₂ - the distance between the pectoral and pelvic fins; P₂An - the distance between pelvic and anal fins; An B - length of anal base; Hyoid teeth - teeth on the hyoid bone of the lower jaw; Cut mark - cutthroat mark; Rain stripe - rainbow stripe; Age - the age of fish as calculated from scale readings; Wt. - weight in grams; Sex, F - female, M - male; Sex organs - sexual condition at time of examination; Mature R - mature ripe; Mature Un. - mature unripe; Mature S - mature spent.

BOW RIVER FISH

No.	TL	SL	HL	HD	S	IO	M	ED	S to O	O to D	BW	BD	CPL	CPD	DL	AL	P ₁	P ₂
1	530	478	103	74	29	35	56	20	73	146	40	87	70	41	74	24	62	54
2	374	340	74	52	18	24	39	14	51	111	41	69	53	30	53	21	44	37
3	505	450	100	63	23	32	53	19	61	154	47	91	72	41	63	22	65	54
4	378	340	78	54	20	25	45	14	53	121	39	73	51	32	51	17	46	39
5	370	330	74	51	19	24	40	15	50	113	43	79	52	34	50	25	50	43
6	386	345	78	53	22	27	48	15	55	114	41	72	44	33	60	15	52	46
7	330	297	65	45	13	24	36	14	46	101	36	66	46	30	59	22	42	37
8	515	459	120	73	34	39	77	20	73	154	54	104	66	49	69	41	74	64
9	457	409	100	61	29	33	61	18	68	132	39	77	60	39	62	31	63	55
10	373	335	80	49	19	27	48	17	54	116	38	69	50	31	53	28	53	46
11	426	379	83	53	18	27	46	16	55	127	44	82	67	35	60	25	56	50
12	451	395	98	60	23	28	55	19	60	136	45	90	64	38	68	25	64	56
13	364	322	71	47	17	24	39	16	45	110	40	79	55	33	55	26	52	46
14	417	370	83	53	19	28	44	18	49	132	44	85	58	35	64	28	60	50
15	428	381	82	53	18	27	44	16	49	139	46	86	58	36	63	26	59	52
27	235	212	48	30	11	16	24	13	32	72	24	54	35	20	36	15	35	30
28	458	411	104	63	27	35	63	19	69	132	44	86	66	39	69	31	64	58
29	400	360	76	52	14	26	37	16	49	116	43	84	59	32	61	29	52	45
30	364	326	74	51	16	26	40	16	45	111	37	75	52	33	56	26	52	47
31	401	354	78	53	19	24	49	16	49	131	44	93	61	36	67	24	61	54
32	372	333	71	48	14	24	38	16	45	116	41	79	53	31	58	23	51	42
33	346	303	77	51	17	26	43	15	48	103	37	81	51	30	53	21	51	45
34	461	414	98	60	28	35	60	19	66	128	47	92	71	39	65	31	59	54
35	367	327	78	51	19	27	46	15	50	109	39	79	54	30	56	31	53	44
36	405	365	77	50	19	28	46	16	52	120	44	78	61	34	58	29	56	48
37	446	401	93	57	25	28	59	17	54	138	45	92	64	36	68	28	64	53
38	512	460	94	62	24	36	53	18	62	151	53	94	65	43	71	35	74	58
39	539	482	107	76	40	42	82	21	89	153	53	104	73	43	-	37	70	62
40	487	431	113	69	32	39	69	19	74	127	-	85	65	39	82	31	71	63
41	392	353	85	53	20	28	48	17	58	112	36	76	53	32	57	29	54	45
42	342	311	66	45	15	23	36	16	38	97	36	74	48	29	51	24	44	39
43	393	346	82	53	18	27	43	17	52	116	43	87	54	35	69	26	62	54
44	243	217	50	34	12	16	26	12	31	70	26	61	38	21	39	16	36	32
45	461	411	93	62	25	36	58	19	64	145	51	104	59	43	75	31	64	57
46	415	369	77	54	18	26	42	15	52	128	44	83	55	34	66	26	57	51
47	490	436	108	67	25	36	62	19	70	148	51	111	68	46	81	36	72	61
48	453	405	88	56	19	29	47	17	53	138	39	73	60	35	72	27	63	56
49	418	373	79	52	19	28	44	16	50	122	43	81	59	37	60	23	58	48
50	359	318	73	48	16	23	42	16	44	112	39	75	49	34	57	21	52	46
51	461	408	99	63	27	31	63	17	63	141	49	103	62	37	71	26	64	58

BELOW CARSELAND DAM

An L	An R	GR	LLS	P ₁ P ₂	P ₂ An	An B	Hyoid Teeth	Cut Mark	Rain Stripe	Age	Wt	Sex	Sex Organs
67	12	19	126	161	109	55	Absent	Absent	Present	9	-	F	Mature R
38	12	19	121	121	73	34	Absent	Absent	Present	3	-	M	Mature R
61	12	20	123	144	102	46	Absent	Absent	Present	9	-	F	Mature R
46	11	20	125	109	80	36	Absent	Absent	Faint	4	-	M	Mature R
48	11	20	123	111	72	38	Weak	Present	Faint	5	-	F	Mature Un
53	11	19	123	113	79	39	Weak	Faint	Faint	5	20	M	Mature R
46	11	20	123	90	74	34	Absent	Absent	Present	2	17	M	Immature
69	11	20	122	153	101	46	Present	Faint	Present	9	54	M	Mature R
59	11	18	127	129	96	45	Absent	Absent	Present	5	28	M	Mature R
48	12	19	124	108	75	36	Absent	Absent	Present	4	18	M	Mature R
53	12	19	123	118	91	42	Absent	Absent	Present	5	28	F	Mature R
57	10	16	119	135	92	38	Absent	Present	Faint	5	32	M	Mature R
46	12	19	120	105	74	35	Present	Present	Present	4	20	M	Immature
55	12	21	129	124	89	42	Absent	Absent	Faint	6	28	M	Mature Un
57	12	20	119	130	88	39	Present	Faint	Faint	4	29	F	Mature R
31	12	18	125	66	48	23	Present	Absent	Present	3	5	F(?)	Immature
58	12	19	129	122	89	45	Present	Absent	Present	7	32	M	Mature R
52	12	23	131	115	91	41	Present	Absent	Present	5	24	M	Mature Un
49	12	18	130	106	78	34	Absent	Absent	Present	5	19	M	Mature Un
54	11	19	125	123	87	37	Present	Present	Absent	4	25	M	Mature Un
50	13	19	137	109	74	37	Absent	Absent	Present	4	21	F	Mature Un
42	11	19	130	99	70	31	Present	Present	Present	3	19	M	Mature Un
57	11	18	129	131	92	45	Absent	Absent	Present	7	37	M	Mature R
48	12	17	130	106	79	37	Absent	Faint	Faint	4	21	M	Mature R
52	12	19	131	114	85	38	Absent	Absent	Present	4	24	M	Mature Un
59	11	21	131	128	92	40	Present	Present	Present	5	31	M	Mature R
63	12	20	134	139	110	55	Absent	Absent	Faint	8	45	F	Mature S
73	13	19	125	141	110	55	Absent	Absent	Present	7	53	M	Mature R
69	12	21	129	134	95	51	Absent	Absent	Present	6	34	M	Mature R
51	12	21	132	118	77	38	Absent	Absent	Faint	4	21	M	Mature Un
42	11	22	129	107	74	35	Absent	Absent	Faint	4	-	F	Immature
57	12	19	123	116	78	42	Absent	Present	Faint	4	26	F	Mature R
32	12	20	126	68	49	25	Absent	Absent	Present	3	7	M	Immature
60	12	20	131	139	94	49	Absent	Absent	Present	5	43	M	Mature R
57	11	18	128	121	94	36	Weak	Faint	Faint	6	24	F	Mature R
64	12	19	131	141	101	48	Absent	Absent	Present	5(?)	51	M	Mature S
61	12	20	127	137	93	42	Absent	Absent	Present	6	-	F(?)	-
53	12	22	131	118	89	41	Absent	Absent	Present	5	-	F(?)	-
50	11	20	129	110	71	36	Absent	Present	Absent	4	-	M	Mature R
59	12	17	129	144	98	42	Weak	Faint	Faint	5	40	M	Mature S

Table 1. Summary of data for the 1990-1991 season.

Year	Month	Day	Time	Location	Species	Sex	Age	Weight (g)	Length (mm)	Wing (mm)	Tail (mm)	Bill (mm)	Foot (mm)	Claw (mm)	Ear (mm)	Eye (mm)	Ear (mm)	Eye (mm)	Ear (mm)	Eye (mm)
1990	Jan	1	08:00	Forest	Parula	Male	Adult	120	150	100	80	20	15	10	5	3	2	1	1	1
1990	Jan	2	08:00	Forest	Parula	Female	Adult	110	140	90	70	18	14	9	4	2	1	1	1	1
1990	Jan	3	08:00	Forest	Parula	Male	Adult	125	155	105	85	22	16	11	6	4	3	2	1	1
1990	Jan	4	08:00	Forest	Parula	Female	Adult	115	145	95	75	20	15	10	5	3	2	1	1	1
1990	Jan	5	08:00	Forest	Parula	Male	Adult	130	160	110	90	24	18	12	7	5	4	3	2	1
1990	Jan	6	08:00	Forest	Parula	Female	Adult	120	150	100	80	22	16	11	6	4	3	2	1	1
1990	Jan	7	08:00	Forest	Parula	Male	Adult	135	165	115	95	26	20	13	8	6	5	4	3	2
1990	Jan	8	08:00	Forest	Parula	Female	Adult	125	155	105	85	24	18	12	7	5	4	3	2	1
1990	Jan	9	08:00	Forest	Parula	Male	Adult	140	170	120	100	28	22	14	9	7	6	5	4	3
1990	Jan	10	08:00	Forest	Parula	Female	Adult	130	160	110	90	26	20	13	8	6	5	4	3	2
1990	Jan	11	08:00	Forest	Parula	Male	Adult	145	175	125	105	30	24	15	10	8	7	6	5	4
1990	Jan	12	08:00	Forest	Parula	Female	Adult	135	165	115	95	28	22	14	9	7	6	5	4	3
1990	Jan	13	08:00	Forest	Parula	Male	Adult	150	180	130	110	32	26	16	11	9	8	7	6	5
1990	Jan	14	08:00	Forest	Parula	Female	Adult	140	170	120	100	30	24	15	10	8	7	6	5	4
1990	Jan	15	08:00	Forest	Parula	Male	Adult	155	185	135	115	34	28	17	12	10	9	8	7	6
1990	Jan	16	08:00	Forest	Parula	Female	Adult	145	175	125	105	32	26	16	11	9	8	7	6	5
1990	Jan	17	08:00	Forest	Parula	Male	Adult	160	190	140	120	36	30	18	13	11	10	9	8	7
1990	Jan	18	08:00	Forest	Parula	Female	Adult	150	180	130	110	34	28	17	12	10	9	8	7	6
1990	Jan	19	08:00	Forest	Parula	Male	Adult	165	195	145	125	38	32	19	14	12	11	10	9	8
1990	Jan	20	08:00	Forest	Parula	Female	Adult	155	185	135	115	36	30	18	13	11	10	9	8	7
1990	Jan	21	08:00	Forest	Parula	Male	Adult	170	200	150	130	40	34	20	15	13	12	11	10	9
1990	Jan	22	08:00	Forest	Parula	Female	Adult	160	190	140	120	38	32	19	14	12	11	10	9	8
1990	Jan	23	08:00	Forest	Parula	Male	Adult	175	205	155	135	42	36	21	16	14	13	12	11	10
1990	Jan	24	08:00	Forest	Parula	Female	Adult	165	195	145	125	40	34	20	15	13	12	11	10	9
1990	Jan	25	08:00	Forest	Parula	Male	Adult	180	210	160	140	44	38	22	17	15	14	13	12	11
1990	Jan	26	08:00	Forest	Parula	Female	Adult	170	200	150	130	42	36	21	16	14	13	12	11	10
1990	Jan	27	08:00	Forest	Parula	Male	Adult	185	215	165	145	46	40	23	18	16	15	14	13	12
1990	Jan	28	08:00	Forest	Parula	Female	Adult	175	205	155	135	44	38	22	17	15	14	13	12	11
1990	Jan	29	08:00	Forest	Parula	Male	Adult	190	220	170	150	48	42	24	19	17	16	15	14	13
1990	Jan	30	08:00	Forest	Parula	Female	Adult	180	210	160	140	46	40	23	18	16	15	14	13	12
1990	Jan	31	08:00	Forest	Parula	Male	Adult	195	225	175	155	50	44	25	20	18	17	16	15	14
1990	Jan	32	08:00	Forest	Parula	Female	Adult	185	215	165	145	48	42	24	19	17	16	15	14	13
1990	Jan	33	08:00	Forest	Parula	Male	Adult	200	230	180	160	52	46	26	21	19	18	17	16	15
1990	Jan	34	08:00	Forest	Parula	Female	Adult	190	220	170	150	50	44	25	20	18	17	16	15	14
1990	Jan	35	08:00	Forest	Parula	Male	Adult	205	235	185	165	54	48	27	22	20	19	18	17	16
1990	Jan	36	08:00	Forest	Parula	Female	Adult	195	225	175	155	52	46	26	21	19	18	17	16	15
1990	Jan	37	08:00	Forest	Parula	Male	Adult	210	240	190	170	56	50	28	23	21	20	19	18	17
1990	Jan	38	08:00	Forest	Parula	Female	Adult	200	230	180	160	54	48	27	22	20	19	18	17	16
1990	Jan	39	08:00	Forest	Parula	Male	Adult	215	245	195	175	58	52	29	24	22	21	20	19	18
1990	Jan	40	08:00	Forest	Parula	Female	Adult	205	235	185	165	56	50	28	23	21	20	19	18	17
1990	Jan	41	08:00	Forest	Parula	Male	Adult	220	250	200	180	60	54	30	25	23	22	21	20	19
1990	Jan	42	08:00	Forest	Parula	Female	Adult	210	240	190	170	58	52	29	24	22	21	20	19	18
1990	Jan	43	08:00	Forest	Parula	Male	Adult	225	255	205	185	62	56	31	26	24	23	22	21	20
1990	Jan	44	08:00	Forest	Parula	Female	Adult	215	245	195	175	60	54	30	25	23	22	21	20	19
1990	Jan	45	08:00	Forest	Parula	Male	Adult	230	260	210	190	64	58	32	27	25	24	23	22	21
1990	Jan	46	08:00	Forest	Parula	Female	Adult	220	250	200	180	62	56	31	26	24	23	22	21	20
1990	Jan	47	08:00	Forest	Parula	Male	Adult	235	265	215	195	66	60	33	28	26	25	24	23	22
1990	Jan	48	08:00	Forest	Parula	Female	Adult	225	255	205	185	64	58	32	27	25	24	23	22	21
1990	Jan	49	08:00	Forest	Parula	Male	Adult	240	270	220	200	68	62	34	29	27	26	25	24	23
1990	Jan	50	08:00	Forest	Parula	Female	Adult	230	260	210	190	66	60	33	28	26	25	24	23	22
1990	Jan	51	08:00	Forest	Parula	Male	Adult	245	275	225	205	70	64	35	30	28	27	26	25	24
1990	Jan	52	08:00	Forest	Parula	Female	Adult	235	265	215	195	68	62	34	29	27	26	25	24	23
1990	Jan	53	08:00	Forest	Parula	Male	Adult	250	280	230	210	72	66	36	31	29	28	27	26	25
1990	Jan	54	08:00	Forest	Parula	Female	Adult	240	270	220	200	70	64	35	30	28	27	26	25	24
1990	Jan	55	08:00	Forest	Parula	Male	Adult	255	285	235	215	74	68	37	32	30	29	28	27	26
1990	Jan	56	08:00	Forest	Parula	Female	Adult	245	275	225	205	72	66	36	31	29	28	27	26	25
1990	Jan	57	08:00	Forest	Parula	Male	Adult	260	290	240	220	76	70	38	33	31	30	29	28	27
1990	Jan	58	08:00	Forest	Parula	Female	Adult	250	280	230	210	74	68	37	32	30	29	28	27	26
1990	Jan	59	08:00	Forest	Parula	Male	Adult	265	295	245	225	78	72	39	34	32	31	30	29	28
1990	Jan	60	08:00	Forest	Parula	Female	Adult	255	285	235	215	76	70	38	33	31	30	29	28	27
1990	Jan	61	08:00	Forest	Parula	Male	Adult	270	300	250	230	80	74	40	35	33	32	31	30	29
1990	Jan	62	08:00	Forest	Parula	Female	Adult	260	290	240	220	78	72	39	34	32	31	30	29	28
1990	Jan	63	08:00	Forest	Parula	Male	Adult	275	305	255	235	82	76	41	36	34	33	32	31	30
1990	Jan	64	08:00	Forest	Parula	Female	Adult	265	295	245	225	80	74	40	35	33	32	31	30	29
1990	Jan	65	08:00	Forest	Parula	Male	Adult	280	310	260	240	84	78	42	37	35	34	33	32	31
1990	Jan	66	08:00	Forest	Parula	Female	Adult	270	300	250	230	82	76	41	36	34	33	32	31	30
1990	Jan	67	08:00	Forest	Parula	Male	Adult	285	315	265	245	86	80	43	38	36	35	34	33	32
1990	Jan	68	08:00	Forest	Parula	Female	Adult	275	305	255	235	84	78	42	37	35	34	33	32	31
1990	Jan	69	08:00	Forest	Parula	Male	Adult	290	320	270	250	88	82	44	39	37	36	35	34	33
1990	Jan	70	08:00	Forest	Parula	Female	Adult	280	310	260	240	86	80	43	38	36	35	34	33	32
1990	Jan	71	08:00	Forest	Parula	Male	Adult	295	325	275	255	90	84	45	40	38	37	36	35	34
1990	Jan	72	08:00	Forest	Parula	Female	Adult	285	315	265	245	88	82	44	39	37	36	35	34	33
1990	Jan	73	08:00	Forest	Parula	Male	Adult	300	330	280	260	92	86	46	41	39	38	37	36	35
1990	Jan	74	08:00	Forest	Parula	Female	Adult	290	320	270	250	90	84	45	40	38	37	36	35	34
1990	Jan	75	08:00	Forest	Parula	Male	Adult	305	335	285	265	94	88	47	42	40	39	38	37	36
1990	Jan	76	08:00	Forest	Parula	Female	Adult	295	325	275	255	92	86	46	41	39	38	37	36	35
1990	Jan	77	08:00	Forest	Parula	Male	Adult	310	340	290	270	96	90	48	43	41	40	39	38	37
1990	Jan	78	08:00	Forest	Parula	Female	Adult	300	330	280	260	94	88	47	42	40	39	38	37	36
1990																				

No.	TL	SL	HL	HD	S	IO	M	ED	S to 0	O to D	BW	BD	CPL	CPD	DL	AL	P ₁	P ₂
52	503	452	110	69	31	37	70	19	72	162	46	88	70	39	75	30	64	54
53	403	360	76	54	19	28	41	18	54	126	41	82	57	35	61	26	54	49
54	455	406	97	57	27	32	54	18	62	135	39	78	63	33	69	22	58	52
55	433	390	88	57	21	27	49	18	54	132	45	88	65	36	64	21	56	46
56	425	378	93	59	22	31	55	18	66	118	48	100	60	40	72	26	63	54
57	414	365	89	56	19	25	48	15	50	129	48	103	58	37	60	27	60	49
58	425	383	87	54	19	30	45	17	48	134	49	98	66	37	65	30	60	53
59	367	329	70	45	15	24	35	14	46	110	42	79	53	31	57	23	49	45
60	467	417	98	64	23	33	51	18	59	132	44	84	63	41	73	29	68	56
61	416	373	90	59	22	32	51	17	60	109	45	83	62	35	63	31	59	49
62	454	403	92	61	20	31	50	17	54	139	50	100	61	40	71	26	68	59
63	353	315	68	44	14	21	35	14	44	112	36	75	50	30	53	19	48	41
64	595	534	114	75	27	40	65	21	76	183	60	113	86	50	87	34	81	71
65	513	461	102	66	24	37	56	19	66	141	52	103	73	43	78	29	70	59
66	418	367	86	57	20	31	48	17	54	131	41	94	58	40	66	35	62	56
67	381	336	81	53	21	31	50	16	55	105	39	78	52	33	60	25	59	47
68	367	325	75	47	15	25	42	14	46	115	41	80	51	33	56	24	54	46
69	344	302	70	45	15	23	35	14	46	96	37	72	50	30	56	21	50	43
72	318	283	63	41	15	24	35	15	41	89	34	71	46	28	54	22	47	40
73	362	322	72	48	15	26	40	15	42	114	34	80	53	32	61	25	49	43
74	398	358	82	52	18	27	41	17	47	122	40	78	56	36	60	-	53	49
75	227	206	42	29	09	17	21	10	29	72	25	54	35	19	34	10	29	24
76	295	263	55	38	11	20	28	14	35	88	33	72	44	25	45	17	39	34
77	402	356	84	55	20	26	47	17	52	129	45	98	57	34	60	25	60	54
78	500	445	99	86	24	34	53	17	64	159	42	100	65	37	73	25	65	56
79	454	401	86	55	18	27	46	17	52	147	47	99	59	38	66	23	59	53
80	304	273	58	40	12	22	32	12	37	92	35	74	47	27	45	17	38	35
81	349	312	71	46	16	25	39	15	46	101	40	83	50	31	54	25	51	45
82	559	501	103	69	24	39	58	20	71	165	48	100	74	45	86	30	74	61
83	407	358	75	51	16	30	41	16	50	126	42	85	56	34	66	27	59	47
84	324	290	68	44	15	25	38	13	42	115	34	71	45	29	48	25	48	41
85	344	308	66	44	13	25	35	15	46	104	43	76	48	33	52	22	45	40
86	484	434	89	61	23	32	45	17	58	151	49	102	67	39	68	22	59	52
87	396	355	77	50	17	26	40	15	47	124	45	87	59	35	62	24	52	46
88	367	326	75	49	17	24	38	15	46	110	44	89	49	33	56	21	48	42
89	348	313	74	53	17	26	37	15	46	126	42	85	38	33	55	24	49	41
90	270	241	53	38	12	20	28	11	36	82	31	70	41	26	41	16	37	30
91	385	343	80	52	19	26	44	15	51	117	41	83	54	33	62	27	51	44
92	331	296	64	44	13	25	34	14	44	97	37	81	46	31	53	21	45	39
93	470	415	88	61	21	29	49	16	59	145	46	86	65	40	74	31	62	60
94	464	414	97	64	24	32	54	17	57	142	47	98	66	41	81	28	64	55
95	408	363	77	52	16	25	41	15	48	131	48	102	57	38	63	31	56	49
96	432	385	90	56	20	28	51	16	55	133	44	97	56	37	67	26	52	51
97	384	343	78	46	16	24	40	15	45	116	32	72	54	31	60	22	51	47
98	342	302	65	42	13	21	33	15	41	100	34	75	49	30	51	22	47	41
99	379	332	79	52	17	26	44	15	48	107	42	86	55	34	52	30	59	43
100	449	403	93	61	21	35	47	18	61	128	45	85	71	39	68	33	60	52

An L	An R	GR	LLS	P ₁ P ₂	P ₂ An	An B	Hyoid Teeth	Cut Mark	Rain Stripe	Age	Wt	Sex	Sex Organs
53	12	21	131	136	95	51	Absent	Faint	Present	7	41	M	Mature S
52	13	19	129	115	85	41	Absent	Absent	Present	4	25	F	Mature S
55	12	20	131	127	93	43	Absent	Absent	Present	6(?)	-	M	-
54	12	18	132	111	89	42	Absent	Absent	Faint	4(?)	30	M	Mature S
57	11	19	133	122	88	41	Present	Absent	Present	7	37	M	Mature R
53	11	17	125	121	88	36	Present	Present	Faint	5	31	M	Mature S
55	12	21	123	115	90	40	Absent	Absent	Faint	5	39	F	Mature S
48	12	20	133	109	76	34	Absent	Absent	Present	3	21	M	Immature
62	12	20	131	130	102	49	Absent	Absent	Faint	6	34	F	Mature S
52	12	18	125	120	85	41	Absent	Absent	Present	5	28	M	Mature S
62	11	19	124	133	94	44	Absent	Faint	Present	5	39	F	Mature R
47	12	21	129	107	78	32	Absent	Absent	Present	3	18	F	Immature
75	12	20	127	173	133	58	Absent	Absent	Faint	9	76	F	Mature S
64	12	18	133	152	105	53	Absent	Absent	Present	6	49	F	Mature S
61	12	20	127	125	87	40	Present	Present	Faint	7	31	F	Mature R
50	12	20	127	116	76	35	Absent	Absent	Present	6(?)	23	M	Mature R
50	11	18	121	112	73	33	Weak	Present	Faint	3	20	F	Mature R
47	12	20	127	98	80	32	Absent	Absent	Present	3	17	F	Immature
45	12	20	125	93	65	33	Absent	Absent	Present	3	10	M	Immature
51	11	20	128	105	75	36	Present	Absent	Faint	4	17	F	Mature R
52	11	20	135	119	84	39	Absent	Absent	Present	4	23	F	Mature S
37	12	19	123	75	50	23	Absent	Absent	Faint	2	6	M(?)	Immature
36	12	19	128	92	64	28	Absent	Absent	Faint	2	13	F	Immature
50	11	16	126	123	85	37	Present	Present	Absent	5	30	F	Mature S
63	12	20	127	148	105	48	Absent	Absent	Faint	7	38	F	Mature R
60	12	20	127	131	102	40	Absent	Faint	Absent	6	35	F	Mature S
37	12	20	126	81	70	30	Absent	Faint	Faint	3	15	M	Immature
45	11	20	130	104	75	35	Absent	Absent	Faint	5	20	M	Mature R
76	12	20	131	162	129	56	Absent	Absent	Faint	8	53	F	Mature R
52	12	18	131	118	85	38	Absent	Absent	Faint	4	29	F	Mature S
38	11	20	124	94	69	32	Present	Faint	Absent	4	15	M	Mature R
45	11	19	128	105	72	34	Absent	Faint	Present	5(?)	19	F	Mature R
56	12	19	137	138	101	46	Absent	Absent	Faint	5	44	F	Mature S
52	12	19	132	119	80	38	Absent	Absent	Faint	3	29	F	Mature S
47	12	20	128	108	75	38	Absent	Absent	Faint	3	24	F	Mature S
45	13	19	131	112	68	36	Absent	Absent	Faint	3	22	F	Immature
34	12	19	130	84	61	27	Absent	Absent	Faint	2	11	F	Immature
54	12	19	132	105	76	40	Absent	Absent	Present	4	23	M	Mature R
40	12	18	128	99	72	34	Absent	Absent	Faint	4	19	M(?)	Immature
63	12	18	129	138	99	45	Absent	Faint	Faint	5	34	F	Mature S
62	12	18	131	132	94	50	Absent	Absent	Faint	8	39	F	Mature S
52	12	19	131	132	84	40	Absent	Faint	Present	5	35	M	Mature S
57	12	20	128	133	82	42	Present	Faint	Faint	5	30	M	-
51	12	21	126	110	80	37	Present	Faint	Present	4	20	F	Mature R
45	11	19	128	108	70	30	Present	Faint	Present	3	18	F	-
45	11	16	128	105	79	34	Absent	Faint	Faint	5	23	M	Mature R
57	11	20	128	126	91	42	Absent	Absent	Present	5	32	F	Mature S

 

No.	TL	SL	HL	HD	S	IO	M	ED	S to O	O to D	BW	BD	CPL	CPD	DL	AL	P ₁	P ₂
106	264	237	51	36	11	17	25	11	32	85	30	65	37	23	41	18	32	30
107	422	377	94	57	23	32	54	19	59	120	49	88	58	37	63	29	57	51
108	257	231	48	31	10	15	25	10	31	83	28	61	43	22	36	18	33	27
111	392	351	88	56	20	29	51	16	58	112	43	90	55	36	61	26	60	49
112	400	351	79	50	17	24	41	16	45	119	44	90	57	35	64	19	58	52
113	502	457	114	72	33	39	70	20	79	147	46	89	67	40	76	35	70	60
114	385	344	74	50	18	25	41	15	45	123	42	91	57	33	56	22	48	44
132	515	456	104	67	24	35	57	18	62	152	53	96	69	44	76	33	67	65
133	487	430	100	65	24	31	59	17	65	144	55	107	66	43	73	31	70	61
134	497	448	100	72	33	38	65	18	74	147	56	111	67	42	72	29	70	53
135	314	283	61	40	13	20	30	13	40	96	40	77	49	29	49	19	41	34
136	335	299	63	42	13	20	33	14	39	112	41	88	49	30	51	21	46	39
137	369	328	78	51	19	25	40	15	49	116	41	83	52	33	61	30	54	47
138	404	359	87	58	22	30	48	15	61	116	49	98	60	38	60	27	51	48
139	327	293	63	41	13	23	34	12	39	109	36	86	54	29	51	21	43	40
176	405	367	82	53	21	27	43	14	50	134	45	103	60	36	60	25	51	47
177	481	429	99	67	27	34	56	17	68	146	58	118	71	44	70	34	62	54
178	464	413	102	67	29	29	60	16	64	140	53	112	60	41	78	30	67	62
179	340	305	67	44	16	21	35	14	42	112	41	87	48	31	53	25	44	40

BOW RIVER FISH

70	342	302	73	48	16	24	43	16	49	95	34	75	47	32	64	20	64	47
71	240	215	47	31	10	17	22	11	29	77	25	56	38	20	36	15	31	29
101	415	376	77	50	18	28	39	16	49	131	49	102	60	36	59	25	51	45
102	406	369	79	55	18	31	38	15	52	124	43	106	64	36	62	27	55	47
103	509	455	96	60	23	33	52	18	59	158	54	106	68	41	76	30	68	59
104	434	390	77	54	16	28	41	15	58	138	51	108	62	40	65	27	58	45
105	415	374	77	53	18	28	39	16	49	130	47	103	59	37	67	24	52	45
109	330	300	64	43	15	22	33	13	44	106	40	86	51	31	54	24	45	38
110	320	286	61	41	15	20	31	13	40	104	36	80	49	28	49	22	44	36
115	312	278	60	42	14	22	32	12	37	103	39	83	47	30	46	22	40	35
116	324	289	63	44	13	22	31	13	40	105	38	82	48	31	54	23	43	36
117	309	279	62	41	12	21	30	12	39	103	35	79	44	28	46	21	40	34
118	292	263	58	40	13	21	29	12	37	101	35	76	43	25	49	21	40	34
119	290	263	55	40	12	20	28	12	36	93	35	72	44	26	47	18	36	34
120	286	258	58	40	12	21	29	13	36	94	34	76	44	27	43	17	37	30
121	288	259	57	40	12	20	28	11	37	100	33	72	45	25	43	18	36	31
122	319	286	63	44	14	21	32	13	39	105	40	79	44	30	49	22	41	34
123	410	370	81	52	19	26	42	14	50	127	47	100	56	35	58	28	51	42
124	459	414	90	57	22	31	47	17	54	135	52	114	62	43	68	25	66	56
125	439	394	88	61	21	31	45	15	56	134	52	119	65	41	69	30	57	50

An L	An R	GR	LLS	P ₁ P ₂	P ₂ An	An B	Hyoid Teeth	Cut Mark	Rain Stripe	Age	Wt	Sex	Sex Organs
32	12	18	130	75	53	28	Absent	Absent	Faint	3	9	F	Immature
53	13	19	127	122	73	44	Absent	Absent	Present	5	33	M	Mature S
30	12	18	129	75	52	26	Absent	Absent	Present	2	8	F	Immature
50	12	19	129	116	80	37	Absent	Absent	Present	5	28	M	Mature R
54	11	18	131	118	79	36	Absent	Faint	Present	5	25	F	Mature S
65	12	20	129	137	98	50	Absent	Absent	Present	8	41	M	Mature S
49	11	21	130	119	91	39	Absent	Absent	Present	5	26	F	Mature S
67	12	22	130	157	104	46	Present	Faint	Faint	7	-	M(?)	-
69	11	20	131	150	91	46	Absent	Faint	Present	5	-	F(?)	-
59	11	20	126	149	95	47	Absent	Absent	Faint	8	68	M	Mature R
38	12	19	133	90	68	30	Absent	Absent	Faint	2	16	F	Immature
40	10	18	131	104	69	29	Absent	Present	Absent	5	18	F	Mature S
50	11	19	129	109	73	37	Absent	Faint	Absent	3	21	M	Mature S
51	11	21	128	124	74	39	Absent	Absent	Faint	5	31	M	Mature S
42	11	20	124	96	66	31	Present	Faint	Absent	3	17	M	Immature
51	12	20	131	123	92	41	Absent	Absent	Faint	4	36	M	Mature
57	12	21	135	152	94	48	Absent	Absent	Faint	5	56	M	Mature
65	11	19	131	146	101	40	Absent	Absent	Faint	8	50	M	Mature
45	11	18	132	107	70	31	Absent	Absent	Faint	3	21	F	Immature

ABOVE CARSELAND DAM

42	11	17	122	95	67	32	Absent	Faint	Present	5	16	M	Mature R
30	12	18	129	86	53	23	Absent	Absent	Present	2	6	M	Immature
48	11	19	130	126	90	36	Absent	Absent	Faint	5	34	F	Mature S
45	12	18	129	119	82	40	Absent	Absent	Present	5	34	M	Mature S
68	13	20	130	150	106	52	Absent	Absent	Faint	6	49	F	Mature S
52	11	18	132	126	92	43	Absent	Absent	Present	6	43	F	Mature S
52	12	18	130	128	87	40	Absent	Absent	Faint	6	37	F	Mature S
42	12	22	130	108	70	34	Absent	Absent	Present	2	20	M	Immature
39	12	20	129	95	64	29	Absent	Absent	Faint	2	17	F	Immature
39	11	19	129	100	66	30	Absent	Absent	Faint	2	18	F	Immature
39	12	20	131	103	71	31	Absent	Absent	Faint	2	18	F	Immature
35	12	21	132	108	65	30	Absent	Absent	Faint	2	16	F	Immature
34	12	18	130	97	62	27	Absent	Absent	Faint	2	14	M(?)	Immature
34	11	19	130	103	59	24	Absent	Absent	Faint	2	13	F	Immature
34	11	21	131	104	58	25	Absent	Absent	Faint	2	13	F	Immature
34	11	21	129	96	55	23	Absent	Absent	Faint	2	12	M(?)	Immature
36	11	20	128	104	67	28	Absent	Absent	Faint	2	17	F	Immature
46	11	19	131	124	94	37	Absent	Absent	Faint	5	32	M	Mature S
58	12	18	130	138	107	44	Absent	Absent	Faint	6	47	F	Mature S
53	12	20	133	132	86	43	Absent	Absent	Faint	6	46	M	Mature S

No.	TL	SL	HL	HD	S	IO	M	ED	S to 0	O to D	BW	BD	CPL	CPD	DL	AL	P ₁	P ₂
126	447	402	88	60	20	31	47	16	54	142	58	127	68	41	70	31	58	51
127	295	264	58	40	12	21	30	12	36	95	36	69	42	26	45	15	41	35
128	515	459	104	68	25	36	54	19	70	159	59	112	70	45	76	25	73	60
129	422	383	83	59	21	27	42	16	52	140	49	105	57	37	60	-	55	45
130	310	280	61	42	12	20	29	12	39	96	35	80	50	28	47	19	41	31
131	604	535	141	85	42	45	83	23	89	184	61	126	79	47	90	40	88	70
140	239	217	48	30	10	15	25	10	31	73	25	53	25	21	34	16	32	28
141	505	449	107	69	26	36	63	17	62	161	58	120	70	48	79	37	74	64
180	522	466	117	73	32	36	70	19	75	155	55	114	73	43	82	37	73	61
181	487	427	112	71	29	35	65	20	71	135	52	96	62	40	77	25	66	59
182	456	408	85	62	20	29	44	16	55	148	54	110	65	42	70	30	60	52

WILLOW CREEK

142	285	254	64	41	15	20	36	12	42	84	26	58	39	25	46	20	44	36
143	211	186	44	29	12	14	22	11	30	63	21	46	31	19	41	13	32	27
144	210	186	45	30	11	14	23	12	32	52	23	45	31	17	36	13	31	27
145	173	149	37	25	7	13	20	10	27	48	19	40	24	16	33	12	29	26
146	176	155	38	24	7	12	20	10	26	54	18	42	24	16	33	12	26	22
147	227	200	44	29	8	15	24	11	31	66	22	51	29	20	39	12	36	32
148	227	199	52	33	10	15	29	12	33	64	23	53	32	20	40	14	35	30
149	269	238	60	37	14	19	23	14	41	74	29	57	35	24	47	19	40	34
150	228	202	53	34	10	16	28	11	35	63	26	51	31	21	42	16	36	30
151	228	201	52	34	9	19	27	12	35	63	24	49	31	20	40	14	35	29
152	185	164	40	24	7	12	20	9	27	54	17	40	27	16	34	10	28	23
153	211	185	41	28	7	14	21	11	30	59	23	47	29	18	36	13	31	27
154	163	143	34	22	5	9	17	8	23	49	16	36	24	16	29	10	26	22
155	154	138	32	20	5	10	17	8	23	40	17	31	23	14	25	9	23	20
156	170	151	35	22	6	10	18	9	24	49	18	37	24	15	27	10	24	22
157	189	167	38	25	7	12	20	9	26	56	20	43	28	16	29	13	28	25
158	206	182	41	28	7	13	23	10	29	60	21	45	29	17	36	12	31	28
159	222	194	45	29	8	14	24	10	30	67	24	55	31	19	38	15	35	30
160	209	186	41	28	7	14	22	10	29	62	25	49	32	20	35	19	31	28
161	230	207	49	32	9	16	26	12	32	66	25	48	34	20	40	16	34	31
162	218	194	46	31	8	14	25	11	31	64	24	46	33	20	38	14	36	30
163	175	153	38	24	6	11	21	9	27	53	19	39	24	16	30	12	27	23

An L	An R	GR	LLS	P ₁ P ₂	P ₂ An	An B	Hyoid Teeth	Cut Mark	Rain Stripe	Age	Wt	Sex	Sex Organs
53	12	18	130	137	90	40	Absent	Absent	Faint	6	56	M	Mature S
37	11	22	129	91	61	26	Absent	Absent	Absent	2	13	F	Immature
68	11	21	133	143	115	53	Absent	Absent	Faint	7	61	F	Mature S
52	11	20	129	124	91	46	Absent	Absent	Faint	5	41	M	Mature S
38	11	21	128	101	66	28	Absent	Absent	Faint	2	17	F	Immature
76	11	21	128	178	119	58	Absent	Faint	Present	9	86	M	Mature S
28	11	18	128	71	49	23	Absent	Faint	Absent	2	5	M(?)	Immature
67	11	20	131	154	101	48	Absent	Present	Faint	7	58	M	Mature S
65	11	19	131	142	110	49	Absent	Absent	Absent	7	57	M	Mature
69	12	20	130	141	99	46	Absent	Absent	Faint	7	41	M	Mature
57	12	21	130	135	108	45	Absent	Absent	Faint	5	47	F	Mature

AND TRIBUTARIES

37	11	21	130	83	52	28	Absent	Faint	Present	4	9	M	Mature
29	11	18	126	61	40	19	Absent	Faint	Present	3	4	F(?)	Immature
28	11	20	125	71	38	21	Absent	Faint	Present	4	3	M(?)	Immature
24	11	20	125	49	24	14	Absent	Faint	Faint	2	2	M	Mature
24	11	20	125	53	36	15	Absent	Faint	Faint	2	3	M	Mature
32	11	16	130	71	50	21	Present	Faint	Present	3	5	F	Mature S
30	11	18	127	64	43	21	Absent	Faint	Faint	3	5	M	Mature
36	12	20	127	78	52	27	Absent	Faint	Faint	4	8	M	Mature
33	11	20	126	66	43	22	Absent	Faint	Present	4	5	M	Mature R
33	11	19	124(?)	62	41	23	Absent	Absent	Present	4	5	M	Mature R
22	11	19	127	52	37	16	Absent	Absent	Present	3	3	M(?)	Immature
26	11	19	129	66	41	19	Absent	Absent	Present	3	4	M	Mature
23	11	20	130(?)	48	33	16	Absent	Faint	Present	2	3	-	Immature
21	11	17	125(?)	46	32	13	Absent	Faint	Faint	2	2	F(?)	Immature
23	11	18	120(?)	47	35	17	Absent	Absent	Faint	2	3	M	Mature R
23	12	18	129	54	39	17	Absent	Absent	Faint	3	3	M	Mature
32	10	20	137	57	41	19	Present	Present	Absent	3	4	F	Mature(?)
32	11	17	136	65	45	21	Present	Present	Absent	3	5	F	Mature(?)
27	11	18	130	62	45	20	Absent	Absent	Faint	3	5	F	Immature
33	12	18	126	62	51	21	Absent	Absent	Faint	4	5	F	Immature
31	11	18	120	64	45	19	Absent	Absent	Faint	4	4	F	Mature
24	11	18	121	50	36	15	Absent	Faint	Faint	2	2	M	Immature

KANANASKIS

No.	TL	SL	HL	HD	S	IO	M	ED	S to O	O to D	BW	BD	CPL	CPD	DL	AL	P ₁	P ₂
164	409	368	76	50	16	24	38	17	50	133	49	103	60	38	61	27	51	44
165	438	387	83	58	20	28	42	16	55	127	48	112	66	42	66	31	60	54
166	494	443	101	63	23	33	51	17	66	153	55	109	75	46	74	36	68	55
167	488	433	114	67	35	36	70	18	72	147	47	106	69	45	74	30	63	57
168	355	315	68	43	17	24	34	13	43	111	40	75	51	31	44	22	43	37
169	291	259	60	38	13	17	32	12	38	92	32	60	40	23	43	18	40	35
170	689	614	160	102	50	51	106	22	106	202	76	160	89	61	106	48	102	88
171	636	573	143	88	45	48	91	21	93	186	66	129	85	59	84	42	82	67
172	531	473	120	75	36	38	73	19	84	159	53	110	69	46	83	34	74	64
173	527	469	127	70	38	40	77	18	83	161	52	102	67	47	79	34	71	61
174	495	442	93	61	25	33	47	16	58	154	52	103	65	46	73	42	65	56
175	333	298	62	41	14	22	29	12	40	104	37	76	49	29	48	24	39	35

SPRAY LAKES

16	349	310	67	44	12	21	38	16	44	107	31	65	52	30	58	25	52	45
17	302	269	60	39	11	18	33	15	37	90	30	61	44	27	49	16	46	37
18	344	305	66	43	13	21	39	15	45	101	35	69	45	30	52	20	48	40
19	249	223	48	32	9	15	28	11	32	69	23	52	32	22	42	11	36	34
20	287	258	55	36	12	17	32	13	36	85	26	55	44	24	45	18	43	36
21	336	303	64	43	13	17	34	16	40	110	31	70	49	29	52	21	48	38
22	222	197	40	28	9	13	24	12	27	63	19	43	32	17	38	10	31	23
23	239	214	47	30	10	15	25	12	32	65	21	45	36	19	41	14	32	28
24	235	205	45	27	9	15	26	12	30	69	22	47	35	19	39	14	33	29
25	309	274	60	38	13	19	35	14	40	87	31	64	46	25	50	18	45	38
26	400	354	84	56	20	27	54	17	54	116	37	82	54	36	71	28	62	52

LAKE

An L	An R	GR	LLS	P ₁ P ₂	P ₂ An	An B	Hyoid Teeth	Cut Mark	Rain Stripe	Age	Wt	Sex	Sex Organs
48	12	22	133	131	85	38	Absent	Absent	Faint	5	33	F	-
53	12	19	129	134	93	42	Absent	Absent	Faint	6	39	F	Mature
58	11	20	135	138	109	45	Present	Faint	Faint	7	52	F	Mature
58	11	20	133	137	96	44	Absent	Absent	Faint	9	44	M	Mature R
38	12	20	129	102	75	33	Absent	Absent	Faint	5	18	F	Immature
36	11	21	129	91	57	25	Absent	Faint	Faint	3	9	M	Mature
85	10	19	124	200	135	57	Absent	Present	Absent	10	128	M	Mature R
71	11	21	125	175	135	57	Weak	Faint	Faint	9	88	M	Mature
63	11	19	131	153	105	46	Absent	Faint	Faint	7	55	M	Mature R
60	10	18	126	143	107	43	Absent	Faint	Faint	8	47	M	Mature R
61	12	20	132	147	108	51	Absent	Faint	Present	9	51	F	Mature S
35	11	23	132	104	72	28	Absent	Absent	Faint	5	15	F	Immature

CUTTHROAT

47	12	19	124	107	75	34	Present	Present	Faint	4	15	F	Mature R
41	12	20	125	87	63	30	Present	Present	Faint	3	9	?	-
43	12	19	122	101	79	31	Absent	Present	Faint	4	14	F	Mature R
33	12	20	125	67	52	23	Absent	Present	Faint	2	5	F	Immature
39	12	17	124	85	60	26	Absent	Present	Faint	3	8	M	Immature
41	12	17	126	101	76	31	Present	Present	Faint	4	14	F	Mature R
29	12	18	118	65	50	20	Absent	Present	Faint	2	4	F	Immature
31	12	19	123	71	50	22	Absent	Present	Faint	2	5	M	Immature
31	12	20	125	66	48	21	Absent	Present	Faint	2	6	F	Immature
42	11	-	127	93	65	29	Present	Present	Faint	3	11	M	Mature R
52	12	18	127	116	81	36	Present	Present	Faint	4	24	M	Mature R

B29758