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JUVENILE RAINBOW TROUT RECRUITMENT FROM LOWER WAITAKI TRIBUTARIES

by

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CONTENTS

TABLES

FIGURES

1. INTRODUCTION

Rainbow trout are a distinctive feature of the unique salmonid fishery of the lower Waitaki River. Previous studies indicated some uncertainty about the long term prospect of maintaining rainbow trout in the proposed residual river, an integral part of the proposed lower Waitaki power scheme (Graybill *et al.* 1988). We have found no evidence from our previous studies to suggest that rainbow trout spawn in the mainstem lower Waitaki. We have no assurance, therefore, that they will spawn in the residual river. The tributaries are likely to be the major source of rainbow trout recruitment for the residual river. Information is needed on the timing and magnitude of juvenile rainbow outmigration from the tributaries to assess whether or not recruitment to the residual river will be adequate.

Rainbow trout typically migrate from larger rivers or lakes into small tributary streams to spawn (Hayes 1988, Bloomberg in prep., Irvine 1978, Gordon and MacCrimmon 1982, Biette *et al.* 1981, Sebastian 1979, Kwain 1971, Kwain 1981, and Northcote 1978). The juveniles may rear in the nursery streams from a few days to three years before migrating to the larger stream or lake. Webb *et al.* (in prep.) showed the importance of the Hakataramea and Maerewhenua rivers by documenting the timing and magnitude of the spawning runs of trout from the mainstem Waitaki. More recent studies of the rainbow trout spawning runs into the Awakino River in 1987, 1988, and 1989 indicated that it also ranks as an important spawning tributary for trout in the lower Waitaki (Bloomberg *et al.* 1990).

The objectives of this study were to determine the migration timing and yield of juvenile rainbow trout from major spawning tributaries (Hakataramea, Maerewhenua, or Awakino rivers) to the lower Waitaki River and to assess differences between resident and migrant fish. This report describes the findings of our study of juvenile rainbow trout recruitment extending over two migration seasons, 1988/89 and 1989/90.

2. METHODS AND MATERIALS

2.1 Preliminary Reconnaissance

Preliminary surveys were made from February through June 1988 to determine the general distribution of juvenile rainbow trout in the three major tributaries. These included electric fishing surveys using a battery-powered backpack machine and underwater observations using snorkelling techniques.

2.2 Downstream Migrant Traps

Two trap types for capturing juvenile trout were tested in mid-1988. The first type was a modified inclined-plane trap with an entrance 50 cm wide and about 80 cm high and a length of 2.3 m (Fig. 1). The base and sides were covered with stainless steel mesh with 2- and about 4-mm openings, respectively. The trap was used with the entrance facing upstream and resting on the stream bottom. The trap was inclined to near the water surface at the

downstream end where it was funnelled down to a 10-cm-diameter opening leading to the live box.

The second type of trap was a fyke net modelled after one described by Davis, Congleton, and Tyler (1980). The net had a 1-m-square opening attached to a tubular metal frame with hooks on each corner for quick attachment and release (Fig. 2). The net was made of nylon material with a mesh opening of 4 mm and funnelled down over its 3.7-m length to a 10-cm cod end leading to the live box. The net had a 0.9-m zip near the cod end to facilitate cleaning.

The live boxes were constructed of stainless steel, were 50 cm wide, 50 cm high, and 100 cm long, and could be used for both types of traps. The upstream end was solid except for a 10-cm-diameter tube that extended 30 cm outside the box to attach to the trap via a flexible sleeve and a quick release strap-type clamp and 30 cm inside to act as a fyke to prevent fish from re-entering the trap. The top and bottom were solid, with the top having a wide, hinged lid for easy access. The two sides and the downstream end were covered with stainless steel mesh (2 mm openings) and the downstream end could be removed to facilitate cleaning.

The two trap types were used side by side in the Awakino River in 1988 to compare their relative effectiveness and ease of maintenance. In general performance the inclined-plane traps tended to be more sensitive to debris than the fyke nets. With debris accumulation the velocity was reduced particularly in the downstream portion of the inclined-plane and fingerlings could readily swim upstream out of the trap. The fyke nets, on the other hand, were less sensitive to debris and could go longer between cleaning. The inclined-planes required more effort to set and remove because of their bulk than did the fyke nets.

The fyke nets were considered the gear of choice because they were easier to handle and maintain. We discovered during the trials, however, that the 4-mm mesh on the fyke nets was too large and allowed emergence sized fry to pass readily through the nets. For this reason the inclined-plane traps were used for the 1988/89 season. In 1989/90 we used fyke nets with 2-mm mesh.

2.3 Juvenile Outmigration

The traps were used every third day during the initial intensive fry movement period and then less frequently thereafter. They were placed in the tributaries before dusk and removed after dawn since most downstream movement occurs during the hours of darkness (Hayes 1988 and Irvine 1978). Trials were run in 1989 to confirm this diel pattern.

Captured fish were identified, counted, and released and periodic samples of fish were weighed and measured for fork length. Condition factors were calculated using the formula:

$$CF = \frac{\text{Weight (g)} \times 10^7}{\text{Length (mm)}^3}$$

The estimate of total fry outmigration for a given night was based on the rate of water flow through the trap relative to the total flow of the river. To do this we measured water depth and mean velocity at the trap entrance at the beginning and end of each sampling occasion so that rate of flow through the trap could be calculated. Total flow in the tributaries was obtained from DSIR TIDEDA data. Total fry outmigration for a given night was then estimated by multiplying the number of fish captured by the reciprocal of the proportion of the total flow that passed through the trap. On the intervening non-sampling nights we assumed that the number migrating was the same as that estimated on the nearest sampling night.

To check the validity of using flow in this way to calculate the numbers of outmigrants we measured the trap efficiency in the Awakino on one occasion in 1989. In this trial we used an array of 5 nets that filtered the total flow of the river. We then compared the proportion of the total number of fish captured by the single trap in its usual location with the proportion of the total flow passing through that trap. No such trials could be carried out in the Hakataramea because it is too large to filter all of the flow.

We attempted to place the traps where the water velocity was at least 0.7 m/s to prevent fish from escaping once they had entered the trap. When the velocity was below this level we placed the trap in the maximum velocity available.

Water temperature was measured at the beginning and end of each sampling occasion. The former approximated the maximum temperature for the day while the latter approximated the minimum.

2.4 Juvenile Trout in the Tributaries

After preliminary surveys were conducted as described in Section 2.1, one electric fishing site was chosen in each of the Awakino and Hakataramea rivers to complement the juvenile trapping programme. Sites were generally sampled monthly and ranged from about 30 to 70 m in length. The upstream and downstream ends of each site were blocked with small mesh nets to prevent fish from escaping from the sites. Fish were captured and removed from the sites on up to 3 successive passes using a generator-powered electric fishing machine. Captured trout were identified and counted for each pass. A sample of fish was weighed and measured for fork length and from these condition factor was calculated. All fish were returned to the site after the third pass and after the block nets had been removed. Population estimates were computed using the removal estimation method described by Van Deventer and Platts (1985).

Upon assessing the findings of the first season's juvenile trapping programme we recognised the importance of trying to estimate the number of juvenile rainbow trout remaining in the tributary to rear after the initial burst of fry outmigration. Five additional sites were established in the Awakino River. These were sampled in March 1990 following the second season's juvenile trapping effort. Unfortunately a major flood occurred in the Awakino in late February 1990 that greatly diminished the usefulness of this effort.

3. RESULTS

3.1 General Distribution of Juvenile Rainbow Trout

Juvenile rainbows were observed and captured in each of the 3 tributaries (MAF Fisheries, unpublished data). Low numbers were found in the Maerewhenua River with greater numbers being found over the length of both the Hakataramea and Awakino rivers. This preliminary work suggested that the greatest emphasis should be placed on the Awakino River with less on the Hakataramea and Maerewhenua rivers. The density of juvenile rainbows appeared to be consistently higher for the Awakino than for the other two tributaries. The Awakino is also smaller than the others and therefore easier to sample.

3.2 Juvenile Outmigration

3.2.1 Timing

Weekly electric fishing surveys were carried out in the Awakino River in October/November 1988 to determine the beginning of the fry migration period. Based on this we began trapping downstream migrants in 1988 on 21 November in the Awakino River, 24 November in the Hakataramea, and 27 November in the Maerewhenua. It was immediately apparent that we had missed the beginning of the run because fry were captured in significant numbers on the first sampling night in both the Awakino and Hakataramea rivers (Table 1).

No rainbow fry was captured in the Maerewhenua River in 4 nights of sampling in November/December 1988 (Table 1). Sampling was discontinued when exploratory electric fishing revealed very low numbers of fry around our trapping site in the lower river and at a site in the middle reaches.

In 1989 preliminary sampling was begun in the Awakino and Hakataramea rivers in early October with regular sampling beginning in late October. This enabled us to sample the beginning of the runs in both rivers (Table 2). We did no sampling in the Maerewhenua in 1989/90 because of the poor showing the previous year and to reduce the effort for placing and maintaining traps through the intensive sampling period.

In general for the Awakino, fry migration began in late October, reached a peak in mid November and was virtually completed by mid December (Tables 1 and 2). A similar pattern was found in the Hakataramea in 1988 for the latter half of the run (Table 1). In 1989 in the Hakataramea the run appeared to be virtually completed by late November (Table 2).

3.2.2 Magnitude

The total number of rainbow fry migrating downstream in the Awakino and Hakataramea rivers was estimated from the number captured and the proportion of flow through the trap relative to the total flow. When multiplied by 3, because we sampled every third day, the

estimated number of downstream migrant fry in 1988-89 and 1989-90 was about 16 000 and 69 000 respectively in the Awakino (Tables 3 and 4) and about 20 000 and 7 000 respectively in the Hakataramea (Tables 5 and 6).

Based on the observed pattern in the Awakino in 1989-90 (Table 4) when we sampled the entire fry run, about 50% of the run occurred before late November, the date that sampling began in 1988-89. With this assumption the estimated total run size in 1988-89 would be about 32 000 and 40 000 in the Awakino and Hakataramea respectively. This shows the estimated 7 000 fry in the Hakataramea in 1989-90 to be a particularly small run size.

3.2.3 Trap Efficiency

Trap efficiency was assessed in the Awakino on one occasion in 1989. The proportion of the total numbers of juveniles captured by the single trap at its usual location was 32.1% (627 fish out of 1952 total). The proportion of the total flow filtered by that trap was 36.2% (0.237 m^3/s out of 0.655 m^3/s total). Because of the similarity of these two values, we believe that using flow is a valid way of estimating the total fry outmigration on a given night.

3.2.4 Relationship with Flow

The pattern of fry migration did not appear to be related to the pattern of flow. Peak fry migration occurred when flows were relatively stable (Figs. 3, 4, and 5).

Following the initial pulse of fry movement that ended in mid-December, we caught very few downstream migrants as our sampling continued on a monthly basis through August 1989 (Table 1). We had the opportunity to sample 2 freshes in the Awakino in 1988-89. The first was a small fresh where flow increased from about 0.4 m^3/s to 1.1 m^3/s that occurred on 22 December. The catch, 1 fish, was the same as it had been on the 20 December at the lower flow. We sampled a second and slightly larger fresh in the Awakino of about 1.8 m^3/s on 14 March 1989 and captured 74 juvenile rainbows plus 90 juvenile browns. Significant fish movement had taken place on the second fresh.

A fresh also occurred in the Hakataramea in mid March, but was smaller relatively speaking than that in the Awakino. It was apparently too small to cause fish to migrate since the catch on 14 March 1989 during the fresh was only one rainbow trout (Table 1).

3.2.5 Length, Weight, and Condition Factor

The mean lengths, weights, and condition factors of downstream moving fry in the Awakino were consistently about 26 mm, 0.11 g, and 67 respectively through mid-December in both 1988-89 and 1989-90 (Tables 7 and 8, Fig. 6). This reflects the predominance in the samples of recently emerged fry. Thereafter the values began to increase as fewer emergent fry were available and as fish began to grow. Values for these parameters in the Hakataramea (Table 9) were similar to those in the Awakino except for showing a bit more

variability. There was general consistency between the two years in both systems. Fish captured on the fresh of 14 March 1989 had a mean length of 77 mm, mean weight of 5.6 g, and a mean condition factor of 117 (Table 7 and Fig. 6).

3.3 Juvenile Trout in the Tributaries

3.3.1 Seasonal Abundance

Juvenile trout were sampled monthly by electric fishing over a 16-month period at one site in the Awakino to complement juvenile outmigration studies (Fig. 13). The greatest numbers of 0+ rainbows were captured in January/February 1989 (1988 year class) and December 1989 (1989 year class) (Table 10). This followed the peak migration period, and presumably the peak emergence period, by some 1-3 months. After January/February 1989 when peak numbers were captured the number of juveniles (1988 year class) present declined gradually. Few 1+ rainbows were present after April 1989.

A major flood (about 30 m^3/s) occurred in the Awakino in mid-February 1990. As a result the number of juveniles in the forks bridge site declined about 71% (198 to 57) between the February and March 1990 samplings (Table 10). This compares to a decline of about 27% (117 to 85) between February and March the previous year. There is little doubt that this flood greatly increased the rate of juvenile trout outmigration.

It is probably surprising that any juveniles remained in the forks bridge site following the flood. The character of the site changed dramatically from one dominated by boulders and pools to an aggraded and uniform site with shallow water depths and fine gravel substrate. Even so 56 rainbow juveniles (and 36 brown trout) were captured there in March 1990.

The greatest number of 0+ brown trout were captured at the Awakino site in January 1989 (1988 year class) and December 1989 (1989 year class) (Table 10) even though this followed their emergence period by several months. Some 1+ browns were present through to September 1989 becoming 2+ browns in October and remaining in small numbers through December 1989.

An electric fishing site was established in a side braid of the Hakataramea River in March 1989. Sampling was discontinued there in May 1989 when catches went to very low levels (Table 11). This side braid was apparently too small to accommodate juvenile trout as they grew bigger.

3.3.2 Density

Juvenile trout densities were calculated from the population estimates made monthly in the Haka and Awakino rivers and from sampling at 6 sites in the Awakino in March 1990 (Tables 12 and 13). Peak 0+ rainbow densities were some 3 times greater for 1989 year class fish than for 1988 fish (1.23 versus 0.37 fish/m^2). A similar pattern was shown for 0+ browns. At peak densities (and abundance) 0+ browns were consistently present at higher

densities than 0+ rainbows through to about January/February. Thereafter, however, their densities were similar.

Densities for both species declined significantly between February and March 1990 as a result of the mid-February flood. Based on these limited data it appears that 0+ browns were affected more by the flood (going from 0.83 to 0.11 fish/m^2) than were rainbows (0.62 to 0.18 fish/m^2). It is interesting that the density (and abundance) in April 1989 (0.19 fish/m^2) was similar to that in March 1990 (0.18 fish/m^2) following the flood.

3.3.3 Total Population Size

We estimated the numbers of juveniles rearing in the Awakino even though the mid-February flood reduced the overall usefulness of such a figure. For this exercise the Awakino is considered to consist of the 8-km mainstem and its 2 branches at 2-km each. At face value the densities observed in March 1990 (Table 13) give a total population for the river of some 8 000 0+ rainbow trout at an overall density of 0.13 fish/m^2. Assuming that the flood had not occurred and that a similar reduction in numbers as occurred between February and March 1989 gives a population estimate of some 14 000 rainbows (0.22 fish/m^2). Using the peak density for rainbows as observed in December 1989 (1.23 fish/m^2) an extreme maximum estimate would be about 79 000 fish. In realistic terms the number of 0+ rainbow trout expected to rear in the Awakino in the first several months following emergence would be in the tens of thousands rather than something higher.

3.3.4 Length, Weight, and Condition Factor

The lengths and weights of captured fish increased more rapidly during the summer months and less rapidly during the winter months (Tables 14, 15, and 16 and Figs. 7 and 8). The length-weight relationship (Fig. 9) is described by the equation:

$$\text{Ln Length (mm)} = 0.328 \text{ Ln Weight (g)} + 3.806.$$
$$(n = 981,\ r = 0.995)$$

Condition factors for the 1987, 1988, and 1989 year classes had similar seasonal patterns with generally higher condition factors of about 120 in the summer months and generally lower ones in winter months (Figs. 10, 11, and 12).

Length, weight, and condition factor data for juvenile brown trout from the 1987, 1988, and 1989 year classes are presented in Appendices I, II, and III respectively.

4. DISCUSSION

4.1 Juvenile Outmigration

4.1.1 Timing

As rainbow trout emerge from the substrate some migrate downstream in an initial pulse while others remain in the stream as residents and periodically migrate out over the next

year. We discovered that electric fishing was not a reliable method for determining the beginning of emergence. As a result we missed the first part of the fry migration in the first season. With emergence and downstream migration occurring mainly at night it seems likely that the fry remain in the substrate during the day and are therefore not vulnerable to capture by electric fishing.

The timing of fry migration extended from late October to mid-December reaching a peak in mid-November. We believe this approximates the emergence period. Based on these limited data the timing appeared to be consistent between the two years in the Awakino and between the Awakino and Hakataramea in 1988. In 1989 in the Hakataramea the run appeared to be virtually completed by late November. We are uncertain whether or not this represented an actual shift in timing or generally resulted from the low numbers of migrating fry. We would suspect the latter but without information about the timing and magnitude of the adult run we cannot be sure.

The 6 to 7 week fry migration period was shorter than the spawning period (9-12 weeks Bloomberg and James 1990). This occurs because the water temperatures, which generally control embryonic development, are increasing during the incubation period (Graybill *et al.* 1979). Eggs spawned later are able to "catch up" with those spawned earlier because of the progressively increasing water temperature and the overall emergence period is therefore shortened.

After the initial pulse of the fry migration, the downstream movement of fingerlings seemed to be associated with freshes but not necessarily consistently. Sampling on a minor fresh (increasing from about 0.4 m^3/s to 1.1 m^3/s) on 22 December yielded only one juvenile rainbow while a larger one (from about 0.6 m^3/s to 1.8 m^3/s) on 14 March yielded 74 rainbows. At most other times the catches were virtually nil. It is possible there is some threshold level of fresh that triggers movement in interactions with a number of other variables such as water temperature, phase of the moon, water chemistry, etc.

4.1.2 Magnitude

The estimated total number of rainbow fry migrating downstream in the Awakino ranged from 32 000 to 69 000 and in the Hakataramea from 7000 to 40 000. We are reasonably confident of the general accuracy of these estimates particularly for the Awakino in 1989 (69 000 fry). Our sampling was reasonably frequent (every third night), trap efficiency was good (within several percent), and we sampled during the time of day (2000 to 0800) when nearly all fry movement occurred (in a 24-hour trial 99.8% of fry were captured between 2000 and 0800).

The estimate of 7000 fry for the Hakataramea in 1989-90 is a particularly poor result. The reason is not known but is possibly related to low flows resulting from drought conditions in the area. The extremely poor result observed in the Maerewhenua in the first season most likely resulted from the placement of an earthen dam across the entire flow. The potential for both tributaries should be considerably higher than these results indicate.

Our studies suggest that the magnitude of the fry outmigration from each of the three tributaries is in tens of thousands of fry rather than something higher. Under normal conditions we would expect the Awakino and Hakataramea to rank higher than the Maerewhenua.

4.2 Size and Condition of Downstream Migrants and Tributary Residents

Fry captured in downstream traps were typically emergent-sized fish. They were consistently about 26 mm long, weighed 0.11 g and had condition factors of about 67 (Tables 7 and 8). The electric fishing samples nearest in time were December 1988 and 1989 (Tables 15 and 16) when mean lengths were 35 and 31 mm, mean weights were 0.5 and 0.25 g and mean condition factors were 104 and 83 respectively.

These results can not be directly compared because the electric fishing sample contained post-emergent fish that had already begun to grow and electric fishing is not effective at capturing emergent-sized fish. The minimum values for the December sampling times can be used for comparison and are similar to the results from downstream trapping.

The results from mid-March 1989 (Tables 7 and 15) are directly comparable. The mean lengths, weights, and condition factors for the trapping samples (L = 77, W = 5.6, CF = 117) appear to be similar to electric fishing samples (L = 81, W = 6.7, CF = 120) although no statistical tests were done.

In general it appears that emergent fry have condition factors of about 70 which increases quickly to about 120 as the fish puts on initial weight. Condition factors remain at about 120 while the fish are in the tributaries except for the winter months when condition factors are somewhat depressed. Based on these samples there appears to be no difference in size between downstream migrants and tributary resident rainbow trout.

4.3 General Life History Considerations

As rainbow fry emerge from the substrate some migrate downstream while others remain in the tributary to rear for in some cases up to a year. The extent to which these behaviours are active or passive is unknown. It probably relates to some extent to density but does not appear to be related to fish size.

The extent to which either component contributes to the adult stocks in the main river is unknown. We have some indirect evidence from underwater observations that some fry survive upon reaching the mainstem Waitaki River. Young of the year rainbow trout were observed in the vicinity of the mouths of the Awakino and Hakataramea rivers in January. We believe that these fish originated from the respective tributaries, as rainbow fry were not widely distributed in the mainstem Waitaki at this time (Palmer and Graybill 1990).

Juvenile habitat in general appears to be limited in the mainstem Waitaki and is of generally low quality (Palmer and Graybill 1990). Even so the mainstem has a large area which even at low densities could accommodate substantial numbers of juvenile rainbow trout.

We are reasonably confident that tributary resident juveniles do contribute to mainstem stocks. Some of these migrate within several months of emergence. Whether or not there is a seasonal pattern to this migration is unknown. Some movement was observed to occur on freshes but possibly only those above a certain threshold. Again it is probably density related. As fish grow they require larger territories and with a limited area some have to leave. From a single fresh in March 1989 the size and condition of migrants and fish that stayed behind did not appear to differ.

If we assume that fry do contribute to mainstem rainbow stocks, it would appear that the number migrating is of the same general magnitude as that for later migrating juveniles. Our studies suggested that the fry migration and the "post-fry" population rearing in the Awakino numbered in the tens-of-thousands each. The relative post fry survival of juveniles rearing in the mainstem and the tributaries is unknown. From adult trapping data for the Awakino in 1988 and 1989 (Bloomberg and James 1990) the potential egg deposition was calculated to be about 666 000 and 1 857 000 eggs respectively. These with fry estimates yield egg to post-emergent fry survivals of some 9-11% for 1988 fish and 5-6% for 1989 fish. These are at the low end of the range for egg to emergence survival figures (Bley and Moring 1988) but egg to emergence is not strictly comparable. The relative post-fry survival of juveniles rearing in the mainstem and the tributaries is unknown.

4.4 Relative Importance of the Tributaries

The Awakino River assumed a high profile during the study because the density of rainbow juveniles appeared to be consistently greater there than in the two other major tributaries. In contrast the Maerewhenua River assumed a position of very low priority because of the small numbers of juvenile rainbow captured by electric fishing and fry trapping. An instream dam at an irrigation intake that extended across the entire flow probably contributed to the low number of captures. This and the unusually low flows from drought conditions and water abstractions have undoubtedly adversely affected the rainbow trout runs into the Maerewhenua in recent years. Under normal conditions the Maerewhenua should contribute more to rainbow stocks than was observed during this study.

The Hakataramea River remains of high value for juveniles because of its size. In recent times its habitat for fish has diminished because of water abstraction and poor riparian management. If these latter practices were reversed the habitat quality and quantity would improve significantly.

The Hakataramea showed the greatest variability of the three tributaries in terms of fry yield. The yield was slightly higher in 1988 but was about one-tenth that of the Awakino in 1989. It is possible (even likely) that the life history of rainbows is different in the Hakataramea compared to a smaller stream such as the Awakino. Being bigger the Hakataramea has more rearing habitat. It may be that a higher proportion of the total fry produced remain in the Hakataramea to rear compared to the Awakino. We certainly observed that few 1+ and older rainbow were present in the Awakino whereas the Hakataramea is a noted trout fishing river.

Overall the Awakino and Hakataramea rivers are probably of comparable importance in terms of contributing to the rainbow fish stocks of the mainstem lower Waitaki River. The Maerewhenua River is of lesser importance than the other two but its contribution was particularly depressed over the course of this study.

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TABLE 1. Number of 0+ rainbow trout captured in downstream migrant traps in the Awakino, Hakataramea, and Maerewhenua Rivers, 1988-89.

Date	Awakino		Hakataramea		Maerewhenua	
	Inclined plane	Fyke net	Inclined plane	Fyke net	Inclined plane	Fyke net
21.11.88	20	3	-	-	-	-
24.11.88	47	47	23	-	-	-
27.11.88	112	36	59	-	0	-
30.11.88	104	35	92	-	-	-
03.12.88	115	-	40	-	0	-
06.12.88	82	-	28	-	-	-
09.12.88	43	-	18	-	0	-
12.12.88	10	-	23	-	0	-
15.12.88	3	-	4	-	Sampling	
17.12.88	0	-	0	-	discontinued	
20.12.88	1	-	0	-		
22.12.88	1	0	-	-		
05.01.89	1	5	-	-		
18.01.89	0	0	0	-		
02.02.89	0	-	1	-		
15.02.89	0	1	1	-		
14.03.89	-	74	-	1		
22.03.89	-	0	-	-		
13.04.89	-	0	-	0		
17.05.89	-	0	-	0		
15.06.89	-	0	-	0		
18.07.89	-	0	-	0		
16.08.89	-	0	-	0		

- = No sampling done.

TABLE 2. Number of 0+ rainbow trout captured in downstream migrant traps in the Awakino and Hakataramea rivers, 1989-90.

Date	Awakino	Hakataramea
04.10.89	0	0
19.10.89	0	0
24.10.89	0	20
29.10.89	84	7
03.11.89	276	22
06.11.89	213	13
09.11.89	178	35
12.11.89	297	4
15.11.89	1445	32
18.11.89	1038	8
21.11.89	628	-
24.11.89	772	15
27.11.89	401	6
30.11.89	556	1
03.12.89	779	2
06.12.89	425	0
09.12.89	268	0
12.12.89	103	0
15.12.89	-	1
18.12.89	77	0
21.12.89	105	-
23.12.89	6	-
26.12.89	16	-
03.01.90	9	-
16.01.90	1	-

- = No sampling done.

TABLE 3. Estimated number of 0+ rainbow trout migrating downstream in the Awakino River on days sampled in 1988-89.

Date	Stream flow (m^3/s)	Flow thru trap (m^3/s)	Expansion factor	0+ Rainbow Number caught	0+ Rainbow Estimated number of downstream migrants
21.11.88	1.600	0.107	15.0	20	300
24.11.88	0.900	0.090	10.0	47	470
27.11.88	0.760	0.081	9.4	112	1053
30.11.88	0.670	0.070	9.6	104	998
03.12.88	0.720	0.063	11.4	115	1311
06.12.88	0.600	0.071	8.5	82	697
09.12.88	0.510	0.076	6.7	43	288
12.12.88	0.555	0.081	6.9	10	69
15.12.88	0.455	0.064	7.1	3	21
17.12.88	0.400	0.059	6.8	0	0
20.12.88	0.400	0.050	8.0	1	8
22.12.88	1.070	0.101	10.6	1	11
05.01.89	0.425	0.060	7.1	1	7
				Sub Total	5233
18.01.89	0.900	0.091	9.9	0	0
02.02.89	0.600	0.069	8.7	0	0
15.02.89	0.640	0.062	10.3	0	0

TABLE 4. Estimated number of 0+ rainbow trout migrating downstream in the Awakino River on days sampled in 1989-90.

Date	Stream flow (m^3/s)	Flow thru trap (m^3/s)	Expansion factor	0+ Rainbow Number caught	0+ Rainbow Estimated number of downstream migrants
04.10.89	1.289	0.3312	3.9	0	0
19.10.89	0.971	0.3087	3.1	0	0
24.10.89	1.583	0.3721	4.3	0	0
29.10.89	1.169	0.2981	3.9	84	328
03.11.89	0.913	0.2645	3.5	276	966
06.11.89	0.861	0.2305	3.7	213	788
09.11.89	0.871	0.2304	3.8	178	676
12.11.89	0.727	0.2308	3.1	297	921
15.11.89	0.664	0.2108	3.1	1445	4480
18.11.89	0.611	0.2286	2.7	1038	2803
21.11.89	0.655	0.2369	2.8	628	1758
24.11.89	0.542	0.1843	2.9	772	2239
27.11.89	0.566	0.1769	3.2	401	1283
30.11.89	0.473	0.1423	3.3	556	1835
03.12.89	0.484	0.2023	2.4	779	1870
06.12.89	0.446	0.1637	2.7	425	1148
09.12.89	0.426	0.1348	3.2	268	858
12.12.89	0.395	0.1516	2.6	103	268
18.12.89	2.118	0.5008	4.2	77	323
21.12.89	1.245	0.3616	3.4	105	357
23.12.89	1.184	0.3403	3.5	6	21
26.12.89	1.074	0.3544	3.0	16	48
03.01.90	1.061	0.2972	3.6	9	57
16.01.90	0.569	0.2107	2.7	1	3
			TOTAL	7677	23030

TABLE 5. Estimated number of 0+ rainbow trout migrating downstream in the Hakataramea River on days sampled in 1988-89.

Date	Stream flow (m^3/s)	Flow thru trap (m^3/s)	Expansion factor	0+ Rainbow Number caught	0+ Rainbow Estimated number of downstream migrants
24.11.88	4.485	0.180	24.9	23	573
27.11.88	3.217	0.139	23.1	59	1363
30.11.88	2.403	0.094	25.6	92	2355
03.12.88	2.747	0.123	22.3	40	892
06.12.88	1.836	0.085	21.6	28	605
09.12.88	1.546	0.073	21.2	18	382
12.12.88	1.239	0.053	23.4	23	538
15.12.88	0.993	0.046	21.6	4	86
17.12.88	0.947	0.052	18.2	0	0
20.12.88	0.897	0.042	21.4	0	0
				Sub Total	6794
18.01.89	0.747	0.085	8.8	0	0
02.02.89	1.331	0.108	12.3	1	12
15.02.89	2.077	0.145	14.3	1	14

TABLE 6. Estimated number of 0+ rainbow trout migrating downstream in the Hakataramea River on days sampled in 1989-90.

Date	Stream flow (m^3/s)	Flow thru trap (m^3/s)	Expansion factor	0+ Rainbow Number caught	0+ Rainbow Estimated number of downstream migrants
04.10.89	5.547	0.2800	19.8	0	0
19.10.89	6.367	0.6098	10.4	0	0
24.10.89	9.080	0.4681	19.4	24	388
29.10.89	5.126	0.2277	22.5	7	158
03.11.89	3.773	0.1205	31.3	22	689
06.11.89	3.080	0.3189	9.7	13	126
09.11.89	2.560	0.3018	8.5	35	298
12.11.89	2.104	0.2755	7.6	4	30
15.11.89	1.775	0.1740	10.2	32	326
18.11.89	1.752	0.2047	8.6	8	69
24.11.89	1.708	0.1940	8.8	15	132
27.11.89	1.826	0.1934	9.4	6	56
30.11.89	1.571	0.2115	7.4	1	7
03.12.89	1.195	0.1734	6.9	2	14
06.12.89	1.218	0.1773	6.9	0	0
09.12.89	1.235	0.1370	9.0	0	0
12.12.89	1.246	0.1464	8.5	0	0
15.12.89	1.521	0.1983	7.7	1	8
18.12.89	7.423	0.4095	18.1	0	0
			Total	170	2301

TABLE 7. Mean lengths, weights, and condition factors of 0+ rainbow trout captured in downstream migrant traps in the Awakino River, 1988-89.

Date	No.	Length (mm)			Weight (g)			Condition Factor		
		Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
21.11.88	20	26	1	24-28	-	-	-	-	-	-
24.11.88	20	26	1	25-28	0.12[1]	-	-	68	-	-
27.11.88	20	26	1	24-28	-	-	-	-	-	-
03.12.88	20	27	1	25-29	-	-	-	-	-	-
09.12.88	20	26	3	22-35	-	-	-	-	-	-
12.12.88	10	26	2	23-30	0.12[2]	-	-	70	-	-
05.01.89	5[3]	46	5	39-50	1.1	0.4	0.6-1.6	107	11	98-124
15.02.89	1	48	-	48	-	-	-	-	-	-
14.03.89	29	77	9	59-92	5.6	1.9	2.3-9.3	117	6	105-131

1 Determined by weighing 20 fry together after blotting on paper towel.
2 Determined by weighing 10 fry together after blotting on paper towel.
3 One additional 25-mm fry caught but not weighed.

TABLE 8. Mean lengths, weights, and condition factors of 0+ rainbow trout captured in downstream migrant traps in the Awakino River, 1989-90.

Date	No.	Length (mm)			Weight (g)			Condition Factor		
		Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
29.10.89	30	24	1	22-27	0.10	0.02	0.07-0.15	66	5	58-77
03.11.89	30	25	1	22-27	0.11	0.02	0.08-0.15	70	7	57-85
09.11.89	29	27	1	23-28	0.13	0.02	0.08-0.14	67	6	55-80
15.11.89	30	26	1	23-28	0.12	0.02	0.08-0.15	68	5	56-83
21.11.89	30	25	2	22-30	0.11	0.03	0.06-0.21	67	6	56-83
27.11.89	30	26	1	23-28	0.12	0.02	0.09-0.16	67	6	58-83
03.12.89	30	26	1	23-29	0.11	0.02	0.08-0.15	66	5	58-77
09.12.89	30	26	2	22-28	0.11	0.02	0.08-0.14	63	6	51-75
21.12.89	30	29	6	22-48	0.23	0.23	0.07-1.08	78	12	58-100
26.12.89	14	41	12	24-59	0.76	0.58	0.09-1.94	88	16	60-110
03.01.90	9	38	8	25-52	0.54	0.43	0.09-1.48	83	13	58-105
16.01.90	1	59	-	59	1.96	-	1.96	95	-	95

TABLE 9. Mean lengths, weights, and condition factors of 0+ rainbow trout captured in downstream migrant traps in the Hakataramea River, 1988-89, 1989-90.

Date	No.	Length (mm)			Weight (g)			Condition Factor		
		Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
24.11.88	20	25	1	24-27	-	-	-	-	-	-
27.11.88	20	25	1	23-26	-	-	-	-	-	-
03.12.88	20	25	1	23-28	-	-	-	-	-	-
09.12.88	17	25	1	24-26	-	-	-	-	-	-
02.02.89	1	48	-	-	-	-	-	-	-	-
15.02.89	1	66	-	-	-	-	-	-	-	-
14.03.89	1	74	-	-	5.6	-	-	138	-	-
24.10.89	20	27	1	25-28	0.14	0.01	0.11-0.15	72	6	63-83
03.11.89	21	26	2	23-29	0.12	0.03	0.07-0.18	67	5	58-77
09.11.89	30	23	1	22-26	0.09	0.01	0.08-0.13	70	7	58-85
15.11.89	30	25	1	23-27	0.10	0.02	0.04-0.13	63	9	29-82
03.12.89	2	26	1	25-26	0.12	0.01	0.11-0.13	72	3	70-74
15.12.89	1	36	-	-	0.44	-	-	94	-	-

TABLE 10. Number of trout captured by electric fishing and estimated population size (in parentheses) at the forks bridge site in the Awakino River during 1988-90.

River	Site	Date	Rainbow trout				Brown trout				All trout				Total	
			0+		1+		0+		1+		0+		1+			
Awak	Forks Br	14.12.88	39	(43)	21	(24)	138	(156)	49	(54)	177	(200)	70	(79)	247	(281)
Awak	Forks Br	12.01.89	101	(113)	10	(12)	158	(172)	42	(42)	259	(286)	52	(53)	311	(338)
Awak	Forks Br	22.02.89	105	(117)	10	(11)	97	(98)	31	(31)	202	(212)	41	(41)	243	(253)
Awak	Forks Br	21.03.89	84	(85)	5	(5)	73	(73)	19	(19)	157	(159)	24	(24)	181	(184)
Awak	Forks Br	12.04.89	58	(60)	2		54		12	(12)	112	(117)	14	(14)	126	(133)
Awak	Forks Br	16.05.89	37	(42)	0		37	(39)	9	(9)	74		9	(9)	83	(90)
Awak	Forks Br	15.06.89	40		0		33		6		73		6		79	
Awak	Forks Br	18.07.89	18		0		20		6		38		6		44	
Awak	Forks Br	16.08.89	21		1		26		6		47		7		54	
Awak	Forks Br	18.09.89	28		1		32		3		60		4		64	
Awak	Forks Br	20.10.89	30		1		0		30		30		31		*62	
Awak	Forks Br	21.11.89	31		0		435	(450)	30	(30)	466	(481)	30	(30)	*497	(513)
Awak	Forks Br	19.12.89	338	(394)	5		556	(577)	19	(19)	894	(957)	24	(24)	*919	(980)
Awak	Forks Br	18.01.90	202	(224)	0		358	(390)	9		560	(615)	9		569	(622)
Awak	Forks Br	13.02.90	176	(198)	0		252	(266)	2		428	(463)	2		430	(466)
Awak	Forks Br	06.03.90	56	(57)	0		34	(34)	2		90	(91)	2		92	(93)

* includes 1 2+ brown trout

TABLE 11. Number of trout captured and estimated population size (in parentheses) in electric fishing sites in the Awakino and Hakataramea rivers during 1989-90.

River	Site	Date	Rainbow trout 0+	Rainbow trout 1+	Brown trout 0+	Brown trout 1+	All trout 0+	All trout 1+	Total
Awak	Middle Br	17.05.89	6	1	5	2	11	3	14
Awak	Middle Br	15.06.89	1	1	2	2	3	3	6
Haka	#1	09.03.89**	52		96		148		*148
Haka	#1	12.04.89	12	1	26	0	38	1	39
Haka	#1	16.05.89	4	1	5	0	9	1	10
Awak	#1	23.03.90	7 (7)	0	61 (62)	1	68 (69)	1	69 (71)
Awak	#2	26.03.90	26 (26)	0	29 (29)	0	55 (55)	0	55 (55)
Awak	#3	08.03.90	26 (26)	0	27 (28)	0	53 (54)	0	53 (54)
Awak	#4	06.03.90	56 (57)	0	34 (34)	2	90 (91)	2	92 (93)
Awak	#5	08.03.90	96 (117)	0	70 (74)	33 (35)	166 (189)	33 (35)	199 (225)
Awak	#6	26.03.90	2	1	10	1	12	2	14

* plus 18 juvenile quinnat salmon

** 0+ and 1+ combined

TABLE 12. Estimated population size and juvenile trout density (fish/m^2) at the forks bridge site in the Awakino River during 1988-90.

Date	Rainbow trout				Brown trout				All trout				Total	
	0+		1+		0+		1+		0+		1+			
14.12.88	43	0.13	24	<0.10	156	0.49	54	0.17	200	0.63	79	0.25	281	0.88
12.01.89	113	0.35	12	<0.10	172	0.54	42	0.13	286	0.89	53	0.17	338	1.06
22.02.89	117	0.37	11	<0.10	98	0.31	31	0.10	212	0.66	41	0.13	253	0.79
21.03.89	85	0.27	5	<0.10	73	0.23	19	<0.10	159	0.50	24	<0.10	184	0.58
12.04.89	60	0.19	2	<0.10	54	0.17	12	<0.10	117	0.37	14	<0.10	133	0.42
16.05.89	42	0.13	0	-	39	0.12	9	<0.10	74	0.23	9	<0.10	90	0.28
15.06.89	40	0.13	0	-	33	0.10	6	<0.10	73	0.23	6	<0.10	79	0.25
18.07.89	18	<0.10	0	-	20	<0.10	6	<0.10	38	0.12	6	<0.10	44	0.14
16.08.89	21	<0.10	1	<0.10	26	<0.10	6	<0.10	47	0.15	7	<0.10	54	0.17
18.09.89	28	<0.10	1	<0.10	32	0.10	3	<0.10	60	0.19	4	<0.10	64	0.20
20.10.89	30	<0.10	1	<0.10	0	-	30	<0.10	30	<0.10	31	0.10	62	0.19
21.11.89	31	0.10	0	-	450	1.41	30	<0.10	481	1.50	30	<0.10	513	1.60
19.12.89	394	1.23	5	<0.10	577	1.80	19	<0.10	957	2.99	24	<0.10	980	3.06
18.01.90	224	0.70	0	-	390	1.22	9	<0.10	615	1.92	9	<0.10	622	1.94
13.02.90	198	0.62	0	-	266	0.83	2	<0.10	463	1.45	2	<0.10	466	1.46
06.03.90	57	0.18	0	-	34	0.11	2	<0.10	91	0.28	2	<0.10	93	0.29

TABLE 13. Estimated population size and juvenile trout density (fish/m^2) at sites in the Awakino and Hakataramea rivers during 1989-90.

Site	Mean width (m)	Area (m^2)	Date	Rainbow trout				Brown trout				All trout				Total	
				0+		1+		0+		1+		0+		1+			
Hakataramea																	
1	3	120	09.03.89*		52	0.43			96	0.80			148	1.23		148	1.23
1	3	120	12.04.89	12	0.10	1	<0.10	26	0.22	0	-	38	0.32	1	<0.10	39	0.33
1	3	120	16.05.89	4	<0.10	1	<0.10	5	<0.10	0	-	9	<0.10	1	<0.10	10	<0.10
Awakino																	
1	6.5	325	23.03.90	7	<0.10	0	-	61	0.19	1	<0.10	66	0.20	1	<0.10	71	0.22
2	7.5	375	26.03.90	26	<0.10	0	-	29	<0.10	0	-	55	0.15	0	-	55	0.15
3	5.7	285	08.03.90	26	<0.10	0	-	28	0.10	0	-	54	0.19	0	-	54	0.19
4	4.7	320	06.03.90	57	0.18	0	-	34	0.11	2	<0.10	91	0.28	2	<0.10	93	0.29
5	3.9	195	08.03.90	117	0.60	0	-	74	0.38	35	0.18	189	0.97	35	0.18	225	1.15
6	2.8	140	26.03.90	2	<0.10	1	<0.10	10	<0.10	1	<0.10	12	<0.10	2	<0.10	14	0.10

* 0+ and 1+ combined

TABLE 14. Mean lengths, weights, and condition factors of juvenile rainbow trout from the 1987 year class captured by electric fishing in the Awakino River, 1988-89. (By definition age 0+ fish become age 1+ fish in December.)

Date	No.	Length (mm)			Weight (g)			Condition Factor		
		Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
27.06.88	16	72	12	54- 93	4.5	2.4	1.7- 9.8	112	14	94-141
25.07.88	32	68	10	52- 90	3.4	1.5	1.3- 7.9	104	9	90-122
26.08.88	28	75	16	52-106	5.4	3.5	1.4-14.8	111	14	93-143
19.09.88	38	78	17	52-123	5.9	4.0	1.7-17.9	111	8	96-136
19.10.88	40	87	14	56-122	8.7	4.2	2.2-23.6	122	11	100-149
15.11.88	40	94	12	70-113	10.7	4.1	4.0-19.3	124	7	107-141
13.12.88	20	103	11	89-125	13.3	4.1	7.8-22.4	117	6	104-126
12.01.89	11	104	7	96-118	14.1	2.5	10.8-19.3	124	11	109-151
22.02.89	8	119	11	105-137	21.1	5.7	14.3-28.6	123	8	111-132
21.03.89	6	129	20	105-162	26.8	13.5	13.4-50.6	117	6	109-125
12.04.89	2	139	9	132-145	31.7	9.5	24.9-38.4	117	13	108-126
16.05.89	0									
15.06.89	0									
18.07.89	0									
16.08.89	1	150	-	-	40.4	-	-	120	-	120
18.09.89	1	157	-	-	55.7	-	-	144	-	144
20.10.89	2	141	7	136-146	35.2	5.3	31.4-38.9	125	0	125

TABLE 15. Mean lengths, weights, and condition factors of juvenile rainbow trout from the 1988 year class captured by electric fishing the Awakino River, 1988-89. (By definition age 0+ fish become age 1+ fish in December.)

Date	No.	Length (mm)			Weight (g)			Condition Factor		
		Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
13.12.88	20	35	3	29- 41	0.5	0.2	0.2- 0.8	104	13	82-128
12.01.89	30	52	5	41- 65	1.7	0.6	0.7- 3.1	120	10	99-137
22.02.89	30	71	9	53- 85	4.6	1.7	1.9- 8.1	125	8	109-142
21.03.89	30	81	9	63-100	6.7	2.2	2.8-11.5	120	7	110-139
12.04.89	30	81	11	67-103	6.7	2.6	3.7-12.5	121	10	108-164
16.05.89	30	86	11	68-108	7.8	3.0	3.9-15.0	118	8	107-137
15.06.89	30	88	10	72-108	8.1	2.9	4.0-14.7	115	7	103-128
18.07.89	18	92	12	69-112	8.9	3.2	3.6-14.6	110	6	97-122
16.08.89	22	90	12	70-112	8.6	3.3	3.5-15.5	114	12	102-145
18.09.89	28	96	15	70-130	12.0	5.7	4.3-26.9	127	10	111-156
20.10.89	28	102	14	76-126	14.6	6.0	5.8-25.2	131	12	115-157
21.11.89	30	119	17	90-159	21.9	10.3	8.1-52.6	123	8	108-139
19.12.89	4	126	13	112-141	26.0	10.5	13.7-38.0	124	18	98-136

TABLE 16. Mean lengths, weights, and condition factors of juvenile rainbow trout from the 1989 year class captured by electric fishing in the Awakino River, 1989-90. (By definition these are age 0+ fish.)

Date	No.	Length (mm)			Weight (g)			Condition Factor		
		Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
19.12.89	30	31	4	25-38	0.25	0.11	0.11-0.51	83	16	68-150
18.01.90	30	48	7	33-59	1.28	0.50	0.46-2.23	110	10	92-130
13.02.90	30	59	8	43-72	2.47	1.03	0.85-4.43	111	6	98-120
26.03.90	31	64	7	46-81	2.93	1.07	0.88-5.55	108	8	90-126

FIGURE 1. Inclined plane trap used in the Awakino River

FIGURE 2. Fyke net used in the Awakino River.

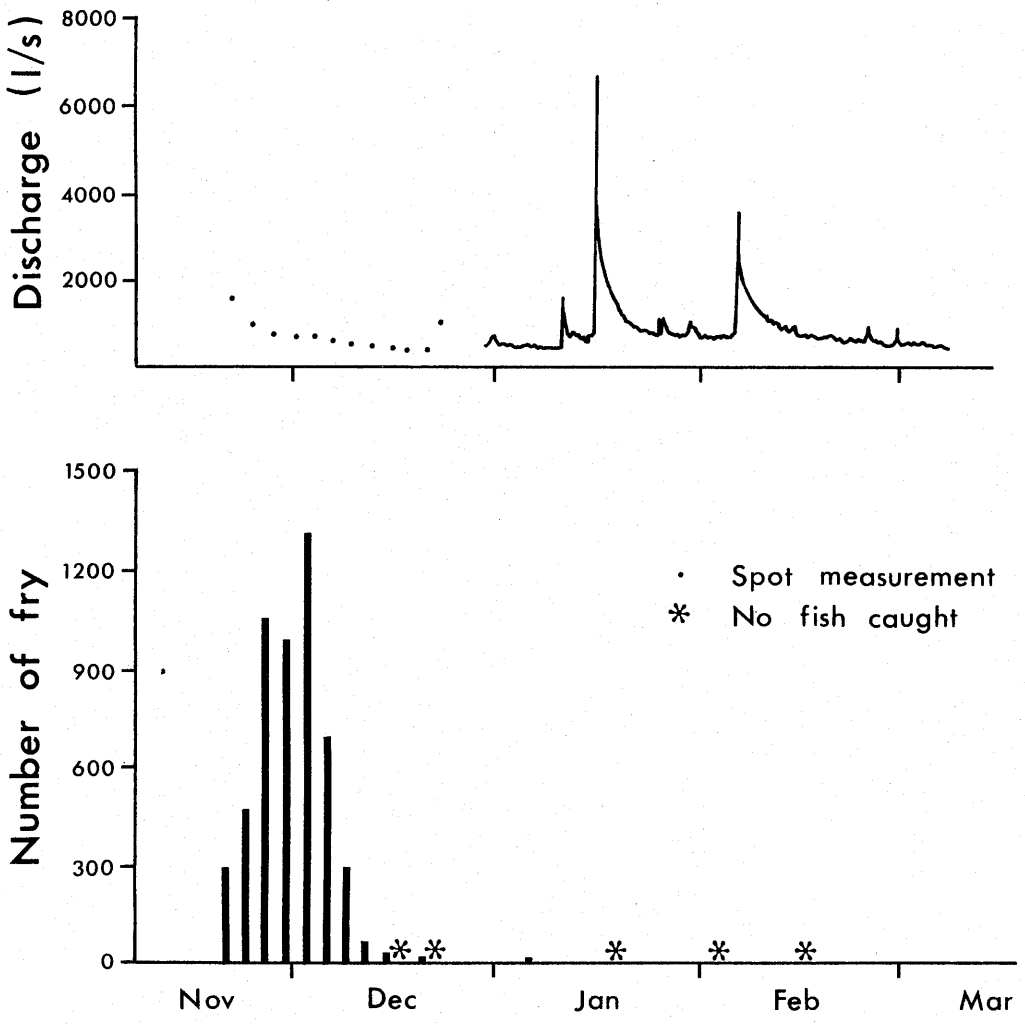


FIGURE 3. Estimated number of juvenile rainbow trout migrating downstream in the Awakino River on days sampled from November 1988 to March 1989. Plot of stream flow is also shown.

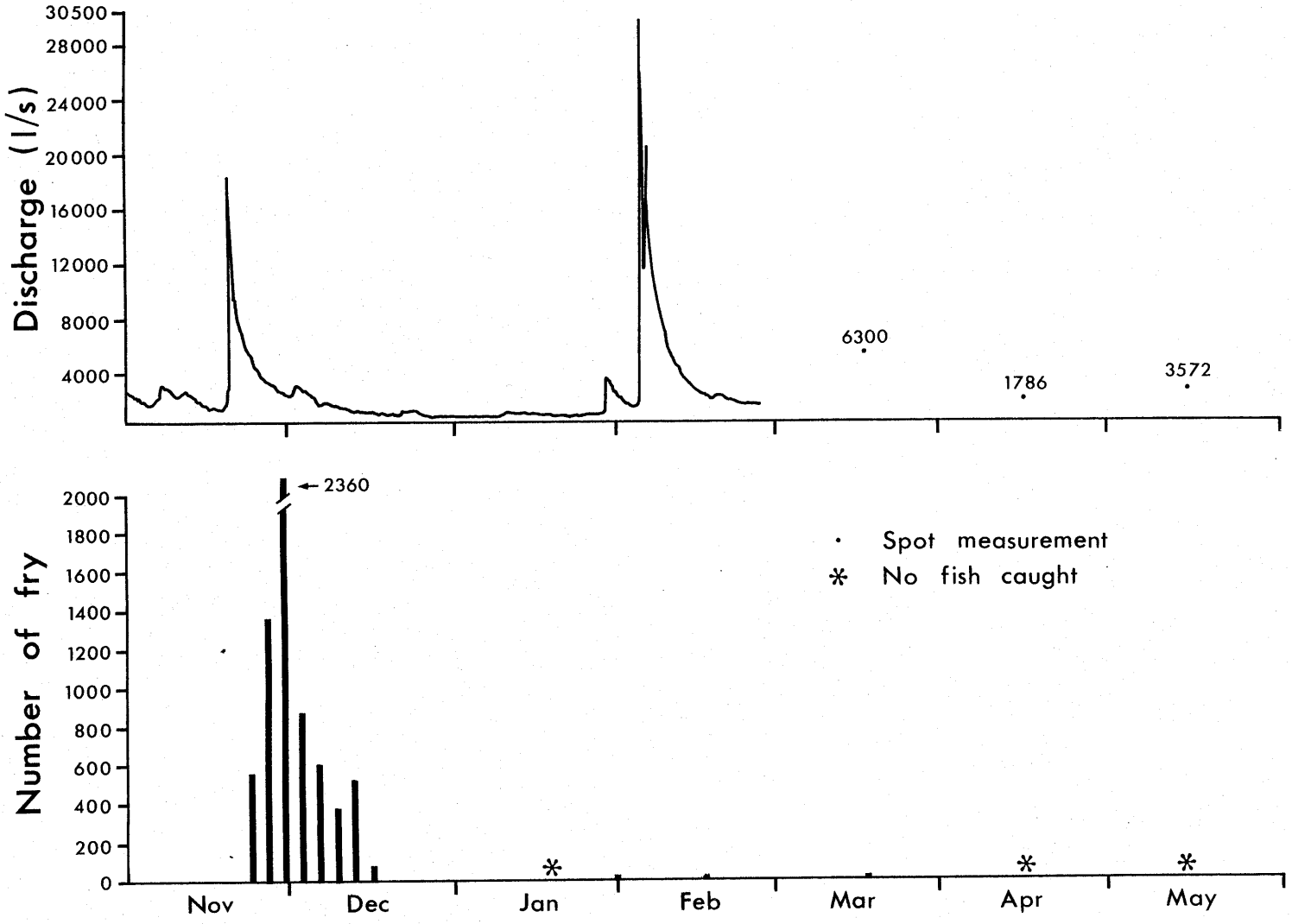


FIGURE 4. Estimated number of juvenile rainbow trout migrating downstream in the Hakataramea River on days sampled from November 1988 to May 1989. Plot of stream flow is also shown.

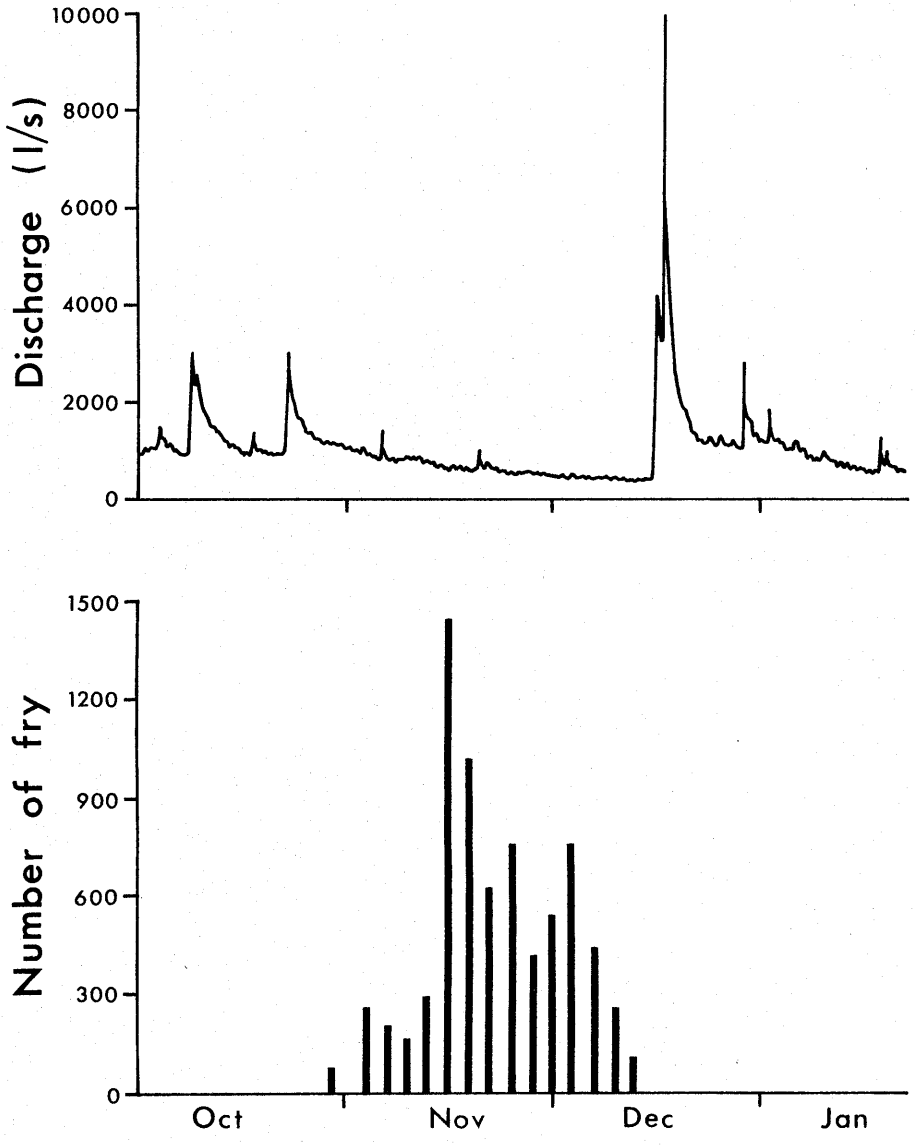


FIGURE 5. Estimated number of juvenile rainbow trout migrating downstream in the Awakino River on days sampled from October 1989 to January 1990. Plot of stream flow is also shown.

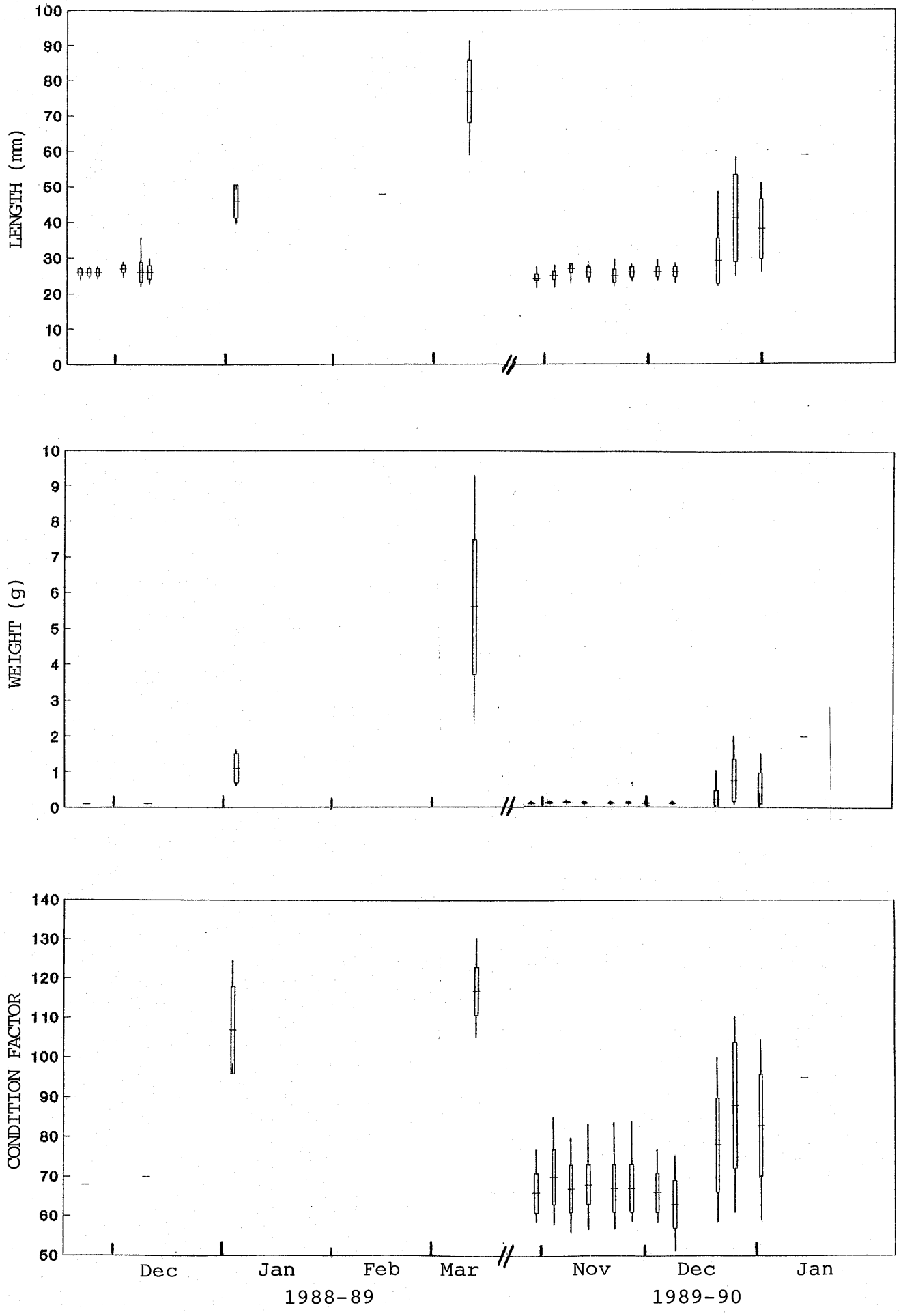


FIGURE 6. Length, weight, and condition factor of juvenile rainbow trout captured while migrating downstream in the Awakino River, 1988-89 and 1989-90. Mean, standard deviation, and range are shown.

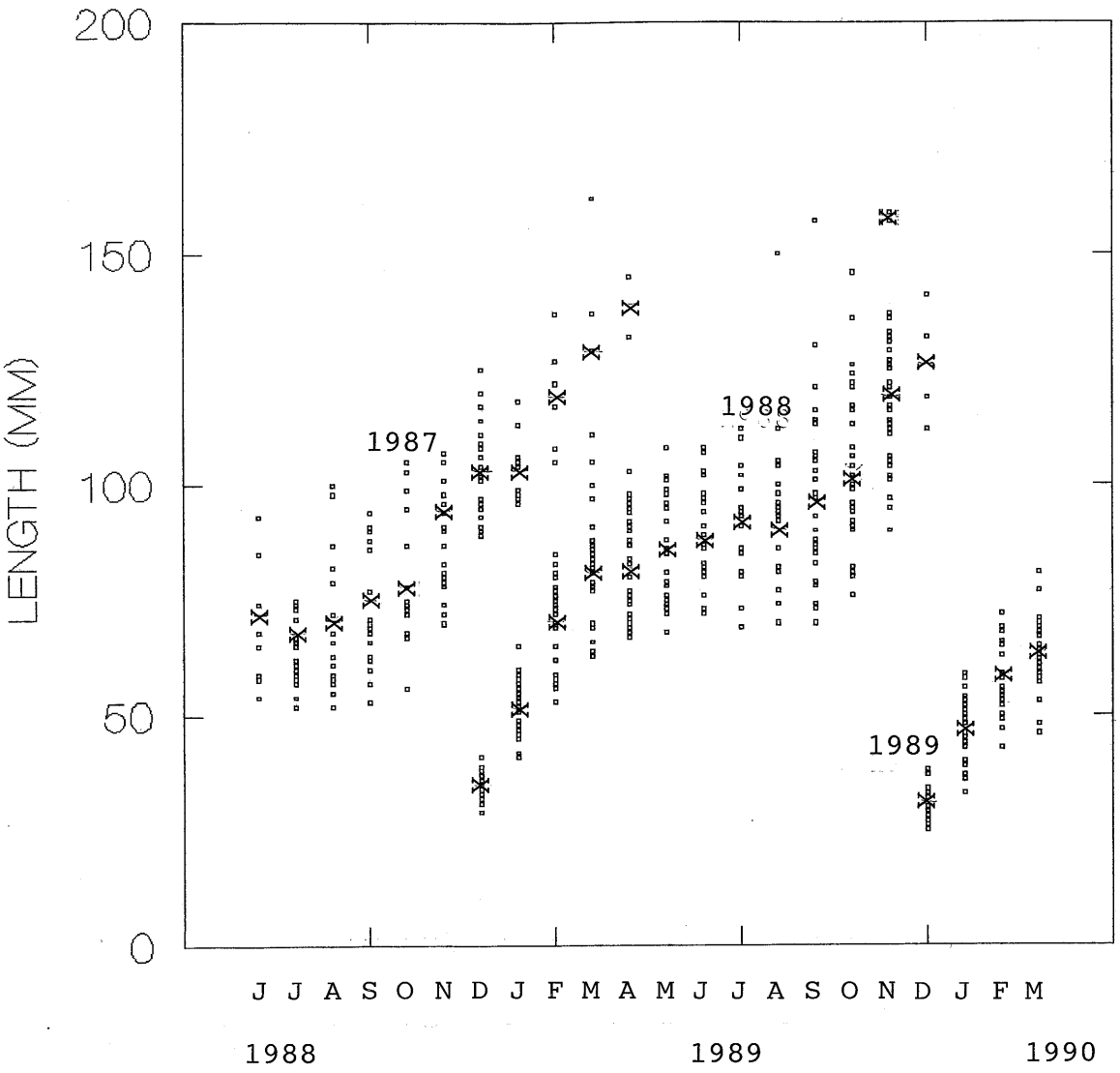


FIGURE 7. Length of juvenile rainbow trout from the 1987, 1988, and 1989 year classes captured by electric fishing in the Awakino River, 1988-90. X = mean length.

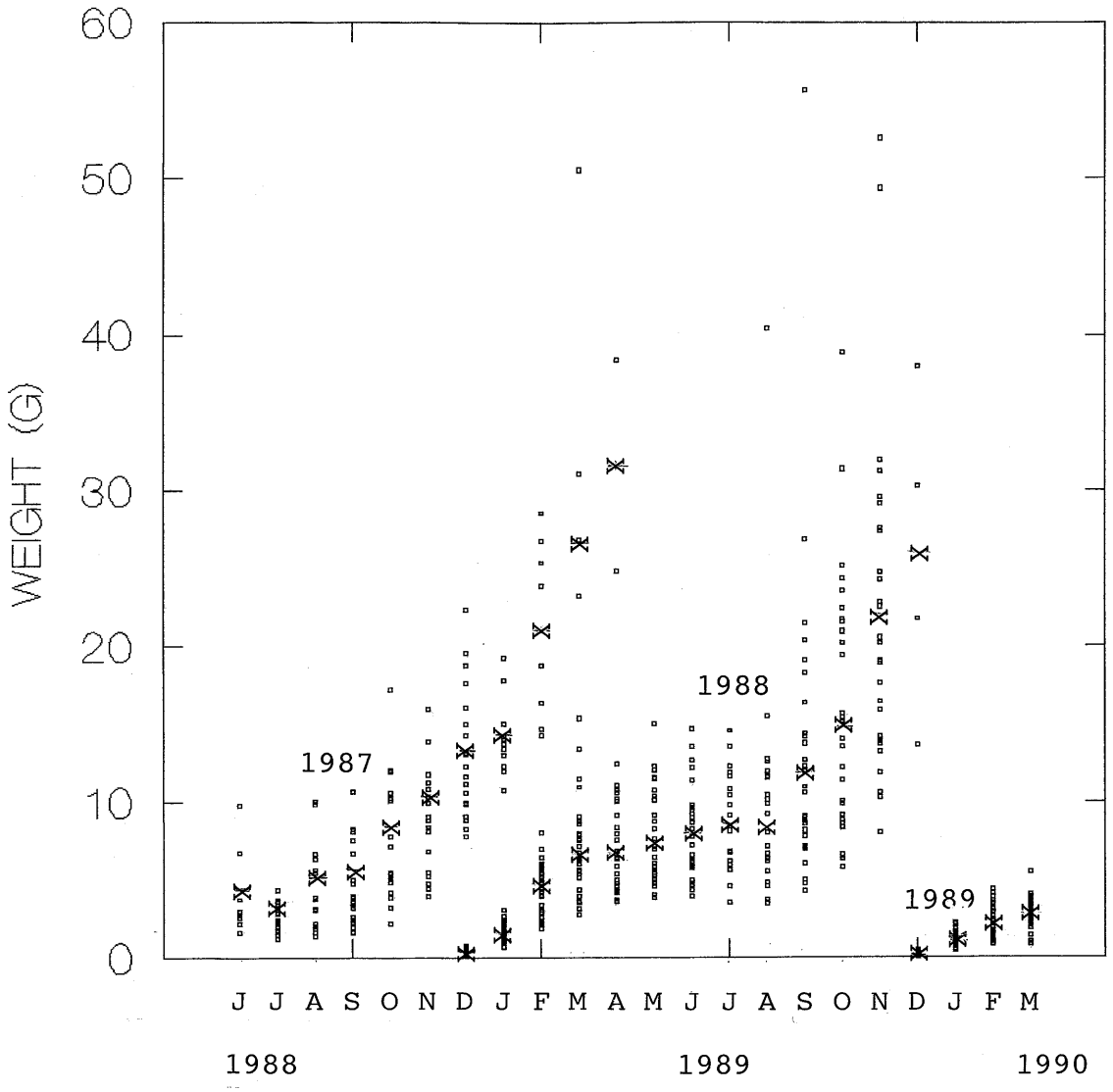


FIGURE 8. Weights of juvenile rainbow trout from the 1987, 1988, and 1989 year classes captured by electric fishing in the Awakino River, 1988-1990. X = mean weight.

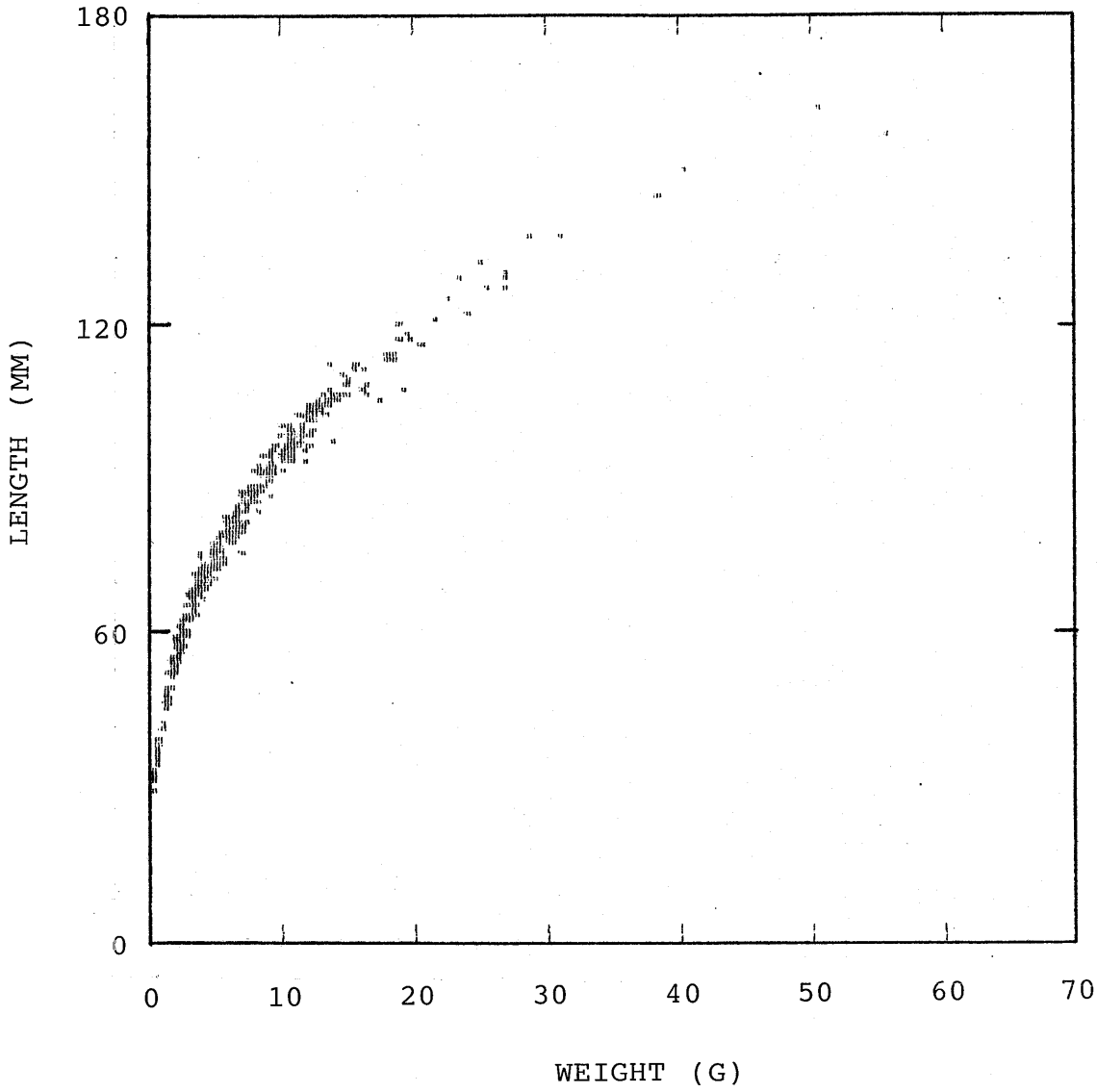


FIGURE 9. Length-weight relationship for juvenile rainbow trout captured by electric fishing in the Awakino River, 1988-90. (n=981, r=0.995)

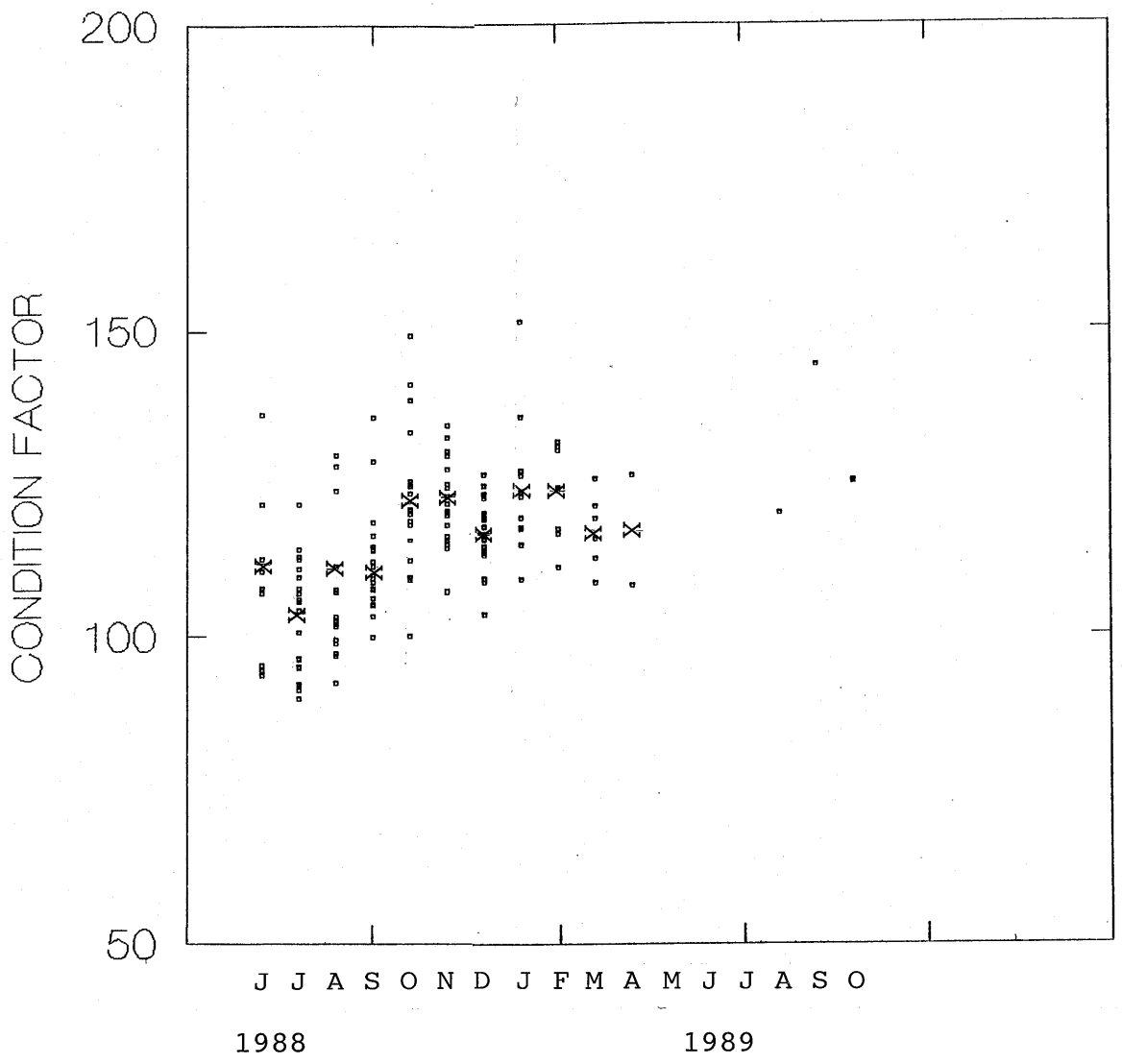


FIGURE 10. Condition factor of juvenile rainbow trout from the 1987 year class captured by electric fishing in the Awakino River, 1988-89. X = mean condition factor.

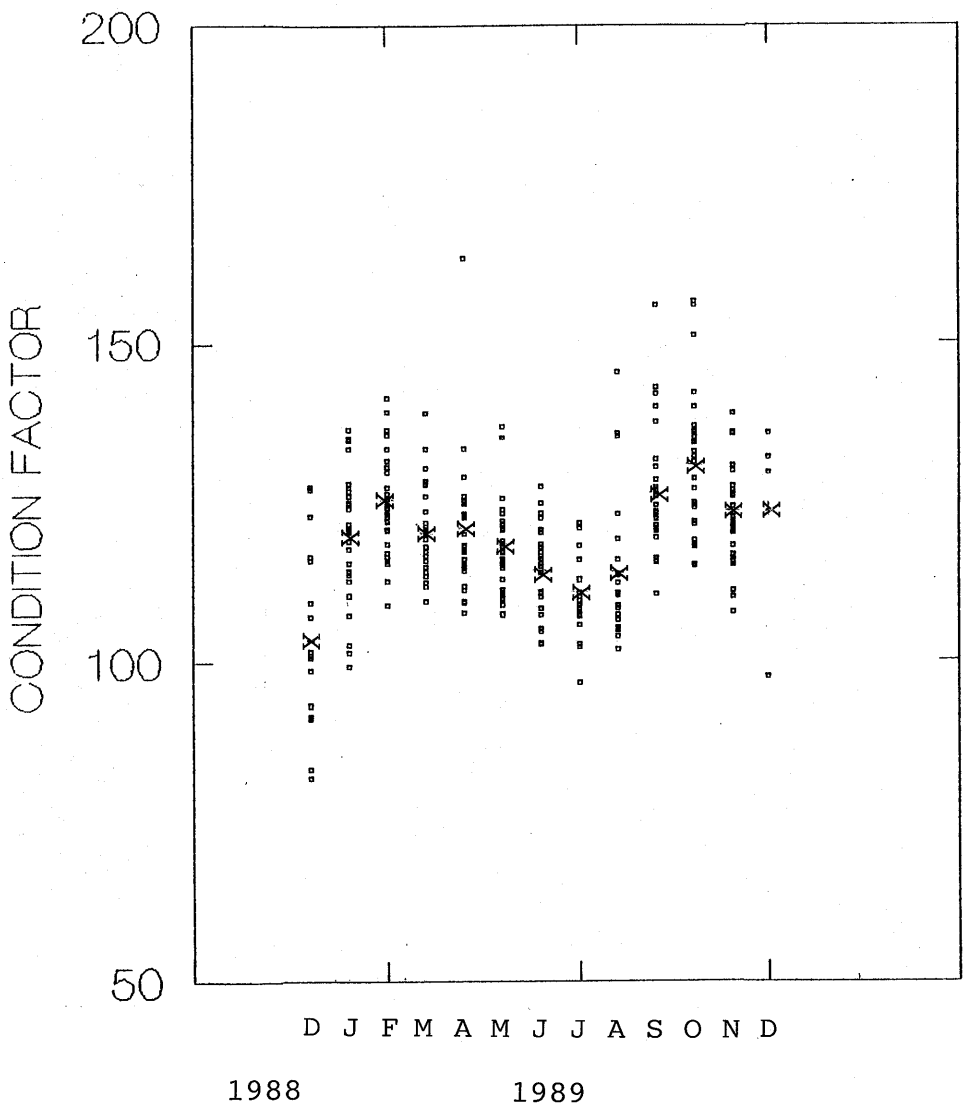


FIGURE 11. Condition factors of juvenile rainbow trout from the 1988 year class captured by electric fishing in the Awakino River, 1988-89. X = mean condition factor.

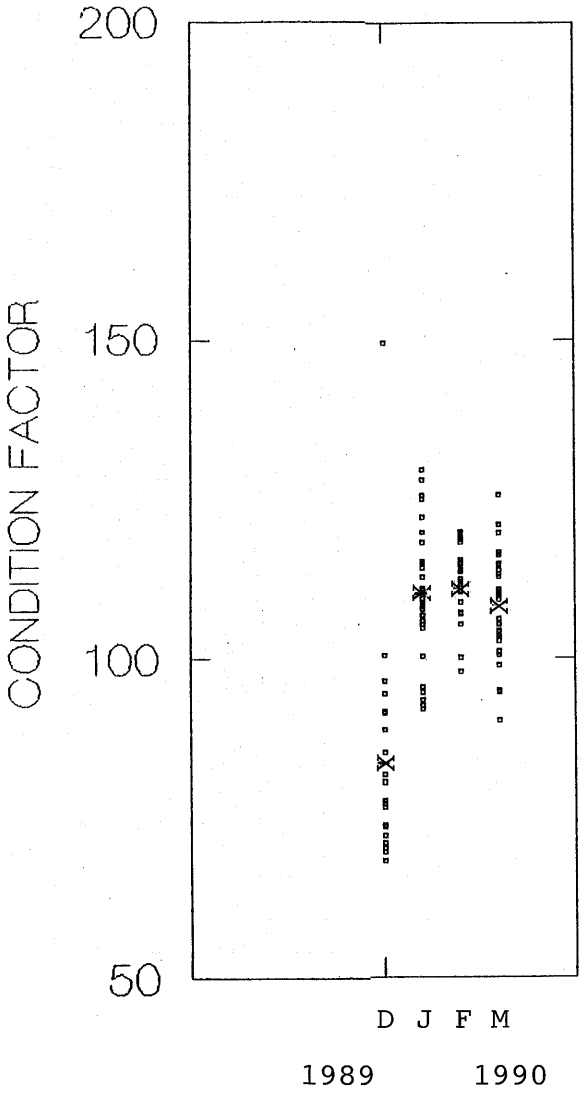
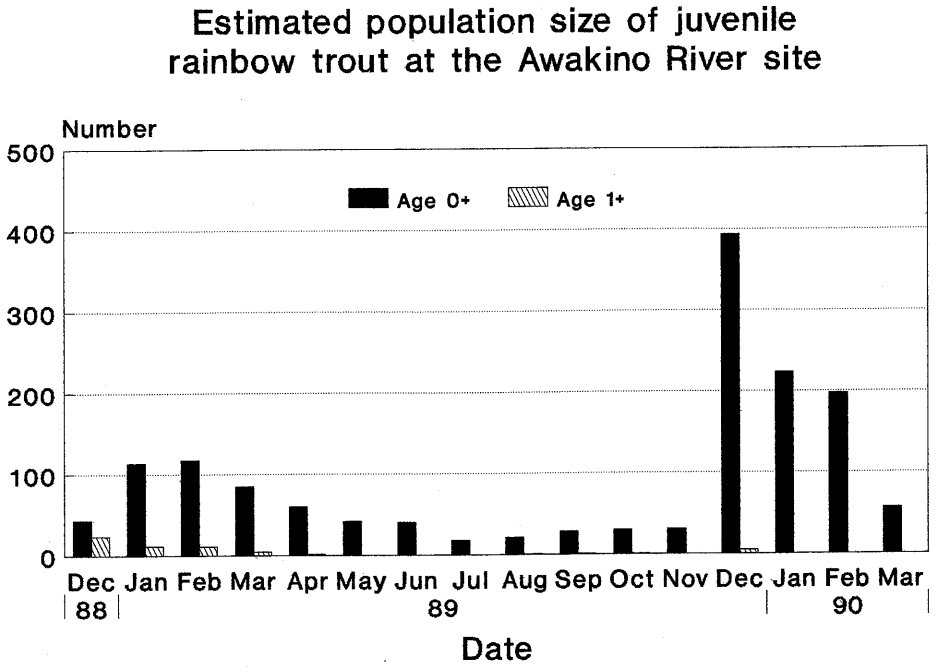


FIGURE 12. Condition factors of juvenile rainbow trout from the 1989 year class captured by electric fishing in the Awakino River, 1989-90. X = mean condition factor.



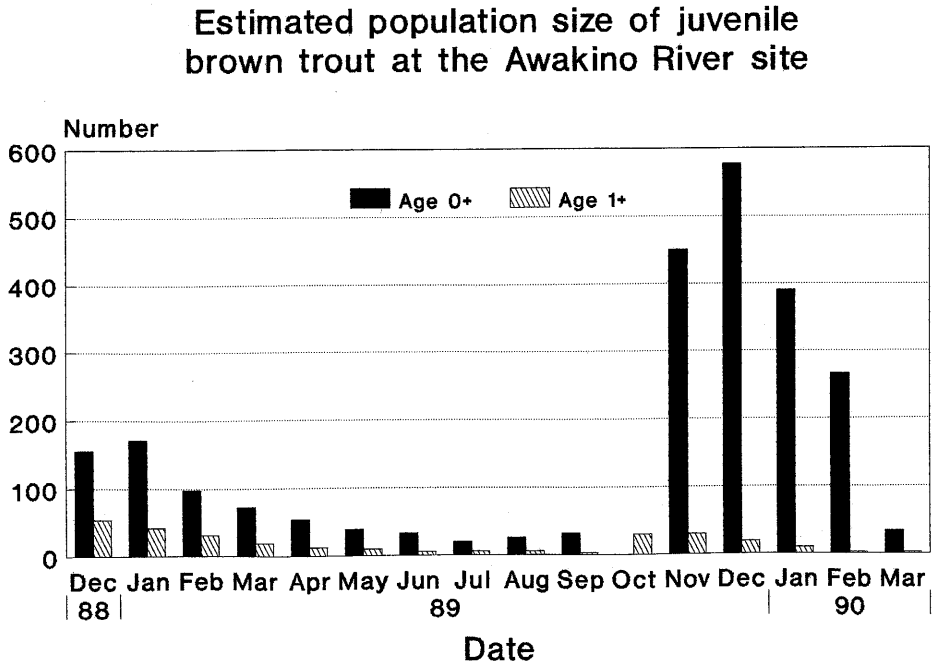


Figure 13. Estimated population size of juvenile brown and rainbow trout at the Awakino River site

Appendix I. Mean lengths, weights, and condition factors of juvenile brown trout from the 1987 year class captured by electric fishing in the Awakino River, 1988-89. (By definition age 0+ fish become age 1+ fish in October.)

Date	No.	Length (mm)			Weight (g)			Condition Factor		
		Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
27.06.88	31	85	8	63-101	7.0	2.2	2.6-12.0	109	9	94-136
25.07.88	29	84	9	67-105	6.6	2.1	3.2-12.2	106	4	97-119
26.08.88	40	96	16	78-146	10.6	6.4	4.9-34.2	109	7	94-124
19.09.88	42	94	13	71-125	9.6	4.5	3.6-23.1	109	8	97-124
19.10.88	34	100	10	83-120	11.8	3.9	6.2-21.5	114	8	97-129
15.11.88	40	106	10	85-127	14.7	4.4	7.3-25.6	119	10	80-137
13.12.88	20	120	12	97-145	21.2	6.1	11.4-37.1	119	5	106-126
12.01.89	30	132	10	114-153	27.1	6.5	17.5-40.5	115	6	104-134
22.02.89	29	142	13	123-176	34.5	9.5	21.7-65.0	117	6	105-129
21.03.89	20	146	13	124-180	36.9	10.6	21.8-66.9	117	6	108-128
12.04.89	12	151	15	129-184	40.9	13.1	26.0-72.3	115	5	106-122
16.05.89	8	158	10	141-167	45.1	8.1	32.6-52.8	114	4	108-118
15.06.89	6	154	11	144-170	39.9	9.1	33.3-51.7	108	6	101-116
18.07.89	6	164	10	145-171	47.6	7.1	33.7-52.7	108	3	105-112
16.08.89	6	160	15	137-172	45.9	11.8	26.2-55.3	110	8	101-122
18.09.89	3	165	12	152-175	55.5	8.0	49.1-64.5	123	15	110-140
24.10.89	1	164	-	-	48.0	-	-	109	-	-
21.11.89	1	199	-	-	98.8	-	-	125	-	-

Appendix II. Mean lengths, weights, and condition factors of juvenile brown trout from the 1988 year class captured by electric fishing the Awakino River, 1988-90. (By definition age 0+ fish become age 1+ fish in October.)

Date	Length (mm)				Weight (g)			Condition Factor		
Mean	No.	S.D.			Mean	S.D.	Range	Mean	S.D.	Range
19.10.88	Present but not weighed or measured									
15.11.88	Present but not weighed or measured									
13.12.88	20	58	3	52- 64	2.1	0.5	1.1- 2.7	108	18	59-131
12.01.89	30	68	8	54- 81	3.7	1.2	1.8- 6.1	115	6	106-132
22.02.89	30	83	7	65- 94	6.9	1.6	3.2- 10.5	119	8	109-141
21.03.89	31	90	9	69-109	8.3	2.2	3.6- 11.5	113	7	84-120
12.04.89	30	93	8	74-109	9.2	2.5	4.4- 15.7	114	5	102-125
16.05.89	30	97	11	69-117	10.4	3.3	3.6- 18.0	109	5	101-125
15.06.89	30	100	10	82-120	10.9	2.9	5.9- 17.5	107	8	98-126
18.07.89	19	99	9	79-110	10.9	2.8	5.2- 15.6	112	14	97-155
16.08.89	25	102	13	72-123	11.7	4.0	4.0- 20.8	107	6	98-117
18.09.89	32	106	15	80-144	15.0	6.5	6.0- 35.8	118	9	99-135
20.10.89	31	116	13	89-144	19.8	6.9	7.6- 37.1	122	9	102-137
21.11.89	29	131	16	102-157	29.1	10.1	11.3- 47.9	124	9	106-154
19.12.89	13	156	22	133-213	53.0	24.4	30.9-122.6	134	8	127-156
18.01.90	8	154	16	136-187	45.5	14.7	29.2- 77.7	123	8	114-136
13.02.90	2	147	20	133-161	38.5	18.5	25.4- 51.5	116	11	108-123
26.03.90	2	149	18	136-161	39.9	14.9	29.3- 50.4	119	3	116-121

Appendix III. Mean lengths, weights, and condition factors of juvenile brown trout from the 1989 year class captured by electric fishing in the Awakino River, 1989-90. (By definition these are age 0+ fish.)

Date	No.	Length (mm)			Weight (g)			Condition Factor		
		Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
21.11.89	30	44	5	27-50	0.9	0.3	0.2-1.4	104	10	90-139
19.12.89	30	56	8	43-67	2.0	0.8	0.8-3.6	107	7	94-119
18.01.90	30	68	9	50-84	3.7	1.4	1.4-6.8	113	9	101-145
13.02.90	29	71	6	59-80	3.9	1.0	2.4-6.0	108	5	97-117
26.03.90	29	79	9	61-93	5.3	1.8	2.4-8.7	105	4	95-112