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**THE EXPERIMENTAL WINTER
ANGLING SEASON LAKES BENMORE
AND AVIEMORE 1969**

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INTRODUCTION

Lakes Aviemore and Benmore are situated in the middle reaches of the Waitaki River system in the South Island of New Zealand. This river system has undergone extensive hydro-electric development since 1928 and these two lakes are the latest to be formed.

Lake Benmore is sited to the east of and downstream from Lakes Tekapo, Pukaki and Ohau. The lake's two arms are overhung by steep sided, tussock-covered, hills which for the most part comprise an impossible barrier to the shore line angler. The few accessible places are not heavily fished. The lake area is 30.5 square miles and the waters are essentially oligotrophic and unproductive. Winters in the area are severe and the majority of the lake is deep; 27 square miles are more than 20 feet deep. The lake was formed and filled between 1962 and 1966. After an initial period of excellent fishing with large fish being caught the size and condition dropped to the 1969 level recorded here.

Lake Aviemore is sited below the Benmore dam. It is approximately a quarter the size of Benmore in area and was filled with water during 1968/69. The brown and rainbow trout showed a tremendous increase in growth rate as had occurred in Benmore. Dense shoals of bullies formed and trout were reported gorged full of these small fish. In an attempt to prolong this period of high fish production it was reasoned that a higher cropping rate by anglers could reduce the trout numbers and hence wasteful competition. Liberal regulations were decided upon and by contrast with most sports fishing waters in New Zealand fishing was allowed throughout the year by the introduction of an experimental winter fishing season in the months of May to August. Bag (8 fish per day) and size limits (10" long) were imposed.

The experimental winter fishing season applied to both Lakes Benmore and Aviemore. It was reasoned that in Benmore

the increased take would thin out the population and reduce competition for food thereby increasing growth rates and condition of the fish present.

METHODS AND INFORMATION AVAILABLE

Other lakes in the Waitaki Valley catchment area have been studied and Technical Field Service reports (T.F.S. Reports 16, 19, 44, 45) published. Also the Waitaki Valley Acclimatisation Society has published rangers' observations and studies in their Annual Reports.

Lake Waitaki, situated below Lake Aviemore, is about Lake Aviemore size but has been in existence since 1928. Surveys ten years ago (Boud, Eldon and Watson 1959) showed that glacial silt was deposited continuously and formed the lakes substrate. This unproductive substrate supported little weed growth, the scanty fauna being chironomids, tubificids and a few snails. Bullies were very scarce possibly due to mud settling around suitable spawning stones and water level fluctuations. Brown and rainbow trout were small, scarce, and in poor condition.

Lakes Tekapo and Pukaki are glacier fed and milky white due to suspended silt. Ohau, the southernmost lake, is clear and supports weed growth, mainly large rainbows, some brown trout and a small, non-migratory sockeye salmon population.

Data about the new lakes, Benmore and Aviemore, was collected by releasing tagged fish and by a compulsory angling diary scheme or creel census. The results which follow are based on this creel census which will continue in seasons to come providing essential information about the development of fisheries in these hydro lakes. These findings will be applicable to new hydro lakes planned for the future.

A total of 1,908 anglers were issued with free permits to fish these lakes during May, June, July and August 1969.

Anglers were asked to fill in an angling diary on the back of the permit. This recorded the lake locality, times spent fishing, and species and length of fish caught. A total of 1648 were returned to the Waitaki Valley Acclimatisation Society and of these 987 permit holders had fished. After the initial returns were received the Society three times circularised these anglers who had not returned their diaries - this produced some further returns but the majority of these late returns were either nil returns or from anglers who had not fished. It is therefore assumed that the data on the permits not returned would be from anglers either catching no fish or not fishing and that the permits collected include data from the majority of the fishing carried out on the lakes in the winter of 1969. A detailed analysis of the data obtained was made by the Society's rangers and Secretary, Mr A.J. Brady. The results were published in stencilled news sheet form and distributed to the press and interested parties just before the 1970 winter season. In the meantime the permits had been sent to the Marine Department for further analysis. A random sample of 500 permits were studied and further facts obtained from the data.

In the results which follow figures such as the total hours spent fishing and total fish caught have been taken from the Acclimatisation Society's analysis since all the returned permits were studied. All other figures and estimates are based on the Marine Department analysis. Thus length frequency tables and some other data are based on the data from only one quarter of the permits issued.

RESULTS.

Lake Aviemore

The Angler and his Catch

Distribution of the permit holders was - Waitaki Valley Acclimatisation Society 51%; South Canterbury 28%; Otago 15%; North Canterbury 4%; and the rest, mainly South Island Societies, 2%.

A total of 12,070 hours was spent fishing by those anglers who had fished and returned permits. The amount of fishing by those anglers not returning permits was probably insignificant. The great majority of the fishing effort was expended by a minority of anglers. The majority of anglers who fished spent only one or two days fishing. Nevertheless, the total hours shows a considerable fishing pressure which was well rewarded by the catch of 4,039 fish.

The effort and catch increased during the winter season, but not in a strict proportional relationship.

TABLE 1

Catch and Angling Effort - Winter Season 1969

	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>Total</u>
Number of Rainbow	163	557	635	664	2,019
Number of Brown	133	315	508	1,064	2,020
Total Catch	296	872	1,143	1,728	4,039
Hours Fished	1,261	2,022	2,878	5,909	12,070
Fish Caught per Hour	.23	.43	.40	.29	.33
% Rainbow in Catch	56	64	56	39	50.0
% Effort	10.4	16.7	23.8	48.9	
% of Total Catch Caught.	7.3	21.5	28.3	42.8	

It was reported in the Waitaki Valley Acclimatisation Society Annual Report for 1969 that for the first three months fish were difficult to catch because they were gorged with bullies and that during August the fish were easier to catch. Diarists catch per hour figures contradict this and show low catch rates in May and August and highest rates in June and July. Many possible causes can be found for the discrepancy; none can be assessed accurately and the true cause is not known. However, the August figure is probably low due to influx of visiting anglers as the weather improved. Being less skillful they may have caught less fish even if fish were easier to catch.

In general, however, the catch per hour was good considering the large average size of the fish.

Length of Fish

The mean length of brown trout caught was 20.6 inches. Rainbow trout were considerably smaller averaging 17.6 inches long. The length distribution of the rainbow trout catch is roughly symmetrical around the mean length, but the brown trout catch shows a definite skew towards the larger fish size. (Table 2 & 3) The rainbow trout would also show this but for the recruitment of smaller fish into the catchable stock during the winter season. (Table 2 & 5) These fish (14 to 16 inches long) are probably two years old.

TABLE 2

Length, Average Weight and condition and % contribution to the total crop of brown trout caught in Lake Aviemore.

Length (inches)	Number	Average Weight (Pounds)	Condition Factor	% Contribution to Brown Trout catch	
				by weight	by number
10	5	.6	60		.7
11	3	.8	60	.1	.4
12	8	1.0	60	.3	1.2
13	5	1.3	59	.2	.7
14	13	1.6	59	.8	2.0
15	16	2.0	59	1.3	2.4
16	23	2.3	57	2.1	3.5
17	34	2.7	55	3.6	5.1
18	44	3.0	52	5.2	6.6
19	59	3.4	49	7.9	8.9
20	85	4.1	44	12.2	11.3
21	75	4.1	44	12.2	11.3
22	92	4.4	41	16.0	13.9
23	91	4.6	38	16.6	13.7
24	62	4.8	35	11.8	9.4
25	20	5.2	33	4.1	3.2
26	9	5.3	30	1.9	1.4
27	9	5.4	27	1.9	1.4
28	4	5.5	25	.9	.6
29	1	5.4	22	.2	.1
30	0				
31	1			.2	.1

TABLE 3

Length, average weight and condition and % contribution to the rainbow trout catch in Lake Aviemore. For comment on condition factor calculation see p.9.

Length (Inches)	Number	Average Weight (Pounds)	Condition Factor	% Contribution to rain- bow trout catch	
				by weight	by number
10	8	1.0	98	.4	1.3
11	0		98		
12	22	1.7	97	1.9	3.5
13	26	2.0	95	2.6	4.2
14	59	2.5	90	7.5	9.5
15	61	2.6	77	8.1	9.8
16	65	2.7	65	9.0	10.4
17	59	2.8	57	8.5	9.5
18	78	3.0	51	12.1	12.5
19	60	3.2	47	9.9	9.6
20	67	3.5	44	12.1	10.8
21	35	3.8	41	6.8	5.6
22	35	4.4	41	7.9	5.6
23	13	4.9	40	3.2	2.1
24	10	5.5	40	2.8	1.6
25	7	6.3	40	2.4	1.1
26	3	6.9	39	1.0	.5
27	2	7.7	39	.8	.3
28	1	8.6	39	.4	.2

TABLE 4

Length composition of brown trout catch from Lake Aviemore in each month. Results from 500 returned permits.

<u>Number of Fish and Month</u>					
<u>Length</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>Total</u>
Unrecorded	5	2	2	3	
Undersized	2	4	1	3	22
10	2	3			5
11	2			1	3
12	3	4	1		8
13		1	3	1	5
14	1	4	2	6	13
15	3	3	5	5	16
16		3	10	10	23
17	3	5	9	17	34
18	4	12	7	21	44
19	2	11	26	20	59
20	9	13	24	39	85
21	9	10	27	29	75
22	6	22	34	30	92
23	11	14	28	41	91
24	4	6	17	27	62
25	1		4	9	20
26	2			7	9
27	1		5	3	9
28	2		1	1	4
29	1				1
30					0
31					1

TABLE 5

Length composition of rainbow trout catch from Lake Aviemore. Results from 500 returned permits.

Number of Fish and Month

<u>Length</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>Total</u>
Unrecorded			3	5	8
Undersized	5	2	3	4	14
10	2	3	2	1	8
11					
12	9	8	2	3	22
13	5	11	7	3	26
14	5	28	15	11	59
15	5	24	13	19	61
16	7	24	13	21	65
17	6	19	18	16	59
18	9	12	29	28	78
19	12	14	16	18	60
20	13	11	23	20	67
21	3	13	15	4	35
22	9	8	6	12	35
23	1	5	3	4	13
24	1	3	1	5	10
25	1		3	3	7
26		1		2	3
27		1		1	2
28				1	1

Weight and Condition of the Fish

The average weight of brown trout was 3.7 lbs; rainbows were lighter at 3lbs. Diarists were not asked to record the weight of fish but many did and 223 fish weights were recorded. (Table 2 & 3) A considerable range of weights were given for a given fish length which may be due to the presence of spawned fish or kelts. Systematic under and over estimates were recorded by some diarists and in general there seems to be a considerable exaggeration of the weights of smaller fish. The derived condition factor of some of these small fish is in the 80's and 90's; this high condition factor seems rather unlikely!

In fish smaller than 17" long rainbow trout were heavier than brown, but at each length above 17" the weights of both species were the same.

The condition factor was analysed for both species and shows a steady decline with increased size of fish. This decline was noticeably greater than expected and was caused by:

- (a) The natural decline of condition with age and length.
- (b) A greater percentage of spawned kelts in the larger fish, and possibly, the occurrence of some non-recovering kelts such as occur in Lake Taupo. (D.F. Hobbs, 1953).
- (c) The natural tendency for anglers to weight correctly large fish and guess (and over-estimate) the weight of smaller fish.

Overall, the condition of the fish was excellent. (Table 2 & 3) Fish under 20 inches had a condition factor of around 50 on the Corbet scale. Over 20 inches long the condition factor dropped to approximately 40.

The Crop

It is possible to calculate from the weights and condition factors given by the diarists the average weight of both species of fish at any length. From this and the diary data on length of fish the total winter season crop is estimated

at 7,300 lbs brown trout and 6,100 lbs rainbow trout, i.e., a total of 13,400 lbs or 6 tons.

The length groups contributing most to the crop are brown trout 20½" to 22½" and rainbows 18" to 20" long. (Table 2 & 3) Although rainbows made up 50% of the catch by numbers they made up only 45% of the weight.

Taking into account the better weather and greater popularity of angling in summer and the fact that there is a greater choice of waters for anglers to fish in summer it is reasonable to assume that the crop of fish remains at approximately the same average level as in the experimental winter season. Hence it is estimated that over the year a total of 12,000 fish (weighing 40,000 lbs (17.8 tons)) are kept. This gives an approximate crop per acre of between 6 to 8 lbs of fish which is the same as the crop per acre obtained from Lake Taupo. (Cunningham 1958) The total catch in numbers and weight is about 5% of Taupo's due to Aviemore's smaller size. The catch is equivalent to about a third of the entire Southern Lakes catch.

Ova lost by Winter Angling

A 14% drop in condition after spawning was found in medium sized brown trout in Lake Hayes in 1958. (Varco 1958 unpublished). Using this to determine which fish were probably kelts a rough estimation of the percentage spawned fish in the catch was made.

More brown trout than rainbow trout were found to be in poor condition and it was estimated that 50% of the brown trout catch were kelts. This high figure is mainly due to the increased catch of brown trout in August after the normal spawning period. A total of 2,020 brown trout were caught, and as 50% of the fish were kelts, 1,000 pre-spawning fish would be taken. Assuming fish were caught in a 1:1 sex ratio then 500 female browns would be caught before spawning. Using the equation: Number of eggs = 659 x Length in cm.^{2.072}

(C.J. Hardy 1967).

The number of eggs these females would have spawned had there been no winter fishing would have been about 950,000.

Fewer rainbow trout were kelts: the proportion was highest in July (37%) but on average only 20% had spawned. By the same type of calculation as above the eggs lost totalled some 900,000 from about 800 fish.

The corollary of the above is that of the kelts caught the browns had spawned 950,000 eggs, and the rainbows 220,000.

Spawning takes place at Deep Creek and also in the shingle around the lake edge. Both species of trout are believed to spawn in this shingle, but whether the eggs hatch and the fry survive is not known.

Bag Analysis - Winter Season 1969

Fish Caught	0	1	2	3	4	5	6	7	8
% Days	38.3	27.1	17.3	9.3	4.7	2.3	0.9		

A few limit bags of eight fish were recorded, but they form a tiny percentage. At a average catch per hour rate of .40, 20 hours would normally be needed to obtain a limit bag! At an average weight of 3.33 lbs eight fish would weigh 26½ lbs; far too much for most domestic deep freezes!

For the bag limit to reduce the catch an appreciable extent, a bag limit of 2 or 3 fish would have to be imposed! The effects of the bag limit on the summer fishery are not known.

Size Limits

Approximately 100 undersized fish were caught, i.e., 1.8% of the catch therefore the size limit of 10" had no significant effect on the winter catch. For the size limit to effectively reduce the catch it would have to be around 15" for rainbow and 18" for brown trout. The effects of the size limit on the summer catch is not known.

DISCUSSION

Since its formation Lake Aviemore has shown a great increase in productivity and an increase in the numbers and

size of the fish caught. This is typical of most newly filled reservoirs and lakes. Although not measured, it is likely that due to the windy nature of the area the lake does not become thermally stratified and is well mixed throughout the year.

Only tussock grasses were flooded and available for bacterial decomposition. Therefore little oxygen would have been consumed by decay of flooded material. High oxygen concentrations were and are probably present throughout the water mass. Thus both deep and shallow areas of the new lake would be productive. This may account for the exceptional character of the boom in productivity.

The overall productivity will probably drop as glacial silt becomes deposited in the depths and the benthic fauna changes accordingly. As the productivity drops several changes could occur in the fish population. The facts that equal numbers were of rainbow and brown trout were caught and that rainbow are easier to catch than brown trout may indicate that in terms of actual abundance rainbow trout may be less common than brown trout and that a disproportionate cropping of rainbow trout is taking place. It is possible that in future there could be a reduction in the numbers of rainbow trout but both Lakes Benmore and Ohau are predominantly rainbow trout waters. It is my opinion that rainbow trout will eventually predominate in Aviemore, but that this could be a slow process.

When the lakes basic productivity drops the average size and condition of the fish will drop unless the anglers have removed and continue to remove sufficient of the stock to reduce competition for food. The population/catch relationship is unknown, but it is thought that the population decrease is inevitable because the enormous numbers of bullies and the availability of other foods will fall with the passage of time.

As it is likely that available food will be reduced if trout conditions and growth rates, but not necessarily abundance, are to be maintained the numbers of fish currently present must be reduced. It is suggested therefore that the

restrictions on size and bag limit be removed and the winter fishing season continue.

Lake Benmore

The Angler and his Catch

As with Aviemore the amount of data not returned is not thought to be significant.

A total of 2,809 fishing hours were recorded on the returned permits. This is considerably less than at Aviemore. This lower effort is probably due to Benmore's inaccessibility and the poorer fishing. The total catch was approximately 1,300 fish.

Throughout the season rainbow trout made up a greater proportion of the catch than brown trout.

TABLE 6

Catch and Angling Effort - Winter Season 1969

	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>Total</u>
Number of Brown	108	107	87	217	519
Number of Rainbow	209	202	111	260	782
Total Catch	317	309	198	477	1,301
Hours Fished	794	645	412	958	2,809
Fish caught per hour	.40	.48	.48	.50	.46
% Rainbow in Catch	66	65	56	54	60
Total % Effort	28.3	22.9	14.7	34.1	
% of Total Catch Caught	24.4	23.7	15.2	36.7	

The effort and catch were roughly proportional all through the season. The catch per hour was higher than at Aviemore. This would appear to indicate a greater abundance of fish which if food is in limited supply would relate to the lower average size. However, it is possible the anglers were more skilled or used a more effective method, but this is not known. Also, if the fish were hungrier than at Aviemore they would be easier to catch.

The effort was comparatively high in May but unlike Aviemore did not show an increase through the season. This may be due to angler preference for Aviemore once the good catches (poorer fish per hour rates but better fish) there were known or due to other factors such as adverse weather.

Length of Fish

The mean length of brown trout (Table 8) was 17.5 inches and of rainbow trout 15.7 inches (Table 7) (15% and 10% shorter than in Aviemore). The size range of both species is similar. Rainbow trout seem to be of two major length groups (Modal lengths 14 and 18") : these could be two separate year classes. No recruitment of a new year class into the catchable population occurs in the winter season. Very few undersized fish were recorded so the 14" rainbow could be two years old. If so, their growth rate is slightly slower than that of the Aviemore fish and slows further after 3 years of life. Fish condition is good.

The small size of Benmore's fish could be due to the effects of accumulating glacial silt, fluctuations in level, and lowered productivity since formation on the availability, production and type of food organism present. The "bullie" population and hence the availability of food for larger fish may have fallen in recent years. Smaller trout can feed on the increased chironomid population and would still be in good condition.

Weights and Conditions of Fish

Weights of only 35 Benmore fish were recorded by all the anglers who fished here. From this small sample condition factor shows the same trend of declining condition with age of fish as in Aviemore. Below 18 inches the rainbow trout have a higher condition factor than the brown trout. This also occurs in Aviemore.

The average weight of brown trout was 2.74 lbs, and of rainbow trout 2.17 lbs. (26% and 28% lighter than in Aviemore).

The Crop

This was calculated in the same way as for Aviemore. The total crop of brown trout in the 1969 winter season was about

TABLE 7

Length composition of rainbow trout caught in Lake Benmore each month. Results from sample of 500 permits.

<u>Length</u>	<u>Month</u>				<u>Total</u>
	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	
Unrecorded	5	19	30	13	67
Undersized	3				3
10	2				2
11	2				2
12	2	1	3	7	13
13	11	6	4	15	36
14	20	10	3	37	70
15	9	9	2	19	39
16	14	3	2	9	28
17	11	1	1	10	23
18	14	8	3	13	38
19	2	7		3	12
20	2	7	4	2	15
21	4	2	2	1	9
22	1		1	2	4
23	1			1	2
24		1			1

TABLE 8

Length composition of brown trout caught in Lake Benmore each month. Results from sample of 500 permits.

<u>Length</u>	<u>Month</u>				<u>Total</u>
	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	
Unrecorded		3	6		9
Undersized					
12		1		2	3
13		1	3	6	10
14	5	4	2	10	21
15	5	4	2	5	16
16	6	8	2	13	29
17	6	5	1	13	25
18	7	8	4	14	33
19	9	8	2	13	32
20	4	5	2	7	18
21	4	3	2	5	14
22		2	2		4
23		2	2	1	5
24	2				2
25		1			1
26	2				2

1,500 lbs and of rainbow trout about 1,700 lbs.

It is estimated that over the whole year a total of 3,900 fish weighing 9,500 lbs ($4\frac{1}{2}$ tons) were kept. This is a quarter of the Aviemore crop. The Benmore brown trout crop contains a greater range of lengths than at Aviemore but Aviemore has only been filled since 1968. The Benmore population is being exploited less by anglers and is subject to a relatively lower cropping rate. Aviemore gave a greater crop per acre than Benmore, but the Aviemore catch rates were not as high as in Benmore.

Ova Loss by Winter Angling

Few weights were recorded by anglers and it is not possible to estimate the percentage of fish which had spawned. However the data is irrelevant as the angler takes only a small proportion of the mature fish. Ample ova would therefore be available for recruitment, provided there are sufficient spawning areas. However, due to recent construction work, spawning tributaries may be adversely affected. The extent of this effect will have to be gauged and, if serious, spawning facilities constructed for these fish. This is with the proviso that there is no successful natural spawning around the lake edge.

Bag Analysis - Winter Season 1969

Fish Caught	0	1	2	3	4	5	6	7	8
% Days	20.4	23.6	20.4	15.1	11.8	4.3	2.1	2.1	0

This distribution is different from Aviemore. This may be because the fish are smaller, commoner and possibly hungrier than in Aviemore and the anglers are probably more skillful and keener than those fishing Aviemore. At the average catch rate of 0.46 fish per hour the bag limit would take 17 hours to reach. The total weight of a limit bag of average weight fish would be 18 lbs. Some bag limits are taken, but the present limit probably reduces the winter catch only very slightly.

Size Limits

Only twelve undersized fish were caught by all winter season anglers. Therefore, even though the fish are considerably smaller than at Aviemore, the size limit is not having any effect.. The effects of the size limit on the summer fishery is not known.

DISCUSSION

Benmore, when first filled, showed a boom in productivity as Aviemore does now. Since then there has been a deterioration in length and weight of fish. The present state is set out in this report. Future trends could have been forecast if year by year records of fish lengths, condition and lake productivity were kept. Unfortunately, they have not been kept, and it is not possible to say if the drop in length and weight of the species concerned is levelling off or still dropping. At the present moment the average length is smaller than that of Lake Ohau: this may show the effect of sediment from Lake Pukaki and Lake Tekapo on Lake Benmore's basic productivity.

It is very difficult to predict what changes the fish population will show in this lake; there are many unknown and variable factors. It should have reached a fairly static or balanced situation now and any further changes should be slow. However, growth rates of larger fish appear to be slow and there are indications that the food supply for these fish is limited. Thinning of the stock by intensive angling should decrease competition for food and increase growth-rates. Therefore the removal of the size and bag limits may have beneficial effects.

COMPARISON OF THE TWO LAKES
PREDICTIONS & RECOMMENDATIONS

The present state of the two lakes is summarised below:

<u>1969 Winter Fishery</u>	<u>Aviemore</u>	<u>Benmore</u>
Average size of fish:		
Rainbow Trout	17.6"; 3.0lbs	15.7"; 2.2lbs
Brown Trout	20.6"; 3.7lbs	17.5"; 2.7lbs
% Rainbow Trout in catch	50	60
Catch per hour: Fish	.33	.46
Pounds	1.0	1.0
Estimated Annual Crop (tons)	17.8	4.25

As yet there is little data to allow reliable predictions to be made but it is possible to speculate on the future development of fisheries in the two lakes.

In Benmore productivity has passed its peak and has fallen to a lower level. Fish are still abundant, readily taken and in good condition. However, growth rates have fallen in recent years and the average size of fish taken has consequently fallen. With further deposits of glacial silt and further fall in productivity the availability of food for larger fish will continue to fall. However, abundant food for small fish will remain and it is anticipated that, unless the production from spawning declines due to deterioration of spawning areas, that the numbers, and survival of small fish will be high. Initial growth will be good but later growth slow. Due to the increased competition food among larger fish growth rates will fall

leading to lower average weight and size of fish. It is therefore important that cropping remains high and it is suggested that the limits on size and bag are removed and the winter fishing continued. The diary scheme should continue and if catch-rates fall significantly the situation should be reviewed.

Aviemore has only recently been filled and the fish population is relatively young. Survival and growth of young fish in the lake has been high. There is abundant food present for fish of all sizes however it is anticipated that the food supply, particularly food for larger fish, will be less abundant in future. If spawning production continues to be high then this will result in lessened growth-rates with a consequent increase in the number of small fish and a fall in the average length and weight of fish caught. The predicted reduction in bully population will result in the larger fish being hungrier and initially catch-rates of these fish may increase. The decline in bullies will have more deleterious effect on the brown trout than on the rainbows and may lead to an increase in the proportion of rainbow trout in the population. This, together with the rainbow trout's greater susceptibility to angling may result in an eventual increase in rainbow trout in the anglers catch. As an increase in the number of small fish and a fall in growth rates due to competition for food is predicted it is suggested that intensive cropping of the Aviemore population continue and that the size and bag limits be removed and the winter season continue. The winter fishing diary scheme should continue and if catch rates decline significantly the management measures should be reviewed.

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WELLINGTON, NEW ZEALAND

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