FRESHWATER FISHERIES ADVISORY SERVICE

FISHERIES DIVISION - MARINE DEPARTMENT

INVESTIGATION REPORT

NORTH ISLAND JOB. NO. 6

ACCLIMATISATION SOCIETY DISTRICT: Hobson

OBJECTIVES: A Survey of the Kai Iwi Lakes to examine:

(a) The condition of the trout stocks relative to the available food supply; and

(b) The suitability of the lake for an additional food supply for trout (in the form of a forage fish) if necessary.

INTRODUCTION

These lakes have previously been described when the first of three former surveys were carried out, and the reports on these surveys should be referred to for complete background information. A brief account of the lakes and the history of the fishery follows to enable some comparisons to be drawn.

Lake Taharoa (585 acres) is the largest of the three coastal dune lakes known as the Kai Iwi Lakes which lie 17 miles north of Dargaville. Connected to Lake Taharoa by a 3ft diameter culvert is Lake Kai Iwi (82 acres) and approximately 400 yards to the northwest of Taharoa is Lake Waikare (86 acres). The lakes have no tributaries of consequence or spawning grounds for trout.

Following the report of Cudby and Ewing (1968) that these lakes possessed favourable environment for trout, 10,000 rainbow fingerlings were released into Lake Taharoa during September 1968. The next year, a further survey of the lakes was carried out by Cudby, Ewing and Wilkinson (1969). Growth rates of the initial liberation were found to be good and little change in the faunal composition was noted. A second liberation of 5,000 marked rainbow fingerlings went into Lake Taharoa and also 5,000 into Lake Waikare in September 1969.

The next survey (Cudby, 1970) showed a falling-off in the trout condition of Lake Taharoa and a marked reduction in several animals indigenous to the lakes. Trout from both liberations had also moved into Lake Kai Iwi via the culvert. No further liberations have been made into the lakes.

The present survey was initiated following reports of a falling-off in trout condition, and also to examine the suggestion, made by Cudby, that the introduction of a suitable forage fish, as an additional link in the food chain, might maintain trout condition.

METHODS

Netting for trout was carried out using a 2" monofilament gill net and a 1½" and a 5" cotton mesh gill net. All samples, as well as any fish from anglers samples, were weighed, measured and stomach contents as well as gonad condition were examined. The fish were also noted as being first or second liberation from the fin clipping.

Observations on the bottom fauna of the lakes were made by diving, using a "Johnson Air Buoy" which was very successful for this sort of work although limited to a depth of 30ft. Square foot bottom samples for qualitative and comparative analysis were also taken.

FINDINGS

Trout Condition:

No trout were caught in the cotton gill nets, possibly because of their size (1½" and 3") being too small and too large respectively for the trout present. The net's bright colouration in the fairly clear lake waters could also have been a factor. Catch return from all of the three lakes with the monofilament net was low. In all, a total of 11 sets of approximately eight hours (shorter sets did not yield results) were made for a total of only 22 fish. This compares poorly with the 124 trout caught in Lake Taharoa by Cudby in September 1970 in a total of four sets of five hours using two monofilament nets. This suggests a reduction in trout population since then as was to be expected.

(a) Lake Taharoa:

Of 21 trout examined from netting and angler catches, 12 were first liberation fish (7 males; 5 females) and of the second liberation fish, two were males and seven females. None of the first liberation female fish had extruded last year's eggs completely (two not at all) and all had new roe forming over the old. Second liberation fish had only current years eggs in varying degrees of maturity.

The mean condition factors for first liberation fish were 125 for males and 134 for females and 137 for males and 130 for females for second liberation fish. Table 1 sets out the data obtained compared with results from the previous surveys.

As expected of trout in a previously unstocked but favourable environment, the condition of the first liberation fish was initially good. The fact that it fell off by September 1970 could be attributable mainly to two factors, an initial overstocking followed by the impact of the second liberation fish. It should be noted that the fish of both liberations showed poor condition at September 1970, but both have now risen markedly. The similarity in growth rate combined with the poorer results from the gill netting on this survey suggests that natural and angling mortality have reduced the trout population to a more balanced level with the native fauna population; this also was confirmed by comparisons of bottom fauna on each survey. It is also noted that although the mean length of the first liberation fish rose from 35.1cms (13.8ins) in September 1970 to 37cms (14.8ins) on this survey, the maximum recorded length and weight of individual fish were 46.6cms (18.3ins) and 1191gms (2lb 10ozs) in September 1970. However, the maximum recorded length and weight of the second liberation fish similarly after two years' residence in the lake were only 41cms (16ins) and 907gms (2lb).

TABLE 1 Fish Condition - Lake Taharoa

1st Liberation	March 1969	September 1970	April 1971
Length range - cms (ins)	26 - 33 (10.25-13.0)	26.5 - 46.6 (10.4-18.3)	33 - 41 (13 - 16)
Weight range - gms (ozs)	228 - 453 (8 - 16)	256 - 1191 (9 - 42)	453 - 765 (10 - 27)
Condition factor range (Corbett)	108 - 146 (39 - 53)	91 - 147 (25 - 55)	108 - 146 (39 - 53)
Mean length - cms (ins)	29 (11.8)	35.1 (13.8)	37 (14.8)
Mean weight - gms (ozs)	340 (12)	49.6 (18)	652 (23)
Mean condition factor (Corbett)	127 (46)	114 (41.5)	125 (45.3)
2nd Liberation			
Length range - cms (ins)		28.2-32.8 (11.1-12.9)	35 - 41 (14 - 16)
Weight range - gms (ins)		284 - 454 (10 - 16)	538 - 907 (19 - 32)
Condition factor range (Corbett)		90 - 127 (33 - 46)	119 - 144 (43 - 52)
Mean length - cms (ins)		32 (12.6)	38 (14.9)
Mean weight - gms (ozs)		357 (13)	737 (26)
Mean condition factor (Corbett)		110 (40)	131 (47.2)

(b) <u>Lakes Kai Iwi and Waikare</u>:

One first liberation trout (male) and five second liberation fish (1 male; 4 female) were examined from Lake Kai Iwi and four female and one male trout from Waikare. Details are shown in the next table with a comparison with Lake Taharoa.

TABLE 2 Comparison of the three Lakes

	Lake Taharoa 1st Lib.	Lake Taharoa 2nd Lib.	Lake Taharoa Combined	Lake Kai Iwi 2nd Liberation Only	Lake Waikare 2nd Liberation Only
Length range cms (ins)	33-41 (13-16)	35-41 (14-16)	33-41 (13-16)	41-46 (16-18)	34-38 (13.5-15)
Weight range gms (ozs)	454-765 (16-27)	539-907 (19-32)	454-907 (16-32)	907-1134 (32-40)	510-624 (18-22)
C.F. range	108-147 (39-53)	119-144 (43-52)	108-147 (39-53)	119-161 (43-58)	103-128 (37-46)
Length mean cms (ins)	37 (14.8)	38 (14.9)	38 (14.95)	42 (16.8)	36 (14.2)
Weight mean gms (ozs)	652 (23)	737 (26)	709 (25)	992 (35)	567 (20)
C.F. mean	125 (45.3)	130 (47.2)	128 (46.2)	133 (48)	125 (45)

A value of 110-112 (40) is average on the metric condition factor scale and only two fish, one in Lake Waikare 103 (37) and one first liberation fish from Lake Taharoa 109 (39) were below this value. Lake Kai Iwi had the highest recorded condition factor - 161 (58) and the best mean value 133 (48) and this bears out anglers' statements that the largest, 1360-1810gms (3-4lb), and the best conditioned fish came from this lake which, of course, had only been "stocked" by trout moving into the lake via the 3' diameter culvert from Lake Taharoa. The gill netting which was carried out at both ends of this lake also showed the lowest return, further suggesting a small population of well conditioned fish. The one "first liberation" male fish taken in Kai Iwi weighed 794gms (28 ozs) and had a condition factor of 119 (43), but as fish were sometimes seen in the connecting culvert at night it is possible that this trout may have only recently moved into the lake.

The poorest conditioned fish were from Lake Waikare which has definitely been overstocked. The lake also had the lowest bottom fauna counts.

The Lake Taharoa fish have an above average mean condition factor 128 (46.2), this of course having improved since the last survey in September 1970.

Trout Stomach Contents

The following table gives a numerical analysis of the stomach contents of the trout caught from the three lakes.

TABLE 3 Trout Stomach Contents

Species	Lake Taharoa															Lake Waikare					Lake Kai Iw			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	1	2	3	4
Freshwater Crab H. *lacustris*	55	39	68	7	2		4	1	11	4	1	2												
Galaxias spp.																	56				6			
Freshwater Crayfish P. *planifrons*							1	1	1		1					3		1						
Bully *Gobiomorphys* spp.			1	1				13		1		1										13		7
Freshwater snail *Potamopyrgus* spp.																					8			8
Water boatmen Corixidae																					6		62	5
Water beetle Coleoptera	1				1														1					
Terrestrial Insects	14										2						3		1	2				

One significant difference that exists compared with the 1969 survey, following the first liberation, is the lack of galaxids in the Lake Taharoa trout stomachs this year.

The freshwater crab seems to have withstood trout depredation fairly well in Lake Taharoa (so far), but not in the smaller Lakes Kai Iwi and Waikare; it is not known to what extent these latter two lakes were originally populated. Three of the five trout examined from Lake Waikare (the poorest conditioned fish) contained terrestrial insects and could suggest a change of feeding habits especially considering the low bottom fauna counts. The number of samples is really too low for reliable evidence and allowance must also be made for seasonal and individual variation in the habits of the trout as well as the other animals.

Bottom Fauna

(a) Lake Taharoa:

In the initial survey in July 1968, diving and general observations showed that the species Hymensoma lacustris (freshwater crab), Galaxias sp., Gobiomorphus basilis (common bully), Parenephrops planifrons (Koura) amongst others were fairly common and widespread. Six months after the first trout liberations little change in the faunal composition was noted (Cudby, March 1969), but in September 1970 coinciding with the poor trout conditions, none of these animals excepting the common bully were seen. On the present survey only the galaxiids and the Koura were not observed in Lake Taharoa; other species were seen, but in reduced numbers since the initial survey. Koura were found in trout stomach contents but of the galaxiids, in spite of an intensive search there was no sign.

Bullies were common and were mainly juvenile, occurring over the beds of Nitella in numbers of 5-6 to the square yard. Anglers reported these fish in large numbers around the lake edges during the summer, and trout feeding extensively on them. This is associated with the bullies spawning period, which occurs at this time, and is a fairly common behavioural pattern. Owing to the different feeding habits of individual fish, it is not thought that this was responsible for the trouts return to condition, although it may have been a factor.

About 20 freshwater crabs were seen at one location, but these also occurred extensively entangled with strands of weed in the trout stomachs and in the bottom samples taken over weed beds. They appeared in a good range from juveniles to adults. These crabs were not visible in the weed beds whilst diving, only over sand. No crabs were seen on the previous year's survey.

(b) <u>Lake Kai Iwi</u>:

All of the previously mentioned species were found to occur, the galaxiids however being confined to small numbers (10 to 15 seen), thought to be juveniles, around the edges. However, R.M. McDowall (pers. comm.) suggests that these may have been adults of the species <u>G. gracilis</u>, which appear to be stunted in these lakes, rarely exceeding 44mm in length. Two frogs were also noted.

(c) <u>Lake Waikare</u>:

All of the previous species were found, but in lower numbers, and with the exception of the freshwater crab. The galaxiids were observed in greater numbers (30-40) than elsewhere. One frog was seen.

The following table gives a numerical analysis of the bottom fauna samples taken from each of the three lakes. Samples were taken randomly at the 10' levels (Nos 1) and 20' levels (Nos 2) over the beds of <u>Nitella</u> at various stations.

<u>TABLE 4</u>

Species	Lake Taharoa			Lake Kai Iwi		Lake Waikare	
	1	1	2	1	2	1	2
Freshwater Crab H. <u>lacustris</u>	13	5	1				
Freshwater snail <u>Potamopyrgus</u> spp.	9	6	5	4	12		
Freshwater mussel <u>Sphaerium</u> spp.				22	3		
Bloodworm C. <u>zealandicus</u>		6	9				
Large dragon-fly larvae U. <u>carovei</u>			1	3	2	1	2
Red damsel fly nymph X. <u>zealandica</u>			2		1		3
Sandy case caddis P. <u>aureola</u>				42	10		

Eels

There was no significant difference in the number of eels seen compared with previous surveys. Ten short-finned eels (*Anguilla australis*) were seen whilst diving in Lake Taharoa and about eight others were seen from the banks in the culvert between Lakes Taharoa and Kai Iwi at night. Three trout were also observed in the culvert. Only one, approximately 8lb, long finned eel (*Anguilla dieffenbachi*) was seen in Lake Taharoa. As previously noted by Cudby, the eels (*A. australis*) are large for their species and this is undoubtedly due to the fact that the only outlet channel to the sea has been blocked for a number of years, thus preventing migration. Details of four eels speared are given below.

TABLE 9 Lake Taharoa Eels (*A. australis* - all female)

Length		Weight		Stomach Contents	
cms	inches	gms	ozs		
94	37	1810	64	3 crabs	1 Koura
94	37	992	35	-	
97	38	2554	90	46 crabs	2 dragon fly larvae
102	40	1867	66	-	

Stomachs of five eels examined in March 1969 contained crabs and Koura only. As these species are dominant in the eels diet, and if migration is not possible, there is a strong possibility that the eel population will be greatly reduced within the next few years.

The suitability of Lake Taharoa for forage fish

Environment: In the original report on the Kai Iwi Lakes in June 1968, before the first trout liberation, Cudby and Ewing recommended, inter alia, that investigations should be carried out to determine the need to alter the stocking rate or to provide additional food supplies for trout, such as a forage fish, should the present population of galaxiids be drastically reduced. The Rotorua smelt, *Retropinna lacustris*, was later suggested as probably being the most suitable type of fish for an additional food supply for trout.

R. lacustris has been liberated quite widely in waters in the Taupo and Rotorua districts with apparently a good deal of success. They were introduced into Lake Taupo in May 1934, with the object of increasing the diminishing trout food supply. Little increases in their numbers were apparent, however, until after 1942 when the level of the lake was artificially raised which had the effect of increasing the sandy areas of the shoreline, probably providing large spawning grounds. In any event the numbers of smelt subsequently increased phenomenally (Burstall 1950). Lake Taharoa has similar sandy areas for spawning, about one half of the perimeter of the lake shore, on the southern and eastern sides, being suitable. Expressed in terms of area, when Lake Taharoa is at its maximum level the total acreage available for smelt spawning could be around 80 acres compared with the lakes total area of 585 acres. The physical environment appears to be otherwise suitable for smelt, and species have already been recorded from a number of northern locations. However, apart from Taupo and possibly Rotorua, attempts to establish smelt in many other seemingly suitable waters have met with little, if any, success.

There are no suitable spawning beaches for smelt in the two smaller lakes, but the introduction of smelt into them is not being considered.

Food: In her studies on smelt in Lakes Taupo and Rotorua, V.H. Jolly thought that the fact that these fish have been able to thrive when introduced into lakes where trout were already well established, shows them to be endowed with a capacity to avoid predation during their development stages. She concluded that the success of R. lacustris in lakes lies in the fact that during the early stages of life they are dispersed in the open waters where they are able to utilise planktonic organisms for food. The crop of smelt which a lake can produce must, therefore, be in direct relationship to the amount of plankton developing in that lake and this is related to its total productivity. In her examination of stomach contents of adult fish, however, Jolly found that the dominant organisms were midges, both larval and adult, which appeared in almost 50% of the stomachs containing food. Crustacea and insect larvae made up the bulk of the remainder, but she concluded that the wide range of organisms found in the gut contents as well as the fact that debris was also common suggests that R. lacustris feeds on whatever food of an acceptable size at hand.

On the basis of these findings, species suitable for adult smelt food in Lake Taharoa would include the freshwater snail and mussel, juvenile bullies, together with the nymph and larval stage of the various types of insects present; however, the larger of these species figure in the trout's diet as well. The apparently suitable midge in adult or larval form has not been recorded and the bloodworm, also suitable, is seemingly scarce. The introduction of smelt accordingly could have a less than beneficial effect, actually competing with the trout for available food.

Insofar as the juvenile fish are concerned, little is known of their quantitative requirements, and although plankton samples were taken on this survey and also by Cudby in 1968, these are of course not sufficient to evaluate the total crop. For various reasons it would be incorrect to assume that the smelt could occupy the place of the galaxiids, which were a mid-water fish and probably fed partially on plankton.

It would certainly appear then that a full limnological study should be carried out prior to any introduction. Such a study would involve extensive and regular sampling for at least two years, but could well be carried out by Auckland University, being in their province, as part of a post graduate study. Indications are, however, that this study could show the lake as being unsuitable for smelt. It can be noted that a recent survey by this department of the Waverly coastal dune lakes revealed - (a) no trout; (b) no smelt. Formerly trout were introduced into the lakes where an indigenous population of smelt were already established.

Other forage fish

Although only the smelt has been considered here, other species could also be suitable. The "Carp" or goldfish, Carassius auratus, which was once dominant in the diet of Lake Taupo trout, and is still taken by trout in other lakes, could be very successful as it is a bottom feeder, but could also offer competition to existing forage species, and accordingly the same criteria as for the smelt should apply.

CONCLUSIONS

Because of natural and angling mortality, the trout population has been reduced in Lake Taharoa and there has been a consequent upswing in the numbers of individual species with the exception of G. gracilis which appears to have vanished entirely. One main factor which led to the fall-off in trout condition seems to have been overstocking. A consequent balance now exists allowing the trout to put on condition. In spite of reduced fish numbers, the lakes can still offer excellent fishing. If the numbers of trout are therefore kept at an acceptable level, there is not an urgent need for a forage fish as an additional food species. A cursory examination of the lake environment and of the habits of the smelt, R. lacustris shows, however, that it would be unwise to introduce this species before a full limnological study was carried out. In any event, success is doubtful.

Lake Kai Iwi offers a smaller population of larger and well conditioned fish as no stocking as such has taken place in the lake, but only movement of some fish from Lake Taharoa into the lake through the connecting culvert. This trend should continue if only small numbers of trout continue to move into the lake, and offers the angler the opportunity to take larger fish.

Although the fish in Lake Waikare appears to be reasonably conditioned at the moment, a fall-off in condition could be expected soon because of the apparent drastic reduction in the native fauna. Its small size suggests also that the fauna will take longer to recover if it does so at all. The lake is mainly used for boating and waterskiing and originally was never recommended to be stocked, in order to preserve the fauna and to act as a form of control lake over the other two. The following recommendations are therefore made for the fishery.

RECOMMENDATIONS:

1. Trout stocking resume in Lake Taharoa in 1972 at the amended rate recommended by Cudby, i.e. 1,200 marked fingerlings annually (marked differently each year).
2. No further stocking at all in Lake Waikare.
3. No direct stocking into Lake Kai Iwi.
4. The decision on the introduction of a forage fish, e.g. R. lacustris, be deferred pending the completion of a full limnological study.
5. As this department does not have the available staff to carry out a limnological study of doubtful result, it is recommended that your society approach Auckland University directly.

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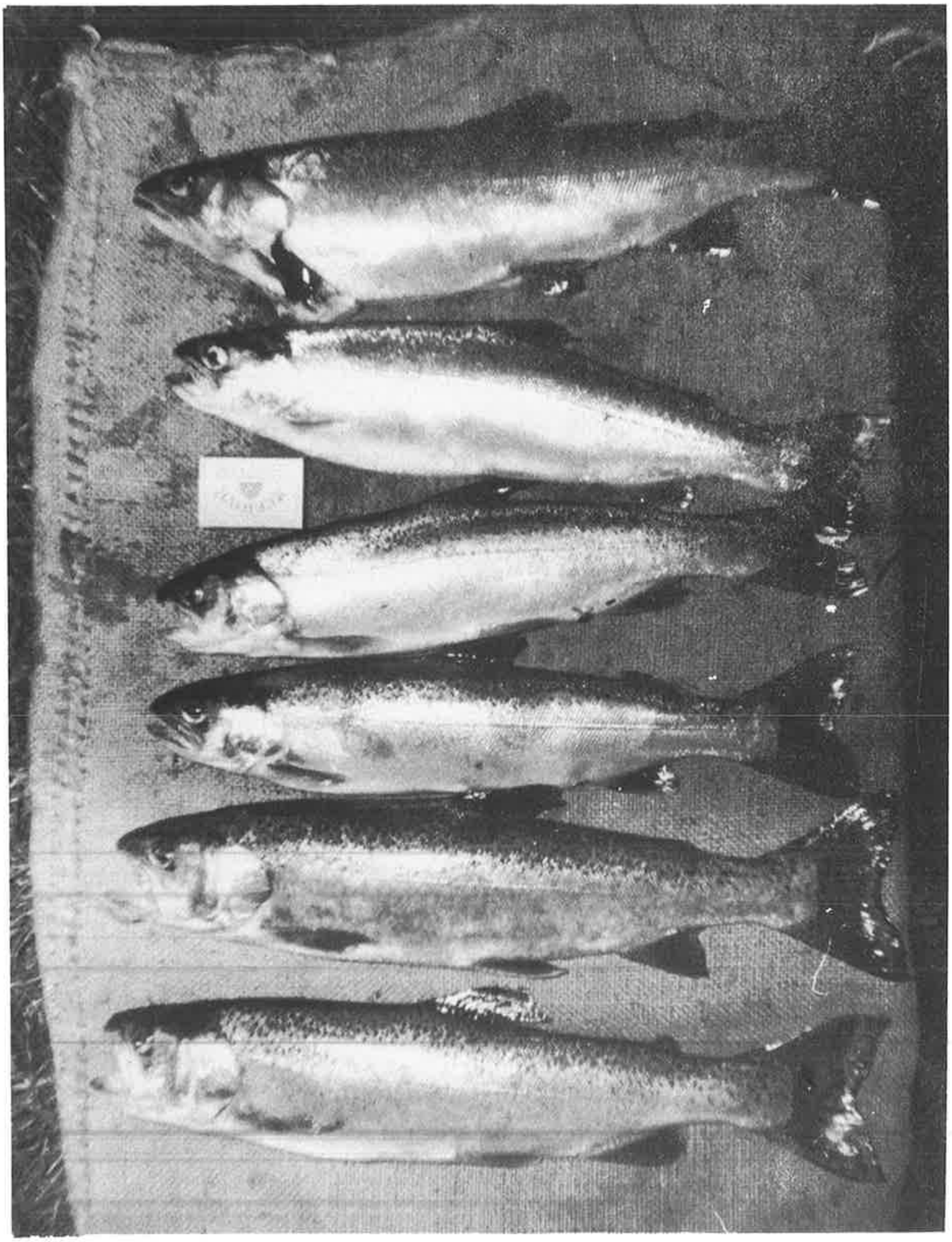

Two Lake Kai Iwi fish top, Lake Taharoa fish below, illustrating comparative fish condition.