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NEW ZEALAND FRESHWATER FISHERIES MISCELLANEOUS REPORT NO. 32

AQUATIC SURVEY OF THE STREAM DRAINING THE OHAU SKIFIELD BASIN APRIL 1990

by

M. Taylor

Report to: Ohau Ski Area Ltd

Freshwater Fisheries Centre

MAF Fisheries

PO Box 8324

CHRISTCHURCH

Servicing freshwater fisheries and aquaculture

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NEW ZEALAND FRESHWATER FISHERIES MISCELLANEOUS REPORTS

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Enquiries to: The Librarian
Freshwater Fisheries Centre
PO Box 8324
Riccarton, Christchurch
New Zealand

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SUMMARY

The stream draining the Ohau Skifield basin was surveyed, using electric fishing and surber sampling methods, in early April 1990. Adult koaro (Galaxias brevipinnis) were abundant in the middle and lower reaches of the stream, while juvenile smelt (Retropinna retropinna) and trout were present in a pond adjacent to the stream near Lake Ohau. None of these fish are rare or endangered. The stream also contained a good variety of benthic invertebrates.

A water abstraction rate of 12.6 $l.s^{-1}$ for snowmaking will reduce flows in the middle and lower reaches by about 20% based on measured flows. However during winter, when flows are naturally reduced by snow, flow reduction due to abstraction could amount to about 30% of the stream flow. This will reduce the amount of habitat available for koaro and benthic invertebrates and could, during dry years, result in fish losses due to competition for the reduced habitat and food supply. Nevertheless, the losses will probably be lower than those which normally occur due to floods and droughts.

We therefore do not consider a minimum residual flow requirement is necessary under normal conditions as sufficent water should be left in the stream under normal conditions to support a good population of koaro and benthic invertebrates. However, if during abstraction, there is no stream flow at the access road ford, then abstraction should cease.

1. INTRODUCTION

MAF Fisheries were contacted by the Department of Conservation (D.O.C) in early April regarding the application for a water right by Ohau Ski Area Ltd. This application was for water abstraction from the stream draining the Ohau skifield basin for snowmaking purposes. The developer wished to abstract water at a rate of 12.6 $l.s^{-1}$ (EIA prep. Alex Hunter) from behind a low weir at the top of the skifield basin during the winter. D.O.C. requested that an assessment be made by MAF Fisheries on aquatic life in the abstraction stream, and whether a residual flow regime would be considered desirable.

The objective was to assess the quality and quantity of aquatic life in the skifield basin stream, and to determine whether:

a) The stream is of sufficient ecological value to merit a residual flow to maintain habitats downstream of the abstraction point.

b) If of sufficient ecological value, to determine a residual flow regime sufficient to maintain this value.

2. STUDY AREA

The Ohau Skifield basin is located on the western side of Lake Ohau in the South Island of New Zealand.

The stream draining the Ohau Skifield rises largely from springs at an altitude of approximately 1676 m asl and flow generally south east towards the lake for 4km. The catchment area is approximately 480 hectares.

From its source, to the abstraction point 150m downstream, the stream follows a gentle cascading, slightly serpentine course. The stream bed and banks are stable with tussock growing to and overhanging the stream margin, and lichens and moss growing on the rocks (Fig. 2). Downstream of the proposed abstraction point, to the access road ford at 640 m a.s.l. the stream gradient steepens, and below the beech treeline at 1000 m a.s.l. , a 10m wide floodbed has developed (Fig. 3). Stream flow in the middle reaches is more turbulent than in the head waters, with many 1 to 2m waterfalls flowing over large boulders interspersed with shallow pools (Fig. 4). The stream flows out of the skifield basin at the access road ford, where an abrupt reduction of stream gradient occurs. Below this point the flow becomes more placid and the stream follows a sinuous course for 700m across a 60m floodplain towards the lake, before entering a shallow gorge and entering the stream bed gravels (Fig. 5). The stream reappears for 200m on the downstream side of the gorge, before disappearing into the gravel 400m from the lake, Deep and recent flood alluvium and the main road embankment at this location, appears to preclude the stream flow directly into the lake. A largely springfed pond on true left of the stream course probably receives water from the skifield stream during floods (Fig. 6).

Figure 1. Use of electric fishing techniques.

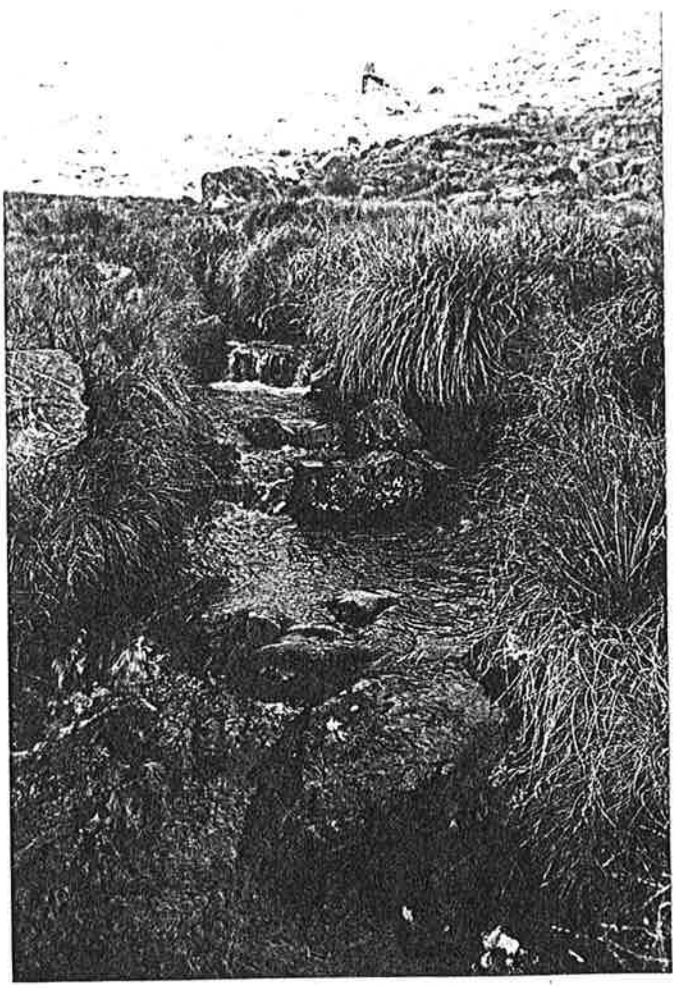

Figure 2. Stable headwaters

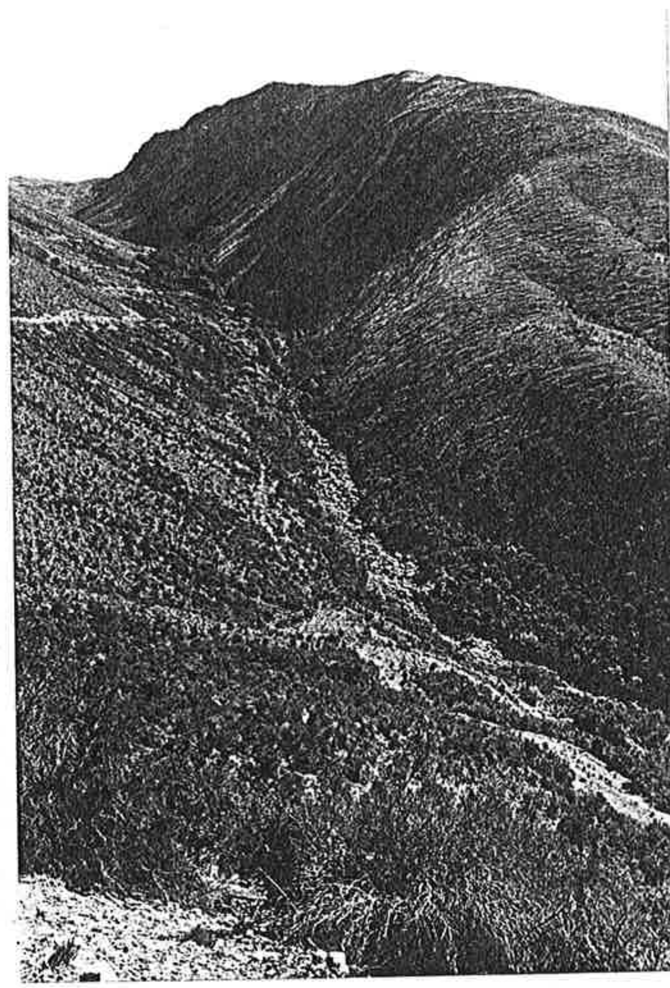

Figure 3. Steep middle reaches and floodbed.

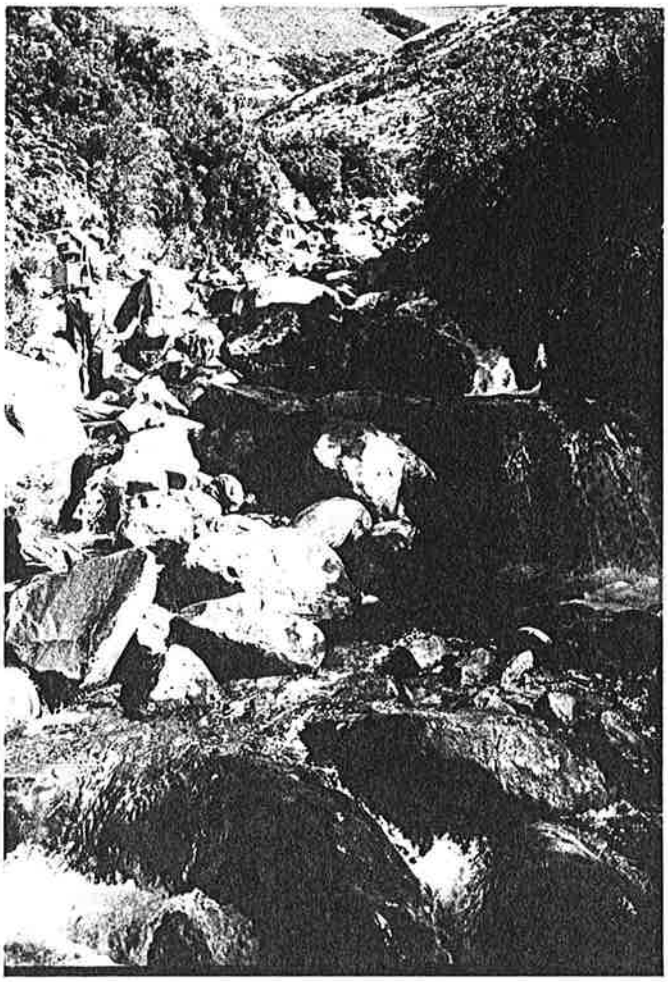

Figure 4. Waterfalls and tumbling flow in the middle reaches.

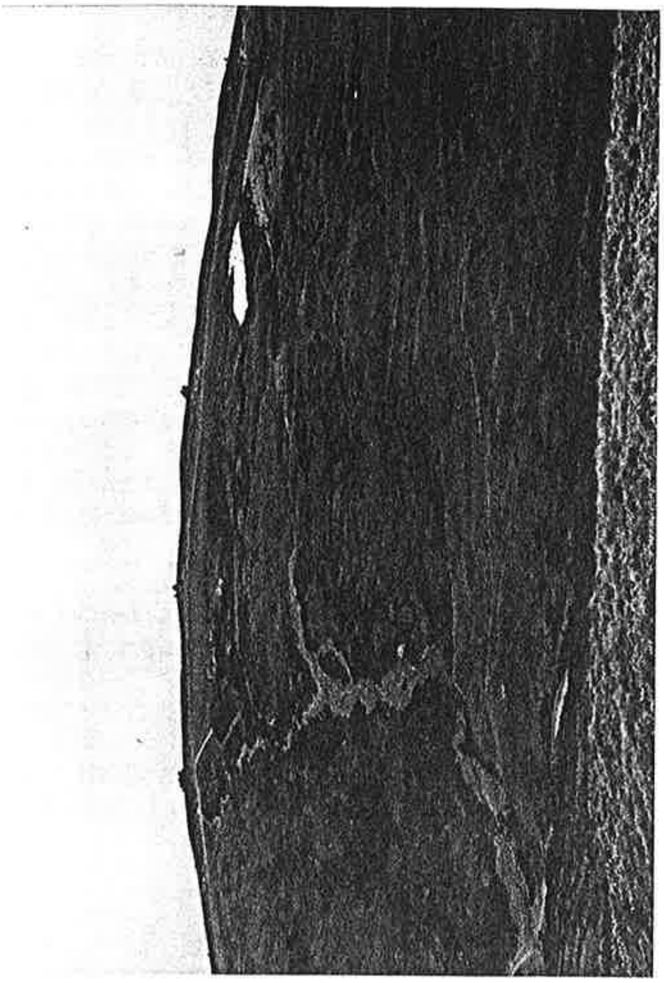

Figure 5. Floodplain and meandering watercourse in the lower reach.

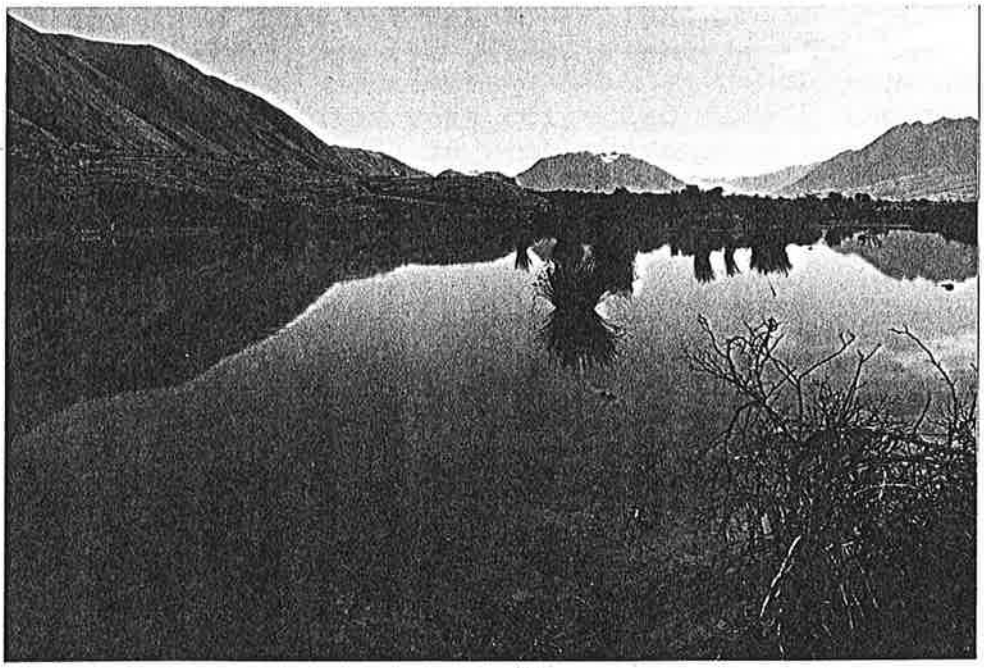

Figure 6. Pond in the lower reach, near the air strip. Smelt, trout, and koaro were collected from this site.

3. METHODS

The survey was conducted on the 10th and 11th April 1990, from above the abstraction point on the skifield basin tributary (NZMS 1 S99 3499 4709), to its disappearance into the gravels near the main road (NZMS 1 S108 3531 4687). A detailed itinerary of the work is provided in Appendix I.The lower stream course has diverted 1km further south than that depicted on NZMS 1 S108.

An electric fishing machine (pack set type) in conjunction with a stop-net was used to capture fish for identification and measurement (Fig. 1). Electric fishing when correctly carried out, only narcotises fish, which, upon recovery, may be released unharmed. Extremely low water conductivity in the high and middle reaches of the stream (17.5 µs) meant that small quantities of rock salt had to be placed in the water upstream of the fishing machine to make it work.

"G minnow" traps were used in the pond in the lower area of the catchment. These traps which crudely resemble a Maori eel trap (hinaki), are baited and set overnight in deeper, larger waters which are impractical to electric fish.

Electronic pH, water conductivity, and temperature probes were used to record physical water quality data.

4. RESULTS

The electric fishing, flow gauging, and invertebrate sampling sites are found in Fig. 7.

4.1 Fish Distribution:

Three fish species were found in the Ohau skifield basin.

4.1.1 Koaro (Galaxias brevipinnis).

Koaro is one of the 5 whitebait species. It forms a lacustrine population in Lake Ohau and has been commonly recorded throughout the Lake Ohau catchment, including the stream northwest of the Skifield Lodge (12 sites, Fisheries Database).

In total, 56 specimens were collected from 6 locations, with an average fish density of 0.36 fish per square metre. A photograph of specimens caught above the ford are shown in Fig. 8. Data for the caught fish are given below in Table 1.

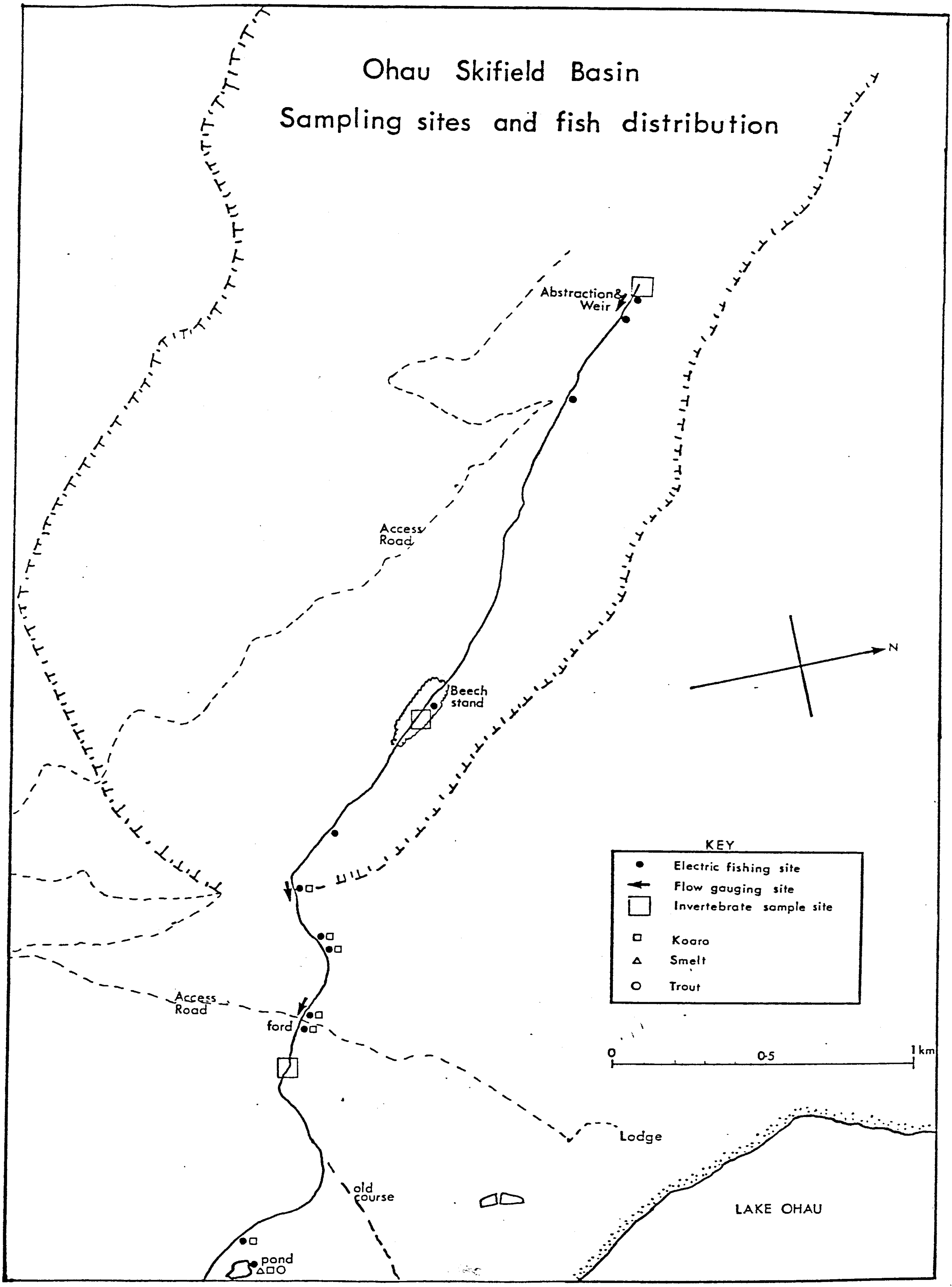

Figure 7. Sampling sites from the skifield stream survey.

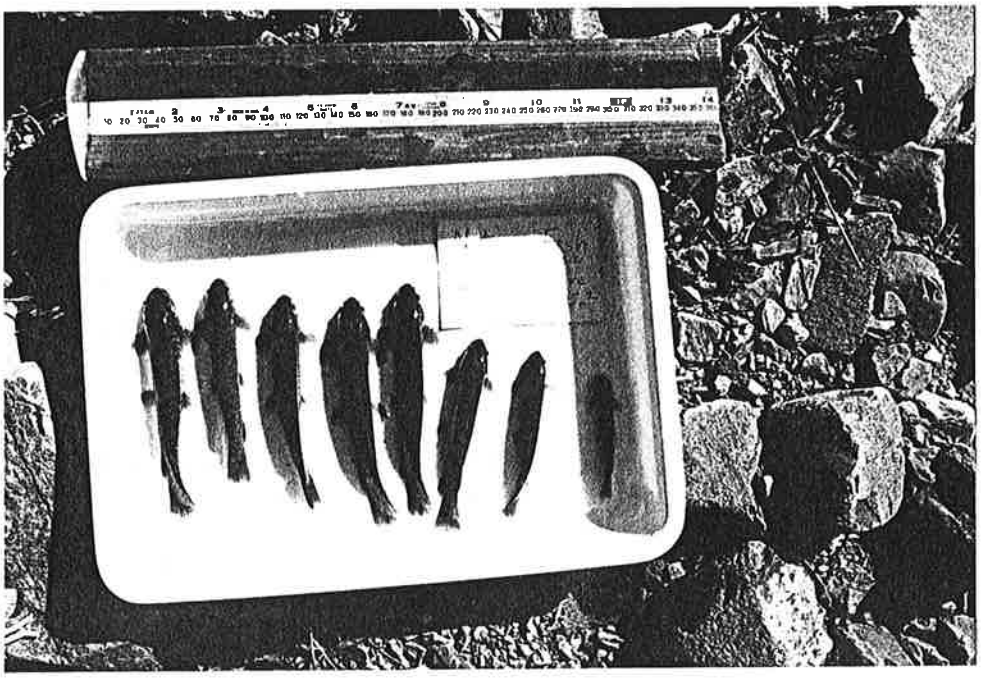

Figure 8. Koaro caught above the access road ford.

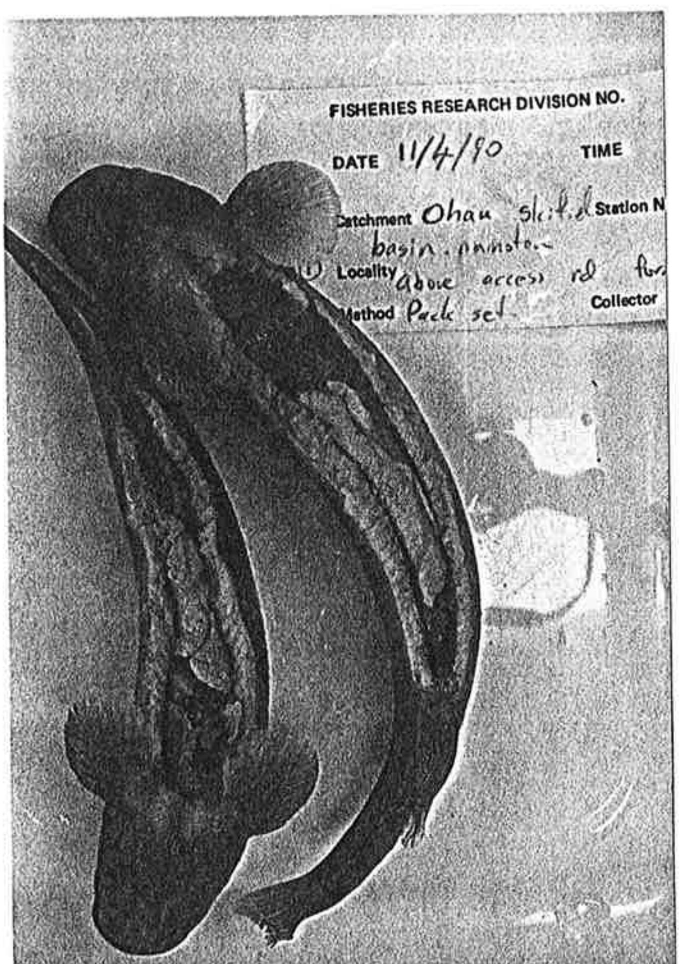

Figure 9. Ovarian development in koaro caught from the skifield stream.

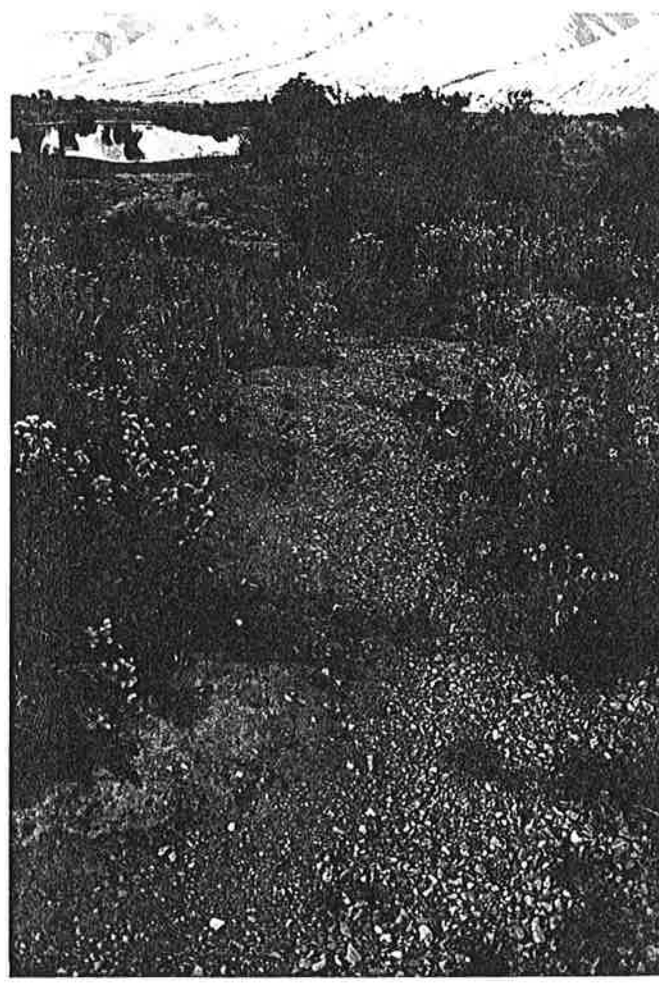

Figure 10. Dry watercourse between pond and skifield stream.

Table 1. Number, size, and density of koaro obtained.

Location	n	Area m^2	Density Fish/m^2	Fish length Min	Mean	Max	sd
Pond inlets	2	?	?	102	102.5	103	0.71
Below ford	27	31.5	0.86	72	122	171	30.1
At ford	11	60.0	0.18	75	136	189	33.4
200m above ford	6	12.0	0.50	70	-	120	-
250m above ford	8	25.0	0.32	72	115.5	137	22.3
450m above ford	2	22.5	0.09	150	150	150	0.0
	56	151.0					

4.1.2 Smelt (Retropinna retropinna):

This species occurs naturally in coastal areas, but recently has been introduced into lakes to provide a forage species for salmonids, particularly in the North Island. However, smelt have not been recorded previously in the upper Waitaki Catchment, despite considerable fisheries survey work in the area (Waitaki Acc. Soc., MAF data).

Large shoals of smelt fry where observed feeding from the pond surface in the lower reaches of the skifield basin. Four specimens caught with a pushnet had lengths of 41, 42, 30, 29mm.

4.1.3 Trout (Oncorhyncus sp.)

On the evening of the 10th April, 3 trout where seen scouting the banks of the pond in the lower reaches, probably feeding on smelt and invertebrates. Owing to poor light, it was difficult to ascertain the species, but they may have been rainbow trout. There may be some egress between the pond and the lake for these fish to become established, or the pond could have been deliberately stocked.

4.2 Benthic invertebrates

Triplicate surber samples were taken from 3 locations (Fig. 7), and population densities of the identified invertebrates are provided in Table 2.

Table 2. Systematic list of invertebrates recorded in the benthos. Mean densities (per 0.1m2) are given for taxa which averaged >1 individual per sample, - ,not recorded, *, <1 individual per sample.

Scientific name	Abstraction pt.	Beech stand	Below ford
PLATYMELMINTHES			
TRICLADIDA			
Neppia montana	14.0	*	-
ANNELIDA			
OLIGOCHAETA	5.0	2.0	6.3
INSECTA			
EPHEMEROPTERA			
Deleatidium spp.	129.7	116.7	183.7
Nesameletus sp.	68.0	27.3	-
PLECOPTERA			
Zelandoperla decorata	-	*	2.7
Zelandobius sp.	3.0	4.3	3.3
Austroperla cyrene	2.7	*	-
Megaleptoperla grandis	-	-	6.7
TRICHOPTERA			
Pyncocentrodes sp.	-	*	1.3
Philorheithrus sp.		3.7	-
Aoteapsyche sp.	*	1.0	64.0
Costachorema spp.	5.0	2.7	3.3
Hydrobiosis frater	1.7	2.7	1.3
H. parumbripennis	-	-	2.0
Psilochorema spp.	-	*	5.0
MEGALOPTERA			
Archichauliodes diversus		-	2.0
COLEOPTERA			
Hydora sp	*	30.0	-
DIPTERA			
Chironomidae	1.7	18.0	48.0
Austrosimulium sp.	-	*	-
Eriopterini sp.	-	-	*
Neocurupia hudsoni	*	63.0	2.3
Nothodixa sp.	-	1.3	-
Empipidae	-	-	1.7
Mean density	230.8	272.7	331.6
No. of taxa	12	18	16

In addition, water spiders (Dolomedes sp.), and the stonefly (Stenoperla sp.) were observed in the reach flowing through the beech stand.

The pond in the lower reaches supported a plentiful supply of waterboatmen (Sigara sp.) and some snails.

Examination of stomach contents from koaro caught from the stream during the day, revealed only a few well digested invertebrates, (Archichauliodes sp., chironomids). Stomach walls of the 3 retained specimens were folded and contracted, indicating the fish probably fed at night.

4.3 Flow gaugings

Data from pygmy meter readings taken from the three gauging sites (Fig. 7) were entered into the hydrological simulation program, RHYHABSIM.

The discharge data for the Ohau Skifield is presented below:

Table 3. Stream flows measured in the skifield stream.

Section	Discharge ($l.s^{-1}$)	Mean Velocity ($m.s^{-1}$)	Cross-section Area (m^2)
At abstraction site	18	0.180	0.102
Upstrm limit of koaro	56	0.182	0.307
At access road ford	64	0.176	0.361

The RYHABSIM program is capable of predicting how water level and water velocity will change when flow is reduced by abstraction. At the upstream limit of koaro penetration, based on measured flows,a drop of 27mm in water level is predicted, with a 5% decline in average water velocity (Appendix II). At the ford, water levels would drop about 20mm, with a 12% drop in average water velocity.

4.4 Substrate evaluations

The composition of the stream bed was estimated at several locations along the stream course. The size of the substrate is important when considering the amount of available cover for fish from flood events and predation.

Table 4. Percentage substrate composition of the stream bed.

Location	% Boulder	% Cobble	% Coarse Gravel	% Fine Gravel	% Sand	% Mud
At abstraction site	40	15	35	10	0	0
300m below pump site	70	10	10	0	10	0
Beech stand	80	15	5	0	0	0
Above ford	80	10	5	5	0	0
Access road ford	40	50	10	0	0	0
600m below ford	10	40	40	10	0	0
Pond	0	0	0	0	0	100

5. DISCUSSION

Water gaugings taken during the survey were consistent with those in the EIA prepared by Alex Hunter (Ski Field Manager). A flow of 18 $l.s^{-1}$ (1080 litres per minute) was recorded at the weir pond site, which represented 28% of the flow at the access road ford (64 $l.s^{-1}$, 3840 litres per minute). At the most upstream site from which koaro where recorded, and the one which would be most effected by the direct effects of the proposed abstraction, a flow of 56 $l.s^{-1}$ was recorded, of which 32% represented water originating from the weir site. Therefore, if the abstraction of 756 litres per minute (Alex Hunter) or 12.6 $l.s^{-1}$ is imposed under the current flow regime, flows would be reduced by 23% at the upstream limit of the koaro population, and 20% at the ford habitat. If during the winter months all the available water at the weir site is required for abstraction, and assuming little change in the relative contributions of downstream drainage basins, then the impacts would increase to 32% and 28% respectively.

Obviously, this will result in a reduction of both stream depth and average water velocity. Reduced water depth is more critical, because of the reduction in steam bed area available for fish and the invertebrates upon which they feed. Results from the RHYHABSIM program indicate that if abstraction occurred under present flows, water levels would drop slightly (27mm), and average water velocity would abate by about 12% (Appendix II). Although winter flows can be 20% lower than those measured (EIA, prep. Alex Hunter), it does seem that stream bed area in the koaro habitat would be little effected.

Shallow runs between pools could dry up at times, and koaro would tend to "hole up" in pools until normal flows resumed again. Koaro, like many native fish, are nocturnal, and forage at night. Therefore its possible that the proposed night time water abstraction may effect koaro inhibiting their foraging zones. Shallow runs which possess good numbers of invertebrates could be denied to the koaro population.

Ovarian development in koaro caught from the skifield stream (Fig. 9), suggests that unlike the sea-going stocks, adults spawn in the stream during the winter or early spring. The larvae are washed down into the lake to develop into the whitebait stage over the spring/summer period. Zooplankton densities are known to peak during this time in other southern oligotrophic lakes (Lake Wakatipu, Jolly 1977), and it is possible lacustrine stocks of koaro have synchronised their lifecycles so that pelagic juveniles can exploit this food source (G. A. Eldon pers. comm.). Koaro probably enter the stream as whitebait in the summer, possibly swimming underground through the gravels, if snowmelt has not broached a mouth to the lake. Therefore, by winter, only adult koaro will occupy the skifield basin stream, and would suffer any potential impact from water abstraction from the snowmaking venture.

Recorded fish densities, size, and condition of these adult koaro were high throughout the skifield stream system, compared with other koaro habitats nationwide. This is partly due to the high natural water quality, and stream bed stability. The steep stream topography are preferred by this species, and the abundance of boulders (Table 4) provides cover during floods. Good fish condition reflects a plentiful food source, and the benthic invertebrate survey (Table 2) indicate a diverse and reasonably abundant fauna typical of a clean water, well oxygenated, high country stream. In the beech section, diversity increased slightly, probably due to slightly higher detrital levels. Of some biological interest is the numbers of <u>Megaleptoperla grandis</u> found in the lower reaches, which is rarely abundant (Winterbourn and Gregson 1981). Overall benthic invertebrate density increased with distance downstream, and provided an abundant food source for koaro in the middle and lower reaches.

Recruitment of juveniles should not be effected significantly by the proposed abstraction, this is because the majority of whitebait in the lake (including those entering the skifield basin stream), are produced from fish in other catchments. Therefore recruitment of whitebait into the skifield stream depends on ecological factors of the lake catchment as a whole, and are not a direct consequence of breeding conditions in the skifield stream alone. Conceivably unmodified streams with more stable flows feeding Lake Ohau, play a role in maintaining juvenile recruitment in less favourable catchment basins, ameorilating the effects of avalanches and other natural disasters on fish habitats.

The very high fish density (0.86 fish/ square metre) recorded below the ford (Table 1), provides an example of the concentration effect that reduced flow has on adult fish stocks. These particular fish were trapped by stream waters flowing through the substrate, and were probably concentrated by recent falling water levels. A dead fish was found at this locality, and I suspect that protracted periods of low water levels in the lower reaches is likely to stress the fish population, due to increased competition for food (invertebrates) and space. In this case, reduction of fish habitat was caused in part by the relatively large quantities of alluvium being transported down the river from the higher reaches. The valley walls in the middle reaches are unstable, and appear to be undergoing accelerated erosion by both natural (floods, avalanches, ice fracture) and man made factors (stock grazing, access road maintenance and use).

Smelt are present in the pond in the lower reaches and although never recorded from the upper Waitaki Catchment before, are unlikely to be effected by the snow making machine operation. The steep stream topography would be entirely unsuitable for this species, and trout would find the stream too small and unstable. However, like koaro, both of these species, probably gain access to the pond from the skifield stream during high flows, as evidenced by a dry course between the two systems (Fig. 10).

6. RECOMMENDATIONS

a) That every precaution be taken to ensure that contaminants from the pump housed over the weir pond do not enter the water.

b) That abstraction should cease if there is no residual stream flow at the access road ford.

7. ACKNOWLEDGMENTS

I would like to thank Poma Palmer, Dept. of Conservation, for the aerial photos of the skifield basin, and the site plan. Mr Wilkie of Beca Steven ltd. on details of the weir pond construction. Thanks to my colleagues Greg Kelly for field assistance and photographs, Paul Sagar for invertebrate identification, and Ian Jowett for the use of his river hydraulics simulation program. Thanks also to Eric Graynoth, and Don Jellyman for refereeing the manuscript. Finally thanks to Mike Neilson for organising food and accommodation at the Lodge, and Alex Hunter for permitting undisturbed access to the stream during the survey.

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APPENDIX I:

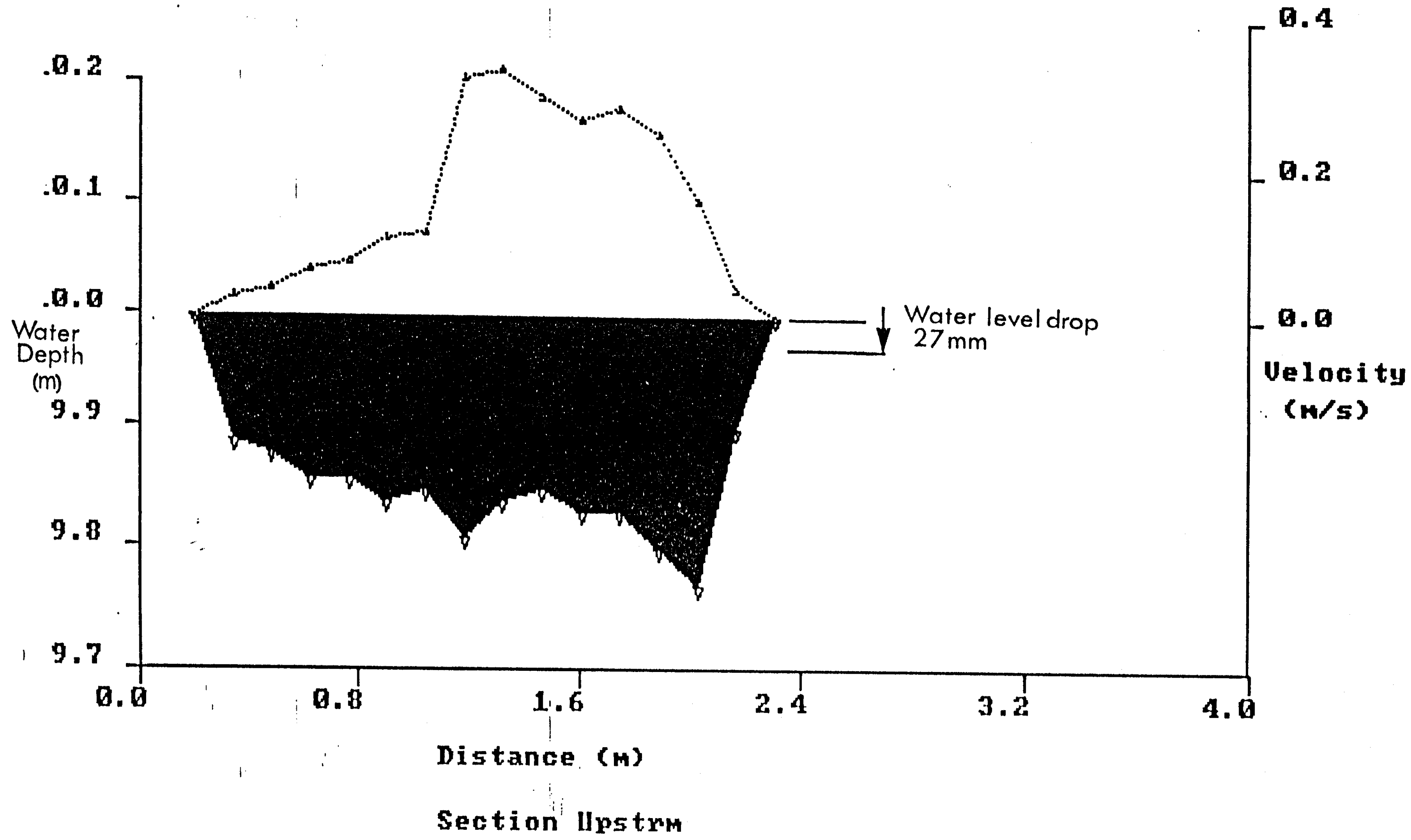
Survey itinerary:

10th April:

After arriving at the skifield abstraction site at 11:30am, 30 metres of the stream bed was electric fished, surber samples (benthic invertebrates) taken, and water temperature, pH, and conductivity recorded. A brief search was undertaken for stranded fish in the old stream course. Notes where made about substrate, flowtype, stream size, stability, and potential cover for fish. Electric fishing was also carried out further downstream where the new access road approaches the stream at a hairpin bend. About 40m of the stream was fished at this location, and notes made on substrate and flowtype. Further electric fishing (30m) took place several kilometres downstream, where a stand of beech surrounds the stream course. Invertebrate samples where taken from this site, and notes made on fisheries values. Finally, we inspected the pond near the main road, took pH and temperature readings, and set 3 fish traps overnight.

11th April:

At 8:00am, the fish traps around the pond were retrieved, and catch recorded. Electric fishing was carried out along the east branch of the skifield tributary between the main road and the access road ford, and a sample of benthic invertebrates were collected here. Further electric fishing upstream of the ford was carried out until the upstream limit of fish distribution was established. Flow gaugings were taken at this point, at the ford, and at the abstraction point.



Appendix If. Stream bed and velocity profile at the upstream limit for koaro distribution.