MAF Fish

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Freshwater Fisheries Centre Annual Report for 1988

New Zealand Ministry of Agriculture and Fisheries 1989

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MAFFish is the fisheries business group of the New Zealand Ministry of Agriculture and Fisheries. It was established on 1 April 1987 and combines the functions of the old Fisheries Research Division and Fisheries Management Division and the fisheries functions of the old Economics Division.

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Cover: Tagging salmon with radio transmitters to track their movement in the Rakaia River.

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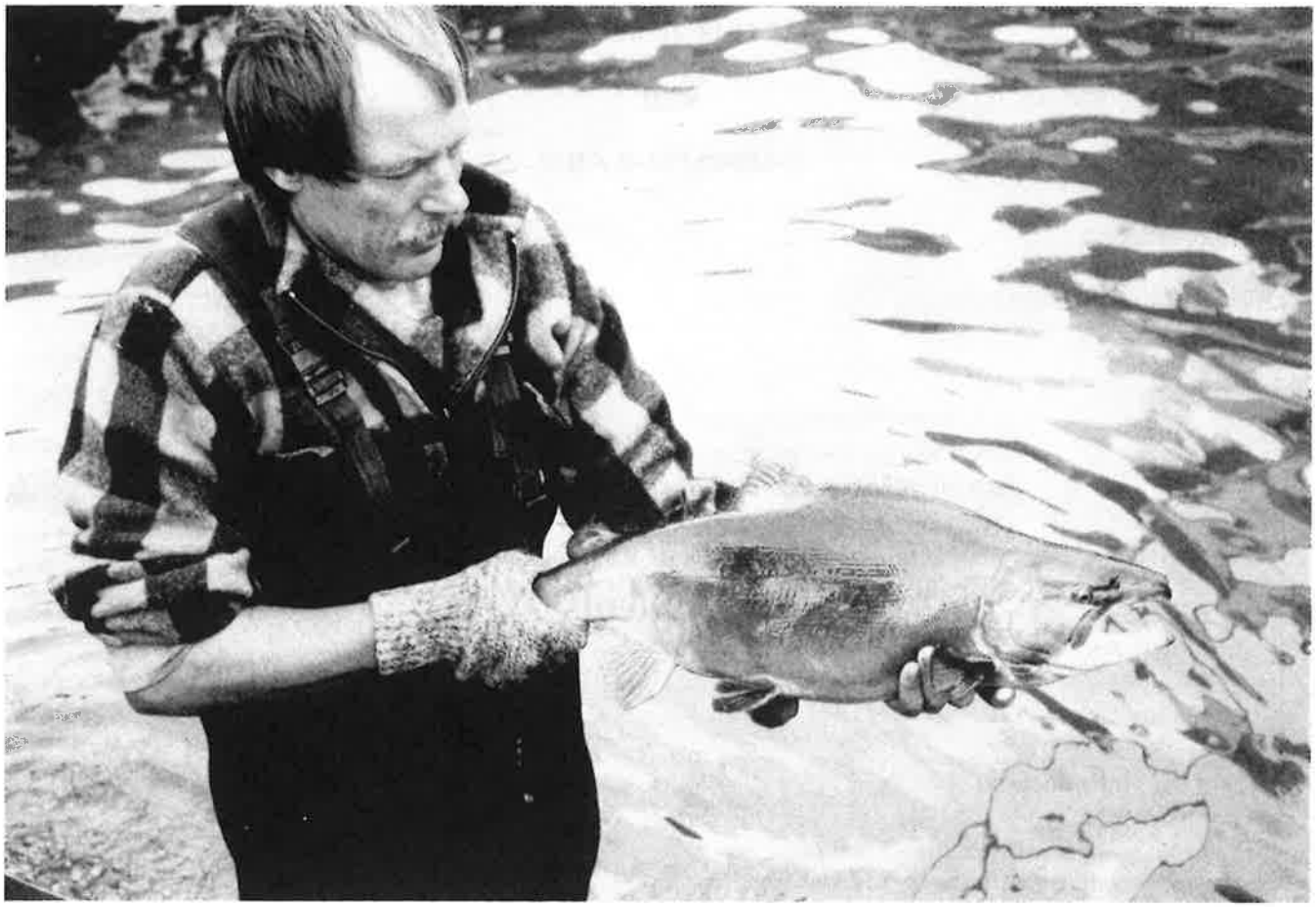


Lindsay Hawke holding a maturing male sockeye salmon reared at the Glenariffe Salmon Research Station. (Photo: Nelson Boustead)

Introduction

Over the last year the staff of the Freshwater Fisheries Centre have settled into the new operational climate now characteristic of all research agencies. The transfer of $500,000 of funding from freshwater to marine research had a strong impact, and nine staff positions were affected, some staff transferred from freshwater to marine research and some took voluntary redundancy or early retirement. A consequence of these changes was the termination of all freshwater research activity at the MAFFish Fisheries Research Centre laboratory at Greta Point in Wellington.

The adoption of a net-funding policy with a move towards charging clients for services, where appropriate, meant that in the 1988–89 year the research group operated on over 40% cost recovery, this partly reflected the historical involvement of Freshwater Fisheries Centre staff in research contracts for clients, particularly Electricorp. For many years Electricorp, and its predecessor the New Zealand Electricity Division of the Ministry of Energy, have taken a very forward looking and responsible attitude towards researching the potential fisheries impacts of proposed electricity generating plants, particularly thermal power schemes on the lower Waikato River and hydro stations on the Waitaki and Clutha Rivers.

When responsibility for the administration of freshwater fisheries changed, after the formation of the Department of Conservation, the Ministry of Agriculture and Fisheries (MAF) examined the functions of the Freshwater Fisheries Advisory Council, which since 1946 had advised Government on the research and administration of freshwater fisheries in New Zealand. The council had the particular brief of ensuring that there was good communication between the recreational fisheries users, the fisheries managers (acclimatisation societies), and fisheries researchers (MAF). Because so much of the former responsibility of MAF had been transferred to the Department of Conservation it was decided to disband the council. Notable contributions to the work of the council for over 20 years were made by Mr C. R. Anderson and Mr D. P. O'Connor, both former presidents of the Council of South Island Acclimatisation Societies. Their long involvement in the work of the council gave valuable continuity to its deliberations, and it is acknowledged here with MAF's gratitude.

Aquaculture research groups have sought to respond positively to the new economic climate. It is Government policy that future use of grass carp in New Zealand will involve sterile triploid fish, and several batches of well-grown triploid fish have been sold to clients, and the fish are now "at work" consuming troublesome aquatic weeds. A warm-water facility has been built at Rotorua to facilitate maturation and artificial breeding of grass and silver carp, after cool spring and summer temperatures in 1987 frustrated attempts to breed these fish.

The salmon research group continued to support the industry by selling ova and smolts and developing a strain of all-female fish that have significant production advantages over male fish. All female stock will be available for sale to the industry after the winter of 1989.

Angler support for salmon research has been forthcoming through the allocation of acclimatisation society funds for rearing smolts for release into rivers to enhance populations for the angler recreational fishery.

The major freshwater fisheries issue of the past year has undoubtedly been the capture of salmon at sea by commercial fishing trawlers. Many salmon were taken, which raised allegations about target fishing by the trawlers. Recreational anglers and salmon farmers expressed grave concerns about the effect of this activity on the return of anadromous salmon to the rivers — for capture by anglers or harvesting by farmers — and this concern, and the perilous state of the New Zealand stock market late in 1987, led to a loss of confidence in ocean ranching salmon. The Minister of Fisheries earlier in 1988 announced a decision to regulate the capture of salmon at sea by excluding trawling for a period over the summer around Banks Peninsula, because data showed that at that time and place most of the salmon taken at sea were being caught.

R. M. McDowall
Manager, Freshwater Fisheries

Lindsay Hawke handfeeding altered sex ratio salmon fry reared on bore water at Silverstream Fish Hatchery. (Photo: Nelson Boustead)

Staff List

(at December 1988)

Manager: R. M. McDowall PhD

Christchurch

Salmon research

Leader: P. R. Todd PhD *salmon, eels, native fish*
- **M. S. Field-Dodgson MSc (Hons)** *salmon culture, salmon ecology*
- **C. L. Hopkins MA** *salmon, fish production, sex control technology*
- **M. J. Unwin MSc (Hons)** *salmon, fisheries resources, computing*
- **N. C. Boustead NZCS** *salmonid diseases*
- **R. A. Dougherty** *salmon at sea*
- **T. Gough** *tagging*
- **L. J. Hawke** *Silverstream, sockeye*
- **S. P. Hawke** *hatchery manager, Glenariffe*
- **D. H. Lucas** *tagging, scale reading*
- **J. R. E. Sykes** *Glenariffe*
- **M. W. Tawa** *Glenariffe*
- **T. J. Washbourne** *fish transport*

Freshwater resource assessment and research

Leader: E. Graynoth BSc (Hons) *recreational fisheries, effects of power development schemes*
- **S. F. Davis BSc (Hons)** *fisheries resources, effects of water abstraction*
- **M. Flain BSc (Hons)** *salmon and trout, rivers and lakes*
- **G. J. Glova PhD** *effects of water abstraction, native fish*
- **D. J. Jellyman PhD** *eels, native fish, effects of water abstraction*
- **I. G. Jowett BE (Hons)** *environmental simulation modelling, hydrology*
- **P. M. Sagar MSc (Hons)** *low flow effects, aquatic benthic fauna*
- **M. L. Bonnett BSc, Dip Sc** *upland galaxiids*
- **G. A. Eldon** *native fish*
- **G. R. Kelly** *native fish, draughting*
- **M. J. Taylor BSc** *native fish, data bases*

Administration

- **D. K. Hide** *administration officer*
- **J. M. Hay** *senior clerk*
- **C. T. Murray** *clerk*
- **C. M. Whaitiri** *word processor operator*

Library

- **J. Potter BA (Hons)**

Advisory Officer

- **B. J. Swale BSc, MA** *freshwater fisheries regulations*

Electric fishing

- **G. B. Smith**
- **M. S. Weeks**

Oamaru

Freshwater resource assessment and research

Leader: G. D. James MSc (Distinction) *fisheries resources*
- **S. Bloomberg BSc (Hons)** *hydro development and fisheries*
- **J P. Graybill MSc** *salmonid ecology, regulated streams*
- **K. L. Palmer MSc (Hons)** *salmonid ecology*

Rotorua

Leader: N. H. McCarter BSc (Hons) *recreational fisheries, aquaculture*
- **J. Hayes PhD** *Waikato River, mining*
- **C. P. Mitchell MSc (Hons)** *native fish, grass carp*
- **J. Richardson BSc** *freshwater fisheries data base*
- **B. Chisnall MSc** *eels*
- **R. R. Strickland** *effects of power development schemes*

Hamilton

Leader: J. A. T. Boubee DPhil *impact assessment of thermal power stations and hydro reservoirs*
- **A. G. Stancliff BSc (Hons)** *whitebait fishery in the Waikato River*
- **K. P. Schicker MSc (Hons)** *sediment and lake hydrodynamics*

Study leave

- **D. K. Rowe MSc (Hons)** *recreational fisheries*
- **B. J. Hicks MSc (Hons)**

Native fish biology and fisheries

Freshwater fish data base

J. Richardson, M. J. Taylor

MAFFish maintains a computer-based store of information on the distribution of freshwater fish species. Nearly 400 new entries were added in 1988, bringing the total to 7860. More than 20 requests for information were received and processed for agencies other than MAFFish.

The new Empress data base system is working well, and data extraction programs are being developed for persons unfamiliar with Empress commands. New field booklets have been printed and distributed to data base contributors. Additional data stored on cards already entered are gradually being added.

Native fish videos

R. R. Strickland, C. P. Mitchell

An encouraging response to a video on whitebait led to support from the Department of Conservation for a video on native fish. A script has been prepared to cover the interest, variety, and conservation values of native freshwater fish. Filming is planned for summer 1988–89.

Whitebait spawning grounds and requirements

C. P. Mitchell, G. A. Eldon

Spawning sites for inanga (*Galaxias maculatus*) were identified (with help from Department of Conservation staff) on all the major Bay of Plenty rivers, the Wairoa River, and the Waikato River. Estimates of egg abundance and preliminary modelling of survivorship suggest that much spawning is undetected, particularly on larger river systems.

Manipulation of known spawning areas on the Kaituna River is planned to develop management strategies which maximise spawning success.

Spawning sites of inanga were also identified during February and March in several West Coast and Canterbury rivers. In some instances these sites had been discovered in the 1930s, but inadequately documented, and knowledge of their whereabouts had been lost. By determining the period and place of peak spawning, and relating that to features like tide and vegetation, we hope to be able to predict spawning times and areas in other river systems. This information is esssential for proper management of the fishery. In some areas, existing spawning grounds are so limited in extent and downgraded by present land use, it is surprising that the whitebait fishery persists.

Two investigations were made of the potential effects of engineering projects on whitebait and other fisheries. Advice was given on mitigation options for a flood control scheme and a bridge construction.

Laboratory spawning of inanga

C. P. Mitchell

Continuation of these trials has finally resulted in natural spawning of inanga. Captive inanga showed a preference for vegetation and soil collected from a natural spawning area; this has obvious management implications.

Whitebait study in the Mokau and Awakino Rivers

S. M. Hanchet

Samples of whitebait collected during the 1986 season were identified, weighed, and measured. *Galaxias maculatus* dominated the catch in both rivers (98.5%), *G. fasciatus* and *G. brevipinnis* were also recorded. Mean lengths at migration of each species were similar to those recorded in the Waikato River, but were much smaller than those recorded from the west coast.

Distribution of kokopu

S. M. Hanchet

The effect of catchment size on the distribution and abundance of banded, giant, and shortjawed kokopu was examined. Electric fishing was carried out at 49 sites in streams draining the Hakarimata Range into the Waikato River. Habitat variables were measured at each site. All three kokopu species had similar habitat requirements for water velocity, cover, and steam stability, but they differed in their microdistribution within a tributary. Banded kokopu preferred sites (either in side branches or mainstems) with a catchment area of 0.1–1.2 km^2. Giant kokopu occurred downstream of banded kokopu (usually in the mainstem), at sites with a catchment area of more than 1 km^2. Too few shortjawed kokopu were caught to delimit catchment size, but they generally occurred with banded kokopu in mainstem sites with a catchment area of 0.3–2.9 km^2.

Upland galaxiids

M. L. Bonnett

Studies of *Galaxias paucispondylus* and *G. prognathus* in the high country of Canterbury are almost complete. Since 1986, regular samples of these fish have been collected from Deep Creek (a small tributary of the

Rangitata River) to provide information on diet, breeding, and life history. Distributions of both species frequently overlap, and many aspects of their life histories are similar. However, *G. paucispondylus* spawns in mid winter, whereas *G. prognathus* spawns in late winter and in autumn.

Interaction for food and space between salmon, trout, and koaro in a lake-inlet stream

G. J. Glova, P. M. Sagar

Overlap in diet and microhabitat of chinook salmon, brown trout, rainbow trout, and koaro was investigated in the lower Ryton River in summer. From the quantity of food in their guts over time, it was concluded that salmon and trout were primarily diurnally active, whereas koaro were nocturnally active. The four species overlapped extensively in microdistribution and diet, moderately fast-water areas being the preferred habitat, and chironomid larvae being the most commonly eaten prey. Other aquatic invertebrates which were important in the diet included larval ephemeropterans, trichopterans, and dipterans. There was no evidence of interspecific predation. The temporal and spatial patterns of resource use by these cohabiting species concur with those observed earlier in a simulated stream environment.

Prey selection of koaro in the Ryton River

G. J. Glova, P. M. Sagar

Samples of benthos, drift, and koaro were collected over 24 h in summer in the lower Ryton River to determine prey selection in this lake inlet population. The fish fed partly size-selectively on benthic invertebrates, with ephemeropterans, trichopterans, and dipterans constituting 95% of the total food eaten, though most was chironomid larvae. The benthic feeding habit of koaro appears to allow it to forage on fairly small prey during the night, a phenomenon that has been reported for other bottom-dwelling native fish in New Zealand.

Stokell's smelt

M. L. Bonnett

There are two species of smelt in New Zealand, the common smelt (*Retropinna retropinna*) and Stokell's smelt (*Stokellia anisodon*). Both are best known for their spawning migrations, when large numbers migrate from the sea into estuarine areas to breed.

Common smelt occur throughout New Zealand, but the distribution of Stokell's smelt is poorly understood, though they are restricted to the east coast of the South Island. Over the spring and summer of 1987–88, samples were collected from various South Island rivers. Stokell's smelt were found from the Waiau River in North Canterbury to the Waitaki River in North Otago; large concentrations were found only in the large, silty, flood-prone rivers south of Banks Peninsula, notably the Rakaia and Rangitata Rivers.

Canterbury mudfish

G. A. Eldon

In the 1987 Freshwater Fisheries Centre annual report, reference was made to an attempt to establish a population of mudfish at Steventon, North Canterbury. It is not known how successful this has been; adult fish are still present, though no fry have been seen. The sanctuary at Peacock Springs is a qualified success; only limited spawning has taken place this year. The second pond at the springs does not appear to have been colonised. In July, a transfer of adult wild fish was made to St Annes Lagoon at Cheviot. This water is very large relative to other known mudfish habitats, and it may be unsuitable. However, an important population will be established if the species does colonise the lagoon, and this would help secure the status of the species.

Freshwater eel studies

D. J. Jellyman

Further analysis of fyke net captures of both species of eel in Lake Pounui, Wairarapa, has been carried out. Results have confirmed previous modelling; water temperature and changes in barometric pressure were important for both species, and changes in water level were particularly important for shortfinned eels.

A new project was begun to investigate the ultrastructure of the otoliths of glass eels arriving in fresh water. Shortfinned glass eels are being collected at monthly intervals from Purau Stream, Banks Peninsula, and another sample is being reared in the laboratory. It is hoped that daily growth rings may be able to be determined, and these could then be used to estimate the length of larval life.

During August 1988 a 1 week study of the biology of the tropical eel *Anguilla obscura* was made on the island of Mitiaro, southern Cook Islands. The investigation, funded by the Ministry of Foreign Affairs, was designed to assess the commercial potential of the eel stock. The study showed that the stock was of medium density, that growth rates were similar to those of New Zealand species, and that recruitment may be intermittent.

Age and growth of shortfinned eels

B. Chisnall

Samples of shortfinned eels were collected from lakes and streams in the lower Waikato River and the Whangamarino Swamp. Otoliths from 252 eels were read successfully. Growth rates were fastest in Lake Waikare, then Lake Waahi, Lake Whangape, pastoral streams, and Whangamarino Swamp.

Age verification by tetracycline labelling

B. Chisnall

Eels were caught in a pastoral stream in the Hakarimata Range, anaesthetised (benzocaine), measured, tagged, and injected with an oxytetracycline. The oxytetracycline, which is deposited in the otolith, may be detected by fluorescence.

Twenty-two eels (12 shortfinned and 10 longfinned) were collected from various areas and, after similar processing, have been maintained in a pool in Rotorua.

Environmental impact of water abstraction and land development

Factors influencing the abundance of trout in rivers

I. G. Jowett

Drift-diving surveys of trout stocks have been made on 127, 1–2 km reaches in 89 different rivers in New Zealand. A total of 15436 brown trout and 6271 rainbow trout were counted.

As a joint project with the Department of Scientific and Industrial Research (DSIR), detailed physical habitat surveys of several rivers were made last summer, though floods on the east coast of the North Island prevented some work from being done. The computer program for this habitat analysis, RHYHABSIM, has been revised and re-written for IBM-compatible computers.

The DSIR have analysed and recorded the results of invertebrate, water quality, and periphyton measurements in these rivers, and they are on a common data base with information on trout stocks, hydrological characteristics, and physical habitat.

Invertebrate habitat models

J. Richardson, I. G. Jowett

This project compliments the above study. The main aim is to develop habitat models for New Zealand benthic invertebrates. Analyses of the data collected are now complete and are being written up for publication.

Invertebrate samples and hydrological data were collected from various habitats in two reaches of the Waingawa River. The 87 samples of invertebrates were divided into seven group types (based on what could be quickly and easily identified and what comprised common fish food items), counted, and weighed. All seven groups showed substrate preferences, and all except *Nesameletus* spp. and Diptera respectively exhibited preferences for depth and velocity as well.

Deleatidium spp. dominated all samples in terms of numbers and biomass, and development of habitat models focused on this genus. About 24 models were developed and tested. The best was a multiplicative preference function which incorporated the suitability of substrate, depth, and velocity. We could find no relationship between our models and other factors such as periphyton abundance, embeddedness of the substrate, overhead shade, or bottom velocity.

Radio-tracking Rakaia River salmon

G. J. Glova

Between January and May 1988, 28 salmon were radio-tagged and released in the lower Rakaia River to determine their rate of upstream movement in relation to river flows, water temperature, weather conditions, distance from river mouth, time of year, and other variables. For much of the period, river flows were very low (less than 130 $m^3.s^{-1}$) and water temperatures were correspondingly high (up to 23 °C). These conditions, and the handling of fish during capture, were stressful to migrating salmon, so not all of the fish tracked showed positive results in terms of upstream movement. In a year of higher base flows and cooler water temperatures, greater success in monitoring salmon upstream movements would be possible.

Fish that were successfully tracked to headwater spawning areas moved an average of 5.4 km per day in April, whereas earlier in the season they averaged only 0.7 km per day, the extra time being spent mostly holding in deep pools. In most instances fish did not migrate up stream or become displaced down stream during peak flows of freshes and floods before early April; however, by mid April fish continued to move up stream during a major flood, probably because of the increased spawning urge.

Rakaia River invertebrate drift

P. M. Sagar, G. J. Glova

Laboratory analyses of all invertebrate drift samples collected during 1984–86 have been completed, and the results are being written up. Three papers are being prepared on: the effects of braid size, discharge, water depth, and season on drift density; diel periodicity of drift; and drift patterns of large and small *Deleatidium* mayflies with respect to predation by fish.

Rehabilitation after gold mining

G. A. Eldon

This study was designed to investigate different methods of stream restoration after alluvial gold mining operations. Two reaches of the Big Hohonu or Greenstone River, which had been diverted by the mining company, were modified and compared with an upstream control site to study densities and recolonisation rates of fish and invertebrates. Unfortunately, a series of floods resulted in substantial movement of substrate, and both reaches became very similar. Field work has now finished, and a draft report has been completed on the changes to physical features, fish populations, and invertebrates. Preliminary conclusions are that, in rivers like the Big Hohonu River, if a flood plain of sufficient width is retained, the river quickly establishes its own character; hence, small diversions are of little consequence compared with changes wrought by natural floods.

Effect of elevated turbidity and collapse of aquatic macrophytes on shallow-lake fish communities in the lower Waikato River

J. W. Hayes

This study compared the fish community of Lake Whangape, a clear weedy lake, with that of Lake Waahi, a turbid weed-free lake. Only one fish, a lacustrine race of common smelt, is absent from Lake Waahi; the population apparently died when the lake went turbid and lost its aquatic macrophyte beds in the late 1970s. The remaining species appear to thrive in the turbid weed-free conditions. Lake Waahi has a significantly larger biomass of common bullies, mosquito fish, rudd, and goldfish than Lake Whangape, but a smaller biomass of inanga and goldfish. Growth and condition of eels was also better in Lake Waahi. The turbid conditions in Lake Waahi appear to have promoted a large increase in the population of the mysid shrimp *Tenagomysis chiltoni*, which is now the most important prey item for carnivorous fish in the lake. A concomitant decrease in the diversity of alternative invertebrate prey items in fish diets suggests that the food chain for these fish has been simplified.

Gordon Glova using equipment to track salmon that have been tagged with radio transmitters in the Rakaia River. (Photo: Nelson Boustead)

Environmental impact of power development

Lower Waitaki River salmon studies

G. D. James, S. Bloomberg, K. L. Palmer

A creel census of salmon anglers was carried out to provide up to date information on the distribution and number of anglers of different licence categories fishing the river. About 80% of angling occurred between the State Highway 1 Bridge and the sea, and about half of the salmon anglers interviewed had Waitaki Valley licences. Only these licence holders were sampled in past postal surveys, so we can now make better estimates of the total salmon catch.

The annual helicopter survey of salmon spawning was completed in late May, and it showed that the 1988 run was one of the smallest on record.

Information has continued to be collected from salmon caught in the annual Waitaki salmon angling competition. Length, weight, age, and condition data have been collected as well as samples of eggs for the estimation of salmon fecundity.

Lower Waitaki River rainbow trout recruitment

J P. Graybill, K. L. Palmer, S. Bloomberg, G. D. James

Studies have begun to assess recruitment of rainbow trout into the lower Waitaki River. The possible sources of recruitment include the upstream hydro lakes via the Waitaki Dam and the major lower Waitaki tributaries. There is no evidence that rainbow trout spawn in the mainstem lower Waitaki. Studies were also begun to assess the effectiveness of the Aviemore spawning race as a means of supplementing rainbow trout stocks in the proposed residual river.

To assess the contribution from the hydro lakes, scales were collected from a few adult rainbow trout caught in Lake Waitaki and they were compared with scales from lower Waitaki (Awakino River) fish. Preliminary assessment showed no discernible difference in scale patterns from the two locations.

The timing and magnitude of downstream fry migration will be assessed in the major tributaries (Awakino, Hakataramea, and Maerewhenua) and in the Aviemore spawning race. Adult traps were installed in the Awakino River and Aviemore spawning race to assess the potential rainbow trout egg deposition for the 1988 runs. Downstream migrants will be trapped in the three tributaries and the spawning race when fry start to emerge from the redds.

Lower Waitaki River advisory work on effects of hydro development

J P. Graybill

The report prepared by MAFFish, Oamaru, called "Fisheries requirements and design features of a residual river within the proposed lower Waitaki power scheme" was released to the public by Electricorp in September. It summarised the results of the lower Waitaki fisheries investigations and included recommendations for developing a residual river. A public information booklet that outlined the findings of the main report was released at the same time. This booklet was distributed widely to anglers and other interested parties.

A comprehensive report which examines the major issues raised by the possible hydro-electric development of the lower Waitaki River is being prepared for Electricorp by WORKS Project Services. The report will contain information about the entire electricity generation scheme investigation, including that from MAFFish on the fish stocks, fisheries, and residual river.

Lower Waitaki River adult rainbow trout

G. D. James, S. Bloomberg, J P. Graybill, K. L. Palmer

The first project aimed for a better understanding of the distribution and relative abundance of medium to large rainbow trout (and incidentally brown trout) throughout the mainstem lower Waitaki River. The large size of the river, its turbidity, and many obstructions mean this is a difficult project. Seasonal drift netting and drift diving surveys are being done when conditions are suitable. Some success has been achieved with drift netting channels up to about 30 cumecs, but it is too early for any conclusions about distributions or abundance.

The second project, a trapping programme with the Waitaki Valley Acclimatisation Society, has been continued this year on the Awakino River. The study has provided data on the size and timing of rainbow trout spawning migrations in this important tributary of the lower Waitaki River. In addition, incidental information from tag recoveries showed that the proportion of rainbows recaught by anglers was very high, perhaps over 50% per year. Some fish moved extensively throughout the main river and were recaught as far away as the Waitaki Lagoon.

Upper Waitaki River power scheme — biology of sockeye salmon

E. Graynoth

This study was initiated in 1975 to ascertain the distribution and biology of sockeye salmon in New Zealand and to assess their fisheries potential. The spawning runs in the Waitaki catchment have been trapped annually and the fish in the lakes netted to determine growth and diet. The spawning runs from 1980 onwards have declined as a consequence of the damming of the Ohau River. During 1988 the specific objectives were to monitor the runs and to continue the analysis and writing up of material collected in previous years.

Larch Stream, at the head of Lake Ohau, was surveyed on 8, 10, 15, 23, and 28 March 1988. For the second consecutive year, no spawning sockeye were seen. On 8 March 1988 about 1100 fish spawned in the streams and ponds near the Ohau C tail race. These fish averaged 32 cm in length and were mostly 3 yr old. Back calculation of growth rates from Otoliths indicated that the fish spent their first year in Lake Ohau, before migrating down stream through Lake Ruataniwha to Lake Benmore. The survival of ova and fry and environmental factors such as water temperature and water level were monitored. Fry emerged from the redds in June.

The low spawning runs into Larch Stream in recent years are of concern because we have been unable to establish runs in other streams and because Larch Stream is becoming increasingly vulnerable to flood damage from the adjacent Hopkins River. The establishment of runs in other streams, such as that at Ohau C, has a moderate to high priority.

If good numbers of adults return to the streams near Ohau C in 1990 and 1991, the failure of earlier transplants to the Ahuriri River and to other tributaries of Lake Benmore was probably caused by a high mortality of fry. If few adults return, the weak link was probably high fry mortality in Lake Benmore.

If a run does eventuate at Ohau C, the stock and fishery could probably be enhanced by the addition of spawning gravel and other stream improvement works. Although the water quality appears to be good, only a limited amount of suitable spawning gravel is available, and this could limit the ultimate size of the stock.

Upper Waitaki River power scheme — juvenile brown and rainbow trout in the Tekapo River system

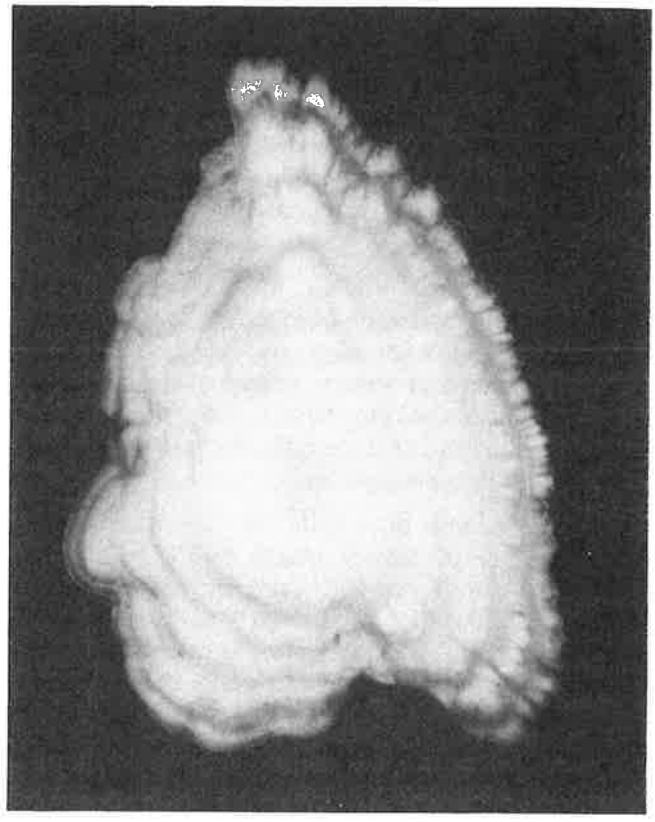
E. Graynoth, N. H. McCarter, S. Bloomberg

The Tekapo River system has been substantially modified by water abstraction for hydro-electric power development and irrigation. Studies were undertaken from 1979 to 1984 to assess the effects of current and proposed water abstractions on the spawning and rearing of brown and rainbow trout. Fry emergence and out-migration was assessed by fry trapping, and juvenile brown and rainbow trout were caught by electric fishing.

Juvenile trout abundance, growth, biomass, and production was lower in the margins of riffles in the unstable braided Tekapo River than in its stable single channel tributaries. For example, mean densities in the Tekapo River were only 51% of those in the Mary Burn tributary. In the Tekapo River yearling brown and rainbow trout averaged 105 and 86 mm in length, biomass averaged 0.53 $g.m^{-2}$, and production averaged 2.63 $g.m^{-2}$ per year.

Growth rates of both species of trout were similar to those in other New Zealand streams and rivers. However, abundance, biomass, and production appear to be closely related to the size of the stream. In large rivers such as the Tekapo, Rakaia, Ashley, and Hurunui, juvenile trout densities and production are much lower than in small stable streams such as the Mary Burn.

Factors limiting juvenile trout stocks in the Tekapo River probably include the lack of cover in riffle margins and the adverse effects of spillway floods on food supplies and migration. However, juvenile recruitment is probably adequate because there are still substantial adult trout spawning runs from Lake Benmore into the Tekapo River. The effects of flow fluctuations and water abstraction on juvenile fish stocks were reviewed, and recommendations were made for the better management of fish stocks and fisheries.



Otolith from a 5 yr old sockeye salmon.

Larch Stream trap for sockeye salmon.

Lake Coleridge water right monitoring

E. Graynoth, P. M. Sagar, M. J. Taylor

There has been concern for several years about the effects of hydro-electric power development on the fish stocks and fisheries of Lake Coleridge. The lake supports a popular fishery for landlocked quinnat salmon, and hundreds of anglers fish the lake during the opening weekend of the fishing season in November. Hydro-electric development has increased and stabilised lake levels and increased the inflow of silty water from the Harper and Wilberforce diversions. Approximately 134 000 t of sediment is discharged each year, and this results in the head of the normally crystal-clear lake becoming very turbid. It is possible that this silt has reduced the weed beds and diminished the aquatic food organisms eaten by trout and other fish.

In 1985 New Zealand Electricity (now Electricorp) was issued with new water rights to divert the Wilberforce River into Lake Coleridge, and it was made a condition of these rights that the effects of the diversion on the fish stocks and fisheries should be monitored. A research programme was prepared for the North Canterbury Acclimatisation Society, then approved and financed by New Zealand Electricity.

Preliminary surveys were undertaken in February 1988 when gill nets were set to catch salmon and trout. Good numbers of brown and rainbow trout and a few quinnat salmon were caught near the Wilberforce and Harper Inlets. Stomach samples, scales, and fin rays were taken from these fish, and diet, age, and growth rates are being investigated. In addition, samples of the aquatic insects and snails eaten by trout were collected, as were native fish such as bullies.

Divers collected 85 quantitative benthic samples from just off the Wilberforce diversion and at depths of 9 and 18 m along four transects of the lake. These samples are being sorted to determine species composition and abundance of the benthic fauna and composition of the flora.

Other studies have included the counting of salmon and trout spawning runs, the seining of juvenile salmonids, and angler creel censuses. The lake was also stocked with over 20 000 yearling salmon in July 1988.

Attempts will be made to determine the distribution of quinnat salmon in the lake by using divers, so that salmon may be more effectively targeted by gill nets in the future.

Lower Waikato River fisheries studies

C. P. Mitchell, J. A. T. Boubee, A. G. Stancliff, K. P. Schicker

The Waikato fisheries group, which is fully funded by Electricorp, is concentrating on the fisheries resources of the lower Waikato River and how they are affected by present and proposed thermal power developments. In addition, a study of Lake Matahina, after earthquake damage and subsequent dewatering to undertake repairs, was made for Electricorp's northern hydro group. A study of smelt in the Waikato reservoirs and lower river (with Professor F. Ward, visitor to the University of Waikato) has also been completed.

Fish and shrimp migration past Huntly thermal power station

J. A. T. Boubee, A. G. Stancliff, K. P. Schicker

The upstream migration of fish and shrimps is being studied at Huntly power station and at a site just below the Waipoa River confluence (a major tributary 15 km up stream of Huntly) to assess the effects of the outfall discharge. Recent modifications to the outfall have reduced both water temperatures and velocities along the sheet-piling facade of the station, with the result that the number of juvenile inanga successfully moving past the station has increased significantly. Although some galaxiids still negotiated the discharge by crossing to the unaffected margin, their distribution had returned to normal by the time they reached the Waipa confluence. Disruption of recruitment to populations in the tributaries up stream and on the power station side of the river was therefore minimal.

Grey mullet biology in the lower Waikato River

A. G. Stancliff, J. A. T. Boubee, K. P. Schicker

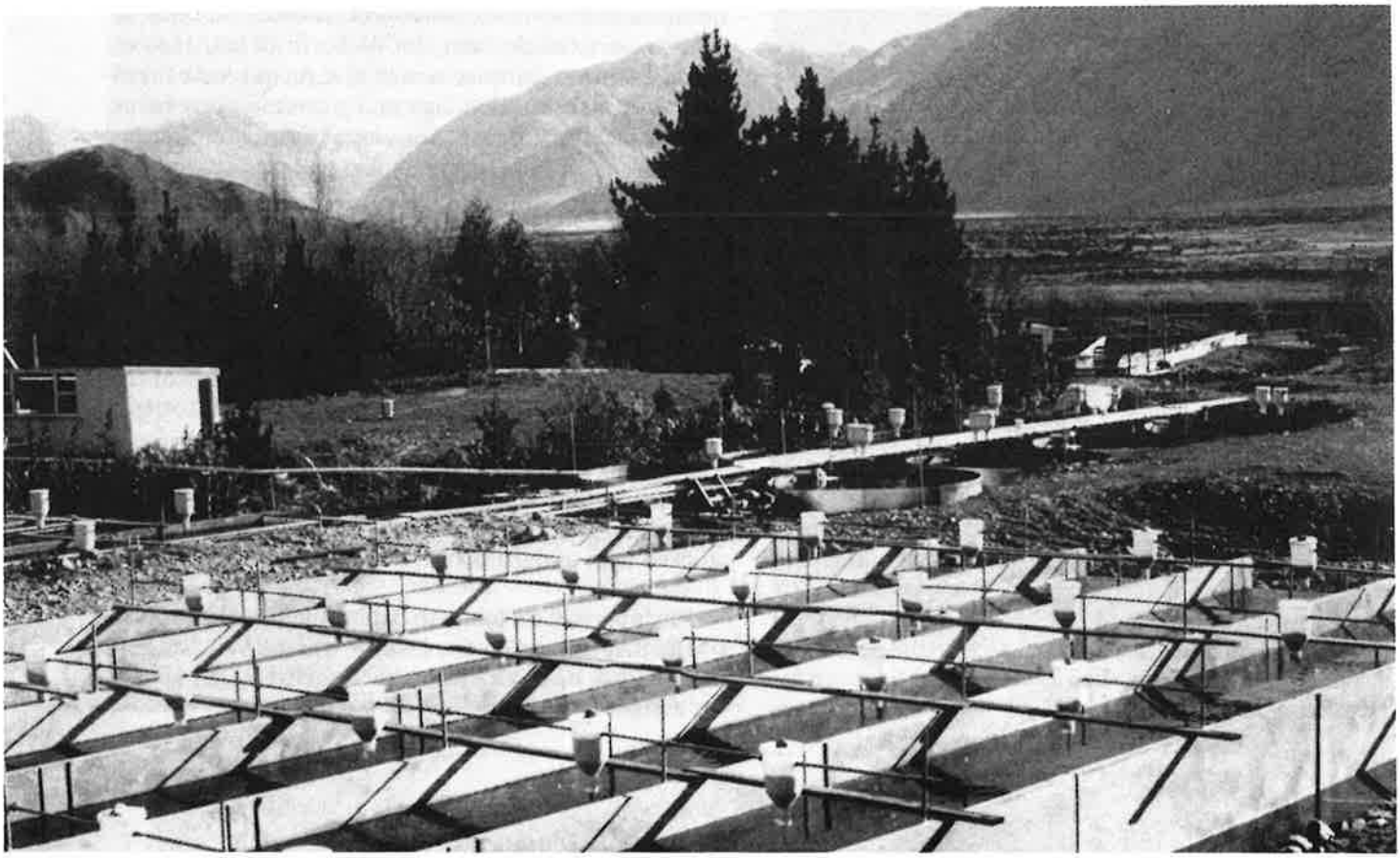
This project involves a netting and tagging programme for grey mullet at Huntly to determine the effect of thermal power stations on grey mullet distribution and the importance of the lower Waitaki River as a rearing habitat. Preliminary tagging in the Waikato River estuary had suggested that grey mullet from the Waikato River contribute to commercial fisheries in the Manukau and Kaipara Harbours. Grey mullet are attracted to the thermal plume below Huntly power station, but it is not known what the implications are for the population.

Thermal preference of juvenile inanga

J. A. T. Boubee, K. P. Schicker

The upper avoidance temperatures of juvenile inanga are being determined at various acclimation temperatures to define more accurately the temperature rises that they can withstand near a thermal discharge. Preliminary results suggest that inanga acclimatised at 18–20 °C avoid temperatures above 25–27°C.

The new raceways at the Glenariffe Salmon Research Station. These raceways enable Glenariffe to rear and release a million chinook smolt for research, enhancement and commerce. (Photo: Nelson Boustead)



Salmon hatcheries and enhancement

Glenariffe Salmon Research Station

M. S. Field-Dodgson, S. P. Hawke, M. W. Tawa, J. R. E. Sykes

The return of adult salmon (2600 fish) to the trap this year was disappointing. However, another successful open day was held in April, and it attracted 1550 well motivated and enthusiastic members of the public. It is rewarding to get this sort of support every year.

This year 3.83 million eggs were stripped and most were incubated at Silverstream to the eyed stage to speed up development; 1.13 million remained at Silverstream, the rest were taken back to Glenariffe for hatching and ongrowing for release into the Rakaia. Borewater temperatures for hatchery supply had an autumn value of 9 °C, but dropped to 6.8–7.5 °C in winter before rising to 9.2 °C in late spring. The first fry hatched on 20 May and were feeding well by 13 June. There was a 2 month delay between early and late hatching, which coincided with stripping times. The first fry (172 700 fish) were put out in the concrete raceways on 19 August.

Nearly 600 000 smolt were graded in January and February. Rakaia releases this year totalled 520 000 and were done in March and August; fish were 35–50 g (145–160 mm). The rest of the fish were released into Lake Coleridge (20 000 at 50 g), and the undersize fish (60 000 at 8 g) were transported to Silverstream for subsequent rearing and release.

Rearing densities this year were conservative at 16 $kg.m^{-3}$, because fewer fish were reared. However, at this low density, and with high water exchange rates, the fish released had an excellent chance of survival.

As well as rearing fish for release, fish were held as part of a programme to produce all-female stock. This takes several seasons, and Glenariffe was used to rear most of the experimental fish before they were sorted and transported to Silverstream for the completion of the work.

Work continues on sockeye, and this year 187 females were stripped (107, 2 yr olds and 80, 3 yr olds), and they produced 270 000 fry. These will be ongrown for sale and broodstock purposes.

Eyed ova sales totalled 1.94 million this year, with fry sales of 120 000 and 19 000 for quinnat and sockeye respectively.

During September and October, when most of the salmon fry are migrating down stream, northwesterly gales persisted for 7 of the 8 weeks and produced consistently high and dirty rivers, including one very large flood. This will affect the salmon run in 1990, when the 3 yr old fish are due to return.

To enable salmon juveniles to continue to be released into the headwaters of our major salmon rivers, the Council of South Island Acclimatisation Societies has agreed to sponsor releases from Glenariffe. In addition, individual acclimatisation societies have agreed to sponsor releases into their local rivers. The Rakaia Fishing Competition Committee have again granted $5,000 for Glenariffe releases. We thank these organisations for their support.

Silverstream salmon hatchery

L. J. Hawke, C. L. Hopkins

In 1988, 201 adult chinook salmon returned to Silverstream, and 57 (28%) of these were tagged. Tagged fish were returns from smolt releases made in 1986 and 1987, experimental groups brought down from Glenariffe and either held for a short period at Silverstream or liberated immediately. So far, the return rates for the two 1986 releases are 1.2 and 1.7%, with 4 yr olds to come in 1989.

About 50 000 smolts of Silverstream stock were reared in 1987–88 at the hatchery and finally released in February (mean weight 58.5 g) and March (mean weight 42.6 g). Immediately after these fish had gone, 60 000 Glenariffe fingerlings, graded out as "runts", were transferred to Silverstream for onrearing. These fish started at an average weight of 8 g and were eventually released in August at 45 g.

Stripping the 1988 returns to Silverstream yielded 300 000 eggs. In addition to these, 3.83 million eggs were transferred from Glenariffe to take advantage of the warmer water and faster embryonic development at Silverstream. To accommodate these extra eggs part of the trough room at Silverstream was reorganised for incubation. Some of the eggs brought down from Glenariffe were fertilised with milt from 3 yr old survivors of a mixed hatchery-reared group of males and sex-reversed females, to provide a supply of altered sex ratio stock for commercial sale. After eyeing, 1.13 million eggs were returned to Glenariffe to complete incubation and for onward rearing for eventual river release. Most of the remaining eggs at Silverstream were sold to fish farmers or supplied to acclimatisation societies. The only eggs retained to hatch and rear on the premises were the altered sex ratio stock (120 000) and 60 000 which had been triploidised for a client.

Salmon research and management

Landings by commercial fishing vessels

M. J. Unwin, R. A. Dougherty, P. R. Todd

In response to widespread concerns about the number of salmon being caught at sea by commercial fishing vessels, all available data on salmon landings since 1983–84 were gathered and analysed. These data included landed weights as reported to the Fisheries Statistics Unit at Greta Point, detailed tow by tow records from trawler logbooks, and coded-wire tag returns.

Reported landings amounted to 12.2 t in 1984–85, 40.4 t in 1985–86, and 68.6 t in 1986–87, equivalent to 1670, 8600, and 19600 fish respectively. Most of the salmon were taken from December to February, in fishing areas 20 and 22 off the Canterbury coast, by large domestic trawlers 21–30 m in registered length. Salmon were caught in waters up to 100 m in depth, and they were strongly associated with red cod and barracouta, the two major target species in the Canterbury Bight. There was a particularly high concentration of salmon off Banks Peninsula from December to January in 1985–86 and 1986–87. From coded-wire tag return data we estimated that in 1986–87, bycatch salmon accounted for at least 45% of the hatchery-reared salmon due to return to fresh water in 1987.

Angling surveys

M. J. Unwin

Freshwater Fisheries Centre (FFC) advice and expertise in relation to surveying angler usage of river fisheries continues to be in demand. Currently, FFC is conducting a postal sample survey of 1100 North Canterbury and Ashburton licence holders to measure angling effort and catch on the various waters in the Rakaia River catchment. We have also assisted with planning angler surveys in Nelson and on the West Coast, on the Motueka, Buller, and Grey Rivers. A 1 day workshop on survey techniques was held with a meeting of acclimatisation society field staff, and a manual based on this workshop has been prepared.

Coded-wire tag returns

D. H. Lucas, T. Gough, M. J. Unwin

A total of 1202 salmon heads was processed by the tag recovery laboratory this season. This number is the lowest for several years, partly because few tagged fish were released in 1985 and 1986, but also because survival of the 1985 brood seems to have been unusually poor. Most of the heads were from salmon caught in 1988, though fish from previous seasons (including two taken in 1982) continue to be handed in.

For the 1988 season, sea-caught salmon again accounted for about 30% of the returns. Anglers caught a further 249 tagged fish, most were taken in the Rakaia, Rangitata, and Waimakariri Rivers. From returns to date, the most successful programmes from the 1985 and 1986 brood years were a study in which two groups of fish raised at Glenariffe were transferred to Silverstream for release and the commercially sponsored releases into Otago Harbour organised by the New Zealand salmon anglers.

Analysis of salmon scale nuclei

D. H. Lucas, M. J. Unwin, M. Flain

Recent developments in the reading techniques used to classify salmon scale nuclei according to life history type promise to give a much clearer understanding of the

Tagging of juvenile salmon by Malcolm Flain, Cathy Elwood, and Fred Lucas. Twenty-one different groups of salmon were tagged for a variety of research projects over the last season. (Photo: Alan Blacklock)

various life histories which characterise salmon in New Zealand. As a result of this work, we can now give a quantitative definition of the "stream" and "intermediate" type nuclei typically found in wild salmon populations, rather than rely on the partly subjective approach used in the past. The new methods also allow fish originating from a hatchery to be identified with a high degree of reliability.

Current work involves reading and re-classifying some of the older scale samples, particularly those which were collected during the early 1970s. These samples are valuable because they were taken before the development of ocean ranching hatcheries, and they are therefore "uncontaminated" by hatchery type nuclei.

Time and size at release study

M. J. Unwin, D. H. Lucas, T. Gough

Returns of adult salmon released during the 1982–84 time and size at release study are now virtually complete, only a few 5 yr old fish from the 1984 brood are expected in 1989. Analysis of the return data has begun.

Interpretation of the results is complicated by high annual variability between the 1982, 1983, and 1984 brood year returns. The 1982 data show an almost linear relationship between release weight and survival to maturity, with a maximum survival of 7.55% from a release of 66 g fish. The 1983 returns show a dependency on release date as well as weight, the highest returns generally resulting from releases of 30–40 g fish in March and April. The 1984 returns have been disappointing, with a maximum survival of only 1.74%, and they show little evidence of any consistent relationship with release date or weight.

Disease status of New Zealand salmon stocks

N. C. Boustead

New Zealand salmon are claimed to be free of various serious diseases on the basis of the absence of clinical signs of disease. This work was undertaken to provide sound scientific data to support this, and it is being conducted in association with fish health laboratories of the United States Fish and Wildlife Service. (Examination for *Renibacterium salmonarium* was begun after a request from the United States for tissues to use as negative controls from disease free stocks.) Initial sampling confirmed there was no evidence of fish viruses; however, results of immunodiagnostic tests have suggested the possible presence of *R. salmonarium*, and all data and remaining samples have been given to MAFQual who are attempting to culture the organism. No clinical evidence of BKD, the disease caused by *R. salmonarium*, is known in New Zealand salmonids.

Whirling disease

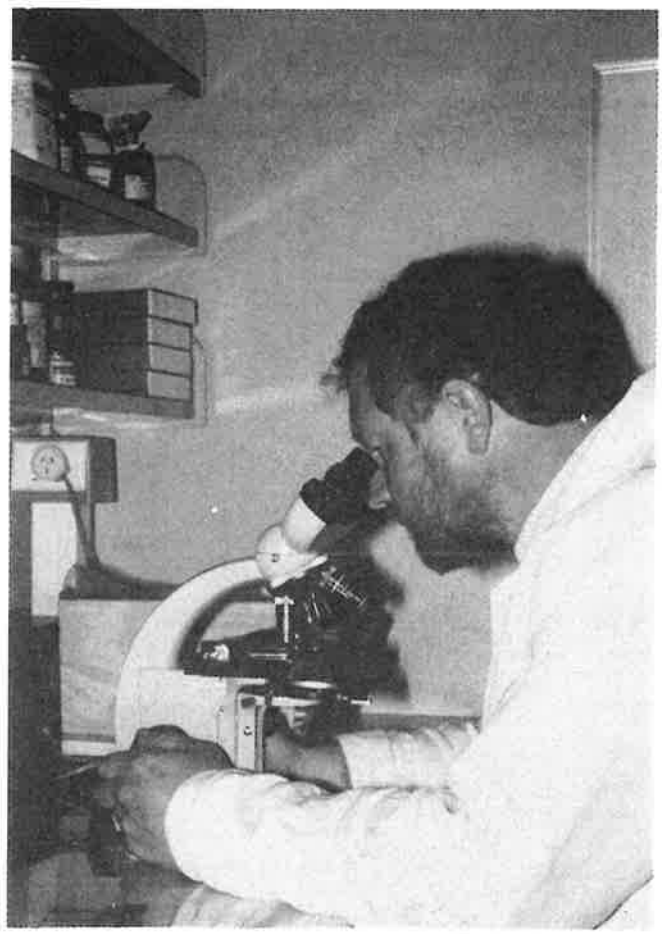
N. C. Boustead

The results of survey work on the distribution of whirling disease caused by *Myxobolus* (*Myxosoma*) *cerebralis* have been prepared for publication. They include results of samples from as early as 1975 and the finding of low levels of the parasite in wild rainbow trout from tributaries of Lake Coleridge in May 1988.

The information on whirling disease was presented at the International Fish Health Conference in Vancouver, Canada, in July. Visits were subsequently made to fish health laboratories at Nanaimo and Seattle to study developments in salmon research and diagnostic work.

The studies on whirling disease have confirmed that the parasite exists at low levels in many east coast South Island rivers, and the natural movement of salmon and trout between rivers makes the spread of the parasite inevitable. Despite it being found in several different locations there is no evidence that the parasite is affecting wild or hatchery stocks.

A review of MAF policies on whirling disease is underway to address the information and some anomalies revealed by the survey work.



Nelson Boustead examining tissues from diseased salmon. (Photo: Brian Swale)

Salmon aquaculture

Industry services and product sales

M. S. Field-Dodgson, C. L. Hopkins

The salmon team is consolidating its commercial activities and is identifying what it can offer the industry and where its strengths lie. A business plan is being prepared to structure activities.

Attention is being paid to the smaller freshwater growers as well as the more visible, larger, sea cage operators, so we can deal with the salmon industry as a whole, and services and products are being advertised.

This year we have sold green and eyed salmon ova and normal and genetically altered fry and have provided fish transport (see below), farm and fish health advice (see below), and smolt micro-tagging.

Genetic manipulation and sex control in quinnat and sockeye salmon

C. L. Hopkins, P. R. Todd

Trials to produce gynogenetic all-female chinook × salmon, by mating chinook females to male sockeye and brown trout, were not successful. About 800 chinook × sockeye fry were hatched, but most were of abnormal shape, and all died over 4 months. However, electrophoretic analysis of a variety of chosen marker enzymes seemed to show that only the chinook genome was active in the cross, a desirable result which suggests that further experimentation could be useful. From the chinook × trout cross, only 21 fry hatched, though most were well-shaped. Isozyme analysis showed the expression of both chinook and trout genes, so some hybridisation had taken place. This work was done in collaboration with Dr Frank Y. T. Sin of the University of Canterbury.

The other method we have used to produce monosex female salmon stock (using masculinised females as paternal parents) has resulted in a large broodstock of such XX males. Some of these will mature in autumn 1989 and, when outmated to normal female chinook, will provide our first all-female stock.

Mike Field-Dodgson, Freshwater Fisheries Centre, with salmon farmers checking oxygen levels in hatchery effluent. (Photo: Nelson Boustead)

Control of sexual maturation by photoperiod

C. L. Hopkins, L. J. Hawke

Captive stocks of salmon, reared entirely in fresh water, tend to mature late in the season. For various reasons we find it more useful to be able to obtain eggs early in the spawning season. It is possible to alter the time of sexual maturation by manipulating the photoperiod regime that the fish are exposed to, and this is being done experimentally at the Silverstream hatchery, initially with a group of XX male chinook brought down from the Glenariffe Salmon Research Station. It is hoped that they will mature at least a month earlier than the rest of this special stock, which is still under normal day length at Glenariffe.

Artificial diet trials

M. S. Field-Dodgson

There is no scientific yardstick in New Zealand for the quality of salmon diets available to salmon farmers. Discussions with one feed manufacturer led to trials to test the efficacy of new diet formulations against the older standard diets. This will enable the company to know which diets grow fish better than others, and it will enable them to answer questions from the farmer on cost and effectiveness.

Fish transport

T. J. Washbourne

MAFFish fish transport was very active throughout the South Island this year transporting fish for acclimatisation societies, commercial salmon farms, and for our own needs. With the increase in the number and size of salmon farms, the movement of fish is becoming an important consideration for the salmon industry. We have transported fish to many regions of the South Island, including 10000 to Marlborough, 150000 to North Canterbury, 30000 to the West Coast, 132000 to mid Canterbury, 40500 to South Canterbury, and 30000 to Otago. The main species was quinnat salmon, but sockeye have also been moved.

As well as the actual transportation, we have been asked to oversee large transportation exercises for salmon companies, and disinfection technology has also been supplied and in some situations disinfection has been carried out for clients.

MAFFish staff, Trevor Washbourne and Tom Gough, releasing chinook salmon smolts into the Kaiapoi River near Silverstream hatchery. These fish were originally reared at Glenariffe hatchery. Returns of salmon of 1.2 and 1.7% have been achieved from the release of these fish. (Photo: Christchurch Press)

Big Glory Bay salmon farming studies

P. R. Todd

Most of New Zealand's 1987–88 salmon production of 1200 t was from Big Glory Bay, Stewart Island, where there are five salmon sea cage farms. Farmers plan to increase the current production of 800 t to about 2000 t, but there has been concern about the environmental impact of salmon farming and the quantity of salmon that could be produced in the bay without causing eutrophication.

Studies commissioned by MAFFish and the Southland Catchment Board, and conducted by the Water Quality Centre, DSIR, Hamilton, have recommended that 3000 t could be produced in Big Glory Bay without increasing nutrient levels to such an extent as to cause significant algal growth and a possible toxic algal bloom. Studies on the accumulation of waste material under the cages has shown that there is a zone extending up to 50 m from the farm edge where the benthic community is obliterated. Beyond this is a 200 m enriched transition zone. The benthic community appears unaffected beyond this point. It was calculated that water clarity would not be changed if total production did not exceed 3000 t. In conclusion, the studies showed that planned production was well below the levels that could cause eutrophication and possible toxic algal blooms, and the immediate environmental impact of salmon farms in relation to sedimentation under the farms was very localised. The study recommended that farms be located over bare mud habitat and 300 m downcurrent from *Lenormandia* meadows, brachiopod communities, scallop beds, and rough-ground habitat. MAFFish and the catchment board are currently reviewing the studies in order to grant full licences and water rights to farms.

This kidney of a salmon is affected by a condition called nephrocalcinosis. This is not an infectious disease, but is caused by high levels of carbon dioxide in the water supply which causes deposition of the visible white calcareous deposits in the ureters of the kidney. This is one of the diseases of salmon diagnosed by the Freshwater Fisheries Centre under the user pays system. (Photo: Nelson Boustead)

Aquaculture information leaflet

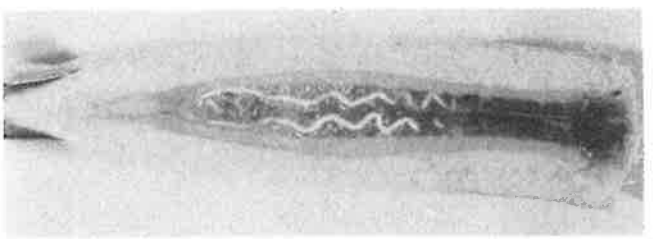
N. C. Boustead, M. Flain, J. Potter

This newsletter to salmon farmers is issued twice yearly. It is distributed to 84 salmon farmers and others with similar interests and contains advertising and extension information from MAF. This year's issues have contained information on whirling disease, imports of Canadian salmon products, use of drugs in salmon farms, all female salmon, and the salmon bycatch. They also contain comprehensive lists of publications on salmon culture that have been received at the Freshwater Fisheries Centre library. Copies of publications of interest to salmon farmers may be obtained from the Freshwater Fisheries Centre at cost.

Fish health services

N. C. Boustead

Submissions, investigations, and inquiries about fish health problems are investigated on a user pays basis. Most of the submissions were from salmon farmers. Some of the diseases identified in 1988 were bacterial gill disease, gill fungus, whitespot, sockeye syndrome, vibriosis, a swollen stomach condition of unknown cause, and nephrocalcinosis. Submissions have been made to MAFQual and to the Salmon Farmers Association about the disease risks associated with Canadian salmon imports. One atypical submission was of goldfish from a local breeder. They were infected with a range of ectoparasites including costia, also known as ichthyobodo. Costia is well known overseas to infect juvenile salmon, but has not been recorded from salmon in this country. Contractural arrangements are being entered into to carry out fish health checks for some salmon farms.



Carp biology and aquaculture

Effect of koi on New Zealand aquatic ecosystems

S. M. Hanchet

A literature review on the potential impacts of koi on New Zealand aquatic ecosystems has been completed for the Department of Conservation. Taxonomy, life history, impacts of common carp overseas, potential impacts of koi in New Zealand, control measures, and management issues were addressed. Conclusions reached overseas suggest that common carp have a detrimental effect on aquatic vegetation, fish, and waterfowl in some waterbodies if they reach a high enough density. These waterbodies tend to be shallow (about 10 m deep), warm (about 18 °C), eutrophic, silty, and small, though larger areas may sometimes be affected. Many waterbodies of this type in New Zealand have already lost their vegetation, but those still with weedbeds have high waterfowl and wetland values and generally low fisheries values.

The likelihood of koi reaching high enough densities to affect New Zealand waterbodies cannot be accurately predicted for several reasons. Firstly, koi is a different strain of carp to that reported causing environmental damage overseas. Secondly, the role of eels in regulating numbers of koi is unknown. Thirdly, the ability of koi to destroy many of the macrophyte species occurring in New Zealand is unknown. However, it was recommended that a monitoring programme be implemented and potential control methods be examined.

Production of triploid grass carp

N. H. McCarter

In previous years spawning of grass carp has been limited by cold temperatures and a short growing season. A warm water aquaculture system was designed and built to condition brood grass carp and to ongrow fry. The system consists of a double skin polythene hothouse and two self-contained water recirculating systems capable of holding up to 200 kg of fish. New production and monitoring equipment has also been designed and tested.

The first deliveries of triploid grass carp were made, for *Hydrilla* control in Napier and for other aquatic plant management projects.

Silver carp

N. H. McCarter

Northland Regional Council wish to stock Lake Oamapere with silver carp to alleviate eutrophication. MAFFish Rotorua will attempt to supply up to 100 000 fry per year to the council for the next 5 yr. Silver carp were successfully spawned at Rotorua in December.

Prawn aquaculture

C. P. Mitchell

Much time was spent on a commercial freshwater prawn (*Macrobrachium*) project. The first priority was quarantine clearance and assistance with ascertaining the disease status. The next was the development of larval diets and feeding regimes. Work was required in equipment design and construction, water circulation, and temperature control systems. Working with the owner, trapping and handling techniques were devised. Growth, pellet feeding, and pond performance schedules were also introduced.

Administration

Library

J. Potter

The Freshwater Fisheries Centre library currently receives 161 periodicals and holds about 1500 books. Our holdings were increased this year when we received some of the freshwater periodicals previously held by the Fisheries Research Centre library in Wellington.

As well as providing services for our own staff (Christchurch, Oamaru, and Rotorua), we undertake reciprocal interloan services to other libraries and assist the public. We also offer membership to interested groups who pay an annual subscription for use of the library and library services. All New Zealand freshwater publications can be obtained or purchased through the library, including the popular *Freshwater Fisheries Report* series and *Freshwater Catch*.

Advisory services

B. J. Swale

With the appointment in April 1987 of an Advisory Officer (Statutory Functions) in Christchurch, practically all freshwater fisheries statute administration (dealing mainly with fish farming) was done from the Kyle Street office, and the relevant document files were transferred from Head Office.

Computing facilities

Access to the Head Office Digital VAX computer, though limited, is still of use, but the significant step for the year was the purchase of powerful desktop computers which have enabled several tasks to be performed more expeditiously without overloading any other systems.

Freshwater Fisheries Advisory Committee

The existence of the FFAC was formally terminated by the Minister of Fisheries with the agreement of the Minister of Conservation. Since no meeting was held in 1988, the forty-sixth meeting, held in 1987, was the last.

The accounting side of freshwater fish farm licensing

In a move designed to radically improve the efficiency of MAFFish revenue handling, the accounts of all freshwater fish farm licencees were put in a computer data base. As a result, clients were invoiced through the computer system for the first time, and this will continue. In an unpopular, but necessary, concomitant move, arrears of licence fees were also billed.

The Freshwater Fish Farming Regulations 1983

A draft brochure to explain these regulations was produced in time to be available at AQUANZ '88. The brochure has been popular. Work has begun on a major revision of these regulations.

Fish transfers (freshwater)

Live fish transfers are required to be authorised by one of several MAFFish officers, and in practice the Manager (Freshwater Fisheries) issues all such authorisations. Most organisations wishing to move fish now understand the procedure, and there seems to be good co-operation. Work is continuing on the compilation of a newly-established transfer data base and on a comprehensive transfer application form for use by clients. The system for checking the disease status of fish before transfer has been enhanced.

Salmon bycatch

The salmon fishing season had already begun in 1987 when the Minister decided what action should be taken in the 1987–88 season. An intensive period of activity saw 16 facilities licensed to receive, hold, process, and deal in salmon caught at sea by commercial fishers, early in 1988. For the 1988–89 season the rules have been altered and changes to the regulations have been drafted.

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