TARGET TAUPO

A newsletter for Hunters and Anglers in the Tongariro/Taupo Conservancy

DECEMBER 2002, ISSUE 41

Department of Conservation
Te Papa Atawhai

Frog Hair®

Freshwater Tippets & Leaders

An Evolution in Freshwater Tapered Leader Design
How do you like 'em ...*Supple or Stiff?*

Frog Hair™ Tapered Leaders are the world's first knotless tapered leaders available with either supple or stiff butt sections.

Supple Butt Tapered Leaders - Frog Hair Supple Butt - Supple Tip Tapered Leaders have an extra supple butt section to provide a tighter loop and a softer turnover for the most stealthy presentation possible. The ultra supple tippet offers superior knot strength, incredible toughness and built-in shock resistance with the most natural, drag-free presentation of any tapered leader.

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High Performance tippet and leader materials: High strength co-polymer uses GAMMA's exclusive proprietary process that dramatically increases the elasticity suppleness, and "Shock Resistance" of the material while achieving an incredibly high strength to diameter ratio. Suppleness and low coil memory make the material easy to handle and tie knots that draw down smoothly for tighter, stronger, more secure knots. The result is a more natural, drag-free presentation for more takes and hook-ups, and greater fighting capability for landing more and bigger fish.

Size	Diameter	Test Strength	Elasticity	Spool Length
6X	.005"/.127mm	3.7lb / 1.68kg	31%	32.8yds / 30 M
5X	.006"/.152mm	4.9lb / 2.23kg	32%	32.8yds / 30 M
4X	.007"/.178mm	6.2lb / 2.82kg	32%	32.8yds / 30 M
3X	.008"/.203mm	8.2lb / 3.82kg	32%	32.8yds / 30 M
2X	.009"/.229mm	11.1lb / 5.05kg	35%	32.8yds / 30 M
1X	.010"/.254mm	13.1lb / 5.95kg	35%	32.8yds / 30 M
0X	.011"/.279mm	15.0lb / 6.84kg	35%	32.8yds / 30 M

Stiff Butt Tapered Leaders - Frog Hair Stiff Butt - Supple Tip Tapered Leaders have a heavier, stiffer butt section when a more powerful turnover is needed to punch through the wind or when fishing in large water with heavy flies. As with the supple butt leaders, the stiff butt leaders also have an ultra supple tippet offering the same superior knot strength, incredible toughness and built-in shock resistance that delivers the most natural, drag-free presentation possible.

Supple Butt Tapered Leaders

Size	Tip Diameter	Test Strength	Butt Diameter	Leader Length
7X5	.004" / .102mm	2.2lb / 1.0kg	.019" / .483mm	9.5 ft / 2.9M
6X5	.005" / .127mm	3.3lb / 1.5kg	.019" / .483mm	9.5 ft / 2.5M
5X5	.006" / .152mm	4.4lb / 2.0kg	.021" / .533mm	9.5 ft / 2.5M
4X5	.007" / .178mm	5.5lb / 2.5kg	.021" / .533mm	9.5 ft / 2.5M
3X5	.008" / .203mm	6.6lb / 3.0kg	.021" / .533mm	9.5 ft / 2.5M
2X	.009" / .229mm	8.8lb / 4.0kg	.023" / .584mm	9.5 ft / 2.5M

Stiff Butt Tapered Leaders

Size	Tip Diameter	Test Strength	Butt Diameter	Leader Length
3X-6#	.008" / .203mm	6.6lb / 3.0kgt	.025" / .635mm	9.5 ft / 2.9M
2X-8#	.009" / .223mm	8.8lb / 4.0kgt	.025" / .635mm	9.5 ft / 2.5M

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OFTEN IMITATED, NEVER EQUALLED

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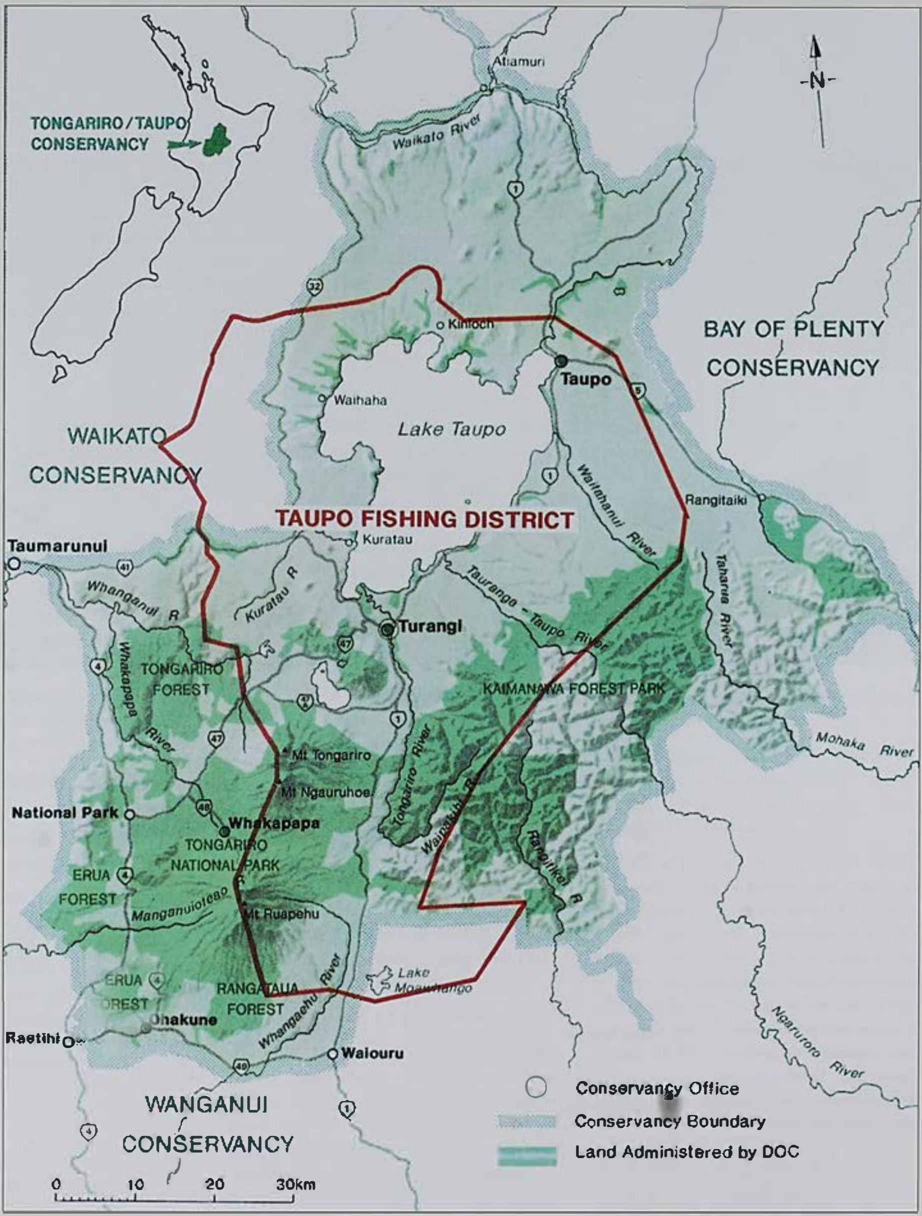


Editorial

Dear Readers,

It is with mixed emotions that I write my last contribution for *Target Taupo* after 13 years and 41 issues. The publication has changed considerably since July 1989 when Glenn Maclean and I first put issue 1 together back in the old Taupo District Office days of DOC. Over the years it has grown to fill an important role in informing hunters and anglers about resource issues. Its greatest strength, I believe, has been to put a biological context aronnd the many observations we all make of the resources we use, enjoy and care so much about. Not everyone has the luxury of biological training, access to or the ability to interpret the latest resource data and *Target Taupo* has provided a readily readable vehicle to achieve this for many users.

I am very proud of my involvement in *Target Taupo*. It has been an important part of my time at DOC. As I now move into a new role outside the public service, I will continue to read future issues with interest to ensure I stay informed.

I first started producing newsletters for hunters in 1987. Just low budget, black and white photocopied pages of words stapled to hunting permits. They were, nevertheless, appreciated by hunters. An American colleague from the Quality Deer Management Association visited that same year and after viewing my efforts encouraged me to continue, stating that from small beginnings grow great things. He was producing a fabulous publication at the time called Carolina Wildlife that had also started from much more humble beginnings.

I believe *Target Taupo* has become a great magazine over the years. I encourage you to read it carefully, and use it to put your own observations of our fishing and hunting resources into context. These resources are incredibly dynamic and we must all keep up with the latest information to ensure we fully understand what's going on to get the best from them.

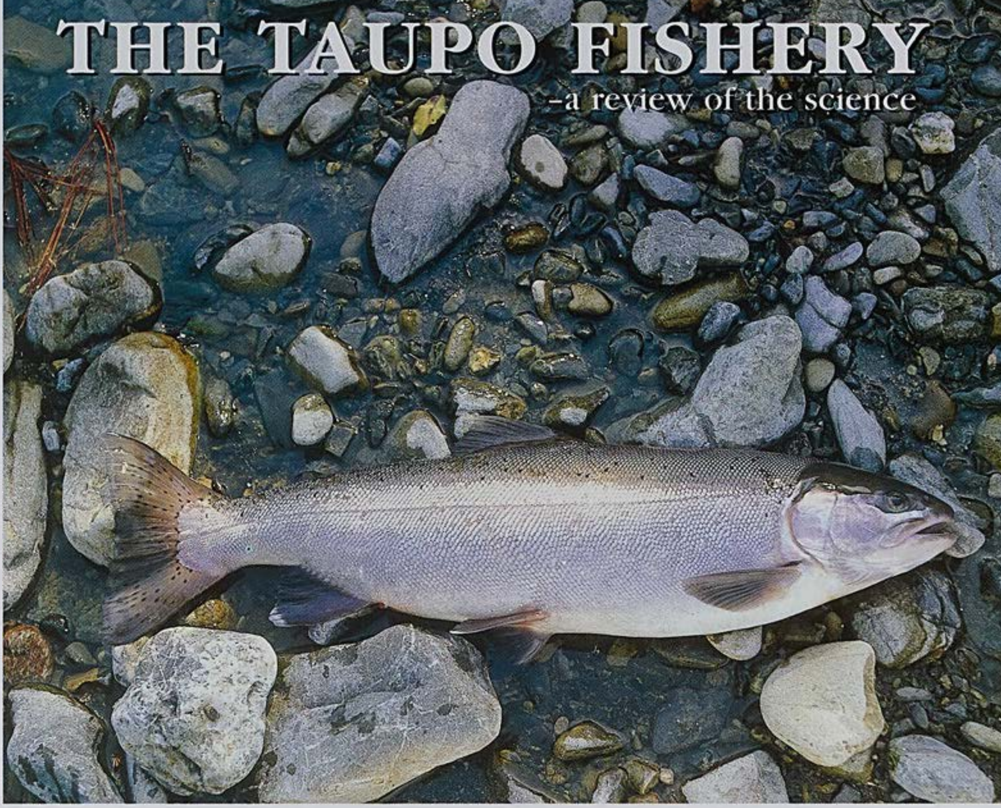
I trust you enjoy the last issue of *Target Taupo* in which I will be involved.

Best wishes

Cam Speedy

THE TAUPO FISHERY

–a review of the science



The essence of the Taupo fishery, a prime wild rainbow trout.

Photo: Len Birch

By Glenn Maclean, Michel Dedual, Dave Rowe and David Speirs

The authors are all fishery scientists, Glenn and Michel from the Taupo Fishery Area of DOC. Dave Rowe from NIWA in Hamilton and David Speirs from Environment Waikato.

As part of the 2020 Taupo-nui-a-Tia project a series of reviews was undertaken of the available scientific information in relation to various aspects of Lake Taupo and its surrounding catchment that are valued by the Taupo community. One aspect is the trout fishery. The following is a condensed version of the review which summarises the scientific information available regarding the history of the fishery, how it functions, its management and use and scopes future issues and threats facing the fishery.

A description of the fishery

The *Lake Taupo Accord* identified that Lake Taupo is an internationally renowned trout fishery. The fishery is also of great importance to Ngati Tuwharetoa. By definition a fishery involves the catching of fish. There are two key aspects to the Taupo fishery:

1 The lake and tributaries provide exceptional conditions to sustain a large population of wild trout;

2 The trout are readily accessible and available to anglers all year round.

Although brown trout (*Salmo trutta*) are present in Lake Taupo, the fishery is almost wholly dependent on rainbow trout (*Oncorhynchus mykiss*).

A National Research Bureau report on The Economic Worth of Recreational Fishing in New Zealand (1991) estimated 8.2% of all anglers (marine and freshwater) who had fished in the previous 12 months had fished at Taupo and that Taupo anglers comprised 42% of all freshwater anglers. The report estimated the total expenditure on recreational fishing at $745 million per annum and, assuming all anglers spend the same amount, this equates to an expenditure of $61 million by anglers using the Taupo fishery in 1991.

History of the Taupo Fishery

1887	Introduction of brown trout (*Salmo trutta*)
1898	Anglers fishing for large brown trout in the Tongariro River Introduction of rainbow trout (*Oncorhynchus mykiss*) into the upper Waikato Stream
1900	Rainbow trout released into streams around the lake
1904	First rainbow trout caught
1906	Release of rainbow trout into Lake Rotoaira
1907	Rainbow trout numbers surpass those of brown trout. Anglers from New Zealand and overseas flock to Taupo
1912	The koaro population can't support the expanding trout population and the size and quality of the trout begin to decline rapidly
1913-1920	Controlled netting to reduce trout numbers
1924	Size and condition of trout exceeds the peak in 1910. The mid-1920s probably reflect the best years of the Taupo fishery
1930	Poor trout size and quality
1934	Smelt released, releases continue through to 1939
1942	Smelt become a large part of trout diet
1951	Incidence of poorly conditioned fish prompt study by D.F Hobbs
1960	Fishing all year round and lead and wire lines permitted, bag limit removed
1962	Lake Kuratau created
1963	Trout size and condition improve and bag limit of 20 re-imposed
1971	Daily bag limit reduced to 10 fish
1972	Lake Otamangakau formed
1980	Daily bag limit reduced to eight fish
1987	Fishing licence sales peak at 83,829
1990	Angling harvest 30% to 50% of total estimated trout production in 1988 and 1989 and fishery declines to low point Daily bag limit reduced to three fish
1998	Minimum size limit increased following effects of Ruapehu eruptions Size and condition of the trout best since 1920s
2000	Largest adult trout population for several decades

A comprehensive summary of the history of the fishery is presented in
Rainbow trout – one hundred years in Taupo waters in Target Taupo 27 (1998).

Management of the fishery

The fishery is managed by DOC, rather than a Fish and Game Council, as a consequence of an agreement between the Crown and Ngati Tuwharetoa enshrined in the Maori Land Amendment and Maori Land Claims Adjustment Act 1926. Amongst other things this Act guarantees everyone rights of access to Lake Taupo and licensed anglers foot access along much of the inflowing streams. In return Tuwharetoa receive a sum equivalent to half of the fishing and boating revenue received from central government in recognition of the benefits of this agreement to all New Zealanders.

The Department manages the fishery in close relationship with the Tuwharetoa Maori Trust Board and also the Taupo Fishery Advisory Council (TFAC) which has a statutory responsibility under the Conservation Act to advise the Department and the Minister of Conservation on matters affecting the fishery and anglers.

Management of the Taupo fishery is directed by the Taupo Sport Fishery Management Plan, a statutory plan which is due for review in 2005. This plan requires that the fishery is managed as a self-sustaining wild trout fishery.

The Taupo Fishery Area has 16 full-time staff including technical experts and a fisheries scientist. The fishery management is self funded from fishing licence revenue which this year will be in the order of $1.5 million. Management involves maximising angling use within the bounds of ensuring fishery sustainability.

Life cycle of trout

Rainbow trout spawn in every stream in the catchment which they can access. In contrast, there are a number of streams which brown trout do not use despite using other apparently similar streams. There are very limited populations of river-resident rainbow and brown trout. Virtually all Taupo trout are lake residents that migrate into streams to spawn. A key feature of rainbow trout in Taupo is that fry are produced nearly every month of the year in most streams, though peak spawning occurs between June and October. The wide range of stream types used by Taupo trout and the diversity of life history patterns are major strengths of the fishery, providing it with the resilience to withstand adverse climatic and environmental impacts.

The life cycle is summarised in figure 1. Each female trout lays between 2000 and 4000 eggs and, after a period of incubation of between eight and 12 weeks depending on the water temperature, the eggs hatch. The newly born fish (alevins) remain in the gravel and obtain nutrition from the yolk sac attached to their body before emerging and starting to swim and feed actively.

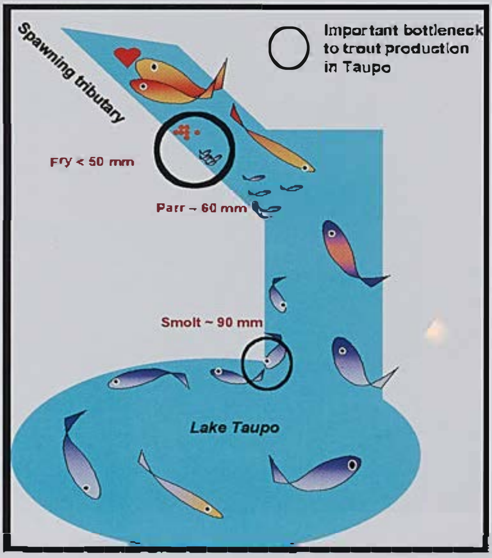


Figure 1.

The life cycle of Taupo rainbow trout

The fry start to migrate in a downstream direction. Some probably emigrate downstream to the lake soon after hatching as they do in other lakes. As the remaining fry grow, their food requirements and swimming ability increase and they move toward faster and deeper water where the food supply is greater. They feed mainly by intercepting drifting invertebrates (insects). At between six and 18 months old they leave their riverine rearing habitat and move to Lake Taupo. Here they feed mainly on smelt and grow for one to two years unless caught by anglers. They then return as three to four year old adults (approximately 540mm in length and just under 2kg in weight) to spawn in the rivers in which they were born. However, a small proportion of fish stray into other tributaries to spawn. Spent adults (fish that have spawned) return to the lake where they feed heavily on smelt which congregate close to the shore to spawn from spring to late summer. However, the rigours of spawning are such that typically only 30% of rainbow trout survive to spawn again though survival appears to be higher in brown trout.

There are several key constraints on the size of the trout population

1. Spawning success: There is a diverse range of factors which determine whether a spawning site is suitable or not. However, Taupo trout demonstrate considerable plasticity in the selection of sites and in general Taupo streams provide extensive areas of exceptional spawning habitat.

The Taupo fishery sustained by natural spawning. Photo Glenn Maclean

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AS SOON YOU CALL HIM JERRY.

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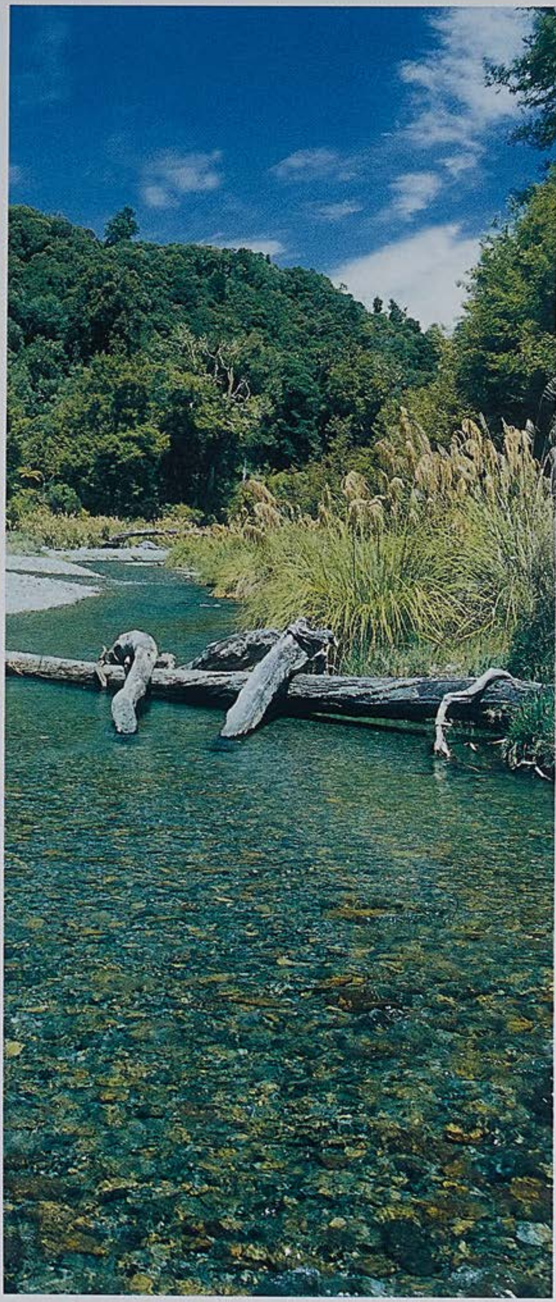


Taupo tributaries provide excellent spawning and rearing conditions. Photo: Glenn Maclean

2. Juvenile survival: The first few days after emergence constitute the single largest source of mortality when more than 90% of fry are frequently lost. If dramatic events like floods occur during this period then the mortality will be even higher. This is the first bottleneck to the total number of fish that the fishery will produce. It is assumed that the number of fry which survive emigration to the lake and rear there are too few to contribute significantly to the fishery. However, this assumption, which is based on a critical size for lake entry, requires more testing.

3. Size on lake entry: Most juvenile trout enter Lake Taupo during late summer and autumn. Some juveniles will survive by eating terrestrial insects and chironomids, however as soon as they are large enough to catch smelt they rely on these for food. Smelt comprise more than 90% of the diet of rainbow trout, which grow at a rate of about 1mm per day. Studies suggest that young trout start to feed on smelt when about 90mm long. Therefore the size at which the juvenile trout enter the lake is important for their survival. We believe that some juvenile trout less than 90 mm in length may survive but their contribution to the fishery is unknown. However, it appears that the larger the fish is on entry to the lake the greater are its chances of survival.

The number and quality of large juveniles entering the lake are initially controlled by the number of fry that survive and subsequently by the quality and quantity of the food and habitat available in the rivers. These parameters are largely dependent on the flow conditions in the river although knowledge of the habitat requirements and factors influencing the survival of trout in their first year, is far from complete. Because the spawning season is spread over a long period, juveniles born late in the season do not have time before winter to grow large enough to survive in the lake and instead spend the winter in the river (referred to as over-wintering). Generally fish that over-winter are larger when they enter Lake Taupo than those which don't, so over-wintering is a desirable feature of the Taupo fishery. Surviving entry into Lake Taupo is the second bottleneck to the number of trout produced.

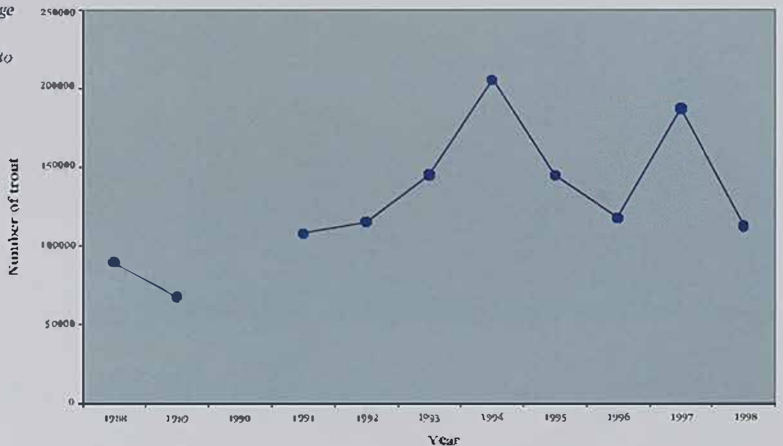
The size of the adult trout population in the lake varies widely from year to year, mainly in response to the prevailing climatic and habitat conditions. Harvest by angling is unlikely to be a major source of variation in the trout population but can be important at times of low trout production. Acoustic counts of the number of large fish (greater than 35cm) in the lake each November from 1988 to 1998 show a threefold variation of between 68,000 and 205,000 trout (graph 1). A similar variation is evident in annual counts of spawning trout numbers.

Over the last 40 years both trout and smelt populations are likely to have fluctuated widely. However, through this period the average size and condition of rainbow trout have remained relatively constant apart from a brief peak in 1997/98 following the eruptions of Mount Ruapehu. This suggests that the trout population in the lake is not generally food limited. This is consistent with studies indicating that the smelt population is not limited by current trout predation. However, the increase in the mean size of trout in the 1997/98 season following the Ruapehu eruptions, which caused a change in the phytoplankton community, implies that a change in the limnetic food web can affect trout growth.

Much of the smelt production is deep within the lake where foraging by visual feeders like trout may be less efficient. The bioenergetics of trout feeding on smelt are such that as the trout get larger they need to catch smelt more easily or catch larger smelt to continue growing. Therefore, while it is likely that the food production in Lake Taupo is generally sufficient to support a population of well conditioned trout, if smelt were more available or of a larger size in the surface waters, the trout may grow to a larger average size. Thus, both the type of food web in the open waters of the lake and the distribution of smelt are important for trout growth.

Although relationships between nutrient supply and gross phytoplankton production have been extensively studied, factors affecting phytoplankton dynamics and their effects on linkages up the food chain to smelt and trout are poorly understood. This constitutes a serious gap in our knowledge about the trout fishery.

Graph 1. Number of large trout counted in Lake Taupo November 1988 to 1998



Angling in the Taupo fishery

Fishing at Taupo has two distinct components based around the lake and the rivers. From spring to autumn boat anglers target the immature and recovering trout in the lake and around the river mouths. Early in the season shallow trolling (harling) is as effective as deeper trolling methods but as the summer progresses and the fish move deeper the use of wirelines and downriggers is necessary for consistent success. Very recently jigging has also become very popular. Success in the lake is very much linked to following the depth of the thermocline (the zone between the warm surface waters and cooler bottom waters).

In spring, shore-based anglers seek trout close to the shore which are feeding on the spawning smelt (smelting) and throughout the year fly fishing anglers target fish which are congregating off the river mouths.

A quite distinct fishery is fly fishing in the rivers over winter for the mature trout making their spawning migration. Traditionally this involved swimming a large fly downstream on a sinking line (wetfly fishing) but since the mid-1980s upstream fishing with a floating line and heavily weighted fly or flies (nymphing) has been more popular.

The Taupo fishery provides exceptional fishing opportunities all year round
Photos: Rob Marshall and Bob Hood

The summer lake angling and winter river angling mean that unlike most trout fisheries Taupo anglers have extensive fishing opportunities all year round.

The Tongariro National Trout Society

The centre is managed by the Department of Conservation in association with the Tongariro National Trout Centre Society. The role of the Society is to promote and foster public interest in, and understanding of, the Taupo fishery, other freshwater fisheries and freshwater ecology through development of the Trout centre wider promotion and education programmes.

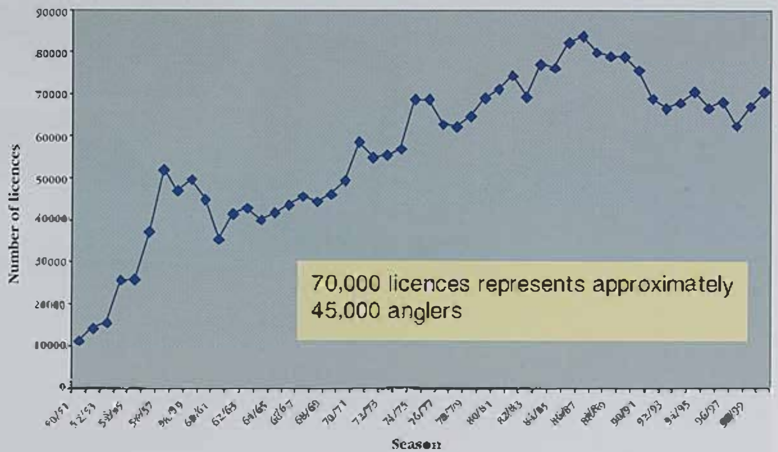
To Join the Society, fill out this form and send $25.

Name: ____________________

Address: ____________________

Post to: Tongariro National Trout Centre Society, P.O. Box 73, Turangi

Graph 2. Taupo fishing licence sales 1950/51 to 1999/2000



The number of anglers using the Taupo fishery increased steadily to a peak in the 1986/87 season before declining and levelling out at around 70,000 licence sales per year (graph 2).

Intensive season-long surveys estimated the total catch and harvest (or fish killed) of legalsized trout in 1990/91 and 1995/96 seasons (table 1). Data from a similar survey in 2000/01 are not yet available.

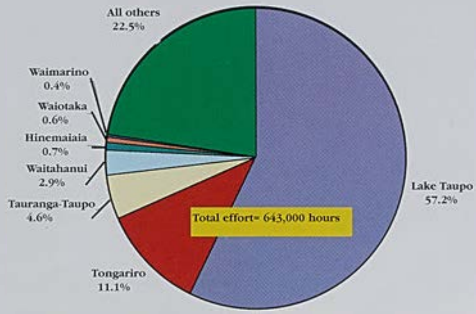
Table 1. Total legal-sized catch and harvest (in brackets) of trout 1990/91 and 1995/96 seasons.

Season	Lake Taupo	Tongariro River	Total Fishery
1990/91	82,880 (69,250)	16,500 (12,500)	140,000 (113,000)
1995/96	99,140 (79,705)	20,860 (13,850)	175,000 (129,600)

The difference indicates the number of legalsized fish caught but not kept.

Despite the greater angler numbers in recent years, a combination of reduced catch rates, more restrictive angling regulations and greater practice of catch and release means the angling harvest is less now than 40 years ago.

Graph 3. Angling effort across Lake Taupo and Taupo tributaries 1995/96 season



The angling effort across the lake and six major fishing rivers over the 1995/96 season is presented in graph 3.

Other interesting statistics from the 1995/96 survey:

Lake Taupo

- Guided anglers comprised 9% of the total effort but took home 14% of the harvest.
- On average 322 anglers fished from a boat each day.
- Anglers released 20 % of the legal catch.
- The average harvest per day was 21 8 fish.

Tongariro River

- The total number of angler visits was 25,390 or 126 anglers every day of the winter season.
- 39% of all legalsized fish were released alive and anglers kept on average 69 trout per day.

Key issues and threats

There are many factors that can affect trout production in Lake Taupo. Currently we believe that the principal bottlenecks occur during (a) the juvenile riverine life phase and (b) on subsequent entry to the lake. However, we can identify four threats to maintaining the current production:

1. Reduction in the quality and/or extent of spawning and juvenile rearing habitats.

2. Reduction in trout growth rates and/or numbers caused by changes in water quality.

3. Negative impacts arising from the introduction of new species.

4. Over-harvest of the trout population.

These threats are outlined in further detail below.

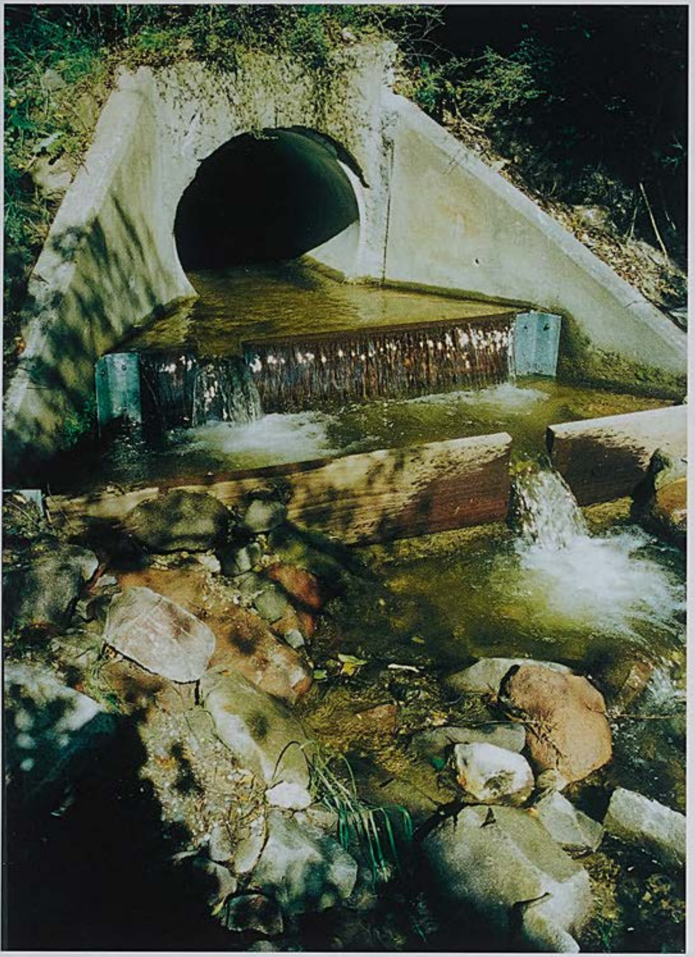
1. Reduction in quality and/or extent of spawning and rearing habitat

Trout need a high-quality stable, environment during egg incubation and emergence and, as juveniles, both adequate habitat and food. Taupo streams provide extensive areas of high-quality habitat but this environment can be easily degraded. The problem of over-harvest in 1990 was caused largely by the reduced trout populations at this time. It is clear that, for some unknown reason, trout production through this period was substantially less than in earlier and later years.

Important influences are the timing and magnitude of floods. Small floods may be beneficial in cleaning gravels and maintaining habitat quality and diversity. Large floods may be detrimental by wiping out eggs during incubation, displacing alevins and juveniles downstream, stranding and other direct mortality and reducing food abundance. Although floods are largely controlled by natural events, global warming caused by CO_2 emissions may potentially affect the amplitude and frequencies of floods.

Floods can also create log jams in tributaries which block fish migration. Many Taupo tributaries flow through narrow, easily blocked ignimbrite gorges. Access may also be

Maintaining fish access to spawning areas is a key management action. Photo: Jon Palmer



These influences significantly impact on the Taupo trout production. However, the natural influences are part of a wild fishery and there is no obvious reason why the human impacts should be any greater in the future so long as the prudent catchment and fishery management actions continue.

restricted by poorly designed or maintained road culverts or inappropriate riparian management. As a consequence extensive areas of spawning and rearing habitat may become unavailable. Management activity involves identifying and removing any natural blockages and using such tools as the Resource Management Act (RMA) to ensure human activities do not constrain trout migration to existing spawning areas.

Water abstraction and the damming of the Tongariro, Hinemaiaia and Kuratau Rivers for hydro power generation are thought by the fishery managers (DOC) to have had serious impacts on the ecology of the rivers and the amount of habitat and food available to juvenile trout. Impacts may occur through reduced flows or the effect of daily fluctuations in flow as a consequence of hydro generation. These effects are currently being addressed through the renewal of operating consents under the RMA. Conditions agreed for all three rivers are expected to make for a significant improvement to the fisheries in these rivers.

Land management may also seriously affect riverine ecology. Poor farming, roading or logging practices will result in erosion and the increase in sediments entering the rivers, particularly in the poorly structured

Nutrient enrichment threatens the lake qualities we treasure. Photo: Glenn Maclean

pumice soils around Lake Taupo. Concerns over these impacts were the catalysts behind the Lake Taupo Catchment Control Scheme initiated in 1976, and the creation of Lake Taupo Forest, which was planted primarily for "preventing soil erosion, reducing pollution of the waters of Lake Taupo and of the streams and rivers flowing into and out of said lake, and minimising adverse changes in river and lake water". These developments, along with the fact that many streams flow within Kaimanawa Forest Park or other protected areas, mean it is likely that the impacts of sedimentation are less than 50 years. However it is essential that sediment inputs continue to be carefully managed.

As the 1995 and 1996 eruptions highlighted, volcanic activity can have both negative and positive impacts. In the streams a few fish were killed by direct contamination but the most serious effect was caused by the input of the fine ash. This smothered the eggs still in the redds and severely reduced the amount of juvenile trout and aquatic insect habitat. Monitoring and observations at the time indicated there was almost no trout production from the main stem of the Tongariro in the summer following the 1995 eruption. However, the changes in the lake which were discussed earlier allowed those fish which did survive to grow to a larger size than usual. These and other eruptions highlighted the fact that the fishery can quickly recover from such events.

A related and potentially more serious threat is that a lahar from the Mount Ruapehu crater lake will flow out of the Whangaehu catchment into the Tongariro, discharging highly acidic water into Lake Taupo. Modelling indicates this could have a disastrous impact on the lake ecology and trout fishery. This threat has largely been removed by the building of a bund at the likely break-out point within Tongariro National Park.

2. Reduction in trout growth rates and/or numbers caused by water quality change

Changes in water quality will affect limneric, food production which in turn may affect smelt and hence trout production. Lake Taupo is oligotrophic (low in nutrients) and the growth of phytoplankton is thought to be nitrogen limited. Increased nitrogen inputs will increase the lake productivity and this may support larger and/or more smelt. However, any benefit to trout will also depend on where these smelt are distributed through the water column and therefore what feeding opportunities they present. An increase in algal growth will also increase turbidity and decrease water clarity. This may result in a shallower distribution of smelt but trout, especially rainbows, are visual feeders and at some point reduced clarity will reduce their feeding efficiency and hence

In our opinion nutrient enrichment is currently the most serious threat to the Taupo fishery. Changes, which in the long term are likely to be detrimental, appear inevitable unless enrichment ceases.

their ability to grow. Changes caused by cultural eutrophication can also cause effects such as reduced oxygen levels and alter trophic relationships. All sorts of scenarios are possible but in practice cultural eutrophication has most often proven detrimental to salmonid populations. In a worst case scenario the food chain may change and no longer be adequate for smelt or trout.

3. Negative impacts arising from the introduction of new species

Currently smelt comprise more than 90% of the diet of Taupo trout. Such a simple food web optimises energy transfer but the reliance on a single prey species also increases the vulnerability of the trout population. Other than changes in water quality the smelt population could potentially be affected by the introduction of a new fish species through competition or predation, or the outbreak of disease. Once again the scenarios are many and the impact on the trout population uncertain.

Harry Hamilton holds the second biggest catfish we have ever caught (360mm, 770g).

Invasion by a new fish species could also directly compete with trout for food or prey on the trout. Herbivorous species are less likely to be a significant threat owing to the relatively minor role of aquatic plants in the food chain in Lake Taupo. Currently catfish occur in large numbers in the shallow weedy margins of the lake. Despite concerns, extensive research has not revealed any serious impact on the trout population.

The risk of accidental release of an undesirable new species appears low if effective border control measures are in [illegible] However [illegible] species [illegible] become established eradication is almost certainly not an option in a lake the size of Taupo and the potential impact on the fishery could be significant.

Disease outbreaks and parasitic infections could also potentially impact on the trout population beyond repair. Currently no serious trout diseases occur in New Zealand but the biosecurity risk of an unwanted introduction is always present. The most likely pathway is via imported fish products (and unwashed angling equipment, particularly waders). One of the attractions for many overseas anglers is that Taupo trout tend to be perfect specimens and even if a new disease does not kill the fish, the aesthetic impacts may significantly diminish the special attraction of Taupo trout.

4. Over-harvest

As the decline in the late 1980s highlighted, over-harvest can compound low trout abundance in Lake Taupo to have potentially significant impacts on the number of fish surviving to maturity. In the worst case the sustainability of the fishery will be threatened. Poaching, if left unchecked and allowed to increase, could have a similar effect. Currently poaching is small scale, in part because of the difficulty in disposing of large quantities of fish. If the sale of trout were legalised it is expected that poaching would increase using the legal market as a cover.

Gaps in our knowledge

What:

1. Limits the number of juveniles reared in the streams?

2. Is the contribution of trout which enter the lake at less than 90mm in length?

3. Is the cause of the bottleneck in juvenile trout survival in Lake Taupo?

4. Are the dynamics of the smelt population/s?

5. Is the likely impact of changes in the trophic chain on smelt and trout?

and

6. Will be Lake Taupo's physical and biological reaction to water quality degradation and what will be the specific effects on the smelt and trout populations? It is likely that only by going there and seeing what happens will we get a definitive answer to this question. Given that experiences elsewhere indicate that any changes are most likely to be detrimental for the trout population, we hope we will never know this answer.

Uncontrolled poaching could threaten the sustainability of the trout fishery.
Photo: Glenn Maclean

Management of the fishery involves comprehensive monitoring of the trout production and angling harvest and the manipulation of regulations such as daily bag and size limits to ensure these remain in balance. In addition monitoring and enforcement activities are undertaken to ensure the illegal harvest of fish is kept in check.

The 2020 Taupo-nui-a-Tia project

The 2020 Taupo-nui-a-Tia project is a partnership approach between Environment Waikato and Ngati Tuwharetoa to the sustainable management of Lake Taupo and its catchment. The project is intended to deliver a sustainable development action plan for the lake and combines three elements: community participation, iwi processes and supporting science.

The trout fishery review comprised one of 13 reviews as diverse as clear water, safe swimming, safe drinking water, high-quality drinking water, recreational opportunities, outstanding scenery and commercial opportunities. In addition cultural values will be described in the Ngati Tuwharetoa Iwi Management Plan due out in November 2002. Each of these reviews identifies a series of risks to that value. These risks have been collated and the next step now underway involves a comparative assessment of the risks/threats to the ecological integrity of the lake and its catchment. This assessment is being undertaken by a group of scientists whose expertise covers such fields as chemistry, volcanism, hydrology, water quality, periphyton, aquatic invertebrates, aquatic plants and fisheries. A similar risk assessment, which will include community input, will be undertaken with regards to human health, quality of life, economic and iwi values.

There have been numerous comments in the local media recently about the need to protect the lake. These reflect community concerns over the potential deterioration in those values of Lake Taupo that we treasure. However, many of the comments suggest that nothing is being done. In reality a process to ensure these values are protected is already well underway. A major player in the 2020 Taupo-nui-a-Tia project is the Lakes and Waterways Action Group, which comprises members of the community with concerns over the lake. If you would like to be involved you are most welcome to attend its meetings which are held the last Wednesday of every month at the Taupo District Council Offices at 530pm. For further information on the 2020 project check

www.taupoinfo.org.nz.

WAITAHANUI RIVER ACCESS CORRECTION

Several observant readers spotted the error in the Waitahanui River access article in the July 2002 *Target Taupo* (issue 40). The second last bullet point on page 24 stated "All the land on the true right (southern) bank from the State Highway 1 bridge up to Butlers Bend is Maori land." As the sidebar on page 26 correctly points out, the true left or right side of a river is the left or right as you face downstream. In the case above, the southern bank is in fact the true left bank. Our apologies for the confusion.

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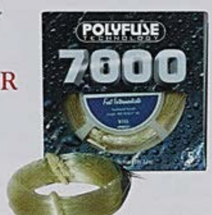

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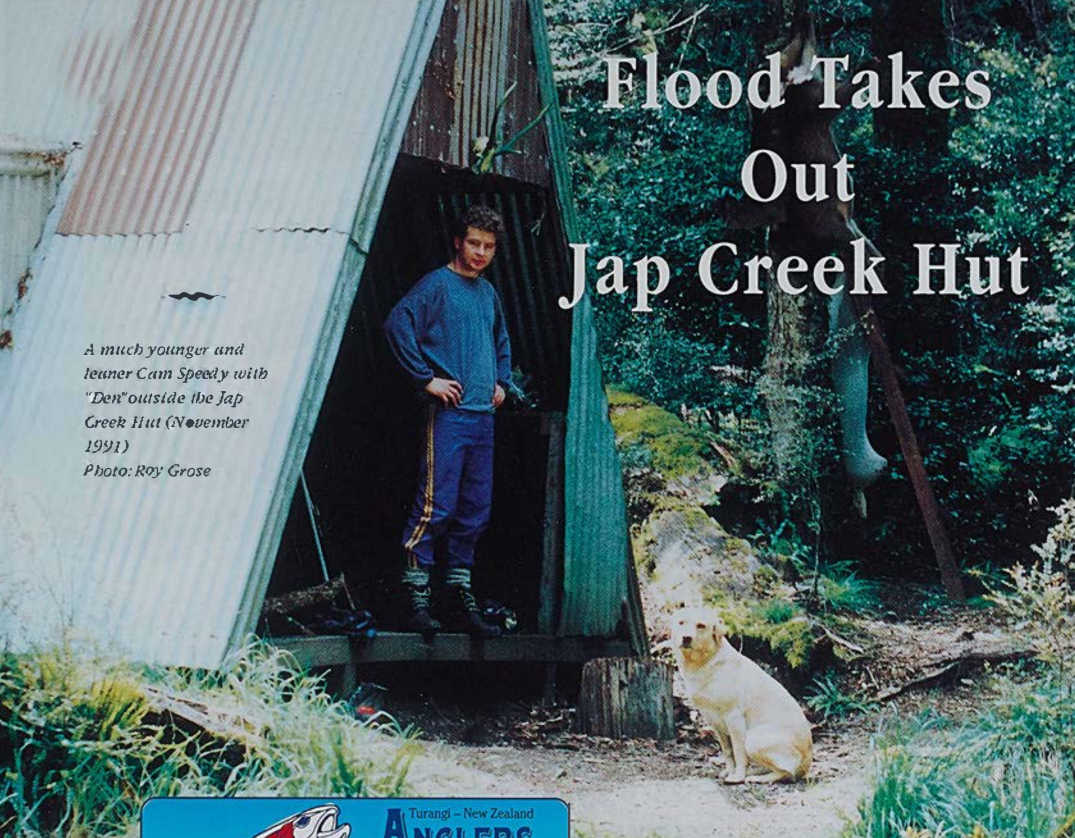
Flood Takes Out Jap Creek Hut



A much younger and leaner Cam Speedy with "Den" outside the Jap Creek Hut (November 1991)
Photo: Roy Grose

Those hunters thinking about using the Jap Creek hut as a hunting base this coming summer or roar need to make a new plan. A large flash flood in February 2002 destroyed the hut, sending its tangled remains more than 100m downstream. A cloud-burst type rainstorm, typical of those experienced in the central high country last summer, appears to have caused a slip in the side creek that entered the main stem just upstream of the hut. A head of pressure obviously built up behind the slip, resulting in the temporary dam bursting and sending a torrent of water down the catchment. A similar flash flood affected the major side creek downstream of the hut in 1989, cleaning out many decades of accumulated log jams and other debris from the catchment.

Side creeks all over the Jap Creek and upper Oamaru River catchments appear to have been affected by the February event. Many even smaller head guts have been scoured right down to bedrock, with flash floods cleaning out all manner

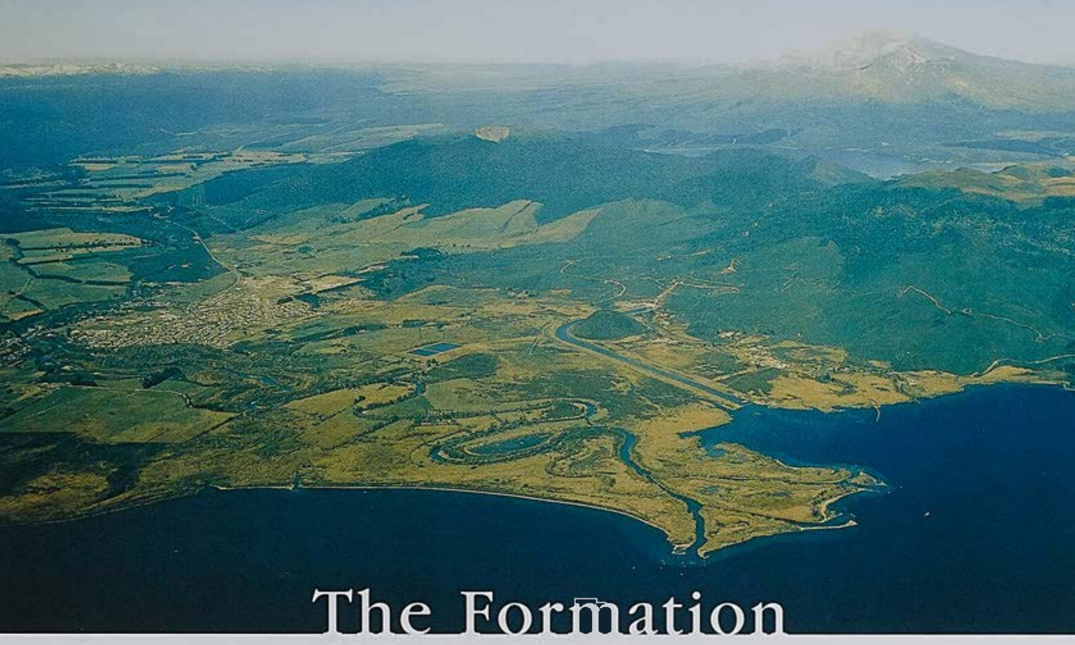
The Jap Creek Hut, now located 100m or more downstream of its original position, as photographed from the air in March 2002
Photo: Paddy Willems

Cam Speedy sits out an earlier flood in 1994

of debris from windfalls and log jams to ferns, leaf litter and soil deposits, as they went. These new streamside scars will take a few years to heal. As mosses, grasses, herbs and other colonising plants, many of which are highly sought-after by deer, grow back over the next few years, there will be some very good hunting along these now open and very easy-to-travel water courses.

The Jap Creek hut, based on an Air Charter Taupo design, was built by the New Zealand Forest Service in 1986 to service a four-year sika deer research study in the catchment. The hut had fallen into disrepair in recent years and was due to be removed when the flood hit. The remaining debris is due to be removed some time in early summer.

A NIWA rain gauge on the Umukarikari Range further west recorded a rain event last December (2001) which saw 140mm (over five inches) of rain fall in less than one hour.



The Formation Of Lake Taupo

by Jon Palmer

Jon Palmer is the Programme Manager Service for the Taupo Fishery Area

Pictured above

Southern Lake Taupo looking from the Tongariro delta over Pihanga, Tihia, and Kakaramea towards the peaks of Tongariro National Park

Photo DOC Turangi

We are privileged in New Zealand to have many large freshwater lakes on which to recreate. Spending time boating, sailing, fishing, water skiing, or relaxing around the shores epitomises holidays for many New Zealanders. Our lakes range from those filling huge, deep valleys slowly carved out by retreating glaciers to those formed by violent volcanic activity.

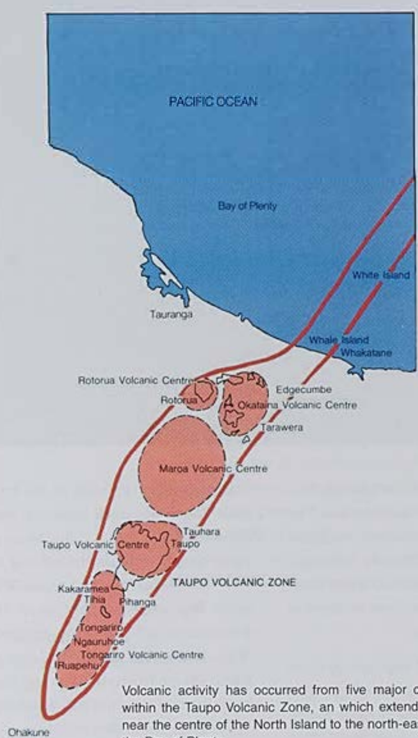
Lake Taupo is part of the Taupo Volcanic Zone which is made up of five major areas of activity: Tongariro, Taupo, Maroa, Rotorua and Okataina. This zone stretches in a north-east/south-west direction from White Island to Ohakune. It is a trough some 3-5km deep, filled with volcanic material. The zone is characterised by down-faulting and is expanding across its width at about 10mm a year. Of the five centres, Taupo has produced some of the most massive and violent eruptions – not only on a local but also on a world scale. Looking out across Lake Taupo on one of those scorching hot mill-pond days in the middle of summer it is difficult to imagine the huge forces that formed the lake, even though we are surrounded by the evidence of past volcanic eruptions. The Taupo area has a very complex volcanic history dating back over 300,000 years. In the last 26,000 years there have been two major pumice eruptions and over 20 smaller eruptions - a complex story. The following article is an introduction to the formation of Lake Taupo, and a description of this evidence.

To start this story we need to describe some of the words used by the volcanologists. Magma is the raw material of volcanoes that forms volcanic (igneous) rocks. Magma is called lava once it reaches the earth's surface. The mineral silica is an important component of magma and volcanic rocks are divided into three broad groups according to the amount of silica in them (Table 1).

Table 1.

Volcanic rock groups as defined by the amounts of silica

Common name	Percentage silica	Colour	Volcano form
Rhyolite	> 67% silica	Light coloured	Caldera/Dom
Andesite	53-67 % silica	Light grey to black	Cone
Basalt	< 53% silica	Black	Scoria cones



Volcanic activity has occurred from five major centers within the Taupo Volcanic Zone, an which extends from near the centre of the North Island to the north-east in to the Bay of Plenty.

Figure 1: Map of the Taupo Volcanic Zone

Courtesy of the Tongariro Natural History Society

Basalt is rare in the Taupo catchment. It is usually associated with lava eruptions such as in Hawaii and the volcanoes in and around Auckland. However, basalt was erupted in the Taupo region 500,000 to 300,000 years ago - K Trig behind Acacia Bay is an example.

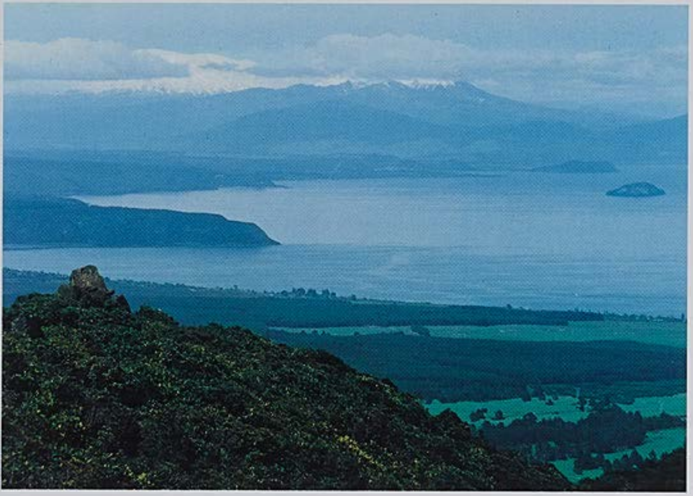
Andesite is the type of rock that forms the bulk of Tongariro National Park and the peaks contained within it. Andesite volcanoes erupt quite frequently and can be explosive, generating rock and ashfalls. Lava flows can also occur.

Rhyolite is the type of rock that has been erupted from Taupo, and makes up 98% of all material erupted from this volcano. Rhyolite can be erupted in many forms ranging from thick sluggish lava domes/flows to welded pumice flows (ignimbrite) to frothy pumice. Chemically they are similar, but the differing names relate to how the rhyolite rocks were formed.

- Rhyolite lava domes and flows are formed when gas-poor magma is pushed up to the surface through a vent, like toothpaste through a tube, to form domes or steep mounds of viscous lava. The domes may be large enough to form substantial hills.
- Rhyolite can also be erupted in vast amounts from vents, usually as the magma reservoir collapses. The material forms unstable eruption columns that collapse

The view south from Tauhara – the distinctive topography of the Lake Taupo Basin is the result of numerous volcanic events over the last 300,000 years

Photo Jon Palmer



and generate avalanches of hot molten rock, gas and pumice – a pyroclastic or pumice flow. These flows slowly cool, fusing rock fragments together to form ignimbrite. Material is distributed away from the vent so no distinctive cone or dome is formed, just large plateau.

- Rhyolite can be erupted explosively from vents when it contains a lot of gas. The gases expand further as the magma reaches the surface, causing it to froth. This gaseous magma cools quickly to become pumice.

The formation of the depression, or caldera, which is now filled by Lake Taupo began about 500,000 years ago. A caldera is a large volcanic depression usually 15-20km in diameter, but can be up to 50km across, and is formed by collapse during and after an eruption. The initial genesis of the Taupo Volcano coincided with the beginning of the uplifting that created the Kaimanawa and Hauhungaroa Ranges. Between 500,000 and 300,000 years ago this depression contained lakes of various sizes that existed intermittently in this area because of volcanic activity in the north, south and west. Cores from deep boreholes at Wairakei illustrate alternating layers of lake sediments and volcanic rock from this period. A large lake may have occupied much of the low-lying land between Reporoa and Turangi at some stage.

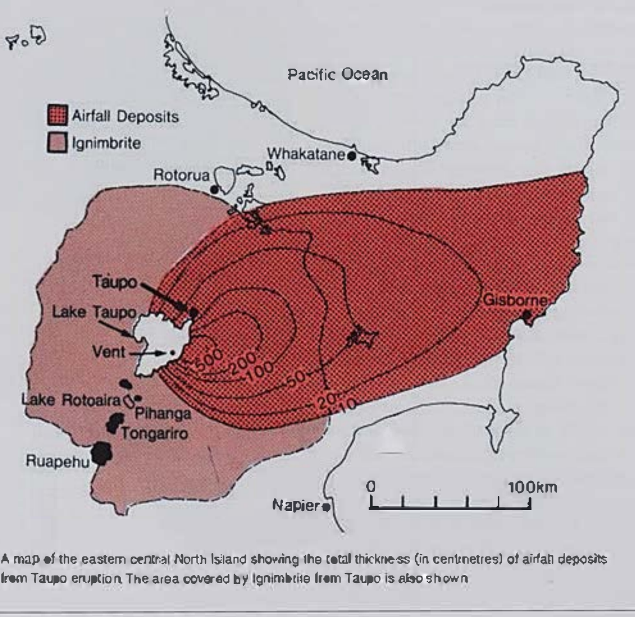
The next major episode in the formation of Lake Taupo occurred between 300,000 and 230,000 years ago. Voluminous eruptions from a large caldera underlying the northern Taupo-Maroa-Mangakino-Whakamaru areas deposited possibly up to 1000 cubic kilometres of ash and bedrock called Whakamaru Ignimbrite that now makes up the cliffs of Western Bays and the massive rock formations near the Whakamaru Dam. Ignimbrite from this eruption is also now exposed along State Highway 1 at Te Toki, Bulli and Ohoumahanga Points along the eastern lakeshore. A "solid" sheet of this rock once covered all the landscape now forming the northern half of the lake. At about the same time this caldera also erupted Rangataiki Ignimbrite that forms the southern portion of the Kaingaroa Plateau. Following those eruptions lakes formed. A gritty-pumiceous sandstone called the Huka Formation is the remains of an ancient lake bed from this time. This mixture of volcanic and sedimentary material is found today at Huka Falls, and makes up those soft, slippery rock outcrops along the Taupo lakefront around to Five Mile Bay.

Between 300,000 and 30,000 years ago several smaller volcanic events helped determine the present shape of Lake Taupo. The southern shore (and boundary) of the lake started to take form with the development of the andesitic volcanoes Kakaramea and Tihia. The eruptive history of this complex is not well known but radio-carbon dating indicates many of the eruptions occurred between 100,000 and 230,000 years ago. Tephra was last erupted from a vent near the eastern end around 40,000 years ago (tephra is a collective term for all unconsolidated volcanic material erupted explosively, including ash, pumice, scoria and volcanic bombs). The Kakaramea-Tihia massif has since been extensively modified by faulting. Water and steam reach the surface along a fault scarp at Hipaua Thermal Area, easily visible on the northern slope of Kakaramea. The faulting and hydrothermal activity weakens the mountainside and modifies the rock into clay. Several landslides have occurred from Kakaramea and Tihia, further defining the southern lakeshore line. The most infamous landslide swept through the Maori settlement of Te Rapa in 1846, killing 55 people including Te Heuheu Tukino II, the Paramount Chief of Ngati Tuwharetoa. The site of the village was moved to be clear of future landslides and renamed Waihi. Pihanga, immediately south of Turangi, is much younger than Kakaramea. The prominent slip visible from the north has exposed a mantle of Taupo pumice and brown andesitic ash from Tongariro National Park volcanoes. This mantle makes it hard to locate the last active crater. The headlands of the northern bays were formed during this period by rhyolite rock pushing up through the Whakamaru Ignimbrite to form lava domes. These headlands define Whangamata, Whakaipo and Mine Bays. The associated valleys that form these main bays and the smaller bays on the northern shores of the lake have also been modified by subsequent faulting. The north-easternmost boundary of the lake was defined with the formation of Mount Tauhara. Tauhara is a complex volcano made up of five overlapping dacite domes. Dacite is a volcanic rock with a composition between that of rhyolite and andesite. The south-western edge of the lake was defined later in this period when further eruptions produced the lava domes of Rangitukua, Pukekaikiore and Kuharua.

The first major pumice eruption from the Taupo Volcanic Centre was the Oruanui eruption 26,500 years ago. This is the largest

Figure 2: The extent of airfall deposits and ignimbrite flows from the Taupo Eruption

Courtesy of the Tongariro Natural History Society



A map of the eastern central North Island showing the total thickness (in centimetres) of airfall deposits from Taupo eruption. The area covered by ignimbrite from Taupo is also shown known eruption in the history of the volcano and one of the largest in the world during the last million years; its enormity is almost beyond comprehension. This eruption, centred near the present-day Western Bay, produced 300 cubic kilometres of ignimbrite and 500 cubic kilometres of pumice and ash Lake Taupo contains 59 cubic kilometres of water in comparison. This eruption distributed air-fall pumice across the entire North Island, being thick from the Bay of Plenty to Mahia Peninsula, and west to Taranaki. The ash was distributed even further with the Chatham Islands, 800km east, being coated with 11cm. This eruption produced enough material to build three Ruapehu-sized cones.

The Oruanui eruption largely determined the present shape of Lake Taupo. Because so much material was removed from depth during the eruption, the surrounding landscape collapsed, forming the northern and western Lake Taupo basins. It was this collapse of the landscape and the displacement of the existing Whakamaru Ignimbrite that exposed the cliffs of Western Bay and the outcrops now visible along the eastern side of the lake adjacent to State Highway 1. The fine grain size of the ash suggests the presence of a large lake prior to the eruption. The eruption formed what the geologists have named the Kawakawa Formation, a layer of pumice up to 100m deep near Taupo This pumice covered the ignimbrite plateaus formed by previous eruptions north and east of the lake. The devastation on the central North Island must have been catastrophic.

There were around 26 smaller pumice eruptions between the Oruanui eruption and the Taupo eruption 1800 years ago These formed shallower layers of pumice across most of the district. Three thousand, four hundred years ago the significant Waimihia eruption produced nine cubic kilometres of rhyolitic pumice from the Horomatangi Reefs area. More rhyolite lava pushed up through the landscape around 5000 years ago to form Motutaiko Island, and again at least 2000 years ago to form the Motuoapa

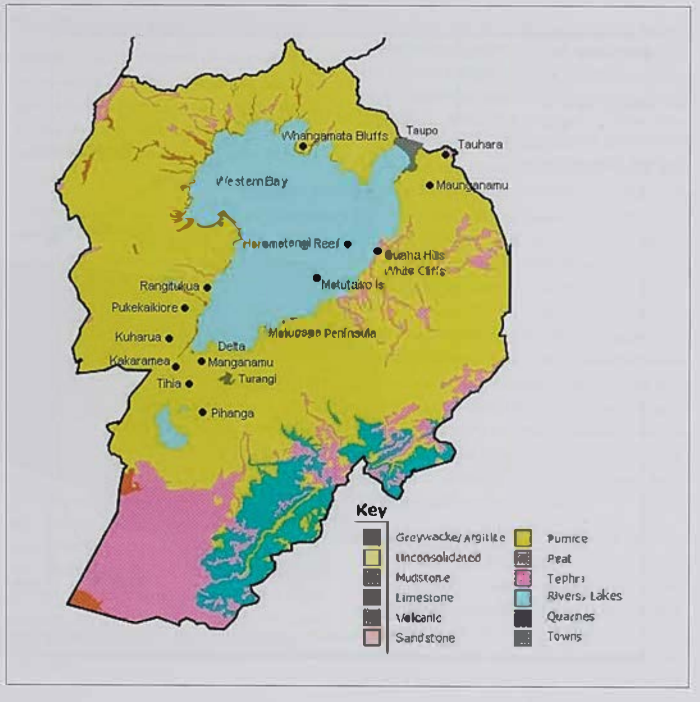


Figure 3: Map of the Taupo district, showing geological features. Source: New Zealand Land Resource Inventory.

Courtesy of Environment Waikato

Motutaiko Island was formed approximately 5,000 years ago from rhyolite lava.

Photo Jon Palmer

Peninsula. Around 3000 years ago there was a significant explosive eruption that produced lava and pumice. This eruption resulted in the formation of the Ouaha ridge adjacent to the White Cliffs, thus defining a large section of Lake Taupo's eastern shoreline. Around 1800 years ago rhyolite domed to form Maunganamu, that small hill near the Bonshaw Park subdivision east of Taupo. At around the same time the small dacite cone, also called Manganamu, formed on the southern shores of the lake, adjacent to the Tokaanu Tailrace.

The Taupo eruption 1800 years ago is the volcanic event that most people are aware of. This eruption happened before humans settled in New Zealand, but its effects on atmospheric conditions have been recorded in Chinese and Roman literature. This literature tells of blood-red sunsets and poor summers over following years. From these references it has been possible to date the eruption at AD 186. The centre of this eruption is thought to be near the Horomatangi Reefs because of the orientation of buried trees, and because of the deep holes adjacent to the reefs which are possibly the remains of the vent. The submerged trees, visible from the air or boat, lying in the shallows offshore from White Cliffs were buried by either the Taupo or Waimihia Eruption, and subsequently uncovered by erosion.

This eruption was the most violent and powerful in the world during the last 5000 years. About 45 cubic kilometres of pumice and 50 cubic kilometres of other material were erupted. This eruption was very complex, comprising six stages. Initially the eruption rate was relatively small, creating a small fall deposit close to the lake. As magma pushed the vent above the lake level the eruption rate dramatically increased, producing a high column that rained pumice over a large area. Lake water eventually entered the vent, causing the eruption to slow and producing a thin, fine pumice layer. After a break of between hours and weeks, water eventually met the magma source, producing a high water-rich plume. The eruption rate increased again when the vent was again cleared of water, covering the entire central North Island, from Taupo to Gisborne, with pumice. The final stage caused the most damage. So much magma had been erupted that the now-unsupported roof of the magma reservoir collapsed, inducing the remaining magma to catastrophically erupt. The resulting eruption column, 50km high, soon collapsed, producing the most violent pyroclastic flow yet recorded. This mixture of hot pumice and rock fragments flowed outwards from the vent at speeds of 600-900km/hour, travelling up to 90kms from the vent and annihilating everything in its path. The resulting deposit is called Taupo Ignimbrite. All major valleys in the central North Island were filled with debris, up to 30m thick in places. Pumice from this eruption exists on Mount Tongariro and at Iwikau Village on Mount Ruapehu, 1000m

The ignimbrite cliffs of the Western bays were exposed by the Oruanui eruption, one of the biggest eruptions in the world in the last million years.

Photo Glenn Maclean

above the level of Lake Taupo. The collapsed magma reservoir now forms the north-eastern arm of Lake Taupo including Tapuaeharuru Bay.

Two-thirds of all flora and fauna within Tongariro National Park were wiped out, the only survivors being situated in the lee of the larger volcanoes. The pyroclastic flow rushed through the gap between the volcanoes and the Kaimanawas, clearing forest to Waiouru. The former forests of the Rangipo area have never recovered because of a combination of ongoing volcanic activity and extreme climate. Vast areas of other forests in the central North Island, such as Pureora, were also buried. However, not all life was extinguished during this eruption. A small grove of black beech trees can be found growing above the cliffs at the northern end of Whanganui Bay. The parent trees or seeds must have survived the eruption, as the seeds could not have been blown here (they are too heavy and the grove is very isolated) and birds do not distribute beech seeds.

Imagine what the landscape of the central North Island would have looked like after this eruption. Basically there was no visible life, no vegetation, little water; just 20,000 square kilometres of pumice and rock fragments. The Lake Taupo basin would have resembled a huge meteor crater. The environment for all intents and purposes was sterile. The loose pumice and ash were easily eroded by rains, and were washed into the basin as mud flows (lahars). Streams in the catchments were choked with sediment and the main rivers originating in the central North Island carried huge loads of sediments to the sea. The sites of Napier, Hastings, Hamilton and Wanganui were buried with debris in the years following. As the lake refilled with water the highly mobile waterlogged pumice also filled in the basin, and being levelled by wave action created a relatively flat floored lake bed. Because so much pumice was washed into the basin the lake outlet was blocked and the lake level rose 33m above its present datum. This blockage eventually eroded and the water level dropped to the present-day (precontrol gates) level, exposing remnant beach terraces which are visible around the lake, especially at Mine Bay.

Around 30 years after the Taupo Eruption the most recent eruptive event occurred from this volcano. Lava domes were erupted under the lake, forming the Horomatangi Reefs and the Waitahanui Bank.

Life gradually returned to the district. Tussocks, grasses and plants with light wind-blown seeds would have been the first vegetation cover followed by pioneer forest species such as manuka and kanuka. As deeper soils started to form, the regenerating scrub and forest would have diversified and been able to support increasing numbers of birds and insects migrating in from neighbouring districts. The birds would have helped with the regeneration by dispersing seeds from neighbouring forests.

As vegetation covered the loose sediments, erosion slowly decreased, allowing the waters of the new lake to clear. It is not known whether the native fish species present in the lake when Europeans arrived (koaro, bullies and koura) migrated up from the Waikato River, or were introduced by Maori. Of course in post-European times trout and catfish along with other native (to New Zealand) and introduced species have been introduced to Lake Taupo.

Since this eruption the Taupo Volcano and its many associated features have been in slumber. Erosion continues to shape the lake, but to a lesser degree because of the present vegetation cover. Pumice soils now cover 1.6 million hectares of the central plateau. These nutrient-poor soils require fertilising to maintain good pasture growth. In areas where vegetation and soils are removed, the underlying pumice continues to be highly susceptible to erosion. This is highlighted with the erosion of river banks and cliffs, particularly during major flood events (see *Target Taupo*, issue 40 – Flooding on the Whareroa River). The Tongariro River in the past 1800 years has carried with it eroded pumice, ash and tephra from Taupo eruptions, and debris from the volcanoes of Tongariro National Park to the lake. Greywacke from the Kaimanawa Mountains has also been washed down into the lake. This eroded material has formed the Tongariro delta at the mouth of the river. The Tauranga-Taupo, Waimarino and Waiotaka Rivers, along with the Tongariro River, have all contributed to the flood plains on the south-eastern edge of Lake Taupo.

Today Lake Taupo is peaceful but can also be spectacularly wild. The storms that roll up the lake can produce waves in excess of 2m high that continue to shape its shores.

There is no reason to believe that Taupo will remain dormant. Taupo continues to be regarded as the most frequently active and productive rhyolite volcano in the world. It is important to note that the Taupo Volcano has erupted 26 times over the last 22,000 years, but only two of these eruptions have been catastrophic. Many of the eruptions, such as the event that formed Motutaiko Island, were small in scale (similar to Ruapehu in 1995/96) and could have been safely observed from the lakefront at Taupo or Kuratau. Scientists continually monitor the lake bed and surrounding district using networks of seismometers and lake level recorders (like giant spirit levels). Indicators such as certain types of earthquake, changes in lake level, and changes in land surface can provide warning of impending eruptions.

The passage of geological time is so immense that it is easy for us in our lifetime to presume that the earth has finished building itself, has stopped evolving and is static. This is not the case at all. It is a dynamic living entity that is still reshaping itself; just the short span of our lifetime gives us a very minor chance of witnessing a huge earth shaping event such as an eruption from the Taupo Volcano.

Whakangarongaro te tangata toitu te whenua

Man passes but the land endures

We would like to thank Brad Scott from the Institute of Geological and Nuclear Sciences for his assistance in writing this article.

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(www.laketauponz.com)

Institute of Geological and Nuclear Sciences
(www.gns.cri.nz/earthact/volcanoes/index.html)

Environment Waikato
(www.ew.govt.nz)

GeoNet
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Sexual Segregation in Deer – Some Management Implications

By Cam Speedy

Cam is a wildlife consultant who previously worked for the department

It is well accepted that in nature different species co-exist by exploiting slightly different opportunities within an ecosystem. Interestingly enough, similar principles can hold for males and females within a single species – especially in deer. Just as with "species segregation", "sexual segregation" in deer is based on the differing physical attributes and nutritional requirements of stags and hinds. The success or failure of any deer management regime, whatever its desired outcomes, will often depend on whether managers have considered the differing traits, needs and behaviours of both males and females in a given herd for a given situation and has important implications for managing deer or deer impact.

When I started working in sika country in the early 1980s, I saw many hinds before I saw my first sika stag. Only with autumn did the stags arrive in the area we worked that first summer. It puzzled me; where had these stags suddenly come from and why had they spent the summer elsewhere? Over time I came to learn that as with many species of ungulate (hoofed) animals, the sexes of sika deer live separately for much of the year, especially over the summer growing season. More recently, as I have grappled with the issue of "deer management" in the context of both achieving habitat conservation outcomes and trying to help private landowners achieve their hunting aspirations, it has become very obvious to me that managers must build an understanding of "sexual segregation" into their management actions if these are to successfully manipulate a deer herd in a desired direction.

In most deer species, related hinds live in home ranges that overlap, forming matriarchal societies involving mothers, sisters, daughters, grandmothers, aunties, nieces etc. While the specifics differ from species to species, in sika deer, most hinds live their whole lives on small ancestral ranges of only 100-200ha within or adjoining those of other related females. While the ultimate success of a hind's offspring may be linked to her social status, she herself will breed whenever environmental conditions allow, regardless of where she fits into the social hierarchy.

Stags, on the other hand, disperse widely: up to 18km or more has been recorded for young sika stags in the central North Island of New Zealand. During summer they form bachelor groups comprising generally unrelated males. Within these fraternal groups, a stag must rise in dominance and rank if he is to eventually command "sire" status and breed. Only a relatively small proportion of stags dominate breeding in deer societies. It is a good way of ensuring that the best and strongest animals dominate gene flow to the next generation. This control of gene flow plays an important part in maintaining the genetic health of a wild deer herd. A younger stag can only rise through the ranks by engaging in competition with other stags over a sustained period of time, and if he is able to attain the required experience, strength and endurance, he will eventually join the privileged few to breed. At least that is the way nature intended it!

Because human harvesting regimes tend to focus on male deer, this natural situation is thrown into complete chaos when we get involved. Our stag-dominated deer harvest regimes occur for two reasons:

1. Traditional game management suggests hinds should be protected because "stag only" harvesting is believed (often wrongly) to be the key to improved hunting opportunity in the future.

2. A hunting regime based around the "if it's brown it's down" philosophy will selectively kill far more males because young stags are so vulnerable to harvest as they disperse into new, unfamiliar country between the ages of 12 and 24 months old.

Neither of these harvesting regimes allows for truly functional fraternal groups to develop owing to a shortage of stags. The stags that do get to breed under this type of management regime do so more because they are lucky or cunning, not because they are necessarily the best or strongest sires. In contrast to a more natural situation, mature stags get pretty lonely each summer under most modern New Zealand deer harvest regimes! During the rut there is less competition to breed because there is a disproportionately low number of mature males in the population. This results in poor rutting. When stags are in short supply a hind will breed with whoever she can find, reducing the genetic fitness of the herd. Deer herds which are biologically imbalanced (i.e. have too great a proportion of female deer) increase habitat impact, reduce trophy quality, and compromise sustainability.

All hunters know that stags and hinds differ in size, shape, colour and appearance. But most don't consider that they also differ in growth rate, physiology, biochemistry, metabolic rate, nutritional needs and social roles, and these differences are reflected in their respective seasonal behaviours, dispersal patterns and home range utilisation. In fact, stags and hinds are so different, they could almost be treated as different species, but they are not. They must come together to breed if the herd is to be successful and survive in the longer term. This "coming together" happens in early autumn as stags move back into the home ranges of the breeding hinds after spending the majority of the velvet season elsewhere in the company of other stags. However, it is in the months leading up to this "coming together" that sexual segregation in deer herds is most critical.

In many parts of New Zealand tough winter conditions and limited habitat quality mean wild deer come out of winter in poor condition. Nutritional conditions improve significantly in spring, providing the opportunity to replace energy reserves. This is why the evolution of deer has them give birth at this time. But it makes no sense for these two very different animals, female deer on the one hand and male deer on the other, to be competing for resources at this important time. Hence, deer have developed mechanisms to separate the sexes to reduce competition.

Stags tend to target high quality feed areas during the velvet season in an attempt to increase body weight rapidly and to grow antlers in preparation for mating. They tend to avoid depleted or heavily grazed areas as they must maximise their intake of quality food at this time. The fact that they often utilise open areas where they are vulnerable to harvest or predators suggests that weight gain is even more important than the increased risk of predation.

As stags move on to their summer range in spring, which may be many kilometres from where they rutted and over wintered, they heavily scent mark these areas with a waxy substance that exudes from their pre-orbital glands (that indentation under each eye). Research suggests this scent marking identifies each individual stag, but that it also tends to intimidate breeding female deer. A breeding hind at this time is looking for solitude in a secluded area which has a good variety of food and cover, both as a predator defence to hide herself and her fawn, and to provide the nutrition required for milk production. She will know her breeding range well as she herself is likely to have been born close by, but she does not want to mix with other deer that may attract the attention of predators at this critical time.

So scent marking serves together with differing habitat requirements to help separate the sexes to allow for important sex specific behaviours with quite different functions to proceed during the growing season. As autumn approaches, the fraternal stag groups break up as stags disperse onto the female breeding range to start competing for mating rights. Their summer sparring will have given them an understanding of where they fit in the pecking order when it comes to deciding who they might take on in a dispute over mating rights. Fawns are now much more independent and mobile and less vulnerable to predation. Autumn is the single most social period of the deer's year with males and females of all ages mixing together on the same range.

As discussed earlier, these differing seasonal social interaction/segregation behaviours displayed by stags and hinds are a feature of natural deer herds. They have developed over millions of years, probably in response to various environmental influences such as predation, feed availability and climate. Such behaviours are an important part of the deer lifestyle and as managers of deer or deer impact, we must understand these aspects of deer biology, whatever our value judgement over deer might be, if we are to be successful managers.

For example, if producing mature stags is the objective (as it is for many landowners who have aspirations of running tourist hunting ventures) and the property is not large enough to accommodate the full life cycles of both hinds and stags, stags may leave the property during summer or permanently disperse into neighbouring areas, where they may be vulnerable to uncontrolled harvest. If the neighbouring properties have a different management/harvest regime in place, the property owner will have no control over the number, age, size or condition of the stags that survive, despite the best intentions and/or management practices on their own land. This is often a major stumbling block for New Zealand landowners who wish to develop hunting ventures.

Similarly, if a property owner has too many breeding hinds on their property they may find that the availability of quality feed may become a limiting factor for their stags. If stags are forced to occupy areas of poor quality feed during the growing season as a result of overstocking, they will grow poorly and develop antlers of lower quality compared with stags which have had access to good feed. Habitat depletion/damage is invariably a function of too many breeding hinds (who lead a relatively sedentary life), not too many stags who by comparison have much wider home ranges and hence spread their habitat impact over a much larger area. Too many hinds in a given herd may also force stags off the property during the summer into situations where they may be exposed to uncontrolled harvest.

If minimising deer impact on habitat values is the management objective, reducing the productive (breeding female) component of the herd should be the focus of any harvest effort and the hunting regime target that part of the herd's range utilised by hinds. It makes no sense to focus the hunting effort where stags are spending the summer as there will be few hinds in these areas, and while removing stags may provide the greatest commercial return, it will have little impact on herd density. It may in fact increase the reproductive potential of the herd, making the problem worse in the longer term. For this reason, if official control (as opposed to eradication) operations are to be effective they should focus on female deer, and therefore, that part of the herd's range predominantly occupied by females during the breeding season. Flying around shooting stags and leaving them to rot will do nothing but anger a large and vocal hunting fraternity who target these very same animals in the rut anyway.

Deer management is a controversial issue in New Zealand owing to the fact that deer have both "pest" and "valued resource" qualities, depending on the value judgement of the landowner/manager/and/or the individuals pursuing them. Regardless of one's perspective though, a sound understanding of deer biology, including such aspects as sexual segregation, should form the basis of any management decisions. To lump stags and hinds into the same bucket and manage them as a single unit is to ignore a whole level of complexity within the deer world which helps to make them the fascinating creatures they are.

Fare

Bryan (Buck) Taylor Retires

Staff of the Department from throughout the Tongariro-Taupo Conservancy recently came together to farewell Bryan on the occasion of his retirement. In delivering the traditional farewell speeches, colleagues consistently alluded to Bryan's team spirit, his willingness to tackle any task and his good humour and quick wit. These attributes will be sorely missed.

Bryan commenced work with the Department around 12 years ago after successfully completing a career with the New Zealand Navy. For the bulk of this time until his retirement he was part of the fishery field operations team working across the full range of fishery management projects. However, it is as an enforcement ranger that Bryan will be best known by many anglers who will have encountered him patrolling the rivers and lakes of the fishing district, usually in the company of his yellow labrador, Jas.

During his time with the fishery management team, Bryan made a substantial contribution to the protection of trout stocks and angling values throughout the district and we are sure that anglers will join us in thanking him for that. In retirement, Bryan plans to acquire a camper van and, with his wife Pam, travel the country. We wish them both well for the future.

well

Rob Marshall Departs

Taupo Fishery Area Ecologist Rob Marshall (Bert) left the Fishery team in late October after five years with us to take up a position with Environment Waikato. Rob was responsible for the various fishery monitoring programmes but also contributed extensively to our advocacy and field operations programmes.

Rob, as part of our technical support team, was regularly called on to provide expert advice. Just occasionally his judgement proved to be flawed, particularly when it came to predicting North Harbour's chances at the start of each rugby season. Still, his departure leaves big waders to fill – they were custom-made on size 15 Redbands. However, Rob is not totally lost to the fishery as we will continue to have a lot of contact with him in his new role based in Taupo for the regional council.

We wish Rob and Symonne all the best with the new career and soon-to-arrive twins.

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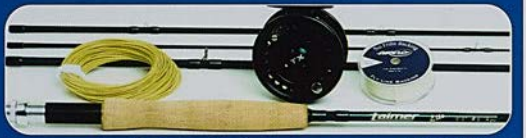

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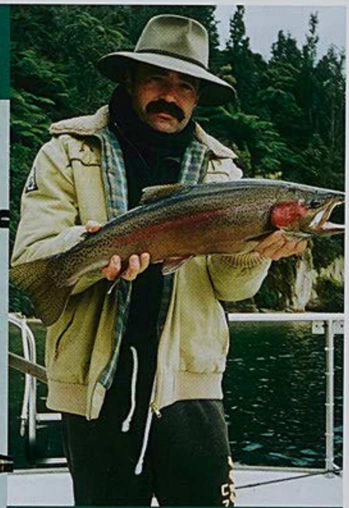

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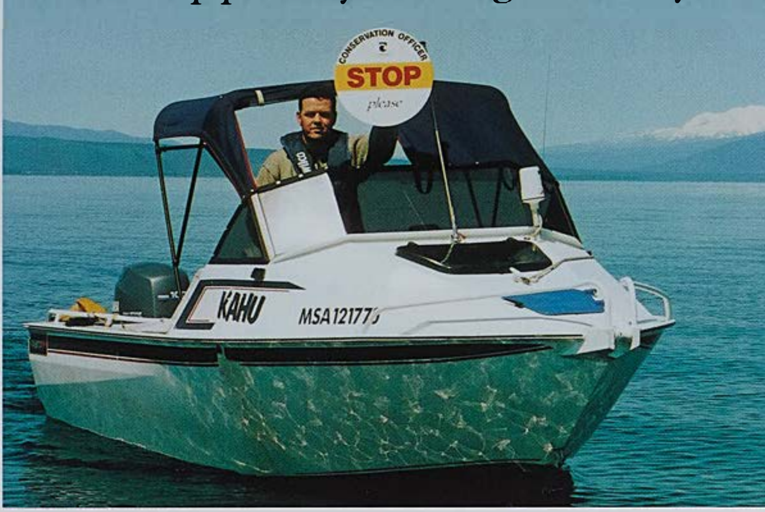


If you see this sign please stop so we can pull alongside.

Photo: Dave Hart

By Dave Hart

Dave is the Taupo Fishery Area Ranger based in Taupo

With the onset of warmer weather signifying the start of the smelting season and angling activity increasing dramatically on the lake, this summer's lake creel survey programme and associated compliance work have begun in earnest for the Taupo Fishery Area staff.

What are "creel surveys" all about? This article seeks to provide a basic understanding of the creel survey programme as a monitoring tool, a few tips on what to do when stopped by our rangers to help the survey process run smoothly, and lastly to reinforce a few relevant fishing regulations.

Creel surveys are used internationally as a fishery management tool, and are one of a number of monitoring programmes we run to provide the information we require to meet the goals of the Taupo Sport Fishery Management Plan. The creel surveys provide an effective way to both gather data on a variety of aspects of the fishery and enable rangers to undertake routine compliance and law enforcement duties in the process. The creel survey programme has been structured to achieve the following objectives:

To establish angler catch rates using statistically robust methodology.

- To identify angler satisfaction with the size and quality of the trout and their angling success and enjoyment, and to identify any concerns they have.
- To obtain data on the size and condition of trout harvested, and to correlate this with angler satisfaction.
- To enforce regulations governing the Taupo fishery.
- To monitor the level of non-compliance.
- To provide an opportunity for communication between fishery staff and anglers.

Staff conduct summer creel surveys on all areas of Lake Taupo and also at lake Otamangakau. Creel surveys are scheduled to cover weekdays, weekends and public holidays, with their timing varied in order to sample angling activity during different periods of the day from early morning through to evening.

One of the most enjoyable aspects of the creel surveys for us is interacting with a wide variety of people out on the water. Reactions to being stopped and surveyed can vary but the vast majority of anglers express their pleasure at seeing rangers out performing compliance work, and in fact the few complaints about being stopped too often are far outweighed by anglers commenting that they are not checked often enough!

For some anglers, being approached and asked to stop by fishery rangers invokes a reaction similar to being pulled over at a police checkpoint - that sudden nervousness or irrational feeling of guilt when you know you've done nothing wrong. No you're not paranoid, this is a common subconscious reaction that most people feel to some extent when being spoken to by an enforcement officer. Anglers who find the process of being stopped and surveyed uncomfortable are reminded that routine compliance checks are made to protect the resource you value, and your participation in the creel survey process is providing valuable data for the future management of the fishery.

The following tips are provided as a guideline to help make the creel survey process run smoothly so that you can get back to the serious business of fishing without undue delay:

- If we wish you to stop your boat we will approach at low speed and hold up a circular metal "STOP" sign.
- If signalled to stop, place your engine in neutral or turn it off. We may instruct you to move clear of the shore or shallow water hazards first before we pull alongside to conduct the survey.
- Wind in your fishing lines and retrieve your downrigger weight if used to prevent them from fouling on the bottom.
- Ensure rods and downrigger arms are kept clear of the gunwales on the side we approach from to prevent any damage as we pull alongside.
- Once we deploy fenders and pull alongside, you can assist by holding the boats steady to prevent any hull-to-hull contact, especially in windy conditions.
- Be prepared to show us your licence and any fish you have caught.
- When responding to the survey questions ensure you give us your own opinion - don't be influenced by others in your group and likewise please don't answer questions for others when they are surveyed.
- Enjoy the experience and remember that our staff are only too happy to answer any questions you may have about the fishery.

During the course of conducting lake creel surveys our rangers occasionally experience the disappointment of finding anglers in breach of regulations. If you haven't done so already, now may be a good time to refresh your knowledge of the regulations by reading those printed on your fishing licence. In the meantime, here are some of the most commonly encountered offences and some suggestions on how to avoid coming to our notice for breaching them!

Failing to produce a current Taupo District fishing licence

This is by far the most common regulatory breach encountered by our rangers. Dealing with anglers who don't carry their licence and the subsequent paperwork take a lot of time for us that could be better spent maintaining and improving your fishery.

In most cases where an angler claims to hold a licence but does not have it with them, they will have their personal details recorded and be required to provide proof of identity, before being given a seven day period in which to produce their licence to the Fishery Area office at Turangi or Taupo. If they fail to do so a prosecution is initiated. In cases where the ranger has cause to suspect the angler does not hold a licence or is in any doubt as to the angler's identity, the angler's fishing equipment will be seized.

Don't have your day on the lake ruined by being unable to prove that you are a licensed angler - carry your licence with you whenever you are fishing. And a final request on the subject: please throw away the pile of out-of-date licences in your fishing vest or tackle box that are invariably proffered to us as you desperately hunt for the current one!

River and stream mouth 300m exclusion zones

Each year our rangers receive numerous complaints about, and encounter, anglers who are trolling or even anchoring to fish well inside the 300m boat exclusion zones. The exclusion zones apply to the mouths of almost every river and stream in the Taupo fishing district, with fly fishing from the shore the only allowed method in a 300m radius of the mouth of the river or stream. The significant exceptions are that trolling is permitted off the Otupoto and Waikino Streams and anglers are permitted to fly fish from a securely anchored boat (but not

White, black and yellow markers indicate the location of stream mouths around which a 300m trolling restriction applies. Such stream mouths are not always obvious from the lake. Photo:Glenn Maclean

troll or jig) at the Tongariro and Tauranga-Taupo River mouths.

The 300m exclusion zones are clearly identified by a tall white pole with black and yellow markings situated close to the mouth of the river or stream. Anglers harling close to shore need to pay particular attention to the location of the 300m limits. A useful way to judge the distance is to imagine three football fields end to end.

Fishing by unlicensed passengers

Fishing licences are not transferable. We occasionally encounter unlicensed passengers, often spouses or children "having a turn" on a licensed angler's rod. If you are heading out on the lake with a group aboard your boat, ensure that everyone who wishes to have a go at fishing has a licence before you leave. Be aware that it is not only the unlicensed angler who is committing an offence; the skipper of the boat is also liable for prosecution by allowing an unlicensed person to fish from their vessel. In short, don't let an unlicensed person touch the fishing gear.

Possession of undersize or excess fish

The taking of fish less than 450mm in overall length occurs more often than most anglers would expect, and incredibly each year at major Taupo fishing contests there are anglers who actually bring in undersized fish to our rangers who staff the weigh-ins! There is no excuse not to have a device for measuring fish on board your boat – be it anything from a custom-made fish-measuring board to a couple of marks spaced 45cm apart somewhere on the boat. Just be sure that your 45cm measure is accurate. Similarly take care measuring the fish; the excuse that an angler thought an undersize fish was long enough because they either didn't measure it or didn't make enough effort to measure it accurately receives little sympathy from our staff. Remember that all fish caught and found to be undersize must be returned immediately to the water, regardless of whether or not they are still alive.

Once you have caught and kept your bag limit of three trout in a day you must cease fishing immediately, and cannot legally start fishing again until 5am the next day. However, if the fishing is good you can extend your fishing opportunities by being selective in the fish you decide to keep. During spring and early summer it is normal that part of your catch will consist of young small fish, or returned kelts that have not yet recovered condition from spawning. While these fish may be of less value to an angler fishing for dinner, they are the very fish that you will be hoping to catch later in the season as prime Taupo rainbows. Ensure these fish are landed and released carefully so as to guarantee their survival.

Finally, while on the topic of regulations and compliance, should you encounter or observe any illegal activity while out fishing please contact us without delay. There is nothing more frustrating for us than to hear about incidents a week after they have occurred. While some information on illegal activity can be investigated at a later date, generally it is of most use to us if passed on immediately. Don't be shy about doing your part to help protect the fishery. A contact number is on your licence, or enter these numbers into your cell-phone memory:

Taupo Fishery Area office (working hours): (07) 386 8607

DOC emergency line (after hours): 0800 DOC HOTline (0800 362 468)

PHOTO: Sporting Life Turangi

2002 Winter
Monitoring Summary

by Rob Hood and Glenn Maclean

Rob is one of the Taupo Fishery Area field staff.

Glenn is the manager of the research and monitoring programme in the area and is editor of Target Taupo

This winter we have once again conducted numerous angler surveys on the local rivers. As well as making the routine licence checks and enforcing regulations, we asked anglers a series of questions which provide a considerable amount of valuable information for management purposes. Since Easter weekend a total of 1968 anglers have been interviewed on the district's rivers, 1377 of whom were fishing the Tongariro River. The number of fish caught and the length of time fished by each angler were recorded and used to calculate the average catch rate (legal-sized fish caught per hour) which can then be compared with historical information. Table 1 presents the results for this winter for the Tongariro, Hinemaiaia, Tauranga-Taupo and Waitahanui Rivers compared with the longterm average.

Table 1. Average catch rate (fish per hour) for the 2002 winter up to and including 30 September compared with the average catch rate recorded for the years since 1984

	Tongariro	Tauranga-Taupo	Hinemaiaia	Waitahanui
No of interviews	1377	283	202	106
2002 catch rate	0.23	0.22	0.27	0.27
Average catch rate	0.24	0.26	*	0.19
Number of years of data	19	12	*	6

* insufficient data

An overall a catch rate of 0.23 fish per hour (one fish every four hours) on the Tongariro River indicates an average season. The winter got off to a slow start as it has done in recent years, with a catch rate of only 0.15 or one fish every 6.6 hours in April. Things improved as the season progressed, with the catch rate increasing to 0.29 (one trout every three hours) in June, but then declined during the prolonged period of low clear flows that followed over July and August (table 2).

Table 2. Monthly average catch rate (fish per hour) for the Tongariro River in 2002

	April	May	June	July	August	September
Catch rate	0.15	0.20	0.29	0.22	0.22	0.28

We are aware that some anglers experienced very good fishing through this period but those starting out or who only get to spend a few days on the river each winter struggled. Then when the rain finally came in late August the major runs occurred in earnest, extending through September and October. This can be seen in the number of fish passing through the Waipa trap (table 3).

Table 3. Actual number of fish trapped in the Waipa Stream each month over the 2002 winter (does not include any adjustment for fish missed during floods

	January	February	March	April	May	June	July	August	September	October
Number	44	31	44	110	146	580	378	493	1232	786

The maiden fish in Lake Taupo are in very good condition this spring. Photo: Glenn Maclean

The September trap run equates to over 40 fish each day. However as usual, and despite our comments in the last issue of *Target Taupo*, most anglers had given fishing away by late August, but those remaining have had some exceptional angling well into October.

Typically the catch rate on the Tauranga-Taupo River fluctuates much more widely than on the Tongariro. For example, it has ranged from 0.14 fish per hour in 1996 to 0.43 fish per hour in 2000. This season's catch rate of 0.22 fish per hour reflects a poor season in terms of angling success, which is likely a reflection of both the numbers of fish present and the reduced angling opportunities as a consequence of the river flowing through the quarry. However, the Hinemaiaia and Waitahanui Rivers have produced well throughout the season and this is reflected in higher than average catch rates.

The trend in catch rates is reflected in our counts of the numbers of spawning trout in different streams. Once a month between June and October a team of divers counts the number of trout present in selected stretches of the Hinemaiaia, Tauranga-Taupo, Waimarino, Waiotaka, and Whitikau Rivers. As is usual during winter, heavy rain at times produced poor river conditions for counting (visibility <3m), which caused us to postpone several counts. Usually conditions quickly return to normal and the counts are rescheduled and completed. However this year frequent rain throughout June and September prevented counts being completed in these months. It is no coincidence that the fishing in the Tongariro River was also much better in these two months than over the rest of the winter. One exception was that a count in the Whitikau River was completed in early September. An unusually low count of only 72 trout was recorded, which highlighted the possibility of a fish passage problem in a gorge, known as the "Grotto", downstream of the surveyed section of river. This problem has occurred in the past (last year the Grotto was found to be blocked with debris, which was successfully cleared, *Target Taupo*, issue 39, pages 64-67) and seemed likely to have occurred again as numbers of trout were present downstream of the gorge.

We investigated and found an apparent blockage which appears to be a natural fall in the bedrock, which is too high and swift for all but the largest and strongest of trout to negotiate. However, this explanation seems unlikely given that previously trout have negotiated the grotto in large numbers. Either the bedrock walls of the chute have altered as a consequence of rock falling off or there is a debris dam under the water. Fortunately the chute subsequently proved to be passable when the flows increased over September and many more fish were counted upstream in early October. When flows drop back to summer levels we will get in and determine what has changed and what can be done to remedy this.

This year's peak counts on all the rivers were slightly less than the average peak count recorded (table 4), another reflection that it was an ordinary season on Taupo rivers.

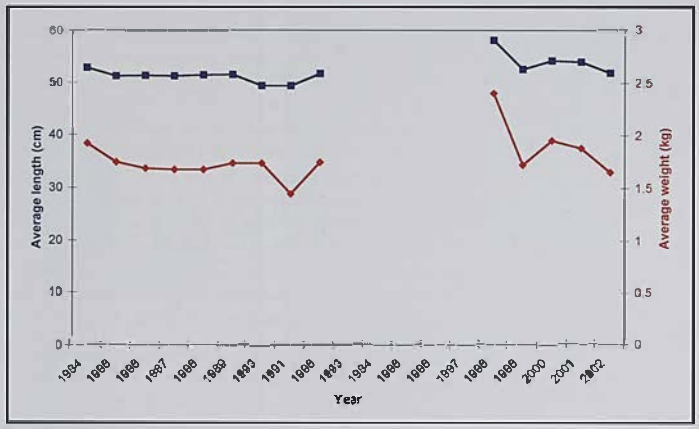
Table 4. 2002 peak spawning count/km (average of two highest counts) compared with average peak spawning count/km for five Taupo tributaries

River	Number of years surveyed	Average peak count/km	2002 peak count/km
Hinemaiaia	13	565	353
Tauranga-Taupo	5	493	398
Waiotaka	9	276	223
Whitikau	12	143	89
Waimarino	10	345	328

By contrast the run through the Waipa Stream, a tributary of the Tongariro, is shaping up to be similar to that of last season (7163 trout), which in turn was only slightly less than the record run in 2000. After nine months operation, 3058 trout have been trapped compared with 3672 fish in the same time last year. While the total trapped is less, only 36% of the rainbow kelts so far recovered as they pass back downstream after spawning have been fin clipped, compared with 77% of the kelts recaptured over the whole of 2001. All fish caught in the trap are clipped and the high proportion of unclipped fish indicates that many more trout migrated upstream when the trap was not operational during a series of small floods early in the season.

The average size of fish trapped up to the end of September is the lowest recorded since trapping began at Waipa in 1998, with rainbow females weighing 1.71kg and males 1.54kg. However, when compared with historical data such as that from the Waihukahuka (hatchery) trap, the size of the fish is consistent with the norm from the fishery over the last 40 or more years. For example, graph 1 compares the average length and weight of fish trapped through the Waihukahuka trap from 1984 to 1992 and the Waipa trap since 1998.

Graph 1. The average length (cm) and weight (kg) of rainbow trout trapped in the Waihukahuka Stream 1984 to 1992 and Waipa trap 1998 to 2002



It is very easy to overlook that the fish size over the last four years and in particular 1998 has been anomalous in terms of the longterm trend in the fishery and there has been quite some comment about how small the fish have been this year. However, as graph 1 indicates they were no smaller than the size anglers have typically associated with the fishery for many years. Clearly it was not as good a year for growth as recent seasons and we suspect the extreme flooding in December 2001 may have contributed to this by impacting on the smelt spawning around the lake edge and in the river estuaries. We expect this to have been a short-term impact and indeed the maiden fish in the lake this spring are in excellent condition and growing rapidly. They also show the classic bright orange flesh we expect of prime Taupo rainbows

Some anglers have commented on the pale colour of some of the fish they have caught in the river despite the fish apparently being in reasonable condition. However, the fish we have seen have invariably been recovering previous spawners which, as we commented on in the last two issues of Target Taupo, struggled to regain condition last summer. A combination of the very late spawning last year and no rain until December to wash the spent kelts back to the lake meant most kelts arrived in the lake too late to take advantage of the spring spawning of the smelt, which was probably also affected by the very rain that finally washed the kelts to the lake. Without this food bonanza these fish were always going to struggle to recover their condition. As a consequence their flesh remains pale even though on the outside they may regain their silver if somewhat slim appearance.

Of interest is that the negative comments regarding fish size and condition were not reflected in the level of angler satisfaction, as only 0.17% of anglers interviewed cited the size and quality of the fish as detracting from their angling enjoyment. The average trout kept by anglers weighed 1.77kg and measured 535mm. The two biggest trout recorded during interviews were rainbow females and were 600mm and 3.60kg and 570mm and 3.50kg respectively. With condition factors of 60 and 68 these were fish any angler would prize.

Early indications are that good fishing can be expected on Lake Taupo this summer. The young fish in the lake are the progeny of the record spawning in 2000 and our monitoring over the following summer recorded the highest densities of juvenile trout rearing in the rivers that we have measured since the programme began in 1996. However, one of the critical influences on how many fish rear to legal size is their survival when they enter the lake in autumn at approximately 18 months old. This is discussed in detail in "The Taupo Fishery - a review of the science" on page 5 and is currently one of the least understood aspects of the life cycle of Taupo trout. We will get an up-to-date estimate of the number of trout when we undertake our annual acoustic measurement of trout numbers in the lake in late November.

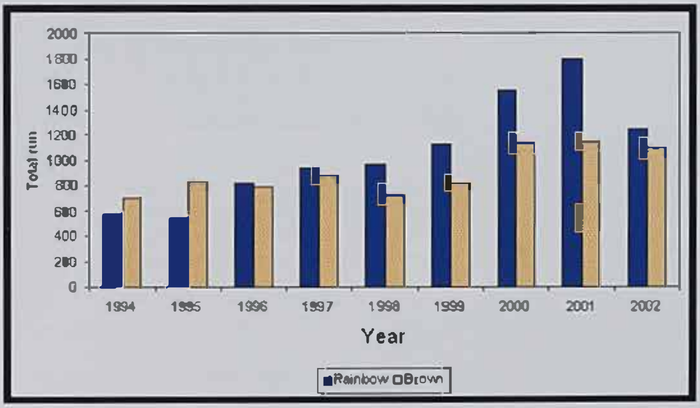
The number of trout fry caught in the Tongariro and Whitikau Rivers this winter is also encouraging. Spring is typically the period of greatest juvenile density and it will be interesting to see if the current highs continue through into December and January. Suffice to say, spawning so far this season appears to have been very successful.

LAKE OTAMANGAKAU

The Te Whaiau Stream trapping season has come to a close with the completion of the ninth consecutive trapping season. In general the season was very successful in terms of both the operation and data collection and in improvements recorded in the trophy potential of the Lake Otamangakau trout population.

Graph 2 presents the adjusted run size (which takes into account fish missed during floods) for the years 1994 to 2002. This year saw the first decline in numbers of rainbow trout passing through the trap since 1995, although the numbers are still high compared with most years. 1242 rainbows and 1097 browns were trapped compared with 1797 rainbows and 1143 browns last year.

Graph 2. Adjusted run in the Te Whaiau trap 1994 to 2002



In contrast the size of the fish in the population has continued to improve. As shown in tables five and six the average weight and length of rainbow and brown trout are the highest since 1996, as are the number and percentage of the population in excess of 4.54kg. These large trout require careful handling to make sure they are unharmed during processing, and seeing and handling them are highlights for the trap operators. It doesn't seem to improve their ability to catch them in the lake though!

Table 5. The average length (mm) and weight (kg) of fish trapped in the Te Whaiau Stream since 1994

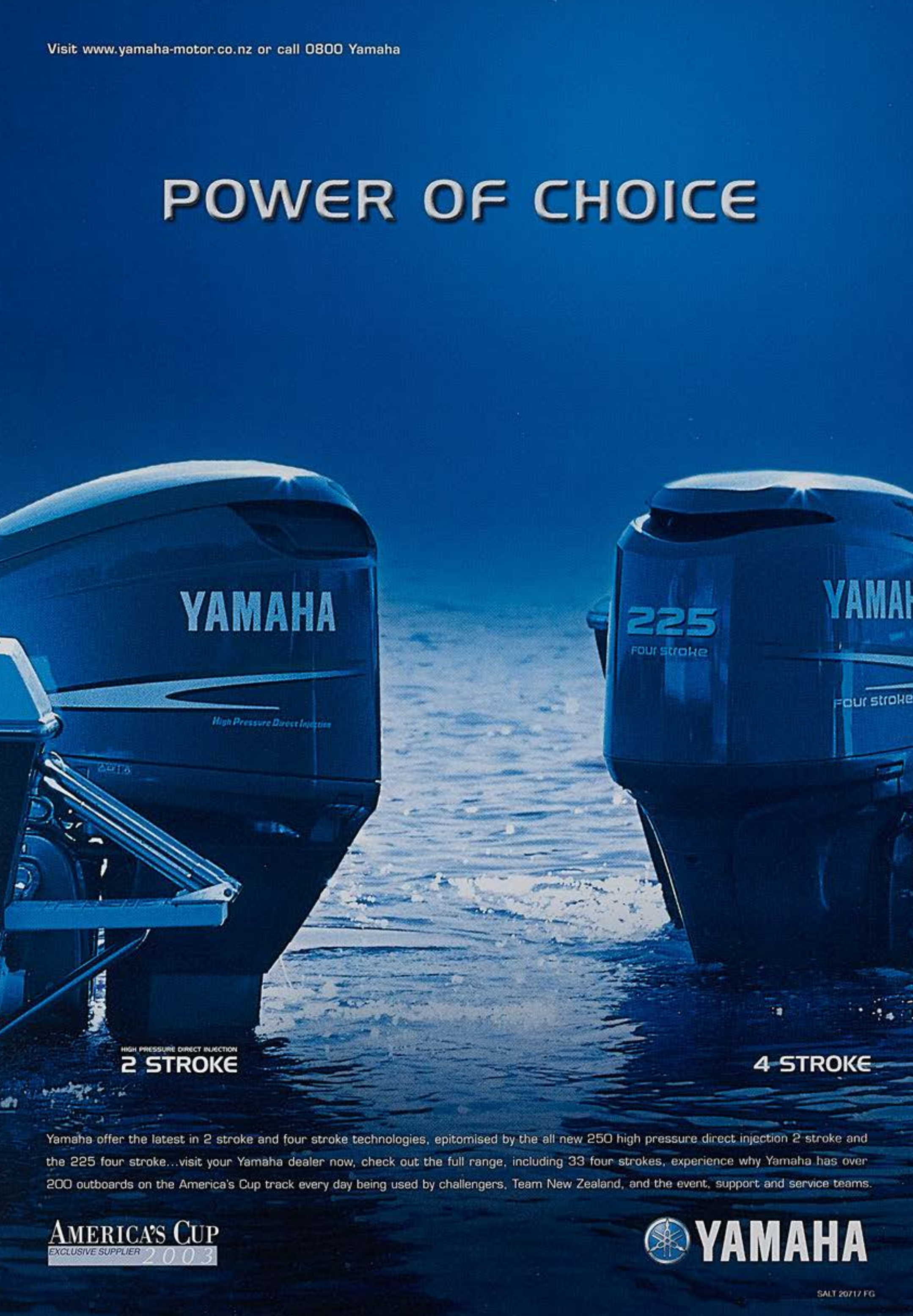
Length (mm)									
Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Rainbow Female	600	615	600	586	586	540	556	590	607
Rainbow Male	593	616	623	600	587	530	567	607	618
Brown Female	572	599	597	570	579	534	530	551	574
Brown Male	599	627	622	611	606	575	571	596	621
Weight (kg)									
Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Rainbow Female	2.82	3.18	3.01	2.6	2.61	2.1	2.18	2.62	2.83
Rainbow Male	2.63	3.05	3.18	2.65	2.51	1.9	2.21	2.69	2.84
Brown Female	2.34	2.85	2.87	2.33	2.47	1.9	1.87	2.12	2.42
Brown Male	2.62	3.08	3.04	2.76	2.76	2.32	2.23	2.52	2.83

Table 6. The number (percentage) of the population trapped in excess of 4.54kg since 1994

	1994	1995	1996	1997	1998	1999	2000	2001	2002
Rainbow	15 (3.8)	36 (8.6)	42 (9.2)	8 (1)	7 (1)	5 (0.6)	1 (0.07)	5 (0.4)	21 (1.9)
Brown	2 (0.4)	9 (1.5)	8 (1.4)	2 (0.2)	2 (0.2)	0 (0)	1 (0.09)	0 (0)	2 (0.2)

The lake Otamangakau fishery appears to be in very good health and anglers can expect an increase in the overall size of the fish in the lake and the number of large fish this summer. If anglers continue to treat this fragile fishery with the care it deserves and practise catch and release carefully, then these fish should continue to flourish. Just remember that these large trout rarely come easy and most are the result of many hours of effort to learn the intricacies of this lake.

Our thanks to those anglers who continue to participate willingly in our surveys and so contribute to the management of the Taupo fishery.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Kaimanawa Forest Park News

KAIMANAWA FOREST PARK HUT MAINTENANCE

As part of our programme of catching up on deferred maintenance of back country huts, Tongariro Taupo Conservancy let a maintenance contract in October for essential work to be completed at Cascade hut.

Bramley Builders from Taupo completed quite a list of tasks necessary to ensure the long-term viability of the hut. These included replacing the floor and the interior wall linings, work on the piles and bearers, fixing leaks and installing new vents in the exterior walls. Yes this hut did suffer from leaky building syndrome!

During the past six months our other Kaimanawa Forest Park huts have also received attention, with new toilets being installed at Boyd and Oamaru and new toilet venting systems at Waipakihi and Cascade. On the list to do this year is a water tank replacement at Boyd.

PRIVATE LAND ADJOINING KAIMANAWA FOREST PARK

Hunters and trampers planning a trip into Kaimanawa Forest Park this summer are reminded to check private land details and gain appropriate permits before they leave.

Free public access is available to Kaimanawa Forest Park, however large areas of private land including East Taupo Lands, Waipahihi and Ohaoko blocks adjoin the forest park. Anyone wanting to use a route that will cross private land must get prior permission from the respective landowner.

In the past many people have mistakenly believed that some form of public right of way existed across private land adjoining Kaimanawa Forest Park. East Taupo Lands in particular have a long history of apparent unrestricted public access whereas people crossing this area were in fact trespassing.

Last year an overseas interest attempted to buy the licence to East Taupo Lands. This resulted in an increase in the licence fee paid by Air Charter Taupo, which presently holds the lease. It is generally agreed that if Air Charter (the lessee) had not retained the lease, the land would almost certainly have been closed to the public.

This has put additional pressure on the lessee to increase revenue generated off the land, which comes mostly from selling exclusive rights to the land to recreational users, mostly hunters. Rather than preventing the public from crossing East Taupo Lands, the lessee has instigated a permit system. Permits cost $30 per person and are valid for 10 days The permit allows people to continue to use the following routes, which cross both public and private land, on the condition that there is no hunting, camping or lighting of fires on the private land:

- Kiko Road to Ngapuketurua to Cascade.
- Cascade to North Arm to Boyd.
- Waipakihi to Ignimbrite Saddle to Ngapuketurua.

Permits to cross East Taupo lands can be obtained from Air Charter Taupo, Lakeland Helicopters and the Turangi and Taupo Visitor Centres.

DOC has updated a large number of Kaimanawa Forest Park maps to show the boundaries of public and private land and has printed a new Kaimanawa Forest Park brochure which gives contact details for access over private land. Signs advising people that they are about to enter private land are situated at all track entrances where tracks through Kaimanawa Forest Park also provide access to East Taupo Lands. The updated Kaimanawa Forest Park maps ($11.00) and brochure ($1.00) are available from DOC, Turangi.

As an alternative to the North Arm – Boyd route through East Taupo Lands, DOC staff have established a new route from Te Waiorupuritia Saddle over Maungaorangi and down into the Oamaru River. The route is due to be marked with orange triangle markers by volunteers from the Taupo Tramping Club in early December.

This alternative will commence from the existing track in the saddle, climb over Maungaorangi (on the Forest Park side) and descend to the Oamaru Valley – ending at the Waitawhero Stream/Oamaru River confluence.

In addition to providing an excellent tramping opportunity across varied terrain, this route will provide hunters with access to some productive hunting areas within the headwaters of the Oamaru River.

WALLABY SIGHTING

Staff are currently following up on an as yet unconfirmed sighting of a wallaby within the headwaters of the Te Waiotupuritia Stream (North Arm) catchment of the Kaimanawas. The sighting was reported by a hunter who allegedly shot at and missed the animal in late October near the northern boundary of Kaimanawa Forest Park and East Taupo Lands.

Wallabies are a serious conservation pest in other parts of the North Island and we are keen to ensure that they don't establish themselves in the Kaimanawas. Hunters are asked to shoot any they see and report all sightings to DOC in Turangi.

Power Scheme Resource Consents

by John Gibbs

John is the Manager of Taupo Fishery Area. He has fished Lake Taupo since the 1950s and his working involvement with the fishery management goes back to 1964

Good progress has been made on two major outstanding resource consent issues with significant implications for the fishery.

Tongariro Power Development

Resolution of the department's Environment Court appeal over the resource consents for this scheme has now been achieved. Most aspects of this scheme had already been settled but the department had lodged an appeal with the Environment Court over the flow regime proposed for the lower Tongariro River. It was considered that this was inadequate in making provision for mitigation of the scheme's effects on the renowned trout fishery.

We have been involved in consultation with Genesis and other stakeholders for over 12 years. A huge amount of effort by both parties has been put into researching the various issues, especially relating to the fishery, and developing desired outcomes and suitable mitigation proposals for the effects of the scheme. Consultation continued with Genesis even while preparation of appeal evidence from the department's expert witnesses proceeded. Eventually the two parties were able to develop an acceptable mitigation package and the department's appeal has been withdrawn.

The solution revolves around the provision of regular flushing flows in the lower Tongariro River to control periphyton (algae) growth which is being stimulated by nutrient input and the more stable flow regime downstream of the Poutu intake. Excessive periphyton changes stream invertebrate communities away from the larger insects like stoneflies and mayflies towards small midge larvae. In turn this affects the feeding and growth energetics of young trout so that fewer of them reach the minimum threshold size (approximately 90mm) required to survive entry to Lake Taupo. The DOC team calculated that a 5mm increase in the length of yearling trout at the time of

Stable flows below Poutu Intake (left) allow the periphyton to grow excessively, (right) affecting the aquatic insects that the juvenile trout rely on for food.

Photos: Glenn Maclean

lake entry would result in a 50% increase in numbers reaching or exceeding the critical minimum size.

The mitigation package involves Genesis monitoring periphyton density and when the agreed trigger level is reached, releasing flushing flows from the Poutu intake during natural freshes to scour periphyton from the river bed. In addition, Genesis is to assist the department in enhancing angling facilities and opportunities on the Tongariro and in research and monitoring the river fishery and its role in the overall Taupo fishery.

As they will only occur during natural freshes, the additional flushing flows over the winter months are also likely to stimulate spawning runs of adult trout into the river and increase activity among fish that have already entered but are lying dormant.

This very satisfactory conclusion is a tribute to both the process and Genesis' and DOC's commitments to consultation, even when it seemed that the differences were intractable. But especially, it was due to the scientific and technical expertise of Taupo Fishery Area technical support staff Glenn Maclean and Michel Dedual and their tenacity and dedication in pursuing a solution, and the professional legal and planning skills of Geoff Hulbert and Greg Carlyon.

The efforts of the whole Fishery team were vital to this project as our understanding of the dynamics of the Tongariro River fishery is dependent on the many years of monitoring trout numbers and production and angling effort and catch. For me it is the culmination of over 35 years involvement in fisheries aspects of TPD.

A wealth of detailed scientific information, including much original research, has been gathered for this case by both parties, much of it relating to the methodologies used for setting environmental and fisheries flows in regulated rivers. Some has already been published in the scientific literature but, in the absence of an airing in court, it would be a shame for it not to be considered in an appropriate forum and contribute to the wider body of knowledge in this field. We are keen to promote opportunities for this to happen.

While DOC and Genesis Power have reached agreement over the lower Tongariro River, the Taupo Fishery Advisory Committee also supports this outcome and has withdrawn its appeal. The Environment Court will still have to address the appeals of other non-fishery parties and the process is expected to be completed in the middle of next year.

Hinemaiaia Power Scheme

Late last year an Environment Waikato hearing granted consents to TrustPower Ltd for their three hydro stations on the Hinemaiaia River. There are a number of appeals lodged with the Environment Court over these consents. DOC has continued discussions with TrustPower Ltd and we are hopeful of reaching agreement with them over flows below the HB (lower) power station and for fish passage over the dam.

Global Warming:
Could it affect the Taupo Fishery?

by Michel Dedual

Michel is the Fishery Area Scientist. Hailing originally from Switzerland, he is also a very enthusiastic angler

Globally, 2001 was the second hottest year on record, just behind 1998. Since 1990 we have seen nine of the 10 hottest years in history.

This coincides with two studies which have confirmed global warming in the Northern Hemisphere. In the first study, Stanford University scientists used records from an annual guessing game held in Alaska. The contest was started in 1917 by engineers building a bridge. When ice halted construction, the idle engineers bided their time by placing bets on when the ice would break up. Now, these years of data have helped climatologists conclude that spring is arriving earlier. Two Spanish scientists have also documented that leaves are unfolding sooner each spring and colouring later each autumn across the Northern Hemisphere. They suggest that the growing season has become nearly 18 days longer during the past two decades in Eurasia and 12 days longer in North America.

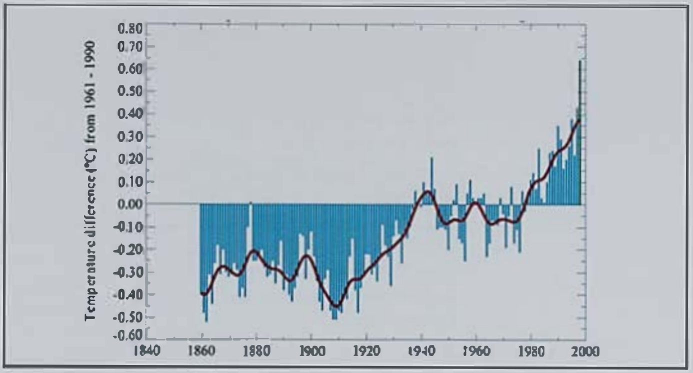
In 2001, the Intergovernmental Panel on Climate Change (IPCC), sponsored by the United Nations, published the most authoritative global-warming report to date. The 3,000-page report contains published and peer-reviewed studies conducted by many of the world's leading climatologists, oceanographers, geographers and other scientists. The IPCC Report projects a warming of between 1.4°C and 5.8°C in global mean surface temperatures by 2100, unless greenhouse gas emissions are cut well below current levels. This warming would be the fastest in more than 10,000 years, with potentially profound disruptions to human life worldwide.

Although natural causes may be playing a role, most experts now believe that heat-trapping pollution from cars, power plants and other sources is the main culprit.

Slips such as this one in the Waimarino, will be more common if rainfall intensity increases.

Photo: Glenn Maclean

Figure 1. Combined global land, air and sea surface temperatures 1860 to August 1998 (relative to 1961-1990 average). Source: The UK Meteorological Office 1997. Climate Change and its Impacts. A Global Perspective



What are greenhouse gases?

Greenhouse gases include carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O).

These gases occur naturally in the atmosphere and keep some of the earth's heat from escaping into space. Without this "green house effect" our planet would be about 60°C cooler and unable to support life as we know it.

By burning fossil fuels such as oil, coal and gas we have been liberating unprecedented amounts of these gases that have been locked away for millions of years in the earth's crust. In doing so we are changing the composition of the atmosphere and accelerating the warming of the earth.

Worldwide the release of CO2 is responsible for 60% of the human-induced greenhouse effect we are witnessing. CO2 lingers in the atmosphere for over a century. Most CO2

emissions come from the transportation and power industries but deforestation also releases large amounts of CO2.

However, in New Zealand the main source of greenhouse gas emissions is animal farming. New Zealand burns less fossil fuel than most of the other countries but the belching and flatulence of the millions of farmed animals produce huge amounts of methane. In 1995 this sector was responsible for slightly more than half (58%) of New Zealand's total green house gas emissions. New Zealand's contribution to global greenhouse gas emissions is small at about 0.5%, but per New Zealander our emissions are exceeded only by Australia, America and Canada.

Impacts of global warming

Over the last century the earth has warmed, with land areas warming more than the oceans and the last two decades being the hottest of all (figure 1).

The average temperature has warmed by 1°C, which is significant since the globe has only warmed 5°C to 9°C since the last ice age. Scientists project that the earth will warm a further 3.3°C to 6.7°C in the next century if greenhouse gas emissions are not reduced.

As the climate warms, model calculations show that evaporation will be enhanced and thus there will be an increase in global mean precipitation (rain and snow) and an increase in the frequency of intense rainfall. However, not all regions will experience an increase in rain and seasonal shifts in precipitation are also projected. In general, precipitation is projected to increase at high latitudes in winter but the arid and semi-arid areas in Southern and Northern Africa, Southern Europe, the Middle East, parts of Latin America and Australia are expected to become drier over summer.

Associated with changes in temperature, sea level is projected to increase by between 15cm and 95cm by 2100 (IPCC), caused primarily by thermal expansion of the oceans and the melting of glaciers.

Global warming is likely to interact with natural climate variability on time-scales of days to decades (e.g., the El Nino-Southern Oscillation (ENSO) phenomenon). Recent trends in the increased frequency and magnitude of ENSO events, which lead to severe floods and droughts, are projected to contin ue in many climate models. These stresses add to existing stresses on resources caused by other influences such as population growth, land-use changes, and pollution.

Impact of global warming in New Zealand

The region's climatic trends are consistent with those of other parts of the world, although experts from the National Institute of Water and Atmospheric Research (NIWA) speak about the climate change in New Zealand as a "regional warming" rather than a global warming.

Sea surface temperature, surface air temperature and night marine air temperature have risen by up to 0.7°C between 1900 and 1990 according to Dr Jim Salinger from NIWA. Night- time temperatures have risen faster than daytime temperatures and the past decade has seen the highest mean annual temperatures ever recorded. However, some weather experts in New Zealand argue that the warming observed is part of a natural climatic cycle rather than induced by human activities.

The longterm weather forecast for New Zealand in the 21st century is that the temperature will increase further; westerlies are likely to increase because the climate may become more El-Niño-like, and the rainfall may become more variable. The meteorological data collected for 40 years in Taupo by Walter de Bont confirm that 2002 is certainly the windiest year of the last decade.

Dr Salinger's work indicates that the strongest warming in the North Island occurred after 1950 and that on a seasonal basis most warming occurs in summer and the least in autumn. Rainfall is projected to increase in the west of the country and decrease in many eastern regions. Under the projected reductions in average rainfall in eastern areas and higher temperatures, dry periods will increase in some regions. Climate models suggest that at the same time, extremely heavy rain-fall events could become more frequent in many areas, increasing the risk of flooding and erosion. Other climatologists expect changes in climate extremes with, on average, fewer frost days during winter and more hot days during summer.

The projected climate changes likely to have the greatest impact on parts of New Zealand are changes in rainfall. Owing to the projected reduced rainfall and increased evaporation, droughts in the east of both main islands are likely to become more frequent. However, some major eastern rivers whose catchments reach back into the Southern Alps or the central North Island high country could maintain or even increase their flows, because of projected rainfall increases in these central areas.

Unusual climatic events, such as snow in Turangi (July 1995), are predicted to occur more often under a global warming scenario.
Photos: Glenn Maclean

By definition, a 100-year flood is really extreme and rare. Historical records indicate that the number of these extreme flooding events occurred disproportionately in the last decades of the 20th century. Existing flood protection works may no longer be adequate and spring flood damage could be more severe and frequent in the future.

Impacts of climate change on the Taupo fishery

The flow in most Taupo streams is dominated by winter rainfall. Streams which are already affected by winter and spring flooding could become even more susceptible to winter flooding.

The exact impacts of flooding on trout are equivocal. Our juvenile trout monitoring has shown that on some occasions floods don't appear to affect the abundance of juvenile trout but on other occasions they may have a major impact. The suddenness of the flood (how quickly it rises) may be more detrimental than the amplitude and may change with a change in rainfall patterns Similarly increases in flood intensity may affect spawning success by displacing the river bottom and destroying the incubating trout eggs.

On the other hand, the susceptibility of eastern streams to drier summers would mean lower flows in summer Low flows restrict the habitat for rearing juvenile trout and increased water temperatures will affect their growth.

By studying the correlation between increased stream temperatures associated with a doubling of CO_2 in the atmosphere and the temperature thresholds of popular angling species such as trout and salmon, it is possible to make projections about how habitats for such species is likely to change Taupo trout spend parts of their lives in both the streams and the lake, and the effects of warming on both these environments need to be considered.

Impacts of changes in stream water temperature

Streams and rivers are relatively shallow, turbulent, and well mixed systems, meaning they exchange heat and oxygen easily with the atmosphere. Therefore an increase in air temperature due to global warming will translate directly into warmer water temperatures for most streams and rivers, thereby altering fundamental ecological processes and species distribution.

The life processes of many aquatic organisms are dependent on water temperature. Warmer water can increase growth rates, stimulate ecosystem production, affect spawning success and migration, or affect species distribution. For example, aquatic invertebrates at the base of the food web (e.g. aquatic insects) may mature more rapidly, albeit to a smaller size, and reproduce more frequently Assuming no change in food resources, invertebrate production of streams and rivers may therefore increase, potentially yielding more food for fish. However, higher water temperatures will also increase the population of microbes and thus the rate of decomposition of organic material, which may result in less food being available for invertebrates and ultimately fish.

More frequent and intense floods could impact on the trout fishery. Photo: DOC Turangi

High water temperature during egg incubation can be a source of egg mortality, but can also stimulate fish growth providing it is below the temperature at which fish stop feeding. Brown trout stop feeding (i.e. stop growing) at temperatures higher than 21°C but rainbow trout continue to feed at temperatures several degrees higher. Therefore, brown trout will be affected by an increase in water temperature brown trout will be affected before rainbow trout.

Trout are coldwater species that thrive in streams with temperatures of 10°C to 18°C. In many areas, the fish are already living at the upper end of their thermal range, meaning even modest warming could render streams uninhabitable. Projected increases in water temperature vary by location, but average increases of 0.4°C to 0.8°C by 2030, 0.7°C to 1.8°C by 2060, and 1.2°C to 2.7°C by 2090 are predicted for the United States, depending on future emissions of heat-trapping gases and which climate model is used.

According to the US Environmental Protection Agency, if warming trends continue 24 states of the continental US could experience a loss of between 50% to 100% of the coldwater fish such as trout, salmon and bass in north-eastern streams, and up to 50% of such fish in the west, over the next century.

Even small changes in water temperature can have a substantial impact on fish distribution. For example, in North America a warming of water temperatures by 4°C would represent a northward latitudinal shift in thermal regimes of about 700km, which would have serious consequences for aquatic ecosystems.

On the other hand warming of water may be beneficial in streams that are currently too cold to hold trout, although we don't expect to see such an effect of global warming in New Zealand and in Taupo in particular, because there are no such streams. Rising temperatures could curtail the range of trout and salmon in New Zealand, causing the northern limit of trout distribution in the North Island to shift southward. However, the actual average water temperature of all the important trout streams in Taupo is well below 21°C. Even with a projected increase of several degrees, celsius it is unlikely that the water will become too warm for the fish to stop growing. In fact we could expect to see accelerated growth of juvenile trout in streams, which would be beneficial.

High water temperatures can also create thermal barriers for migration of adult salmonids. Again we believe that this shouldn't be a problem in Taupo because of the low natural water temperature.

For many of us, coldwater fisheries are one of the things that make life worth living. However, river environments may become less hospitable because of mosquito-borne tropical diseases, such as malaria, dengue fever and encephalitis, spreading southwards. Regardless of location, the disappearance of cold water fish will come at a significant cost to jobs, recreation and regional culture.

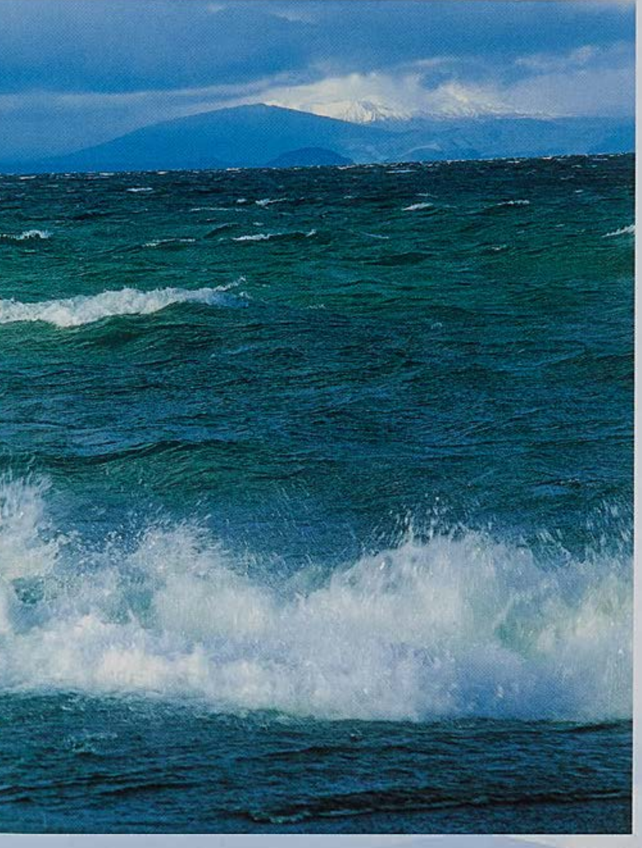
Impacts of changes in seasonal flow regimes

Global warming will produce not only an increase in water temperature but also a change in flow regimes. Lower flows over summer and increased incidence of floods during winter are expected. Both these changes are of concern because they have more potential than the increase in water temperature to affect trout fisheries around Taupo.

The seasonal pattern of precipitation falling on a catchment is translated into surface run-off that feeds into streams and rivers. The extremes of run-off (floods) are critical events that influence species composition and the productivity of aquatic communities. Streams in Taupo have flow regimes characterised by a predictable period of high flow from June to November and low flows from February to April. One major worry about global warming is an increase in flood frequencies and in the suddenness of each event.

Another significant change will be a shift from snow to rain in high-elevation catchments, increasing winter flood peaks and reducing stream flow in late summer. This is expected even if winter precipitation increases in southern latitudes as projected, because excess precipitation will not be stored as snow, which provides a source of run-off to sustain late summer base flow. Lower summer base flows translate into less instream habitat for invertebrates and fish. Further, less water in the stream channel means less water flowing into stream-side groundwater tables, which are important for sustaining riparian tree communities. These ecosystems are likely to experience very significant changes in species, composition and productivity.

Once surface temperatures fall over winter the wind can once again mix the lake. Photo: Glenn Maclean



Lakes

Lakes are very vulnerable to climate change. Historical records indicate that during previous periods of climate change, the distribution of lakes changed dramatically as the balance between precipitation, evapotranspiration and run-off shifted. Many of the physical and chemical features of lake ecosystems depend on the depth of the lake, the amount of heat it absorbs from and releases to the atmosphere, the supply of nutrients and the retention time of water in the lake. Together, these factors determine the thermal characteristics and dissolved oxygen availability in the lake, which influence habitat suitability and the lake's seasonal productivity.

Predicting the consequences of climate change for any particular lake is dependent on an understanding of how species, composition in that lake will change. Studies on Lake Michigan in the US show that an increase in lake water temperatures and a longer warm period in summer months reduce the amount of spring and autumn mixing that helps bring cold, nutrient-rich water from the lake bottom toward the surface and contributes to blooms of phytoplankton, an important food source for zooplankton and fish upon which the trout prey.

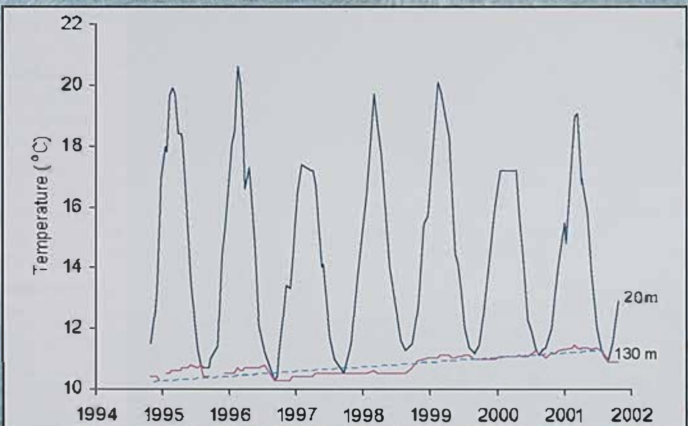
According to Max Gibbs and his colleagues from NIWA in Hamilton, there has been an increase in bottom water temperature in Lake Taupo during the period 1994 to 2001 which has seen the deep parts of the lake warm from 10.6°C to 11.3°C (graph 2). Lake water temperature monitoring over the next one to three years will indicate whether this increase is part of an ongoing stepwise trend (e.g. associated with climate change) or is part of a natural cycle (in which case temperature should subsequently decrease).

A change of 0.7°C doesn't seem to be a large change in water temperature, but Lake Taupo is a very large body of water (60 cubic kilomwetres) and to warm it up even slightly requires a tremendous amount of heat. Max Gibbs believes that the increase in lake temperature is more the result of a lack of cooling than an increase in heat. His argument is based on the fact that in Taupo the regional warming is mainly due to warmer nights. Previously Lake Taupo had a mixing season starting in June and lasting until September. Now the mixing process doesn't start before August but still finishes in September. However, in the long term as the temperature of the bottom waters (hypolimnion) increases, less cooling may be required to reach conditions where mixing can occur.

According to the NIWA report, anything that acts to enhance the stratification and reduce the duration or frequency of mixing of the bottom surface waters will have adverse effects on the lake. The exact impacts of these changes are difficult to predict but they have the potential to affect the entire food chain from phytoplankton to zooplankton, smelt and trout. The phytoplankton and zooplankton communities may change in the species present and in abundance. These changes can in turn affect smelt in either a beneficial or detrimental manner.

As Lake Taupo warms up in the spring and summer, it develops a less dense upper layer and a cool, denser lower layer of water. The upper-layer has high oxygen levels even into late summer, because winds mix the waters to expose them to the air. Because of high light levels, the surface waters are very productive. In contrast, the bottom layer is colder and does not mix with the atmosphere. Dead organic material (phytoplankton, zooplankton, etc) from the productive surface waters falls into these deep waters, where bacteria and other bottom-dwelling organisms consume it, the process depleting the oxygen in the lower depths. Normally the lake mixes each winter and the oxygen is replenished in the bottom waters, but if the depletion of oxygen continues for a prolonged period without mixing, these deep waters may become marginal habitats for many invertebrates and fish. The net result could be to squeeze smelt and trout into

Figure 2. Water temperature at 20m (dark blue line) and 130m (pink line) depths. Winter mixing [illegible]rred where the tw[illegible]eet. The data show [illegible]ck of mixing in winter 1998 and indicate only partial mixing occurred in winter 1999. Data collected by NIWA for Environment Waikato



The winter of 2001 was unusually dry which was reflected by low lake levels

Photo: Glenn Maclean

the top layer of water. In such situations trout density would increase close to the surface and make the fish more susceptible to being caught. This may seem like a bonanza for anglers in the short term, but it may also severely reduce the total productivity of the lake.

In large, deep lakes like Taupo, suitable thermal habitats are expected to increase for almost all fish. These are not only fish which thrive in warmer waters like catfish, goldfish, sailfin mollies and guppies, but also cold water species such as trout, which could also take advantage from a slight warming of deep, cold waters as long as they retained sufficient oxygen. In smaller and shallower lakes like lake Otamangakau, by contrast, the entire lake volume is likely to warm significantly, and trout requiring cold water will suffer from a reduction in habitat. Oxygen concentrations will decline in these warmed waters, further degrading habitat during the stressful summer months. Warming of lakes can also increase the potential for production of nuisance algae like bluegreen algae that are toxic to animals and humans.

Is there anything that we can do?

The IPCC report makes it clear that the goal of stopping global warming can only be achieved by reducing greenhouse gases, especially CO_2, well below current levels. Although the research is discouraging and often frightening, many scientists agree that meaningful reductions in CO_2 emissions could restore the world's climate in time to prevent most of the worst effects.

During the energy crisis in the 1970s, we saw incredible adaptations in the way people used and even produced energy. Those adaptations were lost when the crisis ended, but they don't have to be lost permanently.

As we're contributing to global warming, we can also contribute to its solution. In the long run, we will do so by moving away from carbon-rich fuels like wood, coal and oil and toward natural gas and, ultimately, hydrogen. That is already a long-term trend: in 1860 when people relied on wood for most of their energy, three times as much CO_2 produced for every unit of energy as is produced per energy unit today.

Hydro power may seem like a tempting alternative since it doesn't directly emit greenhouse gases. However, according to the World Commission on Dams, the reservoirs created by dams often trap and concentrate decaying organic matter, which in turn can release large amounts of methane and CO_2.

Want something sooner? That was the intent of the Kyoto Protocol early in 1998, when delegates from most of the world's countries agreed that by 2012 their countries would, on average, cut their greenhouse gas emissions to 95% of their 1990 levels. However, early in 2001, the Bush administration announced that the US would not be bound by the protocol.

Climate change is everybody's business. We all need to take responsibility for contributing to the problem and make an effort to both reduce greenhouse gas emissions and adapt to inevitable changes.

The author wishes to thank Dr Salinger and Max Gibbs from NIWA and Mr Walter de Bont from Taupo.

Free Summer Lake Angling Seminars

Once again this summer we will be presenting two free seminars designed to increase the success of beginning or visiting anglers fishing Lake Taupo.

The seminars are conducted as part of the DOC Summer Programme and are held during the Christmas holiday period when visitor numbers are at a peak. Each year the seminars have proved to be very popular with anglers keen to learn more about the fishery and improve their chances of catching trout.

Topics covered include the life cycle of Taupo trout, how seasonal changes affect where and when fish can be found, various angling methods and rigs, successful use of echo-sounders, catch and release techniques and some key angling and boating regulations. Fishery staff are also available to answer anglers' questions about fishing and the trout fishery.

The seminars last for approximately two hours and are held outdoors, so bring along a deckchair, and don't forget the essential hat, sunscreen and drink. There is no charge to attend and bookings are not required, just bring along your angling friends and we'll see you there!

The location and dates for the seminars are:

Motutere Bay Holiday Park boat ramp	Sunday, 29 December	10am - 12pm
Three Mile Bay boat ramp, Taupo	Saturday 4 January	10am - 12pm

The Motutere Bay seminar will be held rain or shine but the Taupo seminar may be postponed until the following day if conditions dictate. Cancellation or postponement details will be broadcast on local radio stations between 7.15am and 8am on 4 January (and 5 January if necessary) or ring 025 604 7301 for the most up-to-date information.

Hear Fishery Manager John Gibbs pass on some tips about how to be successful on Lake Taupo at this summer's angling seminars.

Photo: Glenn Maclean

Visitor Centre Displays Well Advanced

The display layout and several of Peter's display concepts

The auditorium in the Visitor Centre has been completed with the installation of "state of the art" audio-visual equipment. Its first public use was the screening of the Tongariro National Trout Centre Society's new 15-minute promotional video recently completed by Marabou Films to a visiting school group. This video highlights the work and goals of the society and DOC. It provides an overview of the Taupo fishery and particularly the Tongariro River. It is suitable for all ages and, whilst educational, has some fabulous and exciting footage. Over time, further video presentations will be compiled for the exclusive use of the Society.

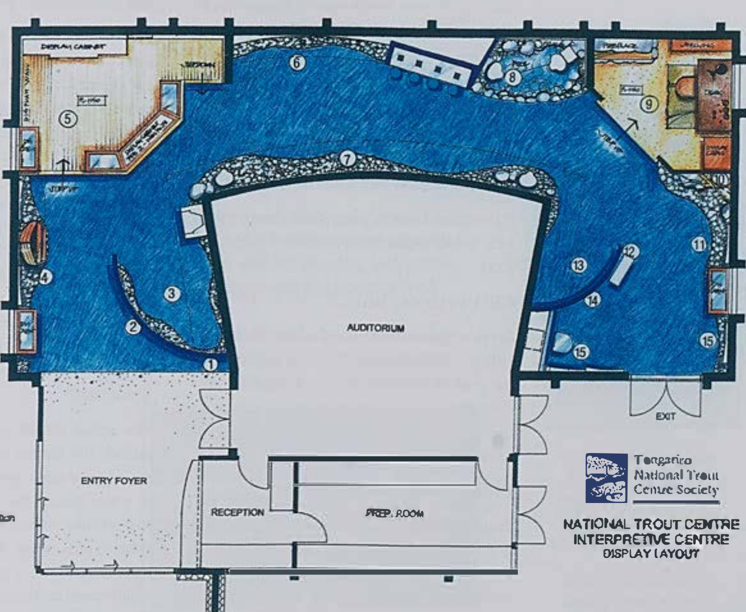
In the Visitor Centre carpet has been laid throughout. Much work and healthy debate have also gone into the many interpretive displays. We are fortunate to have the services of Peter Langford Design to assist us. Final drawings and costings were "signed-off" by the executive in mid September. The set construction for the displays and electrical work will be completed by 31 October. Then the real fun will begin as the scenic painting is completed before each of the 15 display components are brought together.

Whilst not yet in a position to completely fund this display stage, which has been costed at $236,000, we are heartened by the tremendous financial support being received from so many sources. We continue our prudent policy of only committing to work as funds allow. Naturally, fundraising continues to have a high priority, but much other work is being done to further the objectives and vision of the society.

Children's Fishing Days from the centre's pond continue to attract large numbers, with 182 participants on 22 September.

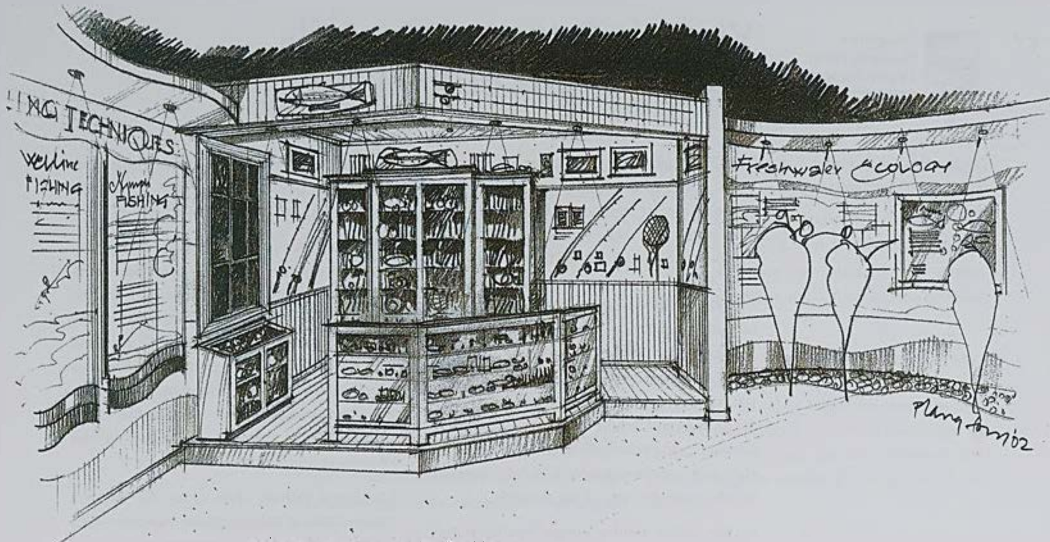
www.troutcentre.org.nz

Have you visited our new website? Development continues and, whilst we have a long way to go, you can at this time see what we are trying to achieve. Early in the new year we hope to have this fully operational.



DISPLAY LEGEND

1. Profile of TNTC Society
2. A description of the Taupo fishery
3. Lifecycle of a Taupo Trout
4. Angling Techniques
5. Angling Museum
6. Freshwater ecology
7. History of angling
8. General management techniques
   • electric fishing machine demonstration
9. Fly-tying
10. Maintaining fish passage
11. Drift diving
12. Acoustic Survey
13. Apprehending poachers
14. Fishery research
15. Current issues and information



Sketch looking toward Angling Museum

Membership winner

The winners of the draw for the $200 voucher kindly donated by Sporting Life, of the Mall, Turangi are Frank and Carol Harwood of Fly Fishing Adventures, Turangi. Congratulations and a special thank you to Sporting Life.

In general, it has been somewhat slow but steady progress with this major addition to the facilities at the Trout Centre complex. As a member, benefactor, major donor or supporter of the society, you can be justly proud of all the achievements so far.

If you would like to join please forward your $25 subscription to PO Box 73, Turangi 2751.

CEO retires, but ...

Gordon Stevenson, our present Executive Officer, ceases his short-term engagement at the end of October. We are delighted, however, that he has agreed to fill a vacancy on the executive and will continue to pursue his interest with the society.

Please be seated!

Trout Unlimited New Zealand has generously donated three very fine tables and seating for use outside the Visitor Centre. Once paving and landscaping are completed this solid and attractive furniture will provide just the place to enjoy a rest, a quiet snack or lunch, and a spot to listen to the birds and the sounds of the centre – we are most grateful for this gift.

Display concepts explained

Designed by Peter Langford, the new displays currently being constructed in the visitor centre will give visitors the opportunity to view a wide range of trout- and fishing-related display subjects that represent the many facets of the Taupo fishery, its management and its ecology. Peter has worked on similar projects before, but as a keen angler himself this project is of special interest to him because of his love of fishing and the Taupo and Central Plateau areas. As a colleague said to Peter recently during an early morning fish before a site meeting: There are not many jobs where you actually get to do first what your meeting is going to be about later".

The actual display subjects are varied and include the history of the Taupo fishery; the life cycle of trout; antique fishing memorabilia; water quality; the protection of the rivers and streams; what DOC does to manage the fishery; plus other themes in a layout that takes visitors on a journey of learning and enlightenment. Also peppered throughout the

Sketch looking toward FlyTiers Hut

display will be enough trophy fish to excite and enthral beginners and experts alike.

"We wanted to theme the display environment in a way that acknowledges the natural beauty of the district and especially the powerful presence of the Tongariro River flowing past the Trout Centre itself. To achieve this we have created a flow path through the displays that winds and curves like the river, and have included borders of river stones and a colour scheme to add to the effect. The feeling created is one of strolling along the river with each area being a new discovery in itself".

Car Park Security

by Bob Hood

Most anglers are aware that angler car parks and boat ramps are a common target for thieves, and while DOC takes measures to help minimise problems, such as trimming vegetation to allow increased visibility of the car park from passing traffic, ultimately people are accountable for their own security. With the summer approaching, it is timely to remind visitors and anglers of measures to minimise the chance of having their vehicle broken into or worse, stolen. While it is impossible to totally eliminate the risk, and some of the preventative measures may seem obvious, it is surprising how often these are ignored.

Ideally valuables should not be left in vehicles, but if they are these items should at least be placed out of sight. We regularly see valuables such as cameras and purses, cellphones and fishing rods left in plain view, which is simply tempting thieves. We also regularly hear the classic statements "she'll be right" or "I'll only be half an hour". It takes a skilled thief only seconds to break into and steal valuables from a vehicle.

Vehicles must be locked! While this sounds obvious, I don't mind confessing that I once left the keys in the boot lock in the rush to get to the river and begin fishing. It was fortunate that my error was discovered by a person who knew I owned the vehicle and so prevented a certain amount of grief. However as it was my wife I wouldn't say the incident didn't cost me! Staff occasionally come across vehicles left unlocked or notice the keys 'hidden' under a tyre.

Vehicle alarm systems may deter some thieves as they may choose to move on to easier targets. However, good quality engine immobilisers prevent all but the most skilled vehicle thieves. Similarly, parking in plain view of others is also a deterrent. Avoid parking on the side of State Highway 1. Many thieves are simply opportunists who stop off for five minutes while travelling between Auckland and Wellington.

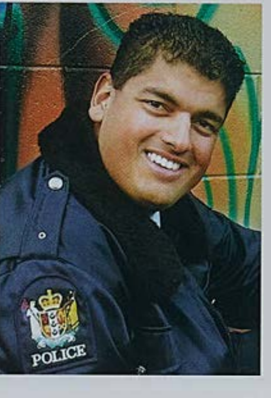
Another option soon to be available is the development of a commercially-run secure parking facility (with surveillance cameras and restricted access) at a local boat ramp.

Overall people simply need to remain vigilant and report any suspicious activity or individuals observed to the Police. While it is easy to be wise in hindsight, if a visitor to the Tongariro National Trout Centre had trusted his instincts several months ago, a very unfortunate incident might have had a better outcome. Whilst walking back to the car park with the visitor, the on-duty ranger was asked how often cars were broken into there. After replying that there hadn't been a break-in for many months and asked why the visitor wanted to know, the ranger was told that the visitor had noticed some suspicious individuals hanging around the car park. Sure enough, when they got back to the car park, they found the only two vehicles there had been broken into, with damage done, totalling several thousand dollars. Both owners were families starting their holidays and lost significant personal effects. The visitor the ranger had talked to initially lost medication and almost $1,000 that was "hidden" in an envelope in the glove box. The break-in forced him to return home and cancel his holiday.

Issues over car security are an unfortunate fact of life wherever one leaves a vehicle unattended in the North Island. It is not a reason not to indulge in your favoured pastime, just to take a little bit of care to minimise the risk.

New Zealand
POLICE
Nga Pirihimana O Aotearoa

Introducing...



Hi – I'm Sunny Peeters and I would like to take this opportunity to introduce myself and fill you in on some recent trends and tips relating to crime. In particular to theft of and from your cars while they are left unattended.

I am the Turangi Police community constable and recently I have been working together with DOC and local iwi to reduce the chances of visitors to our area becoming victims of theft so that you can enjoy the rivers, lakes and bush walks in this area.

We encourage visitors to use the many available and diverse activities on offer. It is not our intention to scare you off. But while you are here we offer the following tips so you can do your part to reduce offending and becoming a victim.

Do lock up and secure your vehicle.

Do leave your vehicle in plain view of others where possible.

Do record and report any suspicious vehicles or persons.

Do set your alarm (if installed).

Don't leave anything of value in your vehicle or keep it out of view from the outside.

If your vehicle is interfered with or property taken make sure that you report it to the nearest Police station as soon as you can or over the phone. Unreported incidents only help the offender.

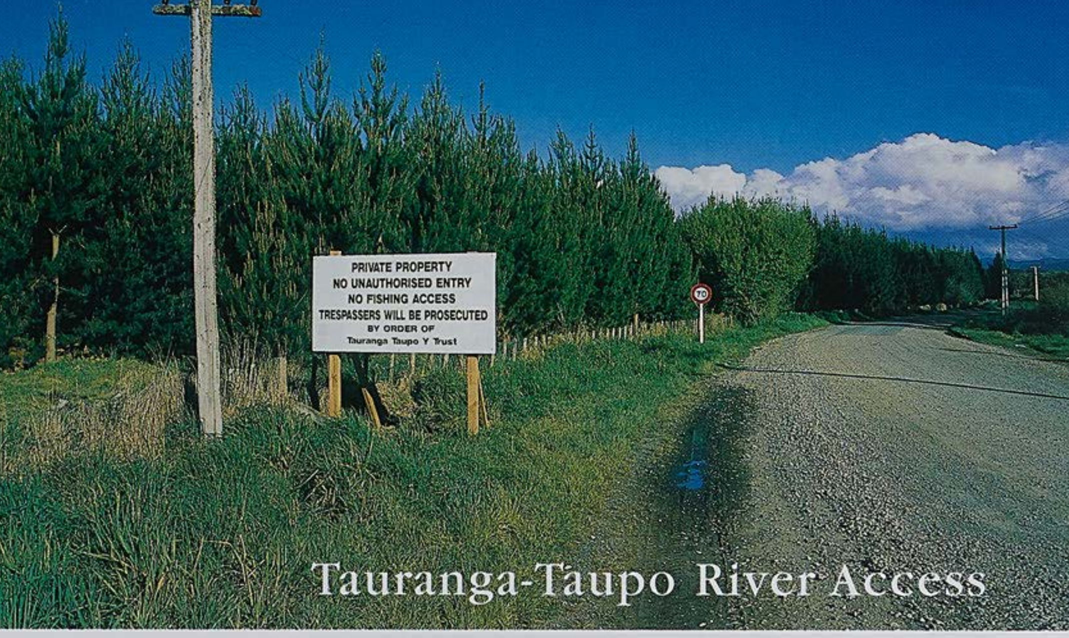
I am working with DOC and other agencies to improve visibility around car parks through vegetation control and our future plans run to random patrols through car parks at high risk times to further discourage offenders. However, these measures are limited and we need a concerted effort from everyone using the car parks around the area to remain vigilant and pay attention to their own security and that of others.

This area has much to offer and I hope that with your co-operation we can ensure that you come and enjoy, then leave and return to do it all over again with no hassle.

I would welcome any feedback and input and can be contacted by emailing bcpeeters@xtra.co.nz (this is only for feedback and not to be used to report incidents or suspicious activity).

I look forward to hearing from you.

Sunny Peeters



Tauranga-Taupo River Access

Photo: Glenn Maclean

Many anglers were concerned when a sign went up alongside Hingapo Road in early October stating, among other things, 'No Fishing Access' (pictured above). While correct, the sign is confusing in that many people have mistakenly taken it to mean there is no longer any fishing access to the river at all.

Hingapo Road is a private road off State Highway One at Te Rangiita which gives access to Lake Taupo Forest and the old Tauranga-Taupo quarry. It has been used by anglers to drive to fishing spots along the Tauranga-Taupo River and many have come to regard it as a public road. - or at least with some right of public use it seems.

The fact is, this has never been the case and the landowners have always objected to people driving all over their land, pushing tracks to the river, cutting fences, blocking roads and obstructing their contractor's operations.

Years back, when policing unauthorised entries became impractical, the owners sought to compromise and manage access. Permitted access was allowed across the farm from Kiko Road and later, after the quarry was fenced, along a track off Hingapo Road on the outside of the fence.

The system was fraught with problems: permits were of limited use, some ignored them and made their own tracks, issuers came and went and it was impossible to employ anyone on a long term basis, if at all, to encourage compliance. Land use also changed and when Kiko Farm was planted in pines, people continued to drive where they had before - with scant regard for the trees - or any fence, locked gate, ditch or barrier erected to dissuade them.

You can probably understand the owners' frustration if you imagine your own reaction to the same use of your property by every Tom, Dick and Harriet.

Well what are they trying to do? – you ask. The landowners are moving toward stopping unauthorised vehicles from driving over their land - they know that anglers have walking access along the river banks and are not trying to obstruct or prevent it. The only legal access to the Tauranga-Taupo River is a 20m wide right-of-way (ROW) for foot traffic only along both banks from the mouth to a point 3 miles (5km) upstream, which is approximately the old Pump Pool. Access beyond this is, and has always been, at the discretion of the land owners. The ROWs are fixed to the river banks as they were in 1926 and the recent break-out channel through the quarry has no legal access along its length. This anomaly will be resolved if the regional council's proposal to re-divert the river back into the old channel goes ahead.

And what is DOC doing about it? Taupo Fishery Area staff maintain walking tracks on the ROWs along the true right river bank from the SH 1 bridge to the Crescent and on the true left river bank from the recently extended carpark at the end of the Tuki Road extension to the dry river bed past the Crescent. We also maintain the extension of Tuki Road through the Oruatua Recreation Reserve for two wheel drive access as far as the boundary with the private land. At that point we have erected a vehicle barrier and a temporary sign as requested and designed by the owners of the private land. The sign explains where legal access exists for vehicles and pedestrians and states that no vehicles are allowed past that point but pedestrians may continue.

The sign has been torn down and replaced three times and the vehicle barrier destroyed and replaced once. Behaviour like that hardly helps any case that may be made for more liberal access.

We have a good, constructive relationship with the landowners representatives and are seeking clarification of several issues from them. In particular whether they have any concerns about how best to manage anglers' foot access on the river bank ROWs and also along those portions of the new river channel through the quarry. We are happy to advise anglers on other access arrangements, if any, which the owners may wish to provide. Ideally, room for carparking near the junction of Hingapo Road will make foot access up the right bank ROW much more practical.

As the articles in the July 2002 *Target Taupo* (issue 40) explained, the Taupo fishery has unique statutory provisions for anglers' access over private land adjoining most of the inflowing rivers. This is quite different from the sometimes confusing and often patchy coverage afforded by the "Queen's Chain" elsewhere in New Zealand. Additionally, many of the Taupo ROWs have formed tracks to assist anglers' access over them and minimise impacts of their use. Notwithstanding that these are legal accesses we must still be aware that they are for the most part on private land and should respect the land and its owners accordingly.

DOES THIS SOUND LIKE YOU?

FISHERY RANGER

A rare opportunity now exists for a person to become part of the field operations team that protects and manages the world famous Taupo trout fishery.

Interested?

You will have to be a person who:

- is seeking a career focused on the outdoors
- is able to get involved in a wide range of field work focussed primarily on fishery monitoring programmes
- is comfortable working in the area of compliance and law enforcement, advocacy and public awareness
- can liaise and work with anglers, fishery stakeholders, the tangata whenua Ngāti Tūwharetoa and the general public
- is a team player and able to be a team leader
- is a keen and active trout fisher

Still interested?

You will need to have proven skill and experience in:

- ecological principles
- electronic information processing
- law enforcement
- developing positive relationships with a wide range of people
- boat handling skills
- health and safety procedures in the workplace

You must also be able to work unsupervised and often outside regular hours including weekends and public holidays and sometimes in remote locations.

For further information please contact Rob McKay, telephone (07) 386 9265 or Jon Palmer, (07) 3869223 or visit www.doc.govt.nz.

The department is committed to the principles of being a good employer and welcomes applications from EEO target groups.

Job Descriptions and PER 1 Application for Employment forms are available from reception, Tongariro Taupo Conservancy Office, phone (07) 386 8607.

Applications, quoting Vacancy number 06/512, must include a completed PER 1 form and full CV with evidence of the required competencies.

Applications close in the Tongariro Taupo Conservancy Office at Noon on 3rd Jan 2003

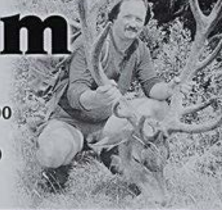
OR PERHAPS THIS?

A second opportunity exists, this time within the Technical Support team of the Taupo Fishery Area. This person will be part of the team providing technical and scientific advice to assist with the management of the fishery with specific responsibility for implementing and co-ordinating the fishery monitoring programmes and analysing and reporting the results. As part of this position the person will be actively involved in our various field and advocacy programmes, and will expected with experience to assume a leadership role.

The position requires a strong tertiary background in ecological management, practical field skills such as diving and boating, positive relationship skills and a keen interest in angling.

For further information please contact Glenn Maclean, telephone (07) 386 9266 or visit www.doc.govt.nz.

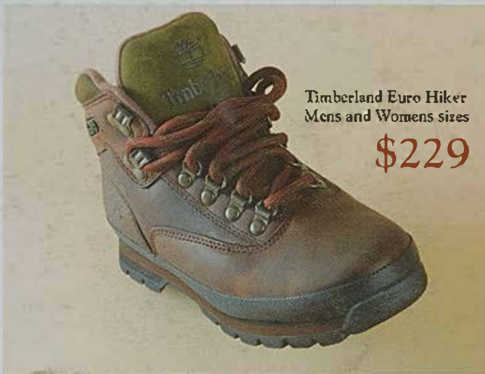
Taupo Field & Stream Directory



To advertise in the Taupo Field & Stream Directory and reach 12,000 annual fishing licence holders, contact Peter McIntosh on (09) 579 3000

F&G 305

THE SUMMER CATALOGUE IS OUT!



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