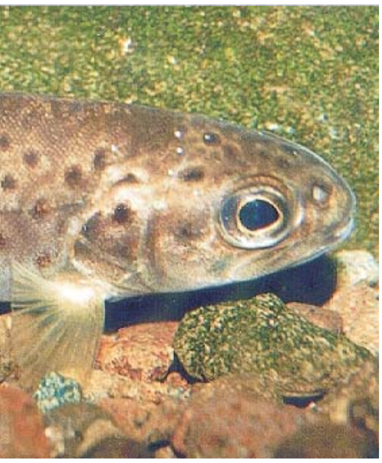


## Chapter 9

# Forestry Effects on Native Fish

***Robin Black***

## Introduction

The initial land-use related investigation into the native fish population within the Pakuratahi and Tamingimingi catchments was carried out by NIWA staff in March 1996 as part of a FRST funded study on plantation forestry effects on stream ecosystems. (Quinn et al., 1996). This report summarised the aquatic biodiversity for 11 coastal Hawke's Bay streams and included 6 sections within the Pakuratahi and Tamingimingi catchments. These 6 sites were only used in the NIWA project in 1995 and all subsequent monitoring carried out by CHH for the purpose of the comparative study was reduced to 2 sites; PM3 (V20/437002) (100 m downstream from the weir) was retained for all forest monitoring, and a new site (Tamingimingi ford) (V20/425977) 50 m downstream from the weir, was chosen for the pastoral site. It is equivalent to TM2U but is more accessible.

## Methods

The principal method of investigation has been electric fishing using the Kainga EFM 300 backpack, supplied by Fish and Game, New Zealand (Eastern Region- Rotorua). The standard 2 m stop net and dip net was used to capture all fish and shown in Fig. 1.

Figure 1. Electric fishing in riffle section below the weir in the Pakuratahi stream Feb 2002

Electric fishing was supplemented with occasional spotlighting of the pool sections at other times of the year to clarify the habitat preferences.

## Monitoring.

The monitoring was generally carried out in the late summer, with a reach length of 100 m wherever practical. There was no monitoring in the Tamingimingi and Pakuratahi catchment between 1997 and 1999. Annual monitoring started again in 2000 and continued in the late summer until February 2005. The Tamingimingi stream survey site reach has not changed in either substrate or bank vegetation throughout the period of monitoring (Figs. 2 and 4).

Access to the Pakuratahi stream above the weir became more difficult in the years after harvesting as the vegetation changed from a grazed understorey of grass, native shrub hardwoods and light blackberry into a thick exotic grass and dense blackberry mixture. The blackberry among the re-

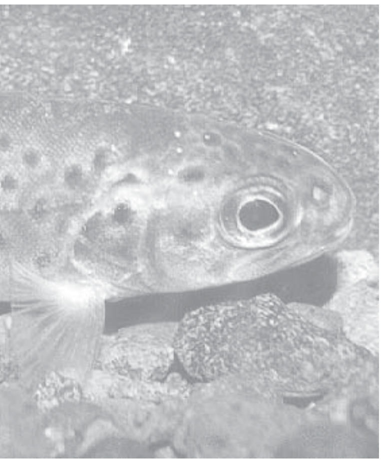


Figure 2. Tamingimingi ford-middle of monitoring reach, 50 m downstream of the weir

planted pines prevented walking access and it was not possible to use other locations upstream of the weir. Figures 3 and 5 show the typical riparian cover on the narrow channel leading up to the weir, and 50 m upstream, respectively in the years 2003-2005.

## Results

### *Pre-harvesting period*

The earliest record in the New Zealand Freshwater Fish database for the two catchments was from an investigation carried out by the Hawke's Bay Fish and Game staff in May 1994. This showed that the Pakuratahi Stream at the weir had a population of Inanga, Torrentfish, Longfin and Shortfin eel and Common Bully. All were identified as either single specimens or rare.

The Tamingimingi was only slightly different, with Shortfin and Longfin eel identified as common, with Common Bully abundant and Torrentfish rare. Figure 4 shows the typical form of the Tamingimingi with a relatively slow run section and a grazed margin. This section has abundant schools of Inanga visible in daylight. The sandy substrate of the run section is unsuitable for the Redfin Bully or Torrentfish. Their favoured habitat is seen in Figure 2.

The NIWA report (Quinn et al., 1996) identified that a wide range of fish was present in both catchments, including Shortfin eel, Longfin eel, Smelt, Common Bully, Redfin Bully, and Blue gilled Bully and Torrentfish. The numbers varied between both sites but they were essentially comparable with 8 and 7 species respectively. This was at the upper end of species richness for large catchment at moderate altitude. The main difference was that the biomass was higher in the pastoral catchment, primarily because of the size of the eels captured. Quinn et al., (1996) concluded that the Pakuratahi stream was characterised by high fish biodiversity compared to Bay of Plenty and Coromandel plantation forest streams. Subsequent regular monitoring of forest streams in both areas by CHH staff has confirmed this conclusion.

Figure 3.
Pakuratahi weir – post harvest

Figure 4.
Tamingimingi stream 50 m above weir

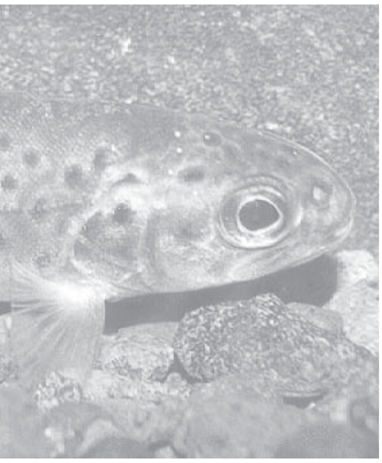


Figure 5.
Pakuratahi Stream, 50 m above weir,
February 2005

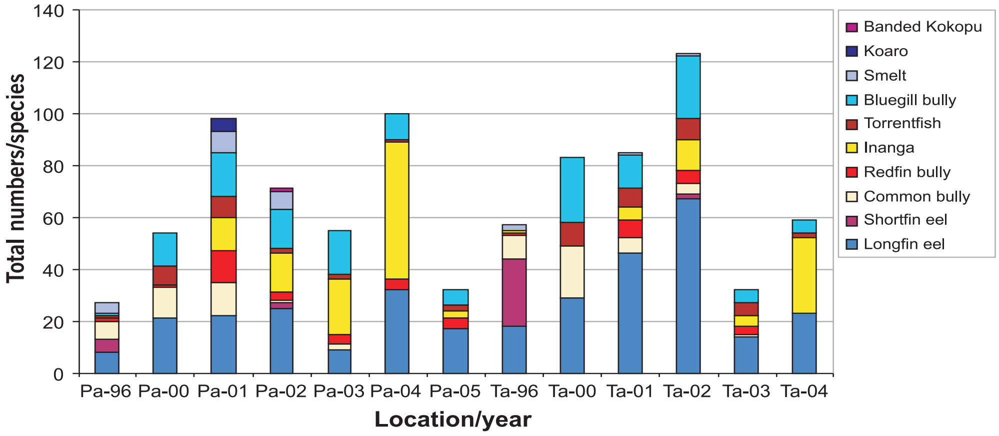
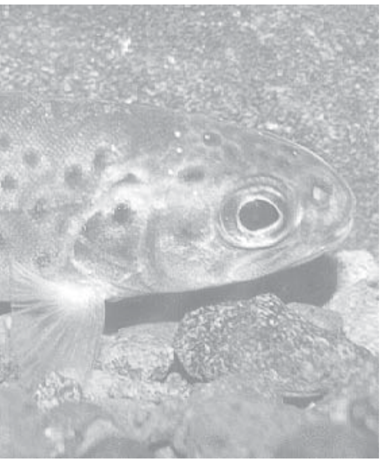



Figure 6. Species and numbers variation during monitoring period (1996–2005).

***Pre-and post-harvesting fish biodiversity and fish numbers***

The initial differences between the two catchments in 1994 were minimal; biodiversity was usually 4-5 diadromous species. This had been raised to 7 species in 1996 by the NIWA study. The presence or absence of Inanga, Common Bully or Blue-gilled Bully was the apparent difference and these could be explained by the substrate and nature of stream reach. The presence or absence of a riffle or pool will skew the data with Inanga seen in both localities and Torrentfish or Blue gilled Bully only being located in the riffles. The highest biodiversity was in 2002 (Fig. 6), 2 years after the completion of harvesting, when 9 fish species were recorded from the Pakuratahi catchment. Recent monitoring by CHHF in an Eastern Bay of Plenty pine forest has shown similar sized catchments to have similar Blue-gilled bully and Torrentfish dominated populations, where pools provide limited habitat.



**Longfin eel** were common in both catchments with 5-20 small eel found in the Pakuratahi stream compared to up to 60 similar eel found in the Tamingimingi. The better habitat in the pastoral catchment meant that only one large female Longfin has ever been consistently present throughout the monitoring period. No large eel (>500 mm) were found in the Pakuratahi.

**Shortfin eel** were identified in both catchments in 1994, 1996 and 2002 but were not as apparently as common as the initial 1996 survey identified.

**Blue-gilled bully** were not originally found in either catchment but they have become quite common in both catchments with relatively constant numbers. They are located in the cobbly substrate riffle areas, usually with 10-20 individuals caught.

**Common Bully.** A more obvious change over time has been the decrease of Common Bully in both catchments from 20% of the population to rare occurrences, in response to changes in the impact of channel hydrology and riparian vegetation.

**Inanga.** This is the only common galaxiid. Inanga are the most visible native fish, and can be seen in schools of up to 50 fish in both daylight and spotlighting in all pools leading up to the monitoring section at PM3, and all pools in the Tamingimingi. These totals are not included in the fish numbers caught by electric fishing expressed in Figures 6 and 9.

**Koaro.** Two adult and 3 juvenile Koaro were identified in 2001 in the Pakuratahi catchment (Fig. 7). The reach below the Pakuratahi weir is not typical of the usual Koaro habitat, which is more high energy with larger rocks and plunge pools. The vegetation impacts on the stream margin will prevent suitable habitat in the upper catchment, possibly from a couple of plunge pools where there is a change in the geology and pools may develop.

Figure 7. Adult Koaro

**Banded Kokopu.** These fish are rare in the Pakuratahi catchment and absent from the Tamingimingi; one adult banded Kokopu was caught in the Pakuratahi in 2002. The monitored sections in both the Tamingimingi and Pakuratahi catchments are not typical of the areas in Tairua on the Coromandel where Banded Kokopu dominate. Investigations in the Tairua and Eastern Bay of Plenty Forest suggest that banded Kokopu are, however, tolerant of both soft and cobbly substrate, low oxygen levels and high and low energy flow sections, although they appear to prefer the iron floc and low oxygen levels consistent with swamp discharges and low output streams. They are likely to remain as relatively rare individual species in the upper reaches of the Pakuratahi stream, however. This is deemed likely because of their preference for the small pools with woody debris in upper catchments.

**Redfin Bully** form a small proportion of the fish numbers in both catchments and are generally confined to the pools containing cobbles or riffle sections.

Torrentfish are relatively common in the riffle section at Tamingimingi and the cobbly run extending 100 m below the Pakuratahi weir (Fig. 8).

**Smelt** were found in the Pakuratahi in 2001 and 2002 only.

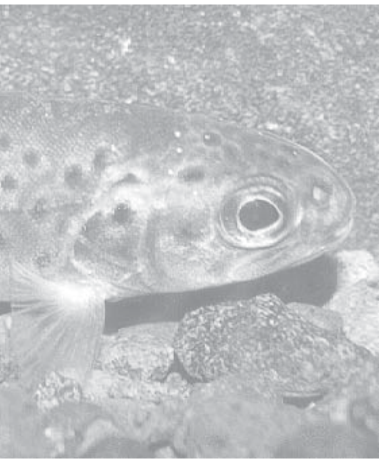


Figure 8. Torrentfish, Pakuratahi catchment below weir

***Species Variation***

In 1994 numbers of species present in both streams was 5. The numbers varied over the ensuing years but the net result was at least 7 in 1996, 2001 and 2002. This is excellent biodiversity. Over the 10 year period the average number of species found in the annual monitoring was 5.75 for the Pakuratahi and 5.5 for the Tamingimingi. The difference is not significant. Rare occurrences of the galaxiid species Koaro and Banded Kokopu were recorded in the Pakuratahi but did not persist to be become common in the lower reaches. None were identified in Tamingimingi stream. This result is comparable for other plantation forest catchments (pre harvest) with significant native riparian areas.

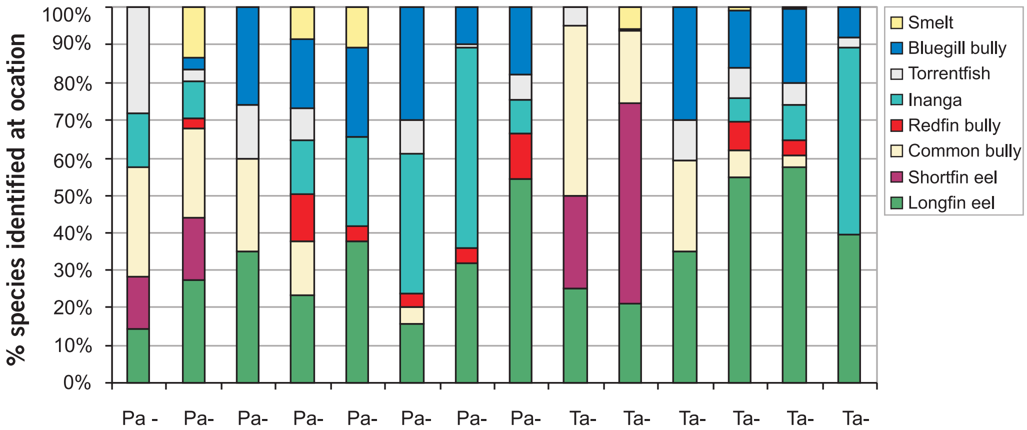
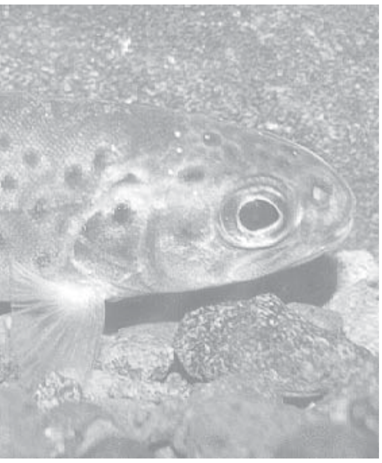



Figure 9. Species variation (1994-2005)

***Assessed fish density***

The size of the area monitored annually in the Pakuratahi catchment declined over the 10 year period with the width of the channel being reduced by at least 50%, because of the encroachment of the stream edge vegetation. The average stream width in 2005 was 0.75 m. The fish density varies in both catchments from 0.5 to 6.8 fish/m$^2$. This variation is based on the different areas sampled; a riffle may have 10 fish or a pool may have either no fish or a school of 40 Inanga. Thus, location of the sample point and the type of stream edge vegetation has a major effect on the likely fish numbers.

The Inanga form the highest density species, travelling in large schools, with the greatest variation in numbers in the Pakuratahi. This was caused by the effect of the edge vegetation capturing the fish and preventing them washing free of the root tangle to the catch net. The open wider expanse of the Tamingimingi channel allowed large schools to move in daylight. The smaller forestry stream



has fish numbers in the 0.5-6.8/m$^2$ range while numbers in the open, wide pastoral stream are in the 0.5-3.2 /m$^2$ range. A noticeable difference was in the section above the weir in the Pakuratahi where the density was in the range 0.5 to 1 fish/m$^2$. This initially suggested a possible barrier caused by the weir (Fig. 3) but this was shown not to be the case on the basis of Inanga being seen in the stilling pond when spotlighting was carried out.

## Discussion

In the pre- harvesting period, the Pakuratahi catchment was grazed by feral goats. This had the effect of maintaining a moderately grazed riparian margin and allowed the stream to occupy the full width of the bed in time of elevated flow. This made the forest stream similar in bed form to that seen in the pasture and pool species such as Inanga were common. The presence of limestone cobbles and small boulders and the changing winter flow maintained pool/riffle/run relationship. This has not been the case after harvesting, with the vegetation progressively reducing the impact of flood flow and sediment input to the channel. The channel is being reduced in width and velocity is being increased. It would appear that bedload is not moving as often in the small storm events which have occurred during the monitored period.

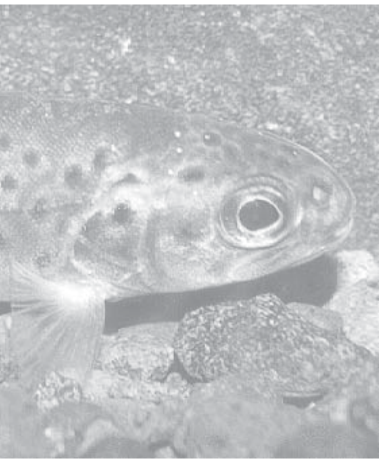
The relatively high volume of spring-fed flow within the Pakuratahi catchment has had the effect of maintaining lower summer stream temperatures without the extremes found in similar sized, non spring-fed catchments, more typical of the coastal HB hill-country. This beneficial impact has a buffering effect on what fish biodiversity variations could be expected from solar exposure resulting from a harvesting operation.

Cover for fish during the daylight is as important as having suitable habitat. The monitored section of the Pakuratahi did not contain any woody debris prior to or after harvesting. This meant that only the substrate, bank form and associated vegetation provided cover. With the increase in available light after harvesting and the removal of goats as part of pest control for re-establishment, the riparian vegetation has recovered very strongly (Fig. 4). This has meant that grasses and blackberry now dominate in some areas along the Pakuratahi channel. The growth of sedges and watercress has also altered the hydrological regime under normal flow.

The pool/riffle/run sequence that existed in the intensely grazed Tamingimingi and partially grazed Pakuratahi catchments is now more confined to riffles and runs in the Pakuratahi because of the confinement of the channel by the encroaching terrestrial and aquatic vegetation. The increased planting setback of the pines will also mean that the riparian area will not be shaded as early as under the original pine forest. This suggests that the apparent overgrown stream vegetation state seen in Figure 5 will persist longer until the maturing pines suppress the blackberry and grasses. This will reduce the habitat for Inanga because of the increased edge velocity and make it more suitable for Torrentfish and Blue gill bullies.

Longfin eel were abundant as juveniles or small adults in the roots of the grasses and weeds growing into the Pakuratahi channel. No larger eel were identified with electric fishing or spotlighting; even in the larger pools further downstream in the Pakuratahi where Inanga predominate.

Both streams contained at least one moderately deep pool. Floating macrophytes provided the cover but only the Tamingimingi contain an eel of any reasonable size. Water cress however, does provide some edge protection for the smaller eel in the section of the Tamingimingi monitored. The broader flow width in the Tamingimingi did however produce a lower velocity habitat more conducive for the Inanga and the one large Longfin eel that appeared to coexist for most of the monitored period.



## Conclusions

There has been a change in the plantation forest stream habitat, not as a result of more sediment but rather from the changed light regime. The grassy vegetation barrier has provided abundant edge protection thereby reducing sediment input from overland flow and providing cover for all fish species. The vegetation has had the effect of changing the available habitat in the forest catchment. This vegetation enhancement has not affected the overall fish biodiversity but the proportion of individual species numbers have changed (Fig. 8). The species numbers have varied over the 10 years of record but the values of 5.5 and 5.7 are not significantly different.

The presence of terrestrial and aquatic vegetation means that total numbers of fish caught by electric fishing have varied because of the inability of retrieving the fish out of the vegetation mat. Spotlighting has confirmed the low fish biodiversity of the pool sections in the Pakuratahi in comparison to the plantation forests in the Coromandel.

The species richness and the Torrentfish/ bluegill bully/redfin/ longfin eel assemblage is a typical pre-harvest fauna from similar sized pine forest in coastal Eastern Bay of Plenty.

Although fish biodiversity has varied over the past 10 years the change is not sufficient to indicate that it has had a negative impact in the interval between forest harvesting and forestry establishment. The change from pasture to plantation forest at the time of original establishment would have generated similar variations. It is not possible to assess what the impact would be of a Cyclone Bola storm on the two catchments. However, given the coastal proximity the catchments they might be expected to recover reasonably quickly because of the short distance required to restock the stream with native species, and that these impacts are far more significant when compared to the harvesting impact.

## Acknowledgements

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## References

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