

Boat electrofishing survey of Te Weta Bay, Lake Rotoiti

CBER Contract Report 32

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the Department of Conservation,
Bay of Plenty Conservancy

by

Brendan J. Hicks

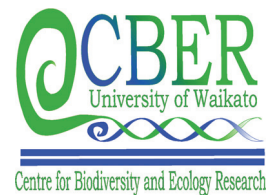
and

C. Alex Ring

Centre for Biodiversity and Ecology Research
Department of Biological Sciences
School of Science and Technology
The University of Waikato
Private Bag 3105
Hamilton, New Zealand

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Email: b.hicks@waikato.ac.nz



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Executive summary

We used New Zealand's first successful electrofishing boat to survey fish in Lake Rotoiti, North Island, New Zealand, principally in Te Weta Bay. The primary objective of the fishing was to see if undesirable fish species such as koi carp (*Cyprinus carpio haemaopterus*; Zhou et al. 2003), brown bullhead catfish (*Ameiurus nebulosus*), and rudd (*Scardinius erythrophthalmus*) have become established. Circular excavations were seen in the lake by a NIWA SCUBA diver in late 2003, and these were similar to nest excavations associated with catfish in other locations.

The native fish common smelt (*Retropinna retropinna*) and bullies (*Gobiomorphus* sp) were caught, with a few goldfish (*Carassius auratus*). Poor water visibility made observations difficult in some parts of the lake, especially on the southern shore and in the outer part of Te Weta Bay closest to the main lake.

Fish densities ranged from 2.3 to 11.7 fish 100 m⁻². These should be regarded as minimal densities because the electroshocked fish were counted from the boat but mostly not retrieved; also, only a single pass was conducted.

No recognised pest fish species were caught, but we cannot exclude the possibility that pest fish might occur at sites that were not fished. No trout were caught, possibly because of the high water temperature (22°C).

1. Introduction

Boat electrofishing has many advantages over conventional fish capture in lakes and rivers, primarily in extending the sampling area with limited resources. Sites need to be visited only once, rather than twice as with net setting and retrieval. Nets are very size and species selective, whereas electrofishing is less selective. The by-catch of diving birds such as shags and dabchicks can also be largely avoided. The University of Waikato commissioned New Zealand's first successful electrofishing boat in July 2003, and this report describes its use in a survey of Te Weta Bay and one other site on the southern shore of Lake Rotoiti. The reason for the survey and choice of sampling locations was the sighting by a NIWA SCUBA diver in late 2003 of two circular depressions bed in the lake (John Clayton, NIWA, pers. comm.). These excavations were similar to nest excavations associated with catfish in other locations.

2. Methods

The electrofishing boat, Hiko Hi Ika (translation from Māori: electrofishing), is a 4.5-m long rigid aluminium pontoon hull with a 2-m beam, and a fishing platform at the bow. The hull has a shallow vee-shape to allow navigation in water ≥ 0.5 m deep. The boat is powered by a 50 HP four-stroke outboard motor, and is equipped with a global positioning system (GPS) and a depth sounder. The electrofishing equipment comprises a 5-kilowatt gas-powered pulsator (GPP, model 5.0, Smith-Root Inc, Vancouver, Washington, USA) that is powered by a 6-kilowatt custom-wound generator. Two anode poles, each with an array of six droppers, create the fishing field at the bow (Figure 1). The boat itself acts as the cathode, and has been authorised as an electrofishing device by the Department of Conservation.

Site 1 on the southern shore (Figure 2) was near the area where one of the circular depressions was seen near the southern shore, and sites 2-5 were located in Te Weta Bay, where another circular depression was seen. These sites were fished on 22 January 2004 (Table 1, Figure 3). Electrical conductivity was measured with a YSI conductivity meter, and the GPP output was optimised to maximise the applied peak voltage. We fished with a frequency of 60 pulses per second. The applied voltage was 60% of range at the low-range setting (50-500 V direct current). This resulted in an applied current of 4-5 amps root mean square. We assumed from past experience that an effective fishing field was developed to a depth of 2-3 m, and about 2 m either side of the centre line of the boat. Thus the boat fished a transect about 4 m wide. This assumption was used to calculate area fished from length fished measured with the GPS.



Figure 1. The electrofishing boat of the University of Waikato in Te Weta Bay, Lake Rotoiti, showing the fishing platform and anodes at the bow. Photo: Kim Young, DOC.



Figure 2. Site 1 on the southern shore, Lake Rotoiti, fished on 22 January 2004.

Table 1. Latitude and longitude from GPS readings (WGS84) taken during fishing in the Lake Rotoiti on 22 January 2004 with the electrofishing boat of the University of Waikato.

Site number	Site name	Latitude start (°S)	Longitude start (°W)	Latitude stop (°S)	Longitude stop (°W)
1	Lake Rotoiti, southern shore	38.040167	176.362167	38.040250	176.360889
2	Lake Rotoiti, Te Weta bay east 1	38.030389	176.355611	38.032361	176.353222
3	Lake Rotoiti, Te Weta bay east 2	38.030389	176.355611	38.033694	176.352694
4	Lake Rotoiti, Te Weta bay west 1	38.033500	176.352778	38.029583	176.355056
5	Lake Rotoiti, Te Weta bay west 2.1	38.029583	176.355056	38.029361	176.354111
5	Lake Rotoiti, Te Weta bay west 2.2	38.029361	176.354111	38.028167	176.354889
5	Lake Rotoiti, Te Weta bay west 2.3	38.028167	176.354889	38.028250	176.354083
5	Lake Rotoiti, Te Weta bay west 2.4	38.028250	176.354083	38.028806	176.352778
5	Lake Rotoiti, Te Weta bay west 2.5	38.028806	176.352778	38.032528	176.352361

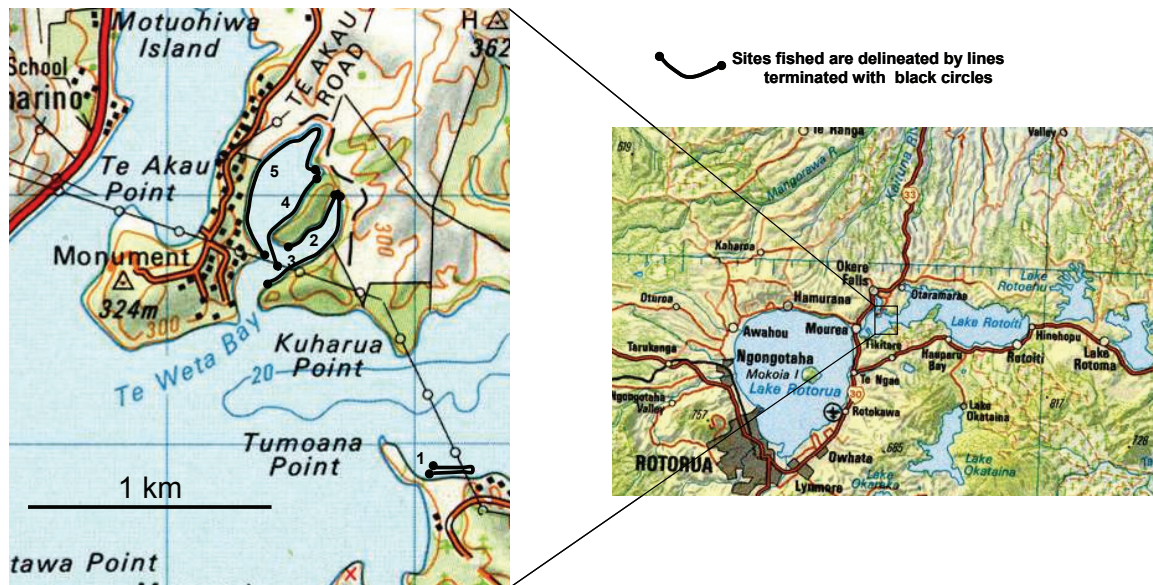


Figure 3. Sites fished in Lake Rotoiti with the electrofishing boat of the University of Waikato on 22 January 2004 (original map scale: 1:50,000, NZMS 260). Numbers in bold refer to the sites in Table 1. Source: MapWorld TopoMap NZ 2.0.

3. Results

Goldfish and some common smelt and bullies that were attracted to the anodes were quickly lifted from the water and transferred to on-board live boxes. After verifying the identity of the smelt and bullies, these taxa were not further retrieved, but the number of immobilised fish were estimated from the boat. Two species of native fish (common smelt, *Retropinna retropinna*, and common bullies, *Gobiomorphus cotidianus*) and one introduced fish species (goldfish, *Carassius auratus*) were captured (Table 2). The habitat was generally suitable for fish, with an abundance of introduced aquatic macrophytes (oxygen weed, *Egeria densa*, and hornwort, *Ceratophyllum demersum*). Emergent vegetation lined much of the shore (Figures 4 and 5). Water depths ranged from 0.5 to 1.5 m, with the exception the channel in Te Weta Bay (site 4), where depths were 2-5 m. Water conductivities (Table 2) were optimal for electrofishing, assuming that the conductivity of the fish was about $150 \mu\text{S cm}^{-1}$. Common smelt were the most abundant and widespread fish species, and were present at all sites fished (Table 3).

Poor water visibility made observations difficult in some parts of the lake, especially on the southern shore and in the outer part of Te Weta Bay closest to the main lake.

Table 2. Sites and physical conditions in Lake Rotoiti fished on 22 January 2004 with the electrofishing boat of the University of Waikato.

Site no.	Site name	Submerged macrophytes	Bank and substrate	Ambient conductivity ($\mu\text{S cm}^{-1}$)	Specific conductivity ($\mu\text{S cm}^{-1}$)	Water temperature ($^{\circ}\text{C}$)
1	Southern shore	<i>Egeria</i> , hornwort	Sand	167.1	180.0	21.3
2	Te Weta bay east 1	Hornwort	<i>Eleocharis</i> , raupo	172.3	183.9	22.2
3	Te Weta bay east 2	Hornwort	<i>Eleocharis</i> , raupo	172.3	183.9	22.2
4	Te Weta bay west 1	Hornwort, <i>Potamogeton</i>	Raupo, <i>Baumea</i>	172.3	183.9	22.2
5	Te Weta bay west 2	Hornwort	<i>Eleocharis</i> , raupo	172.3	183.9	22.2

Table 3. Fish species caught or immobilised in Lake Rotoiti with the electrofishing boat of the University of Waikato on 22 January 2004. Numbers of common smelt at sites 1-5, and common bullies at sites 2-5 were visually estimated.

Site no.	Site name	Elapsed time (hh:mm:ss)	Distance fished (m)	Area fished (m^2)	Depth (m)	Number of fish seen or caught				Minimal fish density (fish 100 m^{-2})
						Common smelt	Bullies	Goldfish	Total	
1	Southern shore	0:13:00	339	1356	0.5-5.0	30	1	0	31	2.3
2	Te Weta bay east 1	0:19:00	303	1212	0.5-1.5	80	30	1	111	9.2
3	Te Weta bay east 2	0:27:00	447	1788	0.5-1.5	120	40	2	162	9.1
4	Te Weta bay west 1	0:26:00	479	1916	0.5-1.5	40	50	0	90	4.7
5	Te Weta bay west 2	0:57:00	852	3408	0.5-5.0	300	100	0	400	11.7



Figure 4. Habitat in Te Weta Bay east at site 3, Lake Rotoiti, 22 January 2004.



Figure 5. Shoreline in Te Weta Bay west at site 5, Lake Rotoiti, 22 January 2004.

Of the three goldfish caught, one was bright orange (Figure 6), which is unusual for a wild goldfish.



Figure 6. Golden coloured goldfish (200 mm fork length) caught at site 3 in TeWeta Bay east. A smaller, wild-coloured goldfish (115 mm fork length) is beneath the larger one.

4. Conclusions

A low diversity of fish was caught in Lake Rotoiti, and no fish species regarded as pests by the Department of Conservation (e.g., gambusia, rudd, brown bullhead catfish, and koi carp) were caught. No eels or other diadromous fish were caught, probably because migration up the Kaituna River is impeded by waterfalls. The shallow habitats around the lake margins usually preferred by gambusia were not sampled, so the lack of this species in the caught cannot be regarded as proof of its absence from the sites that were fished. Previous fishing with the electrofishing boat in the North Island, NZ, in similar conductivities and habitats, and with similar machine settings, has caught eels, rudd, brown bullhead catfish, perch, tench, and koi carp. Power transfer from the water to the fish at ambient conductivities of 100-200 $\mu\text{S cm}^{-1}$ is very effective because it is similar to the conductivity of the presumed fish. Goldfish have effective conductivities of about 100-160 $\mu\text{S cm}^{-1}$ (Kolz and Reynolds 1989).

Boat electrofishing generally provides a good picture of the range of fish species present, especially on water depths of 0.5-2 m. Fish densities in Lake Rotoiti ranged from 2.3 to 11.7 fish 100 m^2 . Fishing with this electrofishing boat in the Waikato region caught a wide range of fish species in water with similar conductivities. For instance, single-pass fishing in July 2003 in a weedy side channel of the Waikato River at 10.3°C with an ambient conductivity of 114 $\mu\text{S cm}^{-1}$ caught 464 fish in 75 mins in a fished distance of about 1000 m (4,000 m^2), implying a minimum density of 11.6 fish 100 m^2 . The catch

included 24 koi carp, 2 rudd, 2 goldfish, 10 shortfinned eels, 1 catfish, 400 smelt, and 25 grey mullet. Fishing in August 2003 in Lake Rotoroa (Hamilton Lake) at 11.0°C and ambient conductivity of 79 $\mu\text{S cm}^{-1}$ caught 80 fish in 65 mins in a fished distance of 600 m (2,400 m^2), or a minimum density of 3.3 fish 100 m^2 . The catch included 10 tench, 10 rudd, 20 perch, 17 shortfinned eels, and 23 catfish. In the shallow margins of Lake Whangape, Waikato, 24 koi carp weighing a total of 87 kg were caught in about 400 m^2 , to give a minimum biomass of about 2,200 kg ha^{-1} . Population estimates of koi carp made from two-pass fishing in 915 m^2 of the Kimihi Wetland outlet on 29 January 2004 were 14.3 fish 100 m^2 , or about 2,140 kg ha^{-1} (Hicks, unpubl. data). Koi carp have been successfully captured at an ambient conductivity of 90 $\mu\text{S cm}^{-1}$ in a pond near Apata, and rudd and trout were caught in an ambient conductivity of 43 $\mu\text{S cm}^{-1}$ in Lake McLaren, Bay of Plenty (Hicks et al. 2004).

Electrofishing can catch a wider range of sizes and species of fish than netting, depending on the choice of mesh size and net types, and catches fish throughout the water column to a depth of 2-3 m. However, one study has shown that electrofishing can be biased towards mid-sized fish, with less efficiency for small and large fish than for medium-sized fish (Bayley and Austen 2002). Common smelt were caught or seen at all sites in our survey, which suggests that small fish were effectively caught, but some large fish might have escaped from the field as the boat approached, or as they first detected the field, but before they entered the zone of galvanotaxis. Trout were not caught, but the water temperatures measured (21-22°C) suggest that trout were probably in the deeper, cooler areas of the lake.

The relationship of the fish caught to the actual number of fish present is unknown, and remains an abiding problem in fisheries research. From removal estimates by electrofishing in wadable streams and rivers the true population size (N) has been estimated as about double the number of fish caught on the first pass. The relationship between population size and the number of fish caught on the first pass (F) was:

$$N = 1.96 F^{1.028} \quad (\text{Jowett and Richardson 1996}).$$

Recent two-pass boat electrofishing in the Kimihi Wetland outlet suggests, however, that only about 20% of fish were caught on the first pass (Hicks, unpubl. data). Despite these limitations, we are confident that our study has provided a good summary of the fish species present in Te Weta bay, and has provided estimates of minimum densities for the sites that were fished.

5. Acknowledgements

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