Electrofishing survey of the Manawatu, Whanganui, and Mokau rivers and Lake Rotorangi, Patea River

CBER Contract Report 30

Client report

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by

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THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

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Contents

Tables

Figures

Executive summary

We used New Zealand's first successful electrofishing boat to survey fish in three large North Island rivers and in Lake Rotorangi, hydro-electric impoundment on the Patea River. The primary objective of the fishing was to see if undesirable fish species such as koi carp (*Cyprinus carpio haemaotopterus*; Zhou et al. 2003), brown bullhead catfish (*Ameiurus nebulosus*), and rudd (*Scardinius erythophthalmus*) have become established in the Manawatu, Whanganui, Patea, and Mokau rivers. Koi carp are known to be present in several ponds within the Manawatu and Whanganui River catchments, and a juvenile rudd was caught by a whitebaiter near the mouth of the Mokau River. Lake Rotorangi has an established trout fishery, but European perch (*Perca fluviatilis*) have been illegally released into the lake, and are numerous near Stratford. This lake is also vulnerable to illegal releases of other fish species, so it was included in the survey. A secondary objective was a general survey of native and sports fish.

Nine species of native fish and three introduced species were captured during the survey of 27 sites in four river systems. Fish habitat was generally poor, with little in-water cover obvious at the shoreline. Aquatic macrophytes were observed only in Manawatu River tributaries (the Koputaroa and Tokomaru streams). All three rivers had U-shaped channels with soft banks generally of clay and mud. Poor water visibility made observations difficult in the mainstems of all the rivers.

Common smelt were the most abundant and widespread fish species, and were present at all sites except those in the Tokomaru Stream and Lake Rotorangi. High water conductivity prevented effective electrofishing at Site 25 in the Mokau River mainstem, where the juvenile rudd was found.

Some unexpected catches in this survey were stargazers in the Manawatu River at Site 1 and 3, 10 km upstream from the sea, and black flounder in tributaries of the Manawatu (Sites 4 and 5), up to 23 km inland. Black flounder were found in the Whanganui River at Site 13, 30 km from the sea. Rainbow trout were caught in the Manawatu River at several sites (Table 4, Figure 3).

No recognised pest fish species were caught, but we cannot exclude the possibility that pest fish might occur at sites that were not fished. Despite these limitations, we are confident that our study has provided a good summary of the fish species present in the three rivers and Lake Rotorangi, and has provided estimates of minimum densities for the sites that were fished.

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. Also, nets set in rivers tend to clog with floating debris, reducing their capture efficiency, and requiring additional time for net cleaning. Finally, nets are very size and species selective, whereas electrofishing is less selective. The University of Waikato recently commissioned New Zealand's first successful electrofishing boat, and this report describes its use in a survey of four large North Island rivers, one of which (the Patea River) has a substantial hydro-electric impoundment (Lake Rotorangi). A secondary objective was a general survey of native and sports fish.

The primary objective of the fishing was to see if undesirable fish species such as koi carp (*Cyprinus carpio haemaotopterus*; Zhou et al. 2003), brown bullhead catfish (*Ameiurus nebulosus*), and rudd (*Scardinius erythophthalmus*) have become established in the Manawatu, Whanganui, Patea, and Mokau rivers. Koi carp are known to be present in several ponds within the Manawatu and Whanganui River catchments, and a juvenile rudd was caught by a whitebaiter near the mouth of the Mokau River. Lake Rotorangi has an established trout fishery, but European perch (*Perca fluviatilis*) have been illegally released into the lake, and are numerous near Stratford. Despite the illegality of their introduction, perch are an acclimatised fish species in New Zealand, and therefore cannot be regarded as a pest fish. Lake Rotorangi is vulnerable to further illegal fish releases, so it was included in the survey.

2. Methods

The electrofishing boat, Hiko Hï Ika (translation from Mäori: 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 as little as 0.5 m deep. The boat is powered by a 50 HP four-stroke outboard motor, and is equipped with a global positioning system and a depth sounder. The electrofishing equipment used is 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, creates the fishing field at the bow. The boat itself acts as the cathode, and has been authorised as an electrofishing device by the Department of Conservation.

Twenty-seven sites were fished between 17 and 20 November 2003 (Table 1, Figures 1 and 2). 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. Applied voltages varied from 40-80% of range at the low range setting (50-500 V direct current), and 30-40% of range at high range setting (50-1000 V direct current). This resulted in applied currents of 2-8 amps root mean square.

Fish that were attracted to the anodes were quickly lifted from the water and transferred to on-board live boxes. Most fish recorded were caught, but in some instances fish attracted but were not held by the field, and escaped. Where the species or genus of these fish was identified, they

were counted. All fish were released after capture with the exception of five perch that were taken from Lake Rotorangi for growth analysis.

Table 1. Latitude and longitude from GPS readings (WGS84) taken during fishing in the Manawatu, Whanganui, Patea, and Mokau rivers with the electrofishing boat of the University of Waikato between 17 and 20 November 2003.

Site number	Site name	Latitude start (°S)	Longitude start (°W)	Latitude stop (°S)	Longitude stop (°W)
Manawatu River					
1	Mainstem	40.51058	175.26733		
2	Mainstem	40.52717	175.29272	40.52800	175.29464
3	Mainstem	40.52894	175.29486	40.52833	175.29358
4	Mangaore Stream	40.53619	175.38789		
5	Koputaroa Stream	40.54403	175.36789	40.54731	175.36908
6	Mainstem	40.53969	175.37136	40.53831	175.37211
7	Mainstem	40.53600	175.38794	40.53481	175.38897
8	Tokomaru Stream (upstream TRB)	40.52675	175.40111	40.52831	175.40467
9	Tokomaru Stream (further up)	40.51986	175.42214	40.51992	175.42442
10	Tokomaru Stream (downstream TLB)	40.52831	175.40467	40.52675	175.40111
11	Mainstem at Opiki	40.42942	175.48769	40.43400	175.48339
Whanganui River					
12	Upstream from boat ramp	39.91208	175.05392		
13	Mainstem at Kauarapaoa Stream	39.80344	175.08625	39.80500	175.08419
14	Upstream from Kauarapaoa Stream	39.80433	175.08556	39.80461	175.08886
15	Upstream from Kauarapaoa Stream	39.80575	175.10636	39.80339	175.10889
16	Mainstem mid-channel upstream	39.80592	175.10614	39.80608	175.09500
17	Mainstem	39.85694	175.08400	39.85578	175.08336
18	Mainstem and Upokongaro Stm confluence	39.86990	175.11368		
19	Mainstem and Mateongaonga Stm confluence	39.89581	175.07792	39.89611	175.07706
Patea River					
20	Lake Rotorangi,Tangahoe, Patea River	39.49028	174.51089	39.49183	174.51156
21	Lake Rotorangi,Tangahoe, Patea River	39.48742	174.51556	39.48672	174.51728
22	Lake Rotorangi,Tangahoe, Patea River	39.48675	174.51828	39.48681	174.51922
23	Lake Rotorangi,Tangahoe, Patea River	39.48481	174.52500	39.48597	174.52331
24	Lake Rotorangi,Tangahoe, Patea River	39.49006	174.51133		
Mokau River					
25	Mainstem at tributary with white bridge	38.70542	174.65122		
26	Mainstem at Hut Creek	38.71394	174.69086	38.71306	174.69028
27	Mainstem at Totara Stream confluence	38.70164	174.71056	38.69939	174.70969

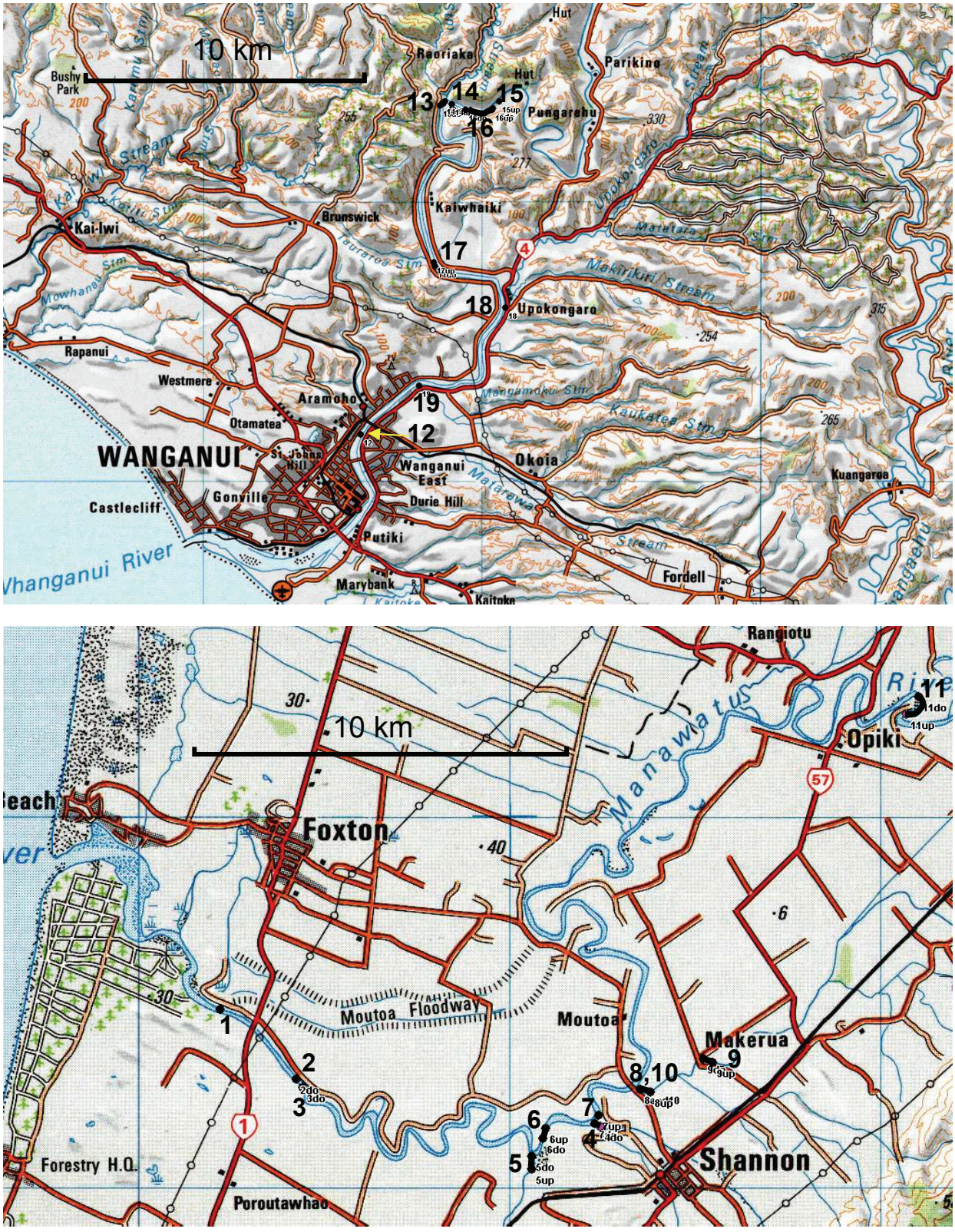

Figure 1. Sites fished in the Manawatu and Whanganui rivers with the electrofishing boat of the University of Waikato between 17 and 20 November 2003 (original map scale: 1:250,000, NZMS 262). Numbers in bold refer to the sites in Table 1.

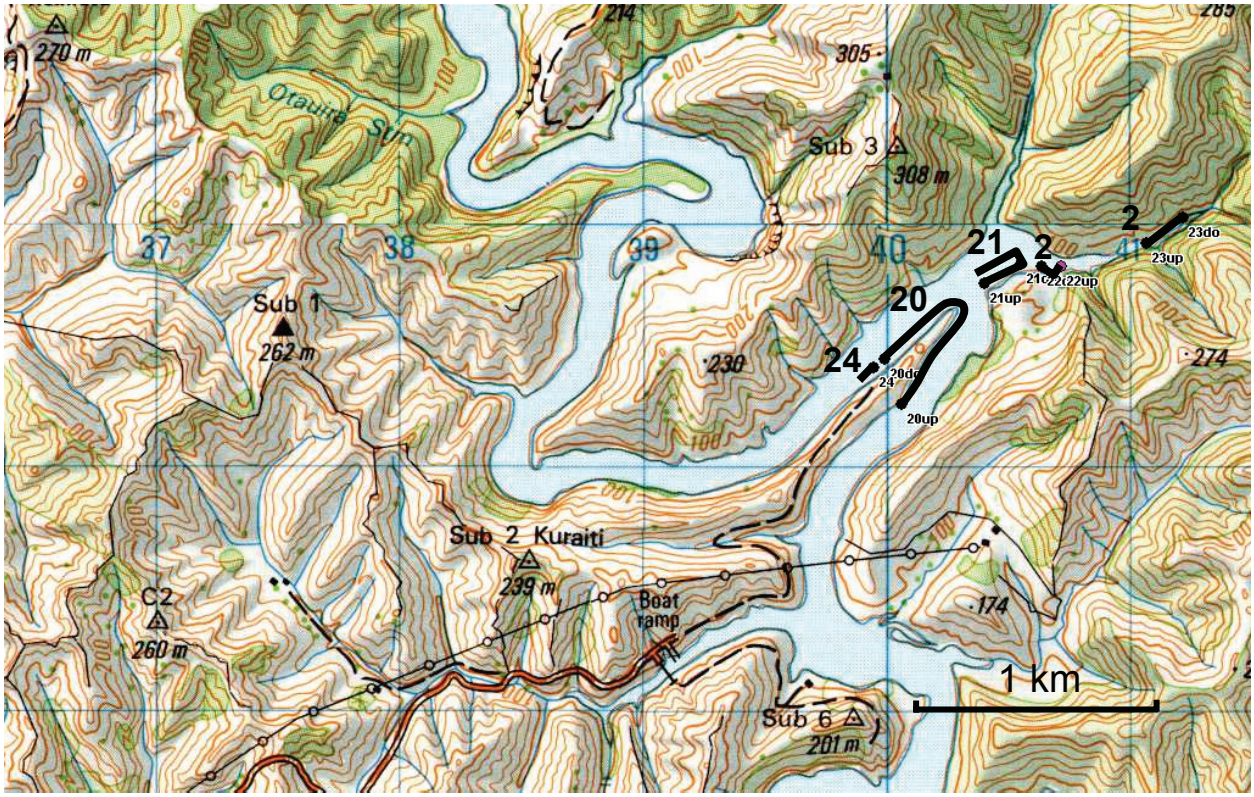

Figure 2. Sites in Lake Rotorangi, Patea River, and Mokau River fished with the electrofishing boat of the University of Waikato between 17 and 20 November 2003 (original map scale: 1:50,000, NZMS 260). Numbers in bold refer to the sites in Table 1.

3. Results

Nine species of native fish and three introduced species were captured during the survey of 27 sites in four river systems (Table 2). Fish habitat was generally poor, with little in-water cover obvious at the shoreline (Table 3). Aquatic macrophytes were observed only in Manawatu River tributaries (the Koputaroa and Tokomaru streams). All three rivers had U-shaped channels with soft banks generally of clay and mud. Poor water visibility made observations difficult in the mainstems of all the rivers.

Common smelt were the most abundant and widespread fish species, and were present at all sites except those in the Tokomaru Stream and Lake Rotorangi (Table 4). High water conductivity (Table 2) prevented effective electrofishing at Site 25 in the Mokau River mainstem, where the juvenile rudd was found. The area fished was calculated by assuming that a transect 4 m wide was fished. Fish densities are a minimum because the proportion of fish captured was unknown, and fish with only relative abundance could not be included. Fish were relatively sparse in Lake Rotorangi.

Some unexpected catches in this survey were stargazers in the Manawatu River at Site 1 and 3, 10 km upstream from the sea, and black flounder in tributaries of the Manawatu (Sites 4 and 5), up to 23 km inland. Black flounder were found in the Whanganui River at Site 13, 30 km from the sea. Rainbow trout were caught in the Manawatu River at several sites (Table 4, Figure 3).

Table 2. Common and scientific names and migratory status of the fish species captured during fishing 2003 in the Manawatu, Whanganui, Patea, and Mokau rivers with the electrofishing boat of the University of Waikato between 17 and 20 November.

Common name	Scientific name	Migratory status
Native fish		
Shortfinned eel	*Anguilla australis*	catadromous
Common smelt	*Retropinna retropinna*	anadromous
Inanga	*Galaxias maculatus*	catadromous
Common bully	*Gobiomorphus cotidianus*	amphidromous or nonmigratory
Yelloweyed mullet	*Aldrichetta forsteri*	marine wanderer
Grey mullet	*Mugil cephalus*	marine wanderer
Stargazer	*Leptoscopus macropygus*	marine wanderer
Black flounder	*Rhombosolea retiaria*	marine wanderer
Yellowbelly flounder	*Rhombosolea leporina*	marine wanderer
Introduced fish		
Brown trout	*Salmo trutta*	anadromous or nonmigratory
Rainbow trout	*Oncorhynchus mykiss*	anadromous or nonmigratory
European perch	*Perca fluviatilis*	nonmigratory

Table 3. Sites and physical conditions in the Manawatu, Whanganui, Patea, and Mokau rivers fished with the electrofishing boat of the University of Waikato between 17 and 20 November 2003.

Site number	Site name	Tidal influence	Macrophytes	Bank and substrate	Date	Ambient conductivity (µS cm^{-1})	Specific conductivity (µS cm^{-1})	Water temperature (^{o}C)
Manawatu River								
1	Mainstem	yes	None	Vertical clay, rock rip rap	17-Nov	126	154	15.3
2	Mainstem	yes	None	Vertical clay, rock rip rap	17-Nov	126	154	15.3
3	Mainstem	yes	None	Gently sloping sand	17-Nov	126	154	15.3
4	Mangaore Stream	no	None?	Gravel?	18-Nov	45	63	9.9
5	Koputaroa Stream	no	*Elodea*	Fine mud	18-Nov	233	301	13.2
6	Mainstem	no	None	Layered willows over sand	18-Nov	112	144	13.4
7	Mainstem	no	None	Sand	18-Nov	112	144	13.4
8	Tokomaru Stream (upstream TRB)	no	Hornwort, charophytes	Steep-sided clay banks	18-Nov	68	92	11.5
9	Tokomaru Stream (further up)	no	*Potamogeton crispus, Elodea*	Steep-sided clay banks	18-Nov	68	92	11.5
10	Tokomaru Stream (downstream TLB)	no	Hornwort, charophytes	Soft mud, willows	18-Nov	68	92	11.5
11	Mainstem at Opiki	no	None	Gravel and sand, willows in places	18-Nov	99	127	13.7
Whanganui River								
12	Upstream from boat ramp	yes	None	Gently sloping mud bank	19-Nov	81	95	17.3
13	Mainstem at Kauarapaoa Stream	yes?	None	U-shaped mud bank, some broken shell rock blocks	19-Nov	76	94	15.2
14	Upstream from Kauarapaoa Stream	yes?	None	U-shaped mud bank, overhanging willows	19-Nov	76	94	15.2
15	Upstream from Kauarapaoa Stream	yes?	None	U-shaped mud bank, overhanging willows	19-Nov	76	94	15.2
16	Mainstem mid-channel upstream	yes?	None	U-shaped mud bank, overhanging willows	19-Nov	76	94	15.2
17	Mainstem	yes?	None	U-shaped mud bank, overhanging willows	19-Nov	76	94	15.2
18	Mainstem and Upokongaro Stm confluence	yes	None	Mud in tributary, steep rock in mainstem	19-Nov	76	94	15.2
19	Mainstem and Mateongaonga Stm confluence	yes	None	Mud in tributary, steep rock in mainstem	19-Nov	76	94	15.2
Patea River								
20	Lake Rotorangi,Tangahoe, Patea River	no	None	Clay and occasional rocks, mostly vertical sides	20-Nov	99	117	16.9
21	Lake Rotorangi,Tangahoe, Patea River	no	None	Clay and occasional rocks, gently sloping shore	20-Nov	99	117	16.9
22	Lake Rotorangi,Tangahoe, Patea River	no	None	Clay and occasional rocks, mostly vertical sides	20-Nov	99	117	16.9
23	Lake Rotorangi,Tangahoe, Patea River	no	None	Clay and occasional rocks, shallow arm, lots of wood	20-Nov	99	117	16.9
24	Lake Rotorangi,Tangahoe, Patea River	no	None	Clay and occasional rocks, flat bottom	20-Nov	99	117	16.9
Mokau River								
25	Mainstem at tributary with white bridge	yes	None	Clay and soft mud	20-Nov	3383	3983	16.8
26	Mainstem at Hut Creek	yes	None	Clay and soft mud	20-Nov	110	131	16.8
27	Mainstem at Totara Stream confluence	yes	None	Clay and soft mud, willow overhanging river	20-Nov	112	134	16.5

Table 4. Fish species and shrimp caught in the Manawatu, Whanganui, Patea, and Mokau rivers with the electrofishing boat of the University of Waikato between 17 and 20 November 2003. Relative abundance: occ = occasional, com=common, abu=abundant, and blank cell = absent.

Site number	Site name	Elapsed time (mins)	Fishing time (mins)	Length fished (m)	Area fished (m^2)	Shortfinned eel	Unidentified eel	Common smelt	Inanga	Juvenile galaxiids	Common bully	Yelloweyed mullet	Grey mullet	Stargazer	Black flounder	Yellowbelly flounder	Brown trout	Rainbow trout	European perch	Shrimps	Minimum fish density (fish 100 m^{-2})
Manawatu River																					
1	Mainstem	10:00	4	50	200			com			occ	3		3		3				abu	4.5
2	Mainstem	11:00		187	748		1	80										1		abu	11.0
3	Mainstem	05:00	12	128	512			30				2		7						com	7.6
4	Mangaore Stream	26:00	25	200	800	1		40							1		3	2			5.9
5	Koputaroa Stream	20:00		378	1512	5	7	com	2						7					abu	1.4
6	Mainstem	11:00	29	166	664			7					2							com	1.4
7	Mainstem	10:00		158	632			abu												abu	
8	Tokomaru Stream (upstream TRB)	21:00		348	1392		1				1									com	0.1
9	Tokomaru Stream (further up)	09:00		193	772	4					2						2			com	1.0
10	Tokomaru Stream (downstream TLB)	21:00		348	1392	2	2						1							com	0.4
11	Mainstem at Opiki	33:00	64	300	1200	6		247			1		1				3	2		abu	21.7
Whanganui River																					
12	Upstream from boat ramp	15:00	7	100	400							1				5				abu	1.5
13	Mainstem at Kauarapaoa Stream	13:00	12	247	988	1	1	48			1				3					abu	5.5
14	Upstream from Kauarapaoa Stream	14:00	14	284	1136	2		26		3	1									abu	2.8
15	Upstream from Kauarapaoa Stream		17	340	1360		1	35	1											abu	2.7
16	Mainstem mid-channel upstream	15:00	16	954	3816		1	6													0.2
17	Mainstem	13:00	13	140	560		1	4												abu	0.9
18	Mainstem and Upokongaro Stm confluence	17:00	13	80	320	1		71	1				1				1			abu	23.4
19	Mainstem and Mateongaonga Stm confluence	18:00	7	81	324			4		1		1			1	1				abu	2.5
Patea River																					
20	Lake Rotorangi,Tangahoe, Patea River	47:00	27	813	3252	3	3				1								4		0.3
21	Lake Rotorangi,Tangahoe, Patea River	17:00	12	334	1336														1		0.1
22	Lake Rotorangi,Tangahoe, Patea River	18:00	15	172	688	4													1		0.7
23	Lake Rotorangi,Tangahoe, Patea River	20:00	15	194	776	1					com								4		0.6
24	Lake Rotorangi,Tangahoe, Patea River	05:00	2	50	200																0.0
Mokau River																					
25	Mainstem at tributary with white bridge	11:00	5	50	200							2				3					2.5
26	Mainstem at Hut Creek	19:00	14	110	440			9		1		2				1				abu	3.0
27	Mainstem at Totara Stream confluence	25:00	20	261	1044	1		10			1	4								abu	1.5

Figure 3. Fish and fishing sites from the Manawatu River. A. Koputaroa Stream; B. 500-mm long black flounder from the Koputaroa Stream; C. the electrofishing boat at Site 1; D. 150-mm long stargazer from Site 3; E. Mainstem at Opiki (Site 11); F. 500-mm rainbow trout from Site 11. Site numbers refer to the sites in Table 1.

The mainstem Whanganui River was very turbid, and had less in-stream cover than the Manawatu River (Figure 4). Lake Rotorangi was clear (Secchi depth about 4 m), and the only cover for fish was a few scattered boulders (Figure 4). No aquatic macrophytes were seen, but a few strands of oxygen weed were seen floating on the surface.

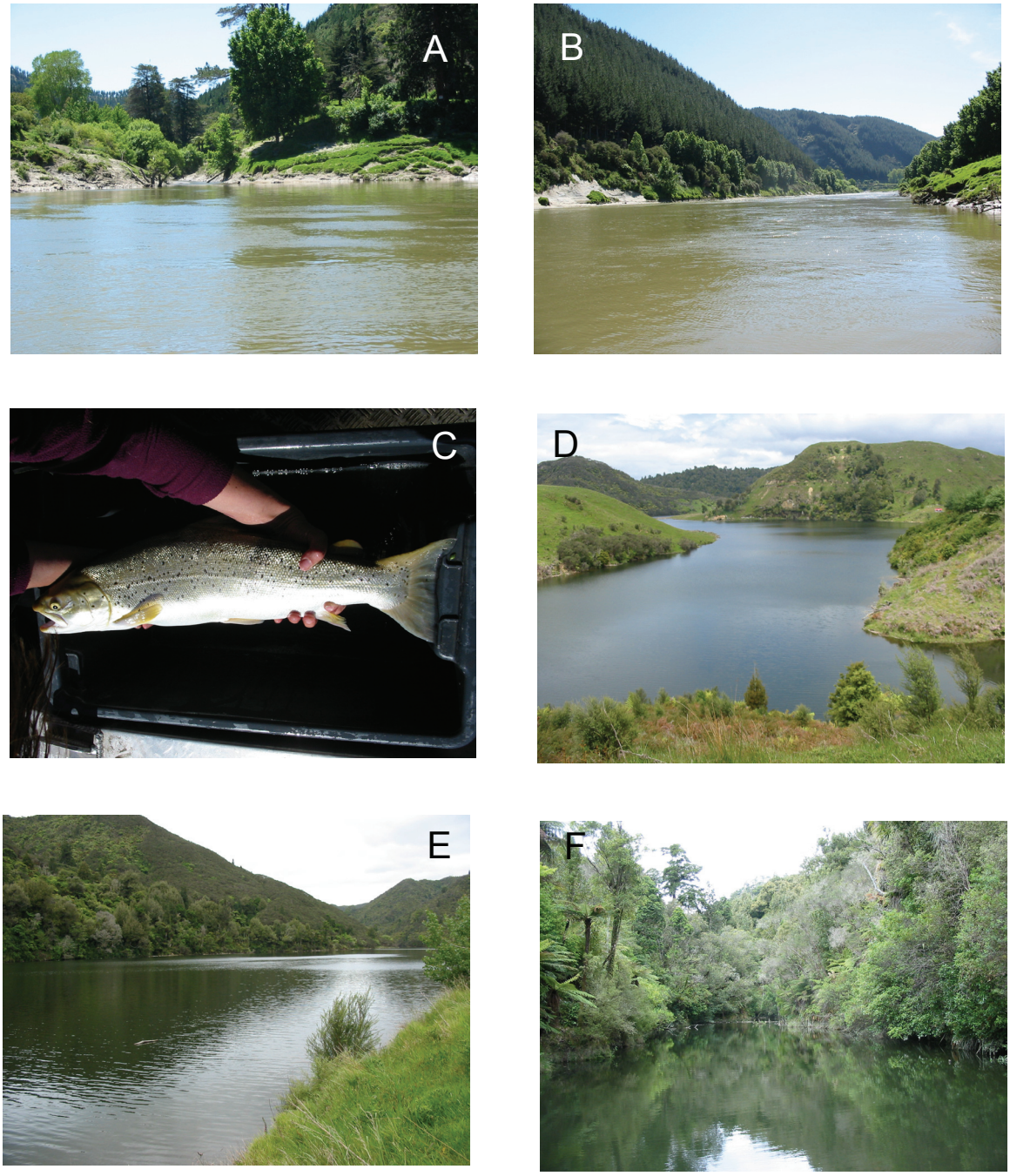

Figure 4. Habitat in the Whanganui River and Lake Rotorangi. A. The mainstem Whanganui at the Kauarapaoa Stream confluence (Site 13); B. The mainstem Whanganui at Site 15; C. 610-mm brown trout from the mainstem Whanganui at the confluence with the Upokongaro Stream; D. Lake Rotorangi viewed from the Tangahoe Valley Road; E. Lake Rotorangi at Site 24; Lake Rotorangi at Site 23. Site numbers refer to the sites in Table 1.

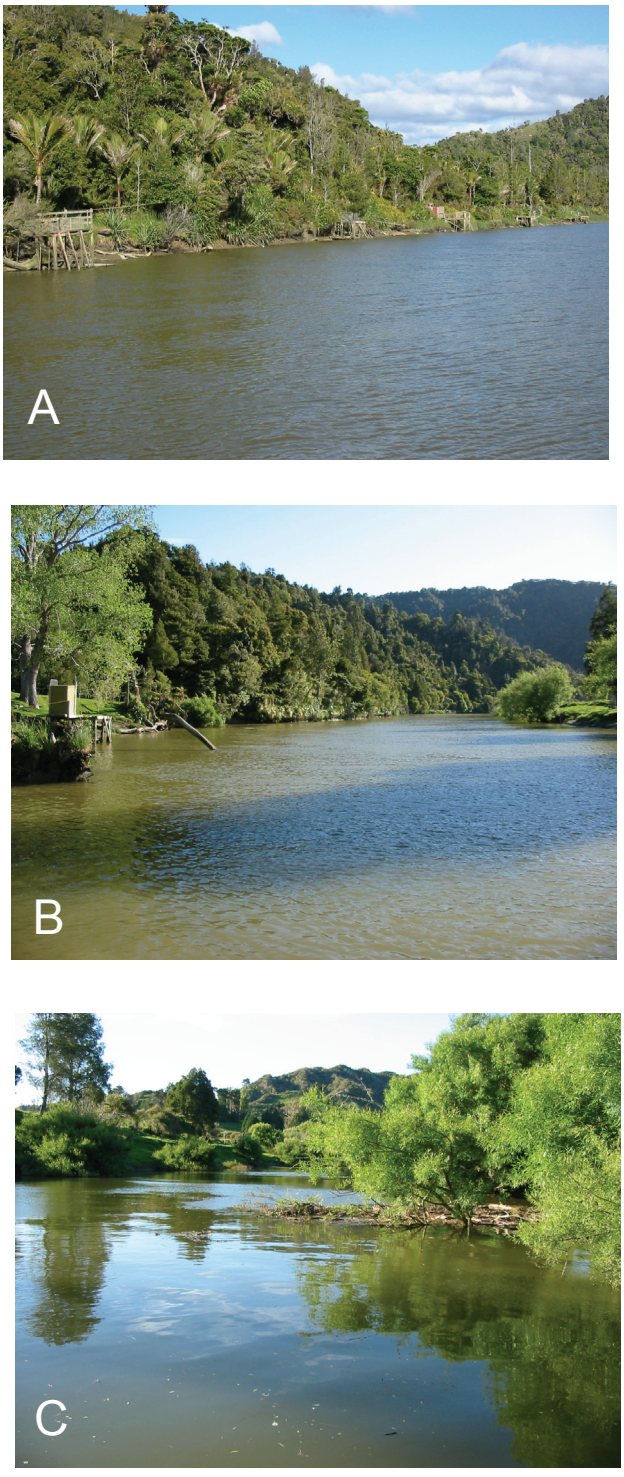

Figure 5. Mokau River. A. Whitebaiters' stands between Sites 25 and 26; B. the mainstem at Site 26; C. the mainstem at Site 27. Site numbers refer to the sites in Table 1.

4. Conclusions

A reasonable diversity of fish was caught in the four major river systems, and no fish species regarded as pests by the Department of Conservation (gambusia, rudd, koi carp) were caught. This is encouraging, as the electrofishing was very effective at all sites except Site 25 in the Mokau River, where the very high ambient conductivity prevented transfer of sufficient power to the fish. Fish densities, however, with only a few exceptions, were quite low.

We do not believe that this was a sampling problem, but rather was a true reflection of fish abundance. Boat electrofishing provides a good picture of the range of fish species present, and fishing with the electrofishing boat in the Waikato region caught a wide range of fish species in water with similar conductivities. For instance, fishing in July 2003 in a weedy side channel of the Waikato River at 10.3°C with an ambient conductivity of 114 μS cm^{-1} caught 464 fish in 75 mins in a 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 μS cm^{-1} caught 80 fish in 65 mins in 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.

Electrofishing can give 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. However, one study has shown that electrofishing can be biased towards mid-sized fish, with less efficiency for small and large fish (Bayley and Austen 2002). Catches of common smelt in many locations in our survey suggest that small fish were well represented, but some large fish probably escaped from the field as the boat approached, or as they first detected the field, but before they entered the zone of galvanotaxis.

The relationship of the fish caught to the actual number of fish present is unknown, and remains an abiding problem in fisheries research. Jowett and Richardson (1996) have suggested that for removal estimates by electrofishing in wadeable streams and rivers, the true population size (N) is 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) is:

$$N = 1.96\, F^{1.028}.$$

Our fishing used only one pass, so we probably caught about half the fish present.

We cannot exclude the possibility that pest fish might occur at sites that were not fished. Despite these limitations, we are confident that our study has provided a good summary of the fish species present in the three rivers and Lake Rotorangi, and has provided estimates of minimum densities for the sites that were fished.

5. Acknowledgements

We acknowledge the efforts of Rosemary Miller and other staff of the Department of Conservation (DOC) for their assistance with field work, and for making this investigation possible. The survey was funded by the DOC, Wanganui Conservancy. We thank June Gibbons, Tom Rouse, Jane Goodman, Andrew Mercer, Rosemary Miller, Rod Smillie, Murray Crombie, and Les Stanley for acting as crew on the boat. Ross Henderson of DOC provided the photographs used for Figures 3C and D.

6. References

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