Fish communities of Lake Whangape—February 2001 survey

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CONTENTS

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ABSTRACT

In February 2001 the Waikato Conservancy of the Department of Conservation conducted a freshwater fish survey in Lake Whangape, Waikato, New Zealand, as part of an ongoing monitoring programme in the lake. This report presents data from this survey and comments on methods used and results from a historic perspective. Fine- and coarse-meshed fake nets, gill net, and trammel nets were used to sample at onshore and offshore positions at five sites around the lake. A beach seine was used to sample small-bodied fish in the littoral zone at night. Shoreline nets caught the majority of fish and given the lack of difference in size distributions caught offshore, it is recommended that only onshore sets be used in future surveys. Coarse-meshed and fine-meshed fyke nets should be used as the sole method for sampling eel (*Anguilla* spp.) and catfish (*Ameiurus nebulosus*) populations. Seines were the most effective means of capturing small fish species and are also recommended for sole use in sampling these species in future. The size distribution of this eel fishery was skewed towards sub-commercial size classes, and was dominated by shortfin eels (*Anguilla australis*). Catches of shortfin eels of commercial size (> 220 g) comprised < 5% of the catch. This figure compares unfavourably with catches from similar nets in 1992 when commercial sizes comprised 18% of catches.

Keywords: *Anguilla australis*, *Anguilla dieffenbachii*, *Cyprinus carpio*, eels, commercial fishing, monitoring, Lake Whangape, Waikato, New Zealand

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1. Introduction

In a move to protect over-exploited eel populations in the Waikato area in 2000, the Department of Conservation (DOC) formally reminded local eel fishers that commercial fishing within Wildlife Management Reserves was prohibited. Eel fishers were also informed that in future this regulation would be enforced at priority wetlands including Lake Whangape. A monitoring programme was initiated to assess the impact of an expected reduction in fishing effort on the native fish community in Lake Whangape. It was hoped that subsequent surveys would reveal that over time:

- The length-frequency distribution of shortfin (*Anguilla australis*) and longfin eel (*Anguilla dieffenbachii*) populations would change, with an increase in the number of large (> 220 g) eels.
- Eel species proportions would change in favour of longfin eels (percent composition by number and biomass).
- Populations of other freshwater fish (especially pest fish) would be impacted (e.g. reduced abundance, change to size distributions) by greater numbers of piscivorous eels in the fish community.

The initial fish-monitoring survey was conducted in April 2000 (West et al. 2000). It was envisaged that repeat surveys would be carried out at 1, 3, 5, and 10-year intervals using the same sampling design. This report documents the results of the second survey conducted on 13/14 February 2001. A description of the study site, its historical fisheries, and geography of the lake outlet, are described in the initial baseline report (West et al. 2000). The aim of this survey was to compare data on eel length-frequency distributions and catch rates of all species, where we had sufficient data. We also wanted to compare methods used in the 2000 and 2001 surveys.

2. Methods

The sampling strategy for February 2001 closely followed that used in April 2000 (West et al. 2000), with some exceptions as described here. Sampling gear was deployed on the 13 February 2001 at the same six sites used in the 2000 survey (West et al. 2000). The site locations are illustrated in Fig. 1, and site descriptions are provided in Appendix 1.

Five different sets of sampling gear were used during the survey (Table 1). At each sit, two coarse-meshed fyke nets and two fine-meshed fyke nets were set, one of each type at onshore positions (i.e. close to the shore) and at offshore positions (i.e. approximately 100 m further into the lake). These nets were not baited. A single multi-panel gill net (10 m × 2 m panels of 25, 62, 87, and 112 mm stretched mesh) was also set at offshore positions at Sites 1, 2, 4, and 5. Night beach seines were undertaken between 10 p.m. on the 13 February and 1.30 a.m.

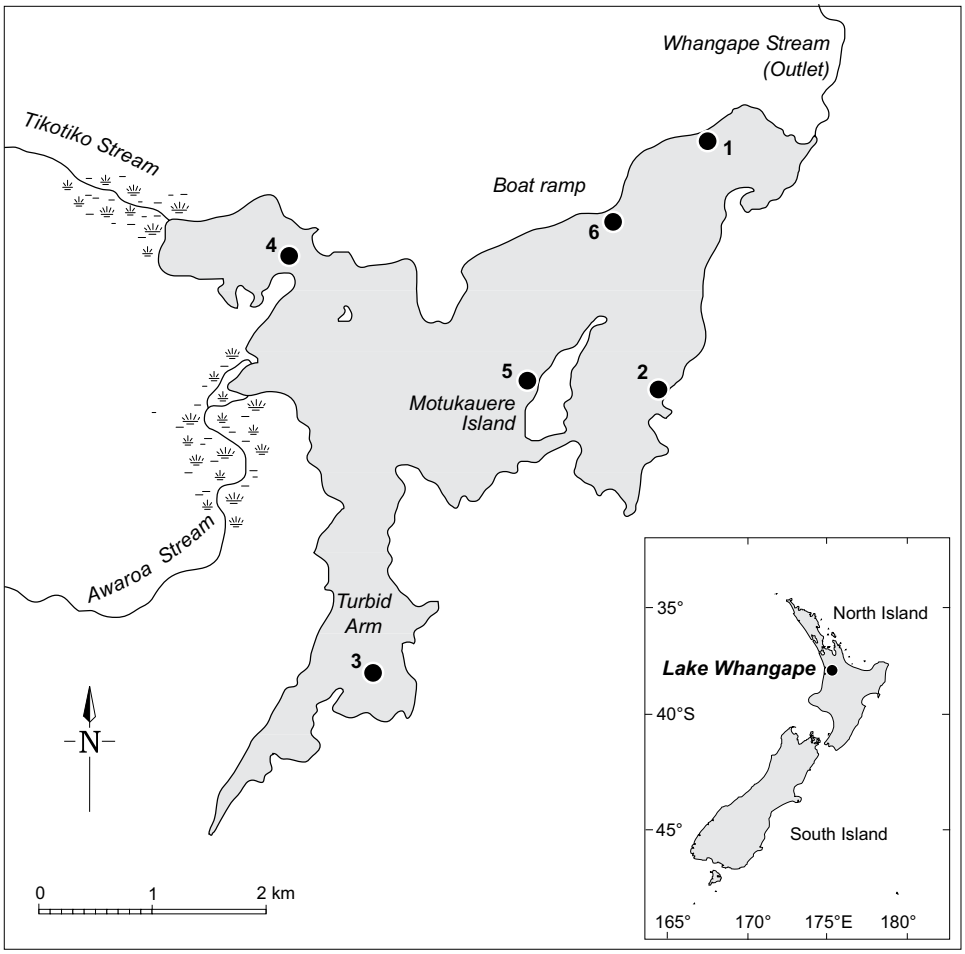

Figure 1. Lake Whangape, Waikato, with sampling sites marked and numbered 1–6. Wetlands are indicated on Tikotiko and Awaroa Streams, where they flow into the lake.

on the 14 February at Sites 2, 3, and 6. One trammel net (50 m × 1.8 m; 100 mm inside mesh; 300 mm outside mesh) was trialled as a method for targeting Koi carp (*Cyprinus carpio*) at Sites 2 and 5. Gee minnow traps were used in the 2000 survey, but not in the 2001 survey.

In most samples all fish were counted, weighed, and measured. However, in some samples where very large numbers of a species were caught, representative sub-samples were used to obtain weights or lengths.

TABLE 1. SAMPLING GEAR USED AT EACH OF THE SIX SURVEY SITES SAMPLED IN THE 2001 LAKE WHANGAPE FISH SURVEY.

	FINE-MESHED FYKE		COARSE-MESHED FYKE		GILL NET	TRAMMEL NET	SEINE NET
SITE	ONSHORE*	OFFSHORE*	ONSHORE*	OFFSHORE*			ONSHORE*
Site 1	1	1	1	1	1		
Site 2	1	1	1	1	1		2 samples
Site 3	1	1	1	1		1	3 samples
Site 4	1	1	1	1	1		
Site 5	1	1	1	1	1	1	
Site 6							3 samples

* Onshore positions = close to the shore, and offshore positions = approximately 100 m further into the lake.

Microsoft Excel 2002 was used to calculate descriptive statistics. A student *t*-test, calculated using SPSS 12.0.1, was used to compare shortfin eel lengths captured in coarse-meshed and fine-meshed fyke net samples and fyke net samples collected from onshore and offshore positions. The raw data used in this report is stored within the DOC document management exchange.

3. Results

A total of 11 species of fish were captured during the 2001 survey, including 6 native species (Table 2). The catch rates for each species at each site were strongly influenced by the sampling gear used (Table 3). Most of the koi were caught in offshore positions in a gill set at Site 1 and a trammel net set at Site 5 (Tables 2 and 3). All but one of the shortfin eels were caught in coarse-meshed and fine-meshed fyke nets. Although widely distributed around the lake, the number of shortfin eels caught at Site 4 was less than half that found at other sites where fyke nets were used (Table 3). The number of shortfin eels captured in the coarse-meshed nets was much lower than in fine-meshed fyke nets, except at Site 4 (Table 3). Seine netting was the only efficient method for capturing gambusia (*Gambusia affinis*), inanga (*Galaxias maculatus*), and smelt (*Retropinna retropinna*). Common bullies (*Gobiomorphus cotidianus*) were also caught in large numbers in the seine nets but, unlike the other small-bodied species, they were also collected in high numbers in the fine-meshed fyke nets. Mysid shrimps (*Tenagomysis* sp.) were observed in seine hauls, but quantities were not recorded. Most of the catfish were caught at Site 2 where a range of sizes were caught using the seine net (42–64 mm) and in both types of fyke nets (54–349 mm). Only relatively small numbers of goldfish (*Carassius auratus*),

TABLE 2. TOTAL NUMBERS OF ALL FISH SPECIES CAUGHT IN LAKE WHANGAPE IN ONSHORE AND OFFSHORE POSITIONS AND FOR EACH NET TYPE USED DURING SAMPLING IN FEBRUARY 2001.

POSITION/ NET-TYPE	*n*	CAT-FISH	COMMON BULLY	MOSQUITO FISH	GOLD-FISH	GREY MULLET	INA-NGA	KOI	RUDD	SMELT	SF EEL	LF EEL
Onshore												
Coarse-mesh fyke	5	31	2	–	3	3	–	1	1	–	45	–
Fine-mesh fyke	5	6	127	10	2	–	–	–	–	1	285	–
Gill net	0	–	–	–	–	–	–	2	–	–	–	–
Seine	8	41	235	426	23	–	264	2	–	140	16	1
Inshore total		78	364	436	28	3	264	5	1	141	346	1
Offshore												
Coarse-mesh fyke	5	–	–	–	–	–	–	–	–	–	27	–
Fine-mesh fyke	5	9	93	1	3	–	1	–	–	–	252	–
Gill net	4	–	–	–	–	–	–	13	–	–	–	–
Trammel net	2	1	–	–	–	–	–	13	–	–	–	–
Offshore total		10	93	1	3	–	1	26	–	–	279	–
Grand total		88	457	437	31	3	265	31	1	141	625	1

TABLE 3. TOTAL NUMBERS OF ALL FISH SPECIES CAUGHT IN LAKE WHANGAPE FEBRUARY 2001, AND CATCH PER UNIT EFFORT (CPUE) FOR SEINE NET SAMPLES AND SHORTFIN EEL SAMPLES FROM COARSE- AND FINE-MESHED FYKE NETS.

SITE	NET TYPE	*n*	SHORTFIN EEL	LONGFIN EEL	COMMON BULLY	INANGA	SMELT	GREY MULLET	GAM-BUSIA	CATFISH	GOLD-FISH	KOI	RUDD
1	Coarse-mesh fyke	2	4	–	2	–	–	–	–	2	3	1	–
	Fine-mesh fyke	2	123	–	48	–	–	–	–	8	4	–	–
	Gill net	1	–	–	–	–	–	–	–	–	–	13	–
2	Coarse-mesh fyke	2	23	–	–	–	–	–	–	29	–	–	–
	Fine-mesh fyke	2	158	–	59	–	–	–	9	7	–	–	–
	Gill net	1	–	–	–	–	–	–	–	–	–	–	–
	Seine	2	1	–	42	34	34	–	218	41	7	–	–
3	Coarse-mesh fyke	2	4	–	–	–	–	–	–	–	–	–	–
	Fine-mesh fyke	2	104	–	21	–	1	–	–	–	–	–	–
	Seine	3	5	–	166	99	55	–	116	–	4	–	–
	Trammel net	1	–	–	–	–	–	–	–	1	–	–	–
4	Coarse-mesh fyke	2	25	–	–	–	–	3	–	–	–	–	1
	Fine-mesh fyke	2	26	–	19	1	–	–	1	–	–	–	–
	Gill net	1	–	–	–	–	–	–	–	–	–	1	–
5	Coarse-mesh fyke	2	16	–	–	–	–	–	–	–	–	–	–
	Fine-mesh fyke	2	126	–	73	–	–	–	1	–	1	–	–
	Gill net	1	–	–	–	–	–	–	–	–	–	1	–
	Trammel net	1	–	–	–	–	–	–	–	–	–	13	–
6	Seine	3	10	1	27	131	51	–	92	–	12	2	–
Total fish caught			625	1	457	265	141	3	437	88	31	31	1
CPUE													
Seine (mean fish^{-1} seine^{-1})			2.00	0.13	29.38	33.00	17.5	–	53.25	5.13	2.88	0.25	–
Coarse fyke (mean fish^{-1} net^{-1})			7.20	–	–	–	–	–	–	–	–	–	–
Fine-mesh fyke (mean fish^{-1} net^{-1})			53.70	–	–	–	–	–	–	–	–	–	–

rudd (*Scardinius erythrophthalmus*), and grey mullet (*Mugil cephalus*) were caught, and only one longfin eel was captured.

Total catches in the fine-meshed fyke nets were similar in both offshore and onshore positions (Table 2). Coarse-meshed fyke nets, however, caught more fish and a greater number of species when set onshore.

The size distributions for shortfin eels caught in the 2001 survey were very similar to those in the 2000 survey (Fig. 2). The mean length of shortfin eels captured in coarse-meshed fyke nets was significantly longer ($P < 0.001$) than those caught in fine-meshed fyke nets (Table 4). The position of the fyke nets had a significant effect ($P = 0.044$) on the mean length of shortfin eels caught, but the difference was only 12 mm and there was almost a complete overlap in ranges of lengths (Table 4).

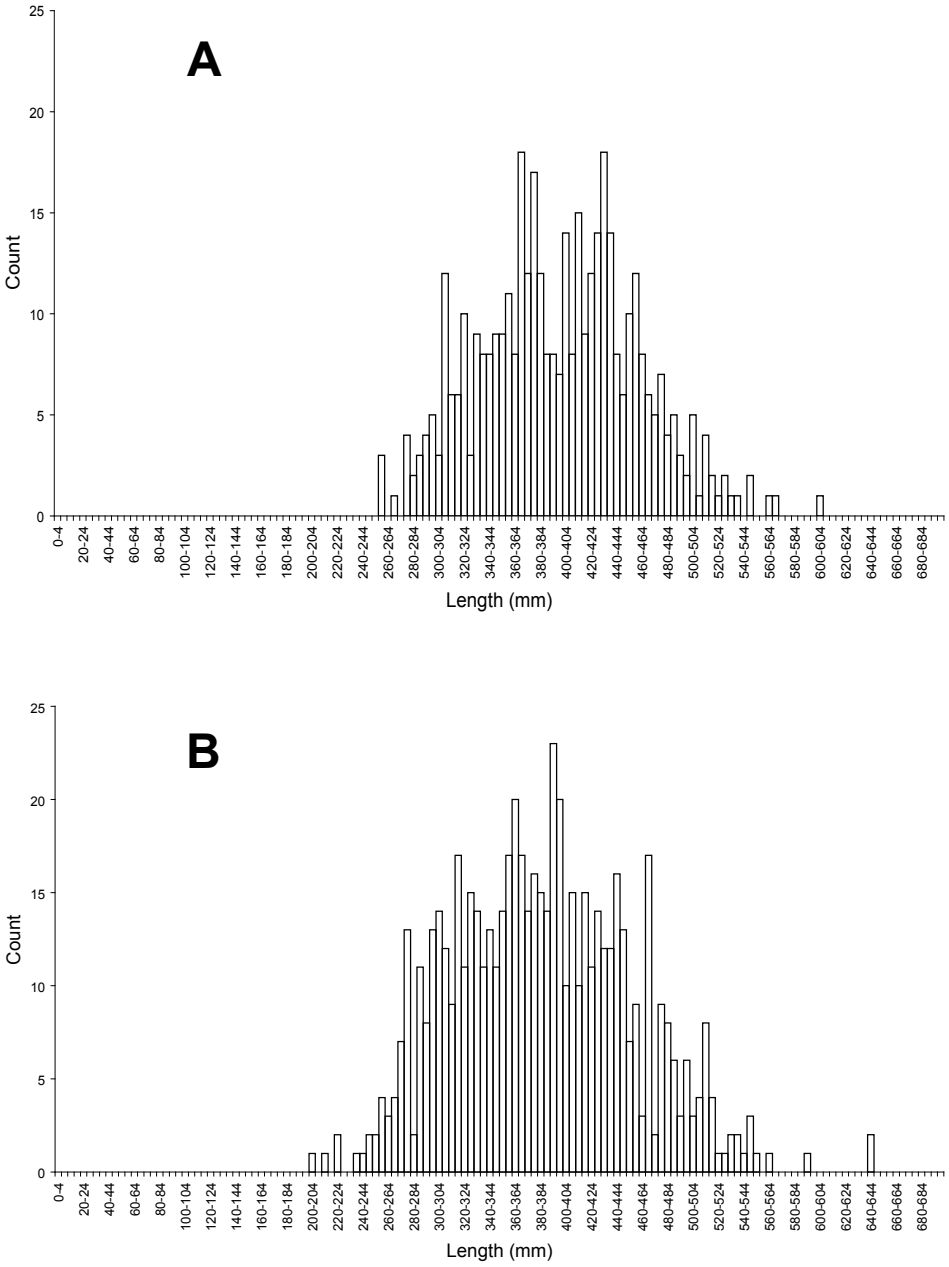

Figure 2. Length-frequency distributions of shortfin eels (*Anguilla australis*). **A**. From combined catches of small fine-meshed fyke nets and large fine-meshed fyke nets (superfykes) in Lake Whangape April 2000 (n = 400). **B**. From combined catches of fine-meshed and coarse-meshed fyke nets in Lake Whangape February 2001 (n = 604). (Re-plotted data from West et al. 2000.)

TABLE 4. COMPARISON OF THE LENGTHS OF SHORTFIN EELS (*Anguilla australis*) IN SAMPLES COLLECTED FROM COURSE-MESHED AND FINE-MESHED FYKE NETS AND ONSHORE AND OFFSHORE NET POSITIONS IN LAKE WHANGAPE, FEBRUARY 2001.

	n	MEAN	RANGE	STANDARD DEVIATION	95% CONFIDENCE INTERVAL	*t*-VALUE	df	*P*-VALUE
Onshore positions (both net types)	330	372	196–639	73	65–81	–2.018	594	0.044
Offshore positions (both net types)	274	384	205–638	68	60–76			
Coarse-mesh fyke nets	72	428	325–534	52	40–64	8.465	109	0.000
Fine-mesh fyke nets	532	370	196–639	70	64–76			

4. Discussion

The methods adopted in 2001 improved sampling efficiencies over the methods used in 2000, and produced comparable size distributions for eels. The proportionately greater catch of larger eels in coarse-meshed fyke nets complemented proportionately greater catches of smaller eels in fine-meshed fyke nets. However, lower catches of eels across all sets of gear used in open-water sites suggest that open-water sites could be dropped from future sampling in favour of increasing effort along the shoreline. This change in sampling methods was originally recommended by West et al. (2000), but was not implemented for the 2001 survey. Given that size distributions of eels from nets were not substantially different between offshore and onshore positions, this change to sampling protocols should not confound future surveys.

Almost twice as many shortfin eels were captured in the February 2001 survey than in the April 2000 survey. This might be a reflection of the cooler water temperatures that would be expected in April compared with February; however, no water temperature data was recorded during the 2001 survey. Lunar phase is known to affect catch rates for some eels under certain conditions, with lower catch rates recorded during the full-moon phase (Jellyman & Chisnall 1999). The 2000 survey was conducted during the full-moon phase (West et al. 2000) while the 2001 survey was conducted close to the last quarter (MacDonald Observatory 2006). This suggests that differences in lunar phase might also have had an influence on the lower catch recorded in 2000 compared with 2001. The effect of water temperature and moon phase on catch rates was recognised by West et al. (2000). West et al. (2000) recommended that the 2001 survey be conducted in summer, and at a time that did not coincide with a full-moon phase, to increase catch rates.

Only three grey mullet were captured in the 2001 survey and none were captured in gill nets. This is a considerably lower catch rate for this species than has been recorded in earlier surveys. A total of 184 grey mullet were caught using gill nets in two separate surveys conducted in 1986/87 and 2000 using 6 net nights and 10 net nights respectively (Hayes 1989; West et al. 2000). This decrease in the capture rates for grey mullet may be due to restricted access into Lake Whangape

over the outlet weir, to commercial fishing, or to a low fishing effort. The weir was first constructed in the early 1990s and grey mullet are known to be poor climbers (Chisnall & Bellingham 1998). Commercial fishers have continued to take grey mullet from Lake Whangape since 2000 (Kevin Hutchinson, DOC, pers. comm.) and this fishing pressure may have also contributed to the lower catch rates observed in the 2001 survey. Grey mullet are a schooling species and would therefore have a patchy distribution in Lake Whangape. It is possible that by chance grey mullet schools did not encounter any of the four gill nets set in the 2001 survey. A more rigorous sampling design incorporating a greater number of net nights would be required to confidently detect any changes in grey mullet populations in Lake Whangape.

The size-distribution of the eel fishery was skewed towards sub-commercial size classes, and was dominated by shortfin eels. This condition is similar to many other exploited North Island lowland waterways (Chisnall & Kemp 2000). Catches of shortfin eels of commercial size (> 220 g) comprised < 4% of the April 2000 catches and < 5% of the February 2001 catches. These proportions compare very unfavourably with the commercial component of catches in previous surveys. In a survey using superfykes (special large fine-meshed fyke nets) in 1992 the commercial component of the eel catch was 18% (NIWA unpublished data, reported in West et al. 2000). An earlier survey in 1987/88 using the same large fine-meshed fyke nets found a commercial component of 8% (Hayes et al. 1990), suggesting the proportion of takeable eels in the population may fluctuate.

Longfin eels are very scarce in Lake Whangape, with only a few individuals recorded in fish surveys conducted in the lake over the last 20 years. Only one longfin eel was caught in the 2001 survey, which is less than the seven caught in 2000, but is comparable with a survey conducted in 1986/87 when no longfin eels were captured (Hayes 1989).

Gill and trammel nets were the only nets that were effective for sampling koi carp. One of the recommendation of the 2000 fish survey report (West et al. 2000) was that alternative methods should be used for sampling koi, including trammel nets. While only two trammel nets were set in 2001 it appears that these nets are not much more efficient at catching koi than gill nets. It is recommended that either a greater number of trammel and gill nets are used in future surveys, or an alternative method for sampling koi be adopted (e.g. boat electrofishing). Another issue with respect to monitoring the koi population in Lake Whangape is that koi are very mobile and widespread throughout the lower Waikato River catchment. It is unlikely that the Whangape outlet weir would restrict the movement of koi, given their ability to negotiate low barriers (Stuart & Jones 2002). The movement of koi in and out of Lake Whangape will make it very difficult to detect any changes in the Lake Whangape koi population which occur in response to decreased fishing pressure by predatory eels.

5. Recommendations

Comparison of catches in freshwater ecosystems between sampling years is fraught with problems. Catch rates, species, and size class compositions can be extremely variable and are readily influenced by a range of factors including season (e.g. water temperature and level), site (habitat quality and quantity), and lunar phase (Jellyman & Chisnall 1999). Given these factors, it is important for any realistic long-term monitoring of fish communities to be as consistent as possible with respect to timing and sampling design. The next round of monitoring in Lake Whangape was due to occur 2005, but has recently been programmed to occur in 2006. The following recommendations are made with respect to future surveys of the fish community in Lake Whangape:

- Re-allocate fishing effort to the shoreline position only and intersperse fine with coarse meshed fyke nets.
- When possible, use superfykes to enable historical comparisons.
- Night seines should be used at all sites, if possible, as this method is the only method suitable for sampling small-bodied fish species.
- Trial the use of small-meshed gill nets used as seines at night along foreshores to target juvenile koi (as recommended by West et al. 2000).
- Develop improved methods for targeting larger koi. This may involve greater use of gill and trammel nets, or new techniques such as boat electrofishing.
- In future surveys, all fish captured should be counted (as previously), but only retain eels and catfish for measurement from coarse- and fine-meshed fyke nets. Grey mullet, koi carp, and goldfish should be measured from gill nets. Inanga, smelt, common bullies, and gambusia should be collected and measured from night seines.
- Conduct a survey of local farmers bordering the lake to gather information on illicit fishing effort over the last five years.
- Assessment of the presence of mysid shrimps should be retained.
- A description of habitat types present and fished should be undertaken on each visit (perhaps using aerial photography if possible). For example, assess proportions of wetland/raupo margin versus shallow open water (< 0.5 m), deep open water (> 1 m), and open water with macrophyte pockets. Macrophyte composition should also be identified.
- Measure water-quality variables, especially water temperature, during each survey.
- To maximise the catch rates for eels, future surveys must not be conducted during the full-moon phase.
- Water-level data should be obtained for the period between fish surveys and used to assess changes in habitat condition and access over the weir.
- Sets of sampling gear should be used consistently at each site to allow better comparisons to be made between sites.

6. Acknowledgements

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Appendix 1

SITE DESCRIPTIONS

The following are descriptions of the sites in April 2000 followed by an interpretation of sampling in February 2001 from hard copy notation.

Site 1

Located below the old Wildlife Service hut. Dense Ceratophyllum beds with soft mud bottom out to 30 m offshore. All fyke nets set inshore of maimai with the gillnet set off snags nearby.

Site 2

Located offshore of pines and patch of raupo, hut by shore 100 m south. Dense *Ceratophyllum* beds with soft mud bottom out to 100 m offshore. A trammel gill net was set off raupo in open water here. The panel gill net and all fyke nets were set inshore, two fyke nets near macrophyte beds and the other two onshore.

Site 3

Located on the eastern side of the arm below the castle-style house. Water in arm very turbid and no beds of macrophytes were seen. Eastern shoreline grazed, with exposed clay predominating in the wave zone.

Site 4

Located in the Tikotiko Stream arm by existing maimai on southern side of arm. Shallow arm with bottom of thick layer of silt amongst *Ceratophyllum* beds. Large numbers of swan seen at entrance to arm.

Site 5

On the western shore of Motukauere Is. Shallow exposed clay and sand shore with *Ceratophyllum* beds occurring 20–30 m offshore.

Site 6

Boat ramp situated on the northern shore of the lake. Access is from the Glen Murray–Rangariri Road. No record of habitat availability was made at the time of the survey.