Wairarapa Moana Fish Survey 2010

Native giant kokopu *Galaxias argenteus*. Once widespread throughout Wairarapa Moana

Prepared for

Wairarapa Moana Wetlands Group

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Contents

1.1 Executive summary

- Nine sites covering 6 waterbodies across Wairarapa Moana were surveyed over autumn 2010 using 5 different netting and trapping methods.

- A total of 873 fish were captured, representing 11 native species (2 threatened species) and 4 exotic species. Five species of native crustacean (1 threatened species) were also found.

- Indigenous biodiversity has declined across Wairarapa Moana alongside an increase in incidence of exotic species. After shortfin eels, perch were the dominant large-bodied species found across Wairarapa Moana. Perch were recorded in all waterbodies except Lake Onoke. The noxious rudd population in Lake Wairarapa appears to be increasing.

- Longfin eel numbers are extremely low. Urgent action and education is required locally and nationally to prevent this species becoming extinct.

1.2 Recommendations

- Further surveying in additional areas of Wairarapa Moana high country riverine sites would identify sites of high aquatic ecological significance where diadromous native species have retained access from the sea along with adequate residential habitat. Identification of such high value sites would be the first step towards protection and/or restoration of sites and access streams.

- Further surveying in additional remnant wetlands peripheral to Lakes Wairarapa and Onoke (e.g. the Pounui Lagoon) would broaden knowledge and provide further baseline data regarding distributions of indigenous species and advent of exotic species.

- Implementing urgent measures to protect threatened, endemic longfin eel populations is essential to prevent this species becoming extinct. Any illegal commercial fishing in Lake Wairarapa should be immediately curtailed. The effects of recreational/customary eeling could be reduced through education in the form of public talks or signage at popular eeling areas detailing the differences between longfin and shortfin eels and the implications of those differences. Facilitation of a community-led moratorium/rahui on all take (commercial and recreational) of longfin eels is my recommendation.

- Identification of historic sites where the threatened brown mudfish have been recorded (desktop exercise) and revisitation to establish A: whether habitat still exists and B: whether mudfish still occur. This would provide a quantitative picture of the decline of wetland species across Wairarapa Moana and establish the degree of urgency with which remaining sites need to be prioritised for protection and/or restoration.

- Surveying the Lake Wairarapa threatened kakahi population would provide valuable information regarding this species long-term persistence. This population is likely

providing a high degree of sediment filtration in the lake and has never been studied. Size frequency distributions are particularly needed as a long lived organism such as the kakahi that shows uniform, large size distributions will likely indicate that this species will soon be extinct in Lake Wairarapa. Kakahi surveying in Lake Pounui would also be useful to confirm whether or not local extinction has already occurred in this lake.

- Controlling perch numbers through systematic removal using nets and traps would reduce predation and competition pressure on native fish, thereby restoring and protecting components of indigenous biodiversity in Lake Wairarapa. Boggy Pond and/or Matthew's Lagoon would provide suitable experimental situations to establish netting effort and time required in order to achieve population reductions.

- Research into competitive dynamics between flounder and perch and between eels and perch would provide greater understanding and quantification of some of the negative effects that perch are likely having on the Lake Wairarapa indigenous ecosystem.

2. Aim and scope of this study

This study aimed to provide information regarding fish communities across Wairarapa Moana as previous surveying has been rare or non-existent. Anecdotal evidence tells us that pronounced declines in indigenous biodiversity have occurred in recent times (due to wetland drainage, forest clearance, river diversion and management and eutrophication) but little of this has been quantitatively documented due to lack of historical standardised data. The present work aimed to establish baseline data regarding fish distributions in open water and littoral margin habitats across Wairarapa Moana. Also reported on are observations of native crustacean distributions, comparisons with historical data, nativeness, discussion regarding control of exotic species and capture efficacy of various net types.

3. Study area

Wairarapa Moana consists of Lakes Wairarapa & Onoke, and their associated remnant wetlands and forest fragments located in the Southern Wairarapa Valley. Lake Wairarapa is a large (18km long; 6km wide), shallow (mostly <2.5m deep) supertrophic lake located in the lower North Island, New Zealand. Historically, the Ruamahanga River flowed through both Lake Wairarapa and Lake Onoke – a system that contained extensive wetland areas and provided habitat and access for large numbers of diadromous[1] native fish species. As a flood-protection initiative completed in 1974, the Ruamahanga was diverted away from Lake Wairarapa and barrage gates were installed at the southern end of the lake. These changes appear to have severely affected the ability of many species to migrate and native fish populations in Lake Wairarapa have dramatically declined or been apparently extirpated as a result (Hicks 1993). In addition, exotic non-diadromous species have been introduced to Lake Wairarapa, creating further changes in the fish community. Lake Onoke now links the Ruamahanga River directly to the sea, as well as providing the link between the sea and Lake Pounui. Lake Onoke is periodically blocked off from the sea by wave action on the Onoke spit - as a result,

[1] Diadromous: an aquatic animal that completes part of its life cycle in freshwater and part in saltwater. New Zealand has a high proportion of diadromous species in its native freshwater fauna.

land managers artificially manage the bar opening to avoid farmland becoming inundated.

The nine sites that were selected for surveying (Fig. 1) included 3 sites in Lake Wairarapa (northern, western and southern); 1 site in Barton's Lagoon – a remnant wetland at the northern end of Lake Wairarapa; 1 site each in Boggy Pond and Matthew's Lagoon – remnant wetlands on the eastern shore of Lake Wairarapa; 2 sites in Lake Onoke (eastern and western) and 1 site in Lake Pounui – the surrounding land of which has retained forest cover (not been cleared for farming) so maintains better water quality than other Wairarapa Moana waterbodies.

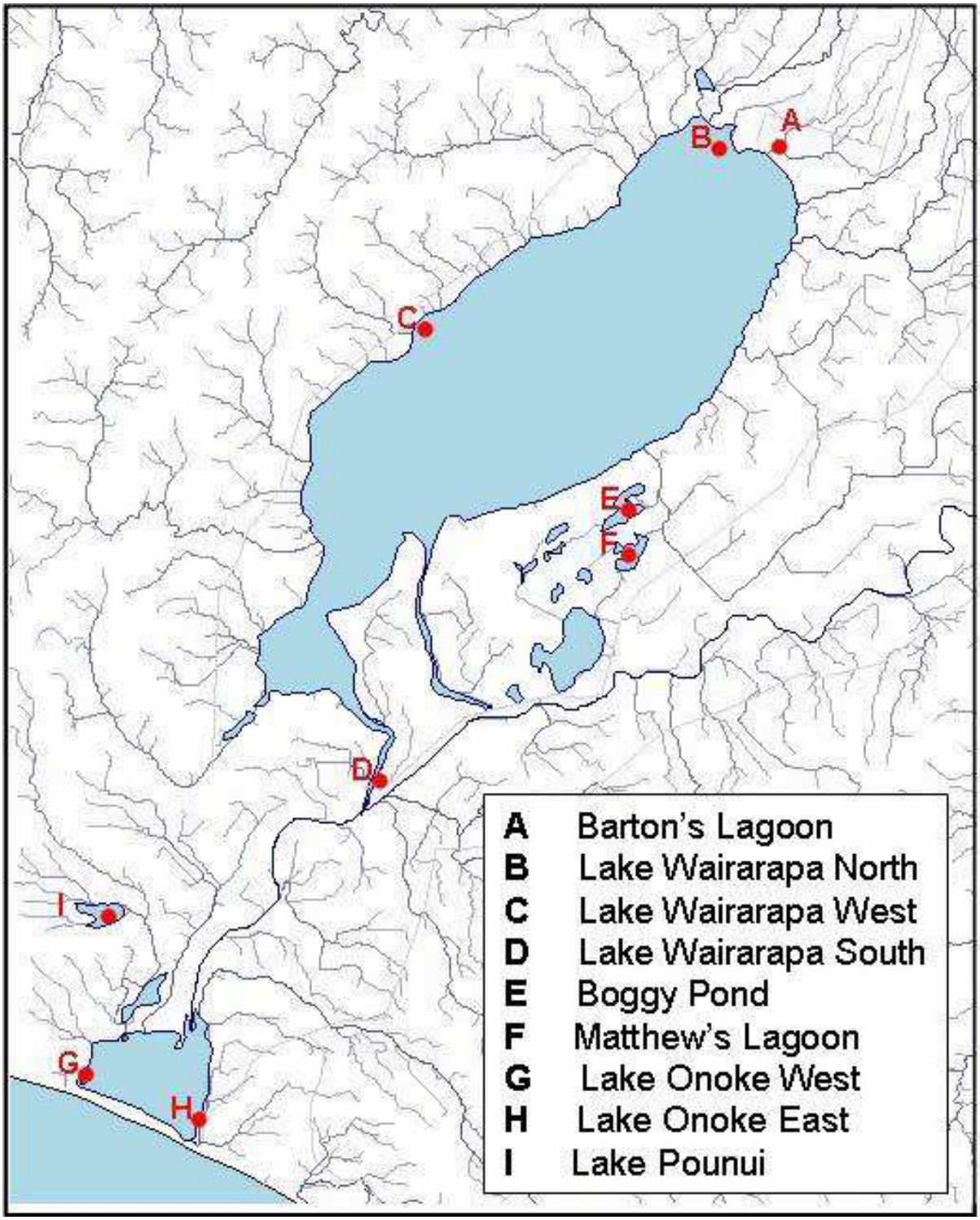

Figure 1. Map showing the waterbodies of Wairarapa Moana and the sites included in the present survey.

4. Existing fish data available

4.1 Barton's Lagoon

No prior records are available for Barton's Lagoon

4.2 Lake Wairarapa

Survey records from Lake Wairarapa are available from the New Zealand Freshwater Fish Database (NZFFD) dating back to the 1960s (Table 1). All earlier records report the presence of native and endemic species only (i.e. no exotic species were found). Additional records from 1991 up until 2009 report the presence of introduced species: brown trout, perch, rudd and tench. The native common bully and common smelt are present throughout the survey record, while lamprey and the galaxiid species, giant kokopu and banded kokopu (adult whitebait) have not been recorded in Lake Wairarapa since the 1960s.

Table 1. Records from the New Zealand Freshwater Fish Database, from a survey conducted in 1991 (Hicks 1993) and a survey conducted in 2009 (McEwan 2009) of fish species caught in Lake Wairarapa. DB: Database record; H: 1991 survey record; M: 2009 survey record. *denotes exotic species

Year(s)	Scientific name	Common name
1961[DB], 1991[H], 2009[M]	*Anguilla australis*	shortfin eel
1961 [DB], 1991[H], 2009[M]	*Anguilla dieffenbachii*	longfin eel
1961 [DB]	*Cheimarrichthys fosteri*	torrentfish
1961 [DB]	*Galaxias argenteus*	giant kokopu
1961 [DB]	*Galaxias fasciatus*	banded kokopu
1961 [DB]	*Geotria australis*	lamprey
1961 [DB], 1991[H], 2007 [DB], 2009[M]	*Gobiomorphus cotidianus*	common bully
1961 [DB], 1991[H], 2007 [DB], 2009[M]	*Retropinna retropinna*	common smelt
1991[H], 2009[M]	*Salmo trutta**	brown trout

1991[H], 2009[M]	*Aldrichetta forsteri*	yellow eyed mullet
1991[H], 2009[M]	*Galaxias maculatus*	inanga
1991[H], 2009[M]	*Mugil cephalus*	grey mullet
1991[H], 2009[M]	*Perca fluviatilis**	perch
1996 [DB], 1998 [DB], 2009[M]	*Scardinius erythrophthalmus**	rudd
1996 [DB], 1998 [DB]	*Tinca tinca**	tench
2002 [DB]	*Carassius auratus**	goldfish
2009[M]	*Rhombosolea retiaria*	black flounder

4.3 Boggy Pond

Two survey records are available for Boggy Pond, both from the NZFFD. The first survey occurred in 1997 and recorded the endemic species brown mudfish and longfin eel. The second occurred in 2002 and recorded an unidentified eel species, the endemic common bully and 2 introduced species, rudd and goldfish (Table 2).

Table 2. Records from the New Zealand Freshwater Fish Database of fish species caught in Boggy Pond. DB: Database record. *denotes exotic species

Year(s)	**Scientific name**	**Common name**
1997[DB]	*Neochanna apoda*	brown mudfish
1997 [DB]	*Anguilla dieffenbachii*	longfin eel
2002[DB]	*Anguilla sp*	unidentified eel
2002 [DB]	*Gobiomorphus cotidianus*	common bully
2002[DB]	*Scardinius erythrophthalmus**	rudd
2002[DB]	*Carassius auratus**	goldfish

4.4 Matthew's Lagoon

No prior records are available for Matthew's Lagoon

4.5 Lake Onoke

NZFFD records report surveys conducted in 1991, 1995, 2005 and 2009 along with 2 isolated observations in 1980 and 1997 (Chinook salmon and giant kokopu respectively) are available (Table 3). Hicks (1993) also conducted a survey in 1991. Species with a range of salinity tolerances are present throughout the survey record, including those not found in other waterbodies within Wairarapa Moana e.g. kahawai, estuarine triplefin and stargazer.

Table 3. Records from the New Zealand Freshwater Fish Database and from a survey conducted in 1991 (Hicks 1993) of fish species caught in Lake Onoke. DB: Database record; H: 1991 survey record. *denotes exotic species

Year(s)	Scientific name	Common name
1980[DB]	*Oncorhynchus tshawytscha**	chinook salmon
1991[H]	*Galaxias fasciatus*	banded kokopu
1991[H]	*Arripis trutta*	kahawai
1991[DB]	*Perca fluviatilis**	perch
1991[DB,H]	*Salmo trutta**	brown trout
1991[DB,H], 1995[DB]	*Anguilla australis*	shortfin eel
1991[DB.H], 1995[DB]	*Anguilla dieffenbachii*	longfin eel
1991[H], 1995[DB]	*Gobiomorphus cotidianus*	common bully
1991[DB,H], 2005[DB], 2009[DB]	*Aldrichetta forsteri*	yellow eyed mullet
1991[DB,H], 1995[DB], 2005[DB], 2009[DB]	*Galaxias maculatus*	inanga
1995[DB,H], 2005[DB], 2009[DB]	*Forsterygion sp*	estuarine triplefin
1991[DB,H], 2005[DB], 2009[DB]	*Retropinna retropinna*	common smelt
1991[DB], 2009[DB]	*Mugil cephalus*	grey mullet
1991[DB,H], 2009[DB]	*Rhombosolea retiaria*	black flounder
1995[DB]	*Leptoscopus macropygus*	stargazer
1995[DB]	*Rhombosolea leporina*	yellow belly flounder
1997[DB]	*Galaxias argenteus*	giant kokopu
2005[DB]	*Carassius auratus**	goldfish

4.6 Lake Pounui

Results from 2 individual surveys conducted in 1997 (February and August) are available from the NZFFD along with the results of a WRC-commissioned survey conducted in 2003 (Joy 2003; Table 4). The introduced species brown trout and perch have been present in Lake Pounui since before 1997. This year was also the last time that the endemic brown mudfish was recorded in the lake.

Table 4. Records from the New Zealand Freshwater Fish Database (1977a: February; 1977b: August) and from a survey conducted in 1993 (Joy 2003) of fish species caught in Lake Pounui. DB: Database record; J: 2003 survey record. *denotes exotic species

Year(s)	Scientific name	Common name
1977a[DB]	*Neochanna apoda*	brown mudfish
1977a[DB], 1977b[DB]	*Galaxias fasciatus*	banded kokopu
1977a[DB], 1977b[DB]	*Galaxias argenteus*	giant kokopu
1977a[DB], 1977b[DB], 2003[J]	*Anguilla australis*	shortfin eel
1977a[DB], 1977b[DB], 2003[J]	*Anguilla dieffenbachii*	longfin eel
1977b[DB], 2003[J]	*Perca fluviatilis**	perch
1977b[DB], 2003[J]	*Salmo trutta**	brown trout
1977b[DB], 2003[J]	*Gobiomorphus cotidianus*	common bully
1997b[DB], 2003[J]	*Retropinna retropinna*	common smelt
1997b[DB], 2003[J]	*Paranephrops planifrons*	freshwater crayfish/koura

5. SURVEY METHODS

Five different netting and trapping methods were employed at 9 sites covering 6 waterbodies. At each site, a 20m cotton trammel set net and a 30m monofilament trammel set net, 2 large mesh fyke nets, 4 3mm gee minnow traps were set

overnight in open water and littoral margins. Sites were also dragged once each with a 10m handheld Danish seine net. All sites were surveyed across April – June 2010. All fish were identified to species and their total length recorded. All perch were sexed if possible. Most fish were euthanized using the iki method although those that were able to be removed from the net alive were returned to the water (e.g. flounder were usually only lightly tangled whereas perch and brown trout were heavily enmeshed and usually dead when the net was lifted. All rudd were euthanized as they are classed as a noxious species). Comprehensive decontamination procedures were followed using saline solution and sunlight exposure to eliminate the possibility of organism transfer between sites.

6. SURVEY RESULTS

6.1 Overall

In total, 863 fish were captured and identified. Eleven native fish species, 5 native crustacean species and 4 exotic fish species were found in the waterbodies surveyed (Table 5). Of the large-bodied fish species, the most numerically dominant was the native shortfin eel (*Anguilla australis*), followed by the exotic perch (*Perca fluviatilis*). Of the small-bodied species, the most numerically dominant was the endemic common bully (*Gobiomorphus cotidianus*). The shortfin eel, common bully and perch were widespread, occurring in all 6 waterbodies surveyed. Five fish species (yellowbelly flounder (*Rhombosolea leporina*), estuarine triplefin (*Forsterygion nigripenne*), grey mullet (*Mugil cephalus*), inanga (*Galaxias maculatus*) and giant kokopu (*Galaxias argenteus*)) were only found in 1 of the 6 waterbodies surveyed.

Table 5. Fish and crustacean species captured across Wairarapa Moana in autumn 2010. * denotes exotic species. As a matter of interest, the threatened freshwater mussel or kakahi was observed in Lake Wairarapa and Lake Pounui.

			Barton's Lagoon (1 site)	**Lake Wairarapa (3 sites)**	**Boggy Pond (1 site)**	**Matthew's Lagoon (1 site)**	**Lake Onoke (2 sites)**	**Lake Pounui (1 site)**	**Total**
Scientific name	**Common name**	**Capture method**							
Aldrichetta forsteri	Yellow eyed mullet	Mono trammel net Cotton trammel net Fyke net Seine net	-	1	-	-	30	-	**31**
Anguilla australis	Shortfin eel	Fyke net Minnow trap	10	70	18	64	2	3	**167**
Anguilla dieffenbachii	Longfin eel	Fyke net	2	1	-	-	-	8	**11**
*Carassius auratus**	Goldfish	Minnow trap Seine net	-	-	6	2	-	-	**8**
Hemigrapsus crenulatus	Hairy handed mud crab	Mono trammel Cotton trammel Fyke net Minnow trap	-	-	-	-	25	-	**25**
Galaxias argenteus	Giant kokopu	Cotton trammel net	-	-	-	-	-	1	**1**
Galaxias maculatus	Inanga	Minnow trap	1	-	-	-	-	-	**1**

			Barton's Lagoon (1 site)	Lake Wairarapa (3 sites)	Boggy Pond (1 site)	Matthew's Lagoon (1 site)	Lake Onoke (2 sites)	Lake Pounui (1 site)	Total
Gobiomorphus cotidianus	Common bully	Minnow trap Seine net	192	106	23	25	1	29	**376**
Forsterygion nigripenne	Estuarine triplefin	Minnow trap Seine net	-	-	-	-	7	-	**7**
Mugil cephalus	Grey mullet	Mono trammel net Cotton trammel net	-	30	-	-	-	-	**30**
Tenagomysis sp	Mysid shrimp	Minnow trap Seine net	-	Many	Many	-	Few	-	**Many**
Paranephrops planifrons	Freshwater crayfish/koura	Mono trammel net	2	-	-	-	-	-	**2**
Paratya curvirostris	Decapod shrimp	Minnow trap	-	Few	-	-	-	-	**Few**
*Perca fluviatilis**	Perch	Mono trammel net Cotton trammel net Fyke net	2	70	3	11	-	3	**89**
Retropinna retropinna	Common smelt	Mono trammel net Seine net	-	14	-	-	1	-	**15**
Rhombosolea leporina	Yellowbelly flounder	Mono trammel net Cotton trammel net Seine net	-	-	-	-	40	-	**40**

			Barton's Lagoon (1 site)	Lake Wairarapa (3 sites)	Boggy Pond (1 site)	Matthew's Lagoon (1 site)	Lake Onoke (2 sites)	Lake Pounui (1 site)	Total
Rhombosolea retiaria	Black flounder	Mono trammel net Cotton trammel net Fyke net Seine net	-	8	-	-	5	-	**13**
*Salmo trutta**	Brown trout	Mono trammel net Cotton trammel net	10	7	-	-	1	2	**20**
*Scardinius erythrophthalmus**	Rudd	Mono trammel net Cotton trammel net Fyke net	-	15	-	10	-	-	**25**
?	Marine/estuarine decapod shrimp	Minnow trap	-	-	-	-	2	-	**2**
		Total	**219**	**322**	**50**	**112**	**114**	**46**	**863**

6.2 Site A: Barton's Lagoon

The site at Barton's Lagoon was silt bottomed with cobbles present. Green filamentous algae was visible along with a number of macrophytes – *Riccia*, *Lemna*, *Azolla*, *Elodea* and rush species along the verges (Fig. 2). Fish surveying showed that common bullies and inanga were both present in the lagoon. Low numbers of perch and high numbers of the introduced brown trout (*Salmo trutta*) were found, along with low numbers of native shortfin eels and 2 large (+1m), old longfin eels. Two quite large freshwater crayfish/koura (*Paranephrops planifrons*) were also captured here, the only site at which they were found to be present (Fig. 3).

Figure 2. The survey site at Barton's Lagoon (site A).

Figure 3. Large freshwater crayfish/koura captured at Barton's Lagoon.

6.3 Lake Wairarapa (sites B, C & D)

6.3.1 SITE B (North)

The survey site at the north end of Lake Wairarapa was open water with a compacted fine sediment bottom. The water is usually highly turbid, however following periods of calm weather, the water can clear and sparse beds of turf plants become visible. Floating *Ceratophyllum* (hornwort) was caught in nets and the water was bordered by a gravel/cobble beach (Fig. 4). The endemic common bully and the native common smelt (*Retropinna retropinna*) represented the small-bodied fish species found during surveying. Of the large-bodied species 6 shortfin eels represented the only native species present. The remainder of the fish captured consisted of large numbers of perch, the noxious species rudd (*Scardinius erythrophthalmus*) and brown trout (Fig. 5).

Figure 4. The survey site at Lake Wairarapa north (site B).

Figure 5. Perch, rudd and brown trout (all exotic species) captured at the northern end of Lake Wairarapa.

6.3.2 SITE C (West)

The survey site on the western shore of Lake Wairarapa was sandy bottomed with submerged woody debris. Rush species border the open water (Fig. 6). A single endemic longfin eel (*Anguilla dieffenbachii*) was captured, along with a small number of shortfin eels and the endemic black flounder (*Rhombosolea retiaria*).

Very high numbers of perch (44) were captured (Fig. 7) and rudd were also present. Common bullies and smelt were both captured at this site.

Figure 6. The survey site at Lake Wairarapa west (site C).

Figure 7. Large numbers of perch captured at the western edge of Lake Wairarapa.

6.3.3 SITE D (South)

Site D, at the southern end of Lake Wairarapa was situated in deep water with a clay/mud substrate with grasses and raupo present at the waters edge (Fig. 8). Seining was not conducted at this site due to the high water depth. The fish species

captured here were distinct from the other 2 Lake Wairarapa sites, in that grey mullet and yellow eyed mullet (*Aldrichetta forsteri*) (both salt-tolerant species) were both present (Fig. 9). High numbers of shortfin eels, along with only one each of the introduced perch and rudd were captured. Common bullies were also present at this site.

Figure 8. The survey site at Lake Wairarapa south (site D).

Figure 9. (Top) grey mullet and (bottom) yellow eyed mullet – salt-tolerant species captured at the southern end of Lake Wairarapa.

6.4 Site E: Boggy Pond

The survey site at Boggy Pond consisted of very shallow open water with a deep mud substrate and sparse raupo on the verges (Fig. 10). Floating macrophytes (*Lemna*, *Azolla*, *Ricciocarpus natans*) and submerged macrophytes (*Potomageton*, *Ceratophyllum*) were abundant. The monofilament trammel net was not set at this site due to extreme shallow water (~40cm maximum) prompting concerns regarding the safety of wading birds. A moderate number of common bullies were captured, along with shortfin eels, very large perch (1.4kg; Fig. 11) and a number of wild-coloured goldfish (*Carassius auratus*).

Figure 10. The survey site at Boggy Pond (site E).

Figure 11. Very large perch captured at Boggy Pond.

6.5 Site F: Matthew's Lagoon

The survey site at Matthew's Lagoon was located in open water verged with raupo, with a bottom of deep muddy sediment and submerged wood (Fig. 12). Submerged macrophytes (*Potomageton*, *Ceratophyllum*) were abundant and floating macrophytes (*Azolla*, *Lemna*, *Ricciocarpus natans*) were present but sparse. Native fish species present included common bullies and a relatively large number of shortfin eels, while the reminder of the fish captured were perch, rudd and goldfish (Fig. 13).

Figure 12. The survey site at Matthew's Lagoon (site F).

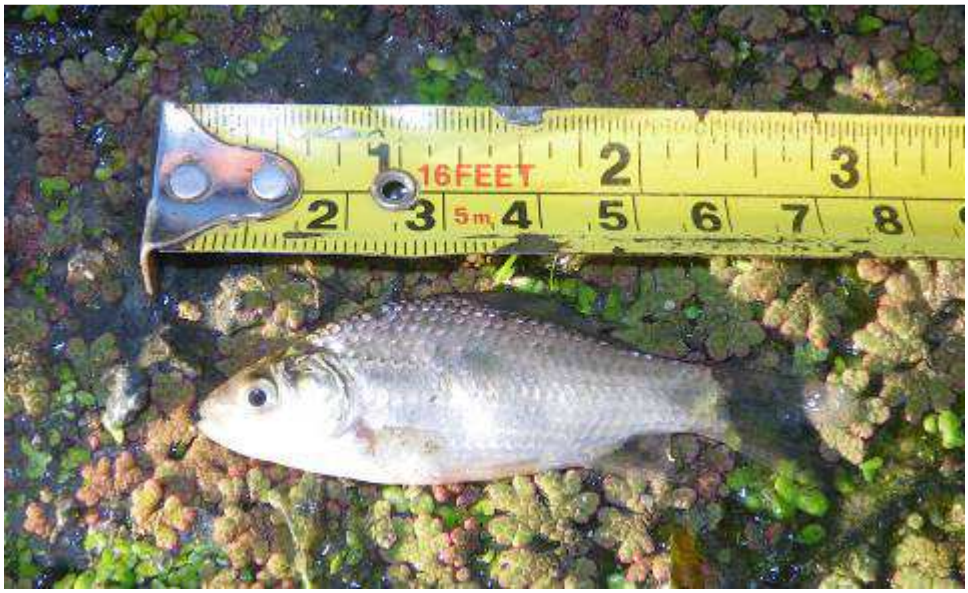

Figure 13. Wild coloured goldfish captured at Matthew's Lagoon.

6.6 Lake Onoke (sites G & H)

6.6.1 SITE G (West)

The survey site at the western edge of Lake Onoke was located in open water with a sandy substrate and the occasional piece of woody debris (Fig. 14). Most of the small bodied fish species captured were estuarine triplefins (Fig. 15), although a

common bully was also found. A single brown trout was the only exotic species encountered at this site – the remainder of fish captured were yellow eyed mullet, yellow belly flounder, a few black flounder (Fig. 16) and a shortfin eel.

Figure 14. The survey site at Lake Onoke west (site G).

Figure 15. Estuarine triplefin captured at the western edge of Lake Onoke.

Figure 16. (Left) black flounder and (right) yellow belly flounder captured at the western edge of Lake Onoke.

6.6.2 SITE H (East)

The survey site at the eastern edge of Lake Onoke was located in open water with sand substrate (Fig. 17). Only six individual fish were captured at this site, although they represented 6 different species and all were native – triplefin, common smelt, yellow eyed mullet, shortfin eel, black flounder and yellow belly flounder (Fig. 18).

Figure 17. The survey site at Lake Onoke east (site H).

Figure 18. Juvenile flounder species (likely yellow belly) captured at the eastern edge of Lake Onoke.

6.7 Site I: Lake Pounui

The survey site at Lake Pounui was located in mostly open water, with emergent rush species (Fig. 19). The substrate consisted of cobbles interspersed with turf communities and various native submerged macrophytes. Large particles of algae were visible suspended in the water column, however the water was predominantly clear. The largest number of longfin eels was captured at this site (although this was only 8 individuals) and included one individual who was 1.2m in length (Fig. 20). A small number of shortfin eels were also present. Three perch and 2 brown trout were captured, along with common bullies and a single giant kokopu – the only one found in the entire survey (Fig. 21).

Figure 19. The survey site at Lake Pounui (site I).

Figure 20. Large longfin eel captured at Lake Pounui.

Figure 21. Giant kokopu captured at Lake Pounui (abrasions present from net).

7. DISCUSSION

7.1 Species distributions

In order of numerical dominance, the endemic common bully was the most numerous small bodied fish species occurring across all sites as well as per site excluding Lake Onoke West (site G) and Lake Onoke East (site H) (Fig. 22). Estuarine triplefins were captured at both Lake Onoke sites as well as common smelt (smelt were also caught at Lake Wairarapa north (site B) and Lake Wairarapa west (site C) during seining but are not included in Fig. 22 in order to facilitate valid comparisons given that Lake Wairarapa south was not able to be seined) at Lake Onoke site H.

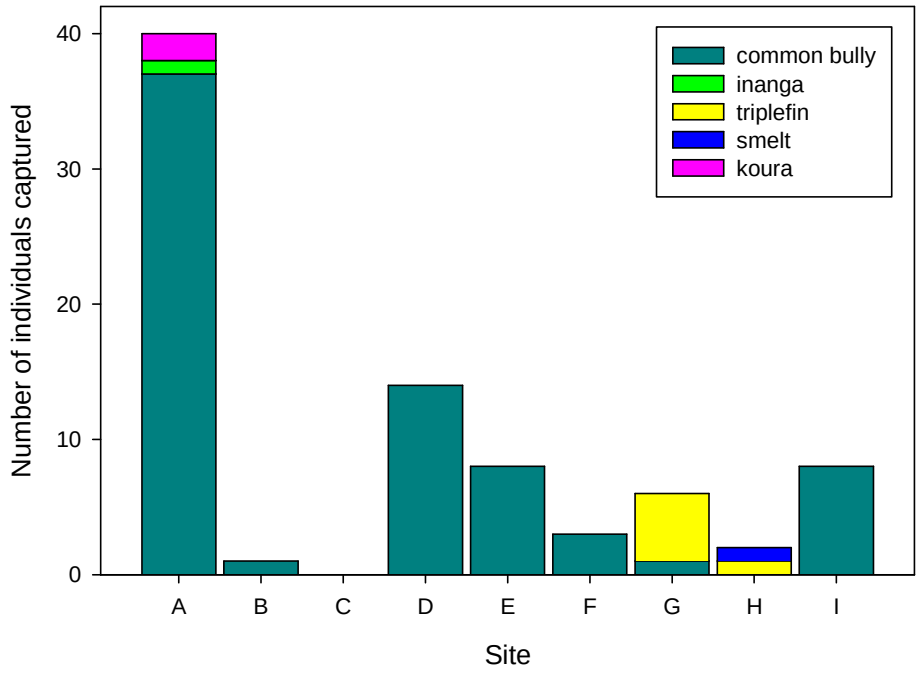

Figure 22. Number of small bodied fish captured at each site (A = Barton's Lagoon; B = Lake Wairarapa north; C = Lake Wairarapa west; D = Lake Wairarapa south; E = Boggy Pond; F = Matthew's Lagoon; G = Lake Onoke west; H = Lake Onoke west; I = Lake Pounui). As site D was not seined, graph does not include species caught while seining in order to facilitate valid comparisons between sites.

With regard to large bodied fish species, the native shortfin eel was caught in the highest numbers, followed by the exotic perch (Fig. 23). Barton's Lagoon (site A), and the Lake Wairarapa northern and western sites (sites B & C) showed similarities in fish communities, while the Lake Wairarapa Southern site was distinct, containing primarily shortfin eels and grey mullet. Boggy Pond and Matthew's Lagoon (sites E & F) contained similar species to each other, as did Lake Onoke West (site G) and Lake Onoke East (site H). Lake Pounui (site I) differed from other sites in that it contained the threatened giant kokopu as well as relatively higher numbers of the threatened longfin eel.

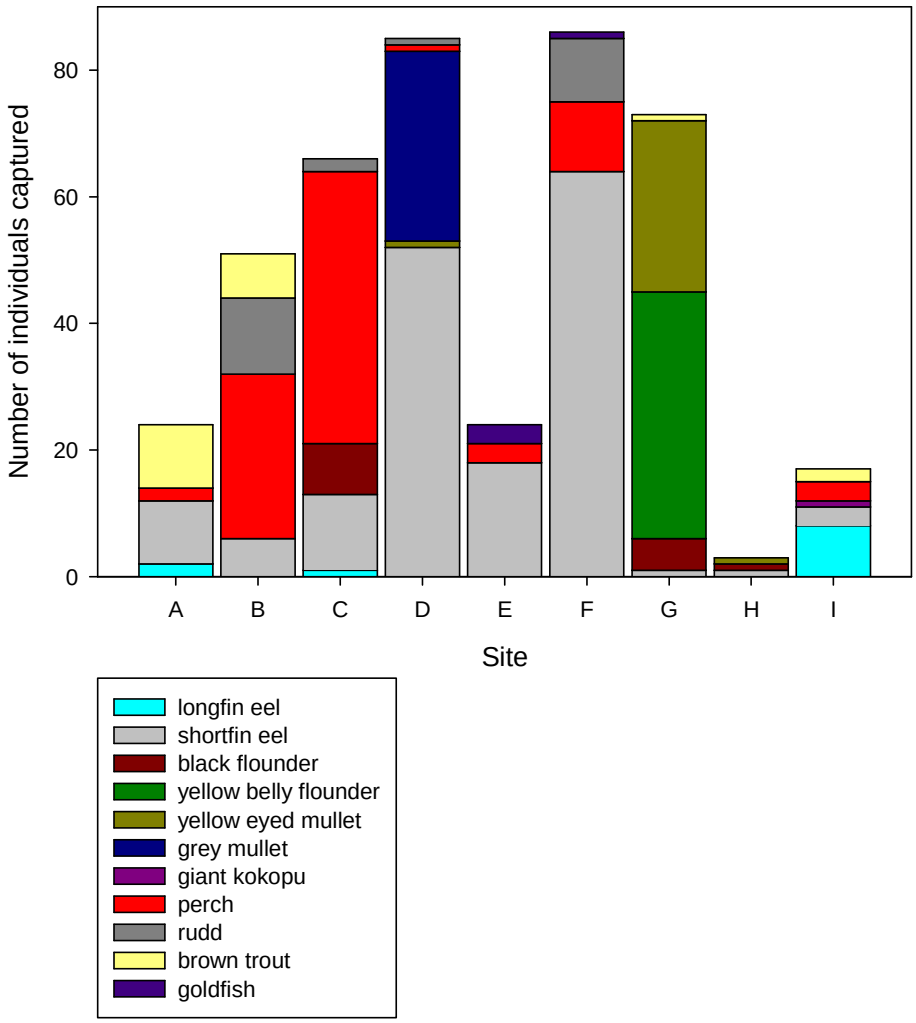

Figure 23. Number of large bodied fish captured at each site (A = Barton's Lagoon; B = Lake Wairarapa north; C = Lake Wairarapa west; D = Lake Wairarapa south; E = Boggy Pond; F = Matthew's Lagoon; G = Lake Onoke west; H = Lake Onoke west; I = Lake Pounui). As site D was not seined, graph does not include species caught while seining in order to facilitate valid comparisons between sites.

Shortfin eels were the most widespread species, occurring at all of the 9 survey sites, followed by the common bully, which occurred at 8/9 sites (Fig. 24). The next most widespread species were all exotic – perch, brown trout and rudd

occurred at 7, 4 and 4 sites respectively. Three species, grey mullet, inanga and giant kokopu were captured at only a single site each.

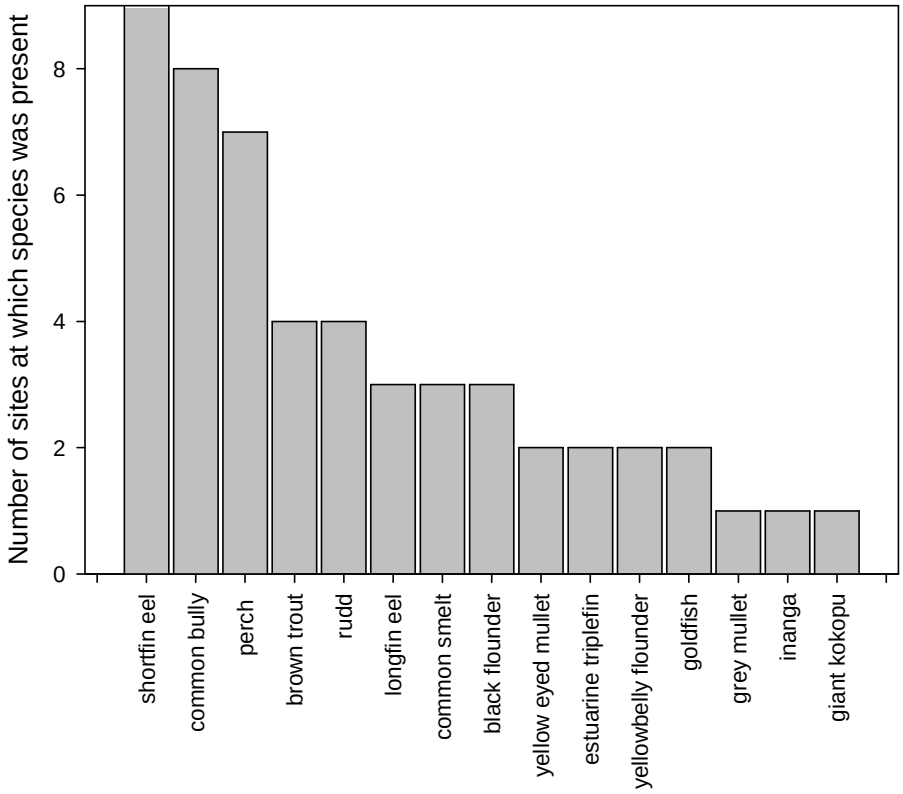

Figure 24. Distribution of fish species across Wairarapa Moana survey sites.

In terms of large bodied species presence, the average across all sites was 68% native species and 32% exotic species. Barton's Lagoon, Lake Wairarapa north and Lake Wairarapa west (sites A, B & C) all contained 50% or more exotic species (Fig. 25), with Lake Wairarapa north representing the least native community across Wairarapa Moana. Lake Wairarapa south, Lake Onoke west and Lake Onoke East (sites D, G & H) all contained 2% or less exotic species, with Lake Onoke east representing the most native community across Wairarapa Moana.

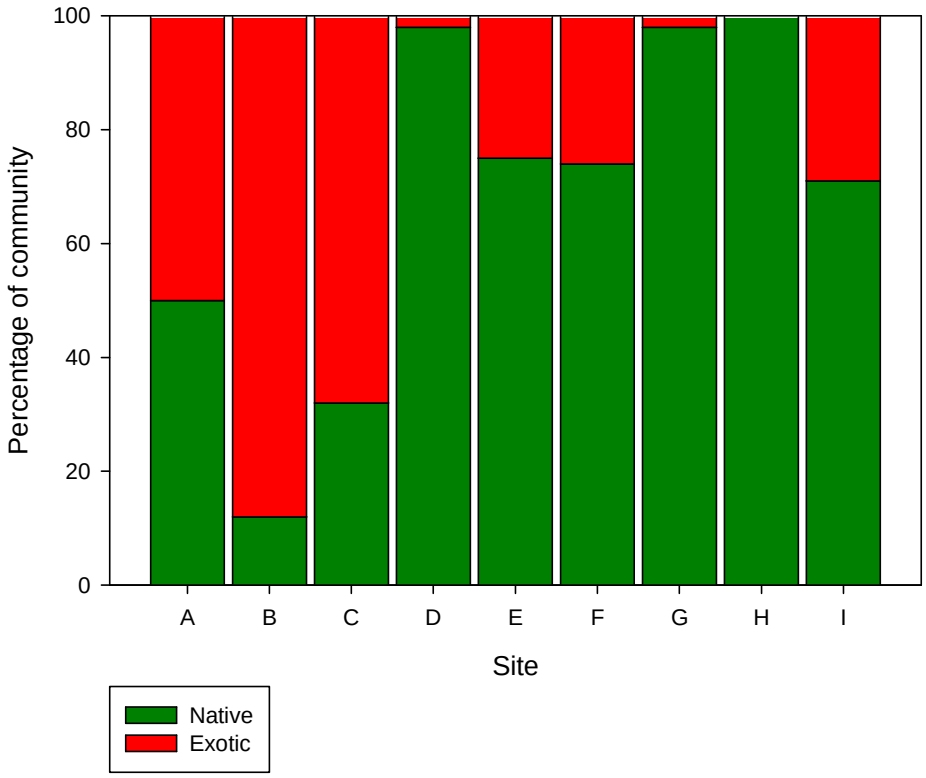

Figure 25. Graph showing the percentage of species captured at each survey site that were native and the percentage which were exotic (A = Barton's Lagoon; B = Lake Wairarapa north; C = Lake Wairarapa west; D = Lake Wairarapa south; E = Boggy Pond; F = Matthew's Lagoon; G = Lake Onoke west; H = Lake Onoke west; I = Lake Pounui).

7.2 Comparisons with previous data

7.2.1 Site A: Barton's Lagoon

No previous data is available for comparison, this survey has provided the first official fish records.

7.2.2 Lake Wairarapa (sites B, C & D)

A fish survey conducted in 1961 recorded the presence of 8 native species in Lake Wairarapa (Table 6). Three individual surveys during the 1990s provided the first

records of exotic species in the lake – perch, rudd and tench and a subsequent survey in 2002 captured feral type goldfish. The comprehensive survey in 2009 recorded 8 native species plus 3 exotic species (perch, brown trout and rudd). The present survey captured 7 native species and 3 exotic and thus observed a lake community the same as in 2009 – dominated by high numbers of exotic, non migratory species. Inanga were not captured during the present survey. This diadromous species is undoubtedly negatively influenced by severe barriers to migration such as the barrage gates and the Onoke bar closures, as well as being at risk from habitat loss and overharvest. The exotic tench has not been recorded since 1998 and is likely not present in the lake. While goldfish were not captured during the present survey they have been observed recently (McEwan 2010). Today, Lake Wairarapa is home to perch in very high densities, prompting concern regarding the impacts this species is having on native ecosystems. Moderate numbers of brown trout are also present and the noxious rudd population appears to be on the increase. Diadromous native species such as banded kokopu, giant kokopu and lamprey have not been seen since the 1960s. In concurrence with the 2009 survey, the present work recorded very low numbers of the endemic black flounder and longfin eel. This is of considerable concern as these species are held in particularly high esteem by stakeholders both for their biodiversity and fisheries values.

Table 6. Results of historical fish survey records in Lake Wairarapa regarding nativeness. For example, the survey in 1961 recorded only native species, whereas the survey in 1991 recorded 88% native species and 12% exotic species.

Survey year	Percentage of species found native	Percentage of species found exotic
1961	100%	0%
1991	88%	12%
1996	0%	100%
1998	0%	100%
2002	0%	100%
2007	100%	0%

2009	73%	27%
2010	70%	30%

7.2.3 Site E: Boggy Pond

The first survey on record for Boggy Pond (1997) recorded two species, both native: the brown mudfish and longfin eel (Table 7). The following survey in 2002 found neither of these species but recorded 2 additional natives – unidentified eel (highly likely shortfin) and the common bully. This survey also discovered 2 exotic species – rudd and goldfish. The present survey nearly matches the 2002 survey in terms of species presence: common bullies, shortfin eels, perch and goldfish were the species captured. Rudd were not found but the presence of perch was confirmed. Brown mudfish are likely extinct in Boggy Pond due to ephemeral edge habitat loss, increasing eutrophication and predation by perch.

Table 7. Results of historical fish survey records in Boggy Pond showing the percentage of the species captured that were native and the percentage of species captured that were exotic.

Survey year	Percentage of species found native	Percentage of species found exotic
1997	100%	0%
2002	50%	50%
2010	50%	50%

7.2.4 Site F: Matthew's Lagoon

No previous data is available in the NZFFD for comparison, this survey has provided the first official fish records.

7.2.5 Lake Onoke (sites G & H)

Including the present work, 5 individual fish surveys have been conducted in Lake Onoke, from 1991 until 2010 (plus a single observational record of a Chinook

salmon in 1980) (Table 8). The survey in 1991 recorded the presence of 10 native species plus 2 exotic species (perch and brown trout). Seven native species were recorded in a survey in 1995, 4 native species and 1 exotic species (goldfish) in 2005 and 6 native species in 2009. The present survey recorded the presence of 7 native species and 1 exotic species (brown trout – a single individual). The intermittent occurrence of exotic species throughout the survey years is likely due to chance detection of the odd wandering or resident individual every now and then. The apparent drop in the number of native species recorded is likely to be due to variable sampling effort – especially high effort in 1991, when the highest number of native species was recorded. However, the Lake Onoke aquatic ecosystem has likely been degraded by nutrient pollution and sediment inputs from the Ruamahanga River and this could have rendered the local habitat unsuitable for species such as the stargazer. In addition, species such as banded kokopu, which have not been recorded since 1991, are diadromous and occur in far lower numbers in the Wairarapa than historically due to habitat loss, migratory barriers and overharvest both locally and nationwide. The absence of this species is more likely to be a genuine reflection of the status quo, rather than of sampling effort.

Table 8. Results of historical fish survey records in Lake Onoke showing the percentage of the species captured that were native and the percentage of species captured that were exotic.

Survey year	Percentage of species found native	Percentage of species found exotic
1991	83%	17%
1995	100%	0%
2005	80%	20%
2009	100%	0%
2010	88%	12%

7.2.6 Site I: Lake Pounui

Two individual surveys have been conducted in Lake Pounui prior to the current work. In 1997, extensive surveying recorded 7 native species and 2 exotic species and a subsequent survey in 2003 recorded the presence of 4 native species and 2 exotic species (Table 9). The present survey also recorded 4 native species and 2 exotic species (in all cases the exotic species were perch and brown trout). Brown mudfish have not been recorded since 1997 and are likely to be locally extinct in the lake. The diadromous native species banded kokopu were not recorded in the present survey while giant kokopu were (a single individual), but were not captured in the 2003 survey. This is likely to reflect very low densities of both species being present (potentially small relict populations in the lake and inflow and outflow tributaries). Such populations will be under threat of predation by perch and trout along with severely curtailed recruitment[2] due to habitat loss, migratory barriers and overharvest both locally and nationwide. Lake Pounui is unusual in that it is still in a relatively pristine state. The private ownership status of Lake Pounui access and the surrounding land have done and continue to provide a modicum of protection for those fish that do make it to the lake. In addition, the riparian area around the lake has remained forested which has provided for protection of water quality through avoiding the nutrient and sediment pollution that other Wairarapa Moana waterbodies are subjected to. Smelt and freshwater crayfish (koura) were not captured in the present survey but were recorded in both prior surveys. This could be due to variable sampling effort or could represent a genuine absence – further survey work, especially targeting the koura population would provide further information. Empty shells belonging to the threatened endemic freshwater mussel (kakahi) were observed. Targeted surveying to assess whether or not this population has become extinct or not would be useful.

[2] The re-supply of juveniles to a population.

Table 9. Results of historical fish survey records in Lake Pounui showing the percentage of the species captured that were native and the percentage of species captured that were exotic.

Survey year	Percentage of species found native	Percentage of species found exotic
1997	78%	22%
2003	67%	33%
2010	67%	33%

7.3 Longfin eels

The endemic and threatened longfin eel is held in particularly high esteem by stakeholders both for its biodiversity and fisheries values. Longfin eel numbers are extremely low in Wairarapa Moana. Across 9 sites with relatively intensive fishing effort only 9 individuals were captured and 8 of those were in Lake Pounui despite all other sites with records available finding this species historically present. While shortfin eel size was low (most individuals 40-50cm total length: Fig. 26) and only a single elver was captured, no longfin eels below 40cm total length were captured (Fig. 27), representing zero or very low recruitment for a number of years previous. Three longfin eels were large and very old. Overharvest, barriers to migration and habitat loss have driven longfin eels close to extinction and urgent action and education regarding this species is required both locally and nationally.

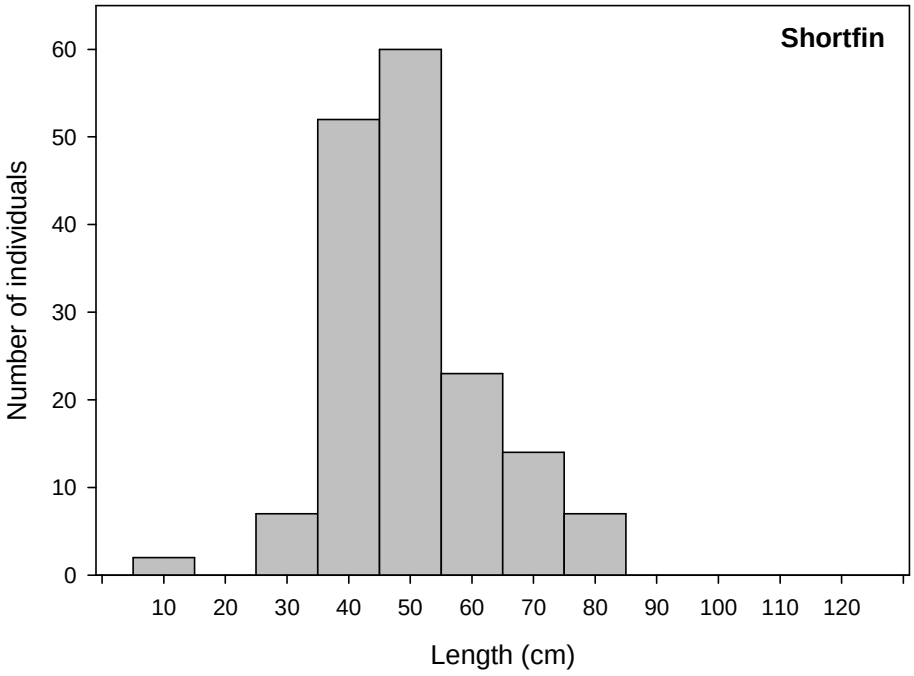

Figure 26. Length frequency distribution of shortfin eels captured across Wairarapa Moana.

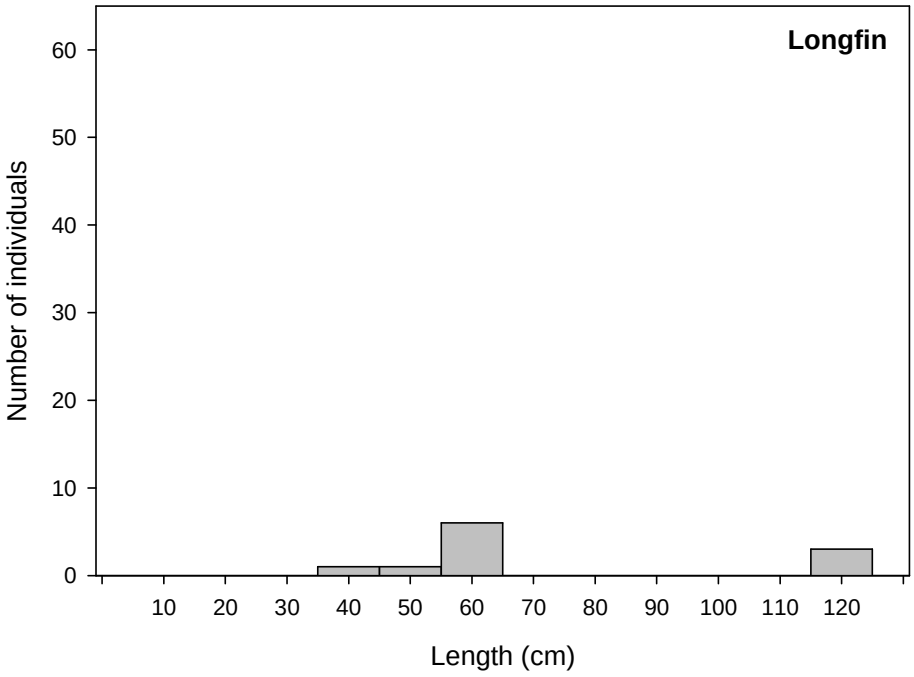

Figure 27. Length frequency distribution of longfin eels captured across Wairarapa Moana.

7.4 Black Flounder

The endemic black flounder is held in particularly high esteem by stakeholders both for its biodiversity and fisheries values. The 1991 fish survey report (Hicks 1991) summarises historical data regarding the black flounder (Fig. 28) in Lake Wairarapa: prior to the diversion of the Ruamahanga River, this species was so numerous that it supported a number of small commercial fisheries, reporting catches of 40-60 flounder per gill net night. Following the diversion, these numbers dropped to 15-25 flounder per gill net night up until 1988, then fell further to around 2-3 flounder per gill net per night in 1991. The 1991 survey produced only 1.7 flounder per gill net night (0-3), for a total of 7 flounder across all 3 sites. Despite the higher survey effort used in the present work (2 trammel nets per site instead of 1), only 8 black flounder were captured across all 3 sites, showing that numbers of this species remain very low in Lake Wairarapa. Black flounder are undoubtedly negatively impacted by migratory barriers such as the barrage gates, habitat loss and predation by and competition with the exotic species perch and brown trout.

Figure 28. Black flounder *Rhombosolea retiaria.*

7.5 Rudd

The presence of the noxious species rudd (Fig. 29) appears to be the result of one or more recent illegal introductions. Rudd were not found during the comprehensive 1991 survey but first Lake Wairarapa records appear in the Freshwater Fish Database in 1996, then again in 1998. During the 2009 Lake Wairarapa fish survey (McEwan 2009), 4 rudd were captured across 3 sites in the Lake (1 at the western site and 3 at the northern site). This year, the same 3 sites yielded a total of 15 rudd (2 at the western site, 1 at the southern site and 12 at the northern site).

Figure 29. Rudd *Scardinius erythrophthalmus*.

A further 10 individuals were captured in Matthew's Lagoon, confirming that this species is well established there. No rudd were caught in the adjacent Boggy Pond, although this is likely due to low sampling efficacy associated with very shallow water conditions. Rudd were found to be present in Boggy Pond in 2002 (NZFFD) and are likely still present. No rudd were captured in Lake Pounui and no records

exist for this species at this site. This is fortunate and likely due to the lake being held in private ownership and therefore presenting restricted access to recreational anglers (This species was recently introduced illegally into New Zealand and spread around for the purposes of coarse fishing). However, it is possible that rudd are present in low numbers and have colonized independently from the Pounui Lagoon where they have been observed in the past (Perrie, A. pers. comm.) Rudd were also not captured in Lake Onoke, despite occurring in Lake Wairarapa and throughout the Ruamahanga catchment. This is likely due to the predominantly estuarine conditions of Lake Onoke excluding this species. Adult rudd are exclusive herbivores (McDowall 1990) and could potentially be feeding on threatened turf species in Lake Wairarapa. Further work investigating whether this is the case would be of value. In addition, the 3 Lake Wairarapa sites should continue to be surveyed to monitor the rudd population, which may be increasing in size.

7.6 Perch

Previous records show that perch were first captured in Lake Wairarapa and Lake Onoke in 1991 and in Lake Pounui in 1997. This survey showed that perch are still present in Lake Wairarapa and Lake Pounui and confirmed their presence in Barton's Lagoon, Matthew's Lagoon and Boggy Pond – this species is now widespread across Wairarapa Moana. The perch population of Lake Wairarapa remains large and healthy. The 2009 survey reported high numbers of large perch and the present survey confirms this is still the case. In concurrence with the 2009 Lake Wairarapa Survey, the majority of perch were of a uniform, large size: of 89 perch captured, 73 (82%) were between 25 and 35cm$_{TL}$ (Fig. 30). Average perch length across all sites was 32 ± 0.5cm $_{TL}$ (mean ± SE) and average perch weight was 468 ± 23g. Despite low sample sizes of perch in Boggy Pond and Lake Pounui (both n = 3), potential differences in individual perch size across sites were detected (Fig. 31. Perch captured in Boggy Pond were comparatively large: of the 3 that were caught, 2 were 44 and 43cm$_{TL}$ respectively – the largest caught across all sites.

Conversely, perch captured in Lake Pounui were comparatively small: of the 3 that were caught, 2 were 10 and 11cm$_{TL}$ respectively – the smallest caught across all sites. These size differences warrant confirmation and further investigation - varying population dynamics responsible for such differences are likely present in different waterbodies throughout Wairarapa Moana and understanding of these dynamics may provide insight into population control or eradication strategies.

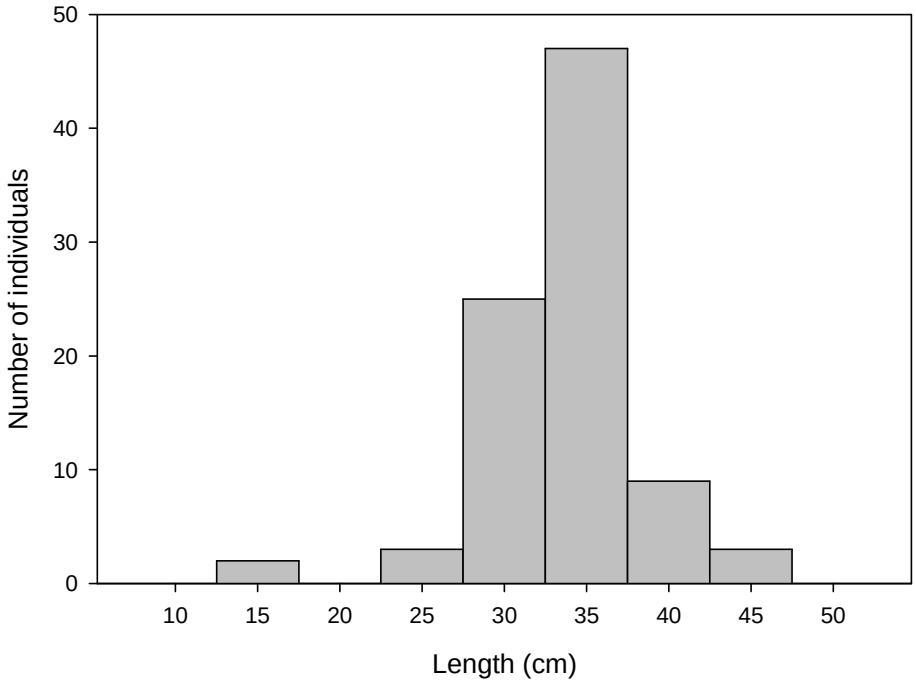

Figure 30. Length frequency distribution of perch captured across Wairarapa Moana.

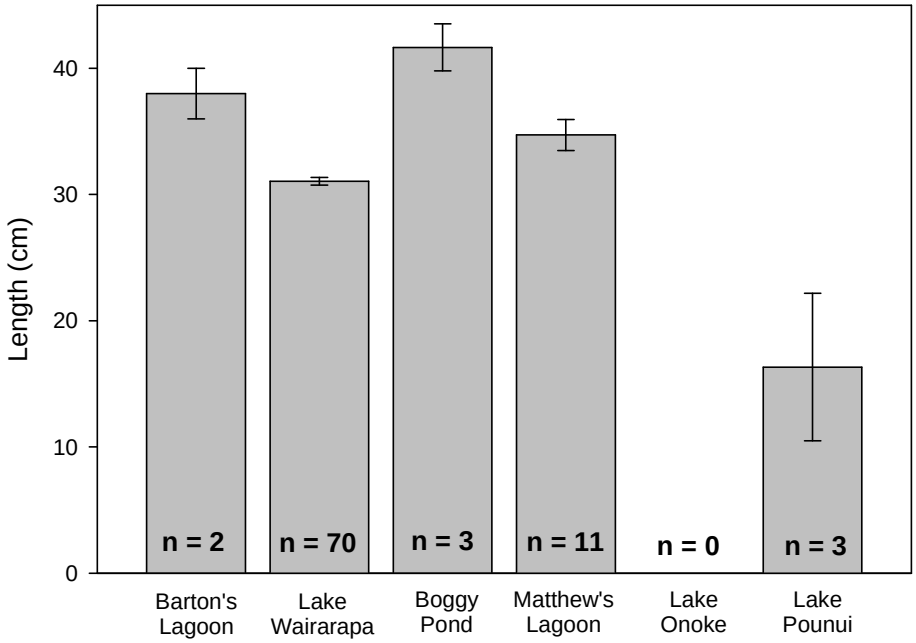

Figure 31. Average length of perch captured in each of the 6 waterbodies (9 sites) included in the present survey.

7.6.1 Perch sex ratios

In concurrence with the 2009 survey in Lake Wairarapa, perch female: male were extremely high. Of the 89 perch caught in this survey, 82 were able to be identified to gender. Of these, 78 were females and the remaining 4 were males. While males were extremely scarce, those that were captured represented a range of sizes (Fig. 32) including a very small individual ($10cm_{TL}$) in Lake Pounui who was sexually mature and in breeding condition (Fig. 33).

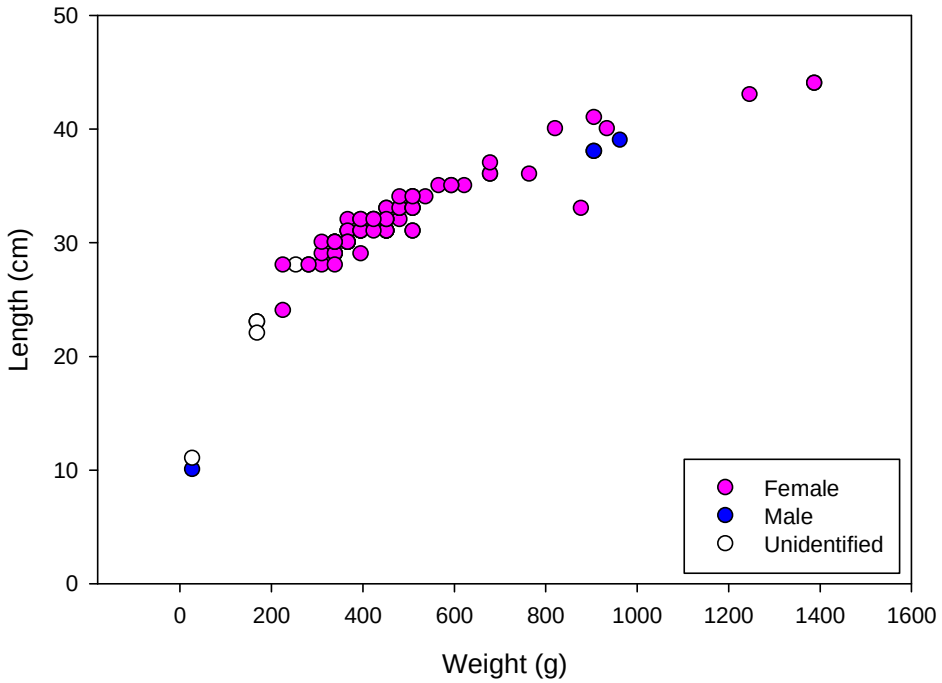

Figure 32. Length, weight and sex of perch captured across Wairarapa Moana.

Figure 33. Very small, ripe male perch captured in Lake Pounui.

7.6.2 Perch control

Adult perch are usually exclusively piscivorous[3] (Persson 1988) and the high numbers of this exotic species present in Lake Wairarapa is undoubtedly impacting negatively on small-bodied native fish communities through predation (Fig. 34).

[3] Piscivorous: describes an animal that feeds exclusively on fish.

The endemic black flounder and longfin eel and the native shortfin eel also rely heavily on small fish for food during their adult life stages (McDowall 1990), thus high numbers of perch are also likely impacting negatively on these species through food competition. The potential for control of perch numbers through netting and trapping was been evaluated in a set of lakes in the South Island (Closs et al 2001). Progressive removal was judged to be worthwhile as it was effective in lowering perch numbers and efforts also coincided with marked increases in numbers of common bullies.

Figure 34. Eleven native bullies removed from the stomach of a single perch captured in Lake Wairarapa.

7.7 Nativeness

Nativeness has decreased across Wairarapa Moana (Fig. 35). A single survey in 1961 recorded 8 native species and 0 exotic species. No surveys were conducted during the 1970s or 1980s (although a single observation is recorded in 1980). Five surveys were conducted during the 1990s (1991, 1995, 1996, 1997 & 1998) and together these recorded the presence of 15 native species and 4 exotic species (brown trout, perch, rudd & tench). Including the present work, 6 individual surveys were conducted across Wairarapa Moana in the 2000s (2002, 2003, 2005, 2007, 2009 & 2010). From these surveys, the presence of 11 native species and 4 exotic

species was recorded. The native species that were not recorded in the 2000s surveys were brown mudfish, banded kokopu, kahawai and stargazers. Kahawai are known to still be present in Lake Onoke (McEwan, unpubl. data) and stargazers may also still be present in Lake Onoke in low numbers. Brown mudfish and banded kokopu are likely extinct in the waterbodies surveyed (although a population of banded kokopu may be surviving in Lake Pounui tributary streams).

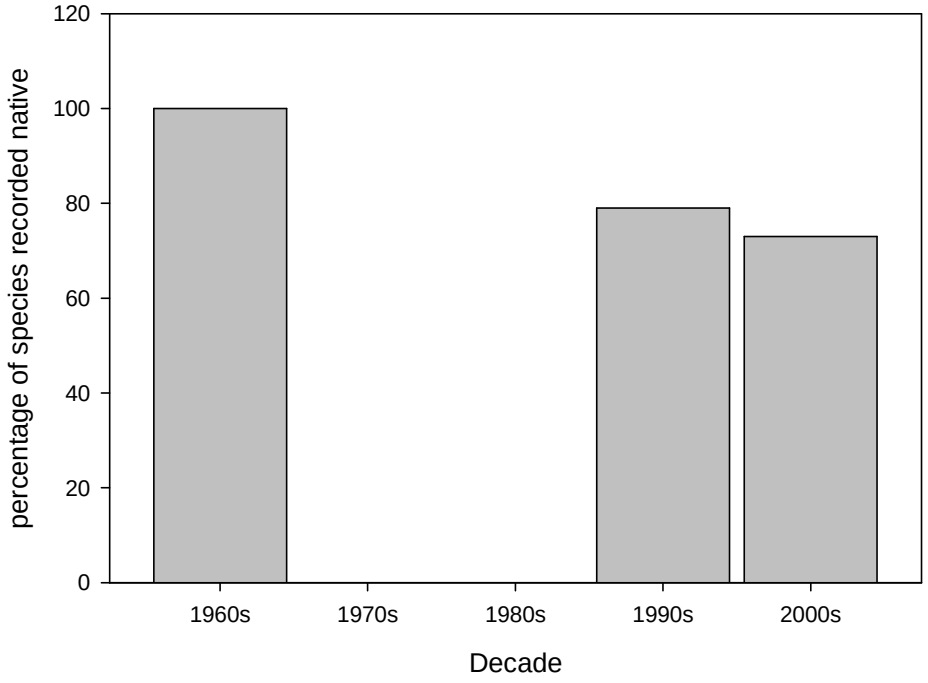

Figure 35. Percentage of species captured during previous survey years that were native.

7.8 Net type efficacy

During the course of the present work, the opportunity was taken to evaluate the capture efficiency of two different types of trammel net in terms of their ability to capture perch and thus facilitate potential control of this species. Across all sites, the monofilament trammel net caught an average of 0.59 ± 0.14 (mean ± SE) fish per net metre per night and the cotton trammel net caught an average of 0.42 ± 0.15 fish per net metre per night (Fig. 36). When looking only at perch, the monofilament trammel net caught an average of 0.26 ± 0.14 perch per net night while the cotton trammel net caught an average of 0.13 ± 0.08 perch per net night (Fig. 37).

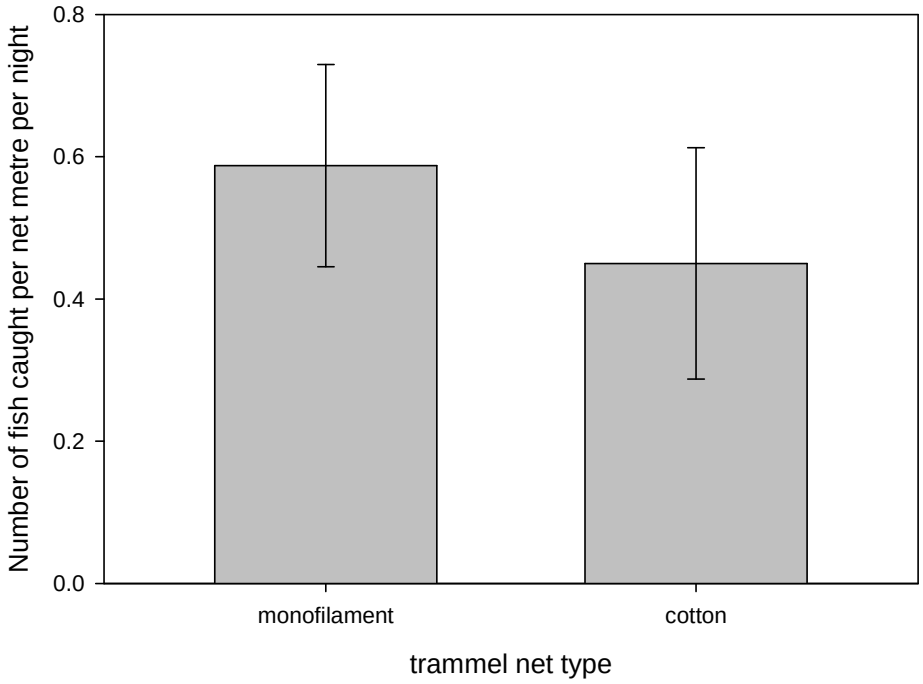

Figure 36. Average number of fish (all species) captured by two different net types.

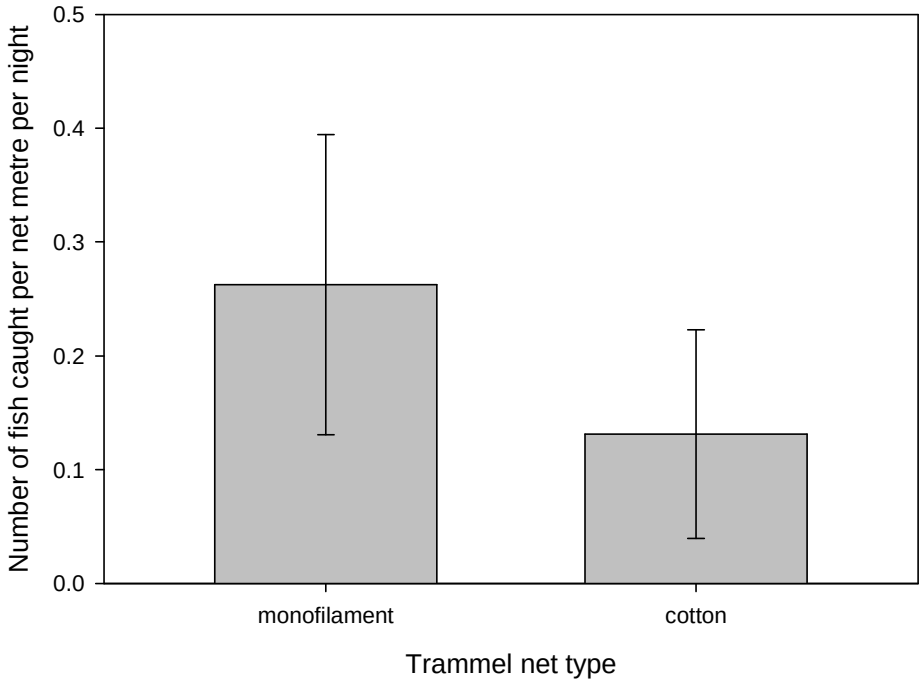

Figure 37. Average number of perch captured by two different net types.

Thus overall, the monofilament trammel net was more effective than the cotton trammel net regarding the number of fish captured but these differences were not statistically significant ($Z(8) = 0.58$, $P = 0.28$ for both). It is important to note that these figures are averages across all sites and therefore include sites where perch were not captured. At those sites where perch were captured in high densities (Matthew's Lagoon, Lake Wairarapa North and Lake Wairarapa West), the monofilament trammel net caught an average of 20 perch per net night and the cotton trammel net caught an average of 7 perch per net night. A sample size of 3 is too low for significance testing, however, in my opinion, the difference between net types is demonstrable and these numbers are high enough for depletion removal in small waterbodies to be effective (using a trammel net(s)). The cotton trammel net was highly effective at catching flounder: at the site where flounder species were captured in high density (Lake Onoke West), the cotton trammel net caught 1.25 flounder per net metre per night while the monofilament net caught 0.6 flounder per net metre per night.

8. ACKNOWLEDGEMENTS

I would like to acknowledge Alton Perrie for his extensive level of assistance with field work as well as report editing and the Department of Conservation Wellington/Hawkes Bay Conservancy for providing trammel nets used in field work.

9. REFERENCES

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10. APPENDIX

Survey data sheets:

SITE A	Bartons Lagoon				
DATE	24.04.2010				
LOCAL ENV	silt bottom with cobbles. Green filamentous algae, riccia, duckweed, azolla, elodea, raupo, rush spp				
COMMENTS					
SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
common	minnow	20			
common	minnow	75			
common	minnow				
common	minnow				
common	minnow				
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common	minnow				
inanga	minnow	75			
elver	minnow	110			
lfe	Fyke	1200			
lfe	Fyke	1200			
sfe	Fyke	700			
sfe	Fyke	400			
sfe	Fyke	600			
sfe	Fyke	500			
sfe	Fyke	400			
sfe	Fyke	500			
sfe	Fyke	400			
sfe	Fyke	300			
sfe	Fyke	350			
koura	Mtrammel	140(from end of tail to rostrum)		male	
koura	Mtrammel	130		female	
trout	Mtrammel	570	1587.572		
trout	Mtrammel	510	1587.572	female	
trout	Mtrammel	500	1190.679	?	
trout	Mtrammel	520	1587.572	?	
trout	Mtrammel	450	1048.932	female	
trout	Mtrammel	510	1502.524	female	
trout	Mtrammel	510	1757.669	female	
trout	Mtrammel	480	1219.029	female	
trout	Mtrammel	490	1247.378	?	
trout	Mtrammel	390	680.388	?	
perch	Mtrammel	360	680.388	female	
perch	Mtrammel	400	822.1355	female	
seining	24.04.2010				
	number	minlength mm			
common	155	as above			

SITE B	Lake Wairarapa North		

DATE	05.05.2010				
LOCAL ENV					
COMMENTS					
SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
common	minnow	65			
few mysid shrimp	minnow				
sfe	fyke	650			
sfe	fyke	500			
sfe	fyke	30			
sfe	fyke	450			
sfe	fyke	400			
sfe	fyke	400			
rudd	fyke	280	340.194	f	very tiny green underdeveloped eggs - all females
rudd	fyke	290	368.5435	f	
rudd	fyke	210	141.7475	f	
rudd	Mtrammel	300	425.2425	f	
rudd	Mtrammel	280	368.5435	f	
rudd	Mtrammel	300	481.9415	f	
rudd	Mtrammel	290	368.5435	f	
rudd	Mtrammel	310	425.2425	f	
rudd	Mtrammel	280	340.194	f	
rudd	Ctrammel	250	255.1455	?	
rudd	Ctrammel	210	141.7475	f	
rudd	Ctrammel	200	141.7475	f	
trout	Mtrammel	380			
trout	Mtrammel	400		f	well developed eggs
trout	Ctrammel	270		f	well developed eggs
trout	Ctrammel	330		f	well developed eggs
trout	Ctrammel	290		?	
trout	Ctrammel	280		?	
trout	Ctrammel	300		m	no milt
perch	Ctrammel	300	340.194	f	
perch	Ctrammel	320	453.592	f	
perch	Ctrammel	300	368.5435	f	
perch	Ctrammel	280	226.796	f	
perch	Mtrammel	310			
perch	Mtrammel	340			
perch	Mtrammel	330	453.592	f	
perch	Mtrammel	330	878.8345	f	
perch	Mtrammel	330	481.9415	f	

perch	Mtrammel	340	510.291	f	
perch	Mtrammel	340	510.291	f	
perch	Mtrammel	320	396.893	f	
perch	Mtrammel	330	510.291	f	
perch	Mtrammel	300	311.8445	f	
perch	Mtrammel	320	425.2425	f	
perch	Mtrammel	300	340.194	f	
perch	Mtrammel	310	425.2425	f	
perch	Mtrammel	320	453.592	f	
perch	Mtrammel	330	510.291	f	
perch	Mtrammel	340	538.6405	f	
perch	Mtrammel	320	396.893	f	
perch	Mtrammel	320	425.2425	f	
perch	Mtrammel	340	481.9415	f	
perch	Mtrammel	330	510.291	f	
perch	Mtrammel	340	510.291	f	
perch	Mtrammel	300	340.194	f	
seining	05.05.2010				
	number	minlength mm			
smelt	9	60			

SITE C	Lake Wairarapa West				
DATE	25.04.2010				
LOCAL ENV	large cobble substrate, rush edges				
COMMENTS	fykes set out in open rather than leading from rush verges due to high wave action. Minnows set off fykes				
SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
sfe	minnow	230			
sfe	minnow	250			
sfe	Fyke	500			
sfe	Fyke	500			
sfe	Fyke	500			
sfe	Fyke	500			
sfe	Fyke	350			
sfe	Fyke	400			
sfe	Fyke	300			
sfe	Fyke	500			
sfe	Fyke	400			

sfe	Fyke	400			
lfe	Fyke	400			
black flounder	Fyke	140			
black flounder	Ctrammel	290			
black flounder	Mtrammel	280			
black flounder	Mtrammel	280			
black flounder	Mtrammel	280			
black flounder	Mtrammel	280			
black flounder	Mtrammel	250			
black flounder	Mtrammel	300			
perch	Ctrammel	320	453.592	f	
perch	Ctrammel	280	283.495	f	
perch	Ctrammel	290	340.194	f	
perch	Ctrammel	320	425.2425	f	
perch	Ctrammel	310	396.893	f	
perch	Ctrammel	310	453.592	f	
perch	Ctrammel	310	396.893	f	
perch	Ctrammel	290	340.194	f	
perch	Ctrammel	280	311.8445	f	
perch	Ctrammel	300	368.5435	f	
perch	Ctrammel	290	340.194	f	
perch	Ctrammel	300	340.194	f	
perch	Ctrammel	240	226.796	f	
perch	Ctrammel	230	170.097	?	
perch	Ctrammel	220	170.097	?	
perch	Mtrammel	370	680.388	f	
perch	Mtrammel	350	595.3395	f	
perch	Mtrammel	350	566.99	?	
perch	Mtrammel	330	481.9415	f	
perch	Mtrammel	310	453.592	f	
perch	Mtrammel	330	453.592	f	
perch	Mtrammel	310	510.291	f	
perch	Mtrammel	310	453.592	f	
perch	Mtrammel	290	311.8445	f	
perch	Mtrammel	290	340.194	f	
perch	Mtrammel	330	481.9415	f	
perch	Mtrammel	310	453.592	f	
perch	Mtrammel	300	368.5435	f	
perch	Mtrammel	300	368.5435	f	
perch	Mtrammel	300	368.5435	f	
perch	Mtrammel	300	340.194	f	
perch	Mtrammel	300	368.5435	f	
perch	Mtrammel	310	368.5435	f	
perch	Mtrammel	310	368.5435	f	

perch	Mtrammel	320	368.5435	f	
perch	Mtrammel	310	368.5435	f	
perch	Mtrammel	330	481.9415	f	
perch	Mtrammel	350	595.3395	f	
perch	Mtrammel	320	425.2425	f	
perch	Mtrammel	310	396.893	f	
perch	Mtrammel	280	340.194	f	
perch	Mtrammel	310	396.893	f	
perch	Mtrammel	300	368.5435	f	
rudd	Ctrammel	210	141.7475	?	
rudd	Mtrammel	290	368.5435	f	very small immature eggs
seining	24.04.2010				
	number	minlength mm			
common	27	10			
smelt	5	15			
msid shrimp	many				

SITE D	Lake Wairarapa South				
DATE	30.04.2010				
LOCAL ENV	deep water (minnows in raupo verges though), clay/mud substrate, grass and raupo verges				
COMMENTS	too deep for seining				
SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
common	minnow	20			
common	minnow	50			
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
lots mysid	minnow				

shrimp					
few paratya	minnow				
sfe	fyke	400			
sfe	fyke	350			
sfe	fyke	350			
sfe	fyke	700			
sfe	fyke	700			
sfe	fyke	600			
sfe	fyke	450			
sfe	fyke	500			
sfe	fyke	500			
sfe	fyke	450			
sfe	fyke	400			
sfe	fyke	400			
sfe	fyke	350			
sfe	fyke	400			
sfe	fyke	400			
sfe	fyke	500			
sfe	fyke	600			
sfe	fyke	600			
sfe	fyke	500			
sfe	fyke	400			
sfe	fyke	400			
sfe	fyke	500			
sfe	fyke	500			
sfe	fyke	400			
sfe	fyke	650			
sfe	fyke	500			
sfe	fyke	450			
sfe	fyke	550			
sfe	fyke	450			
sfe	fyke	500			
sfe	fyke	550			
sfe	fyke	500			
sfe	fyke	600			
sfe	fyke	600			
sfe	fyke	500			
sfe	fyke	400			
sfe	fyke	500			
sfe	fyke	450			
sfe	fyke	450			
sfe	fyke	400			
sfe	fyke	450			
sfe	fyke	500			

sfe	fyke	450			
sfe	fyke	500			
sfe	fyke	500			
sfe	fyke	450			
sfe	fyke	450			
sfe	fyke	400			
sfe	fyke	450			
sfe	fyke	450			
sfe	fyke	400			
sfe	fyke	450			
YE mullet	fyke(gate)	185			
grey mullet	Ctrammel	450			
grey mullet	Ctrammel	430			
grey mullet	Ctrammel	410			
grey mullet	Ctrammel	410			
grey mullet	Ctrammel	410			
grey mullet	Ctrammel	440			
grey mullet	Ctrammel	480			
grey mullet	Ctrammel	440			
grey mullet	Ctrammel	430			
grey mullet	Ctrammel	420			
grey mullet	Ctrammel	400			
grey mullet	Ctrammel	410			
grey mullet	Ctrammel	530			
grey mullet	Mtrammel	400			
grey mullet	Mtrammel	380			
grey mullet	Mtrammel	430			
grey mullet	Mtrammel	420			
grey mullet	Mtrammel	450			
grey mullet	Mtrammel	410			
grey mullet	Mtrammel	420			
grey mullet	Mtrammel	420			
grey mullet	Mtrammel	380			
grey mullet	Mtrammel	370			
grey mullet	Mtrammel	520			
grey mullet	Mtrammel	410			
grey mullet	Mtrammel	390			
grey mullet	Mtrammel	330			
grey mullet	Mtrammel	340			
grey mullet	Mtrammel	410			
grey mullet	Mtrammel	410			
perch	Mtrammel	280	255.1455		
rudd	Mtrammel	280	340.194		

SITE E	Boggy Pond				
DATE	17.04.2010				
LOCAL ENV	deep mud substrate. Shallow open water with sparse raupo. Floating macrophyes duckweed azolla riccipcarpus natans. Lots submerged macrophytes potomageton sp, hornwort				
COMMENTS	mono trammel not set due to concerns re wading birds. New site, very shallow, we were unsure if we would catch anything (setting in approx 40cm of water). In retrospect, would set trammel as shallowness didn't stop cotton trammel catching plus we have only ever caught diving waterbirds)				
SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
common	minnow	30			
common	minnow	50			
common	minnow	60			
common	minnow				
common	minnow				
common	minnow				
common	minnow				
common	minnow				
goldfish	minnow	22			
goldfish	minnow	70			
goldfish	minnow				
goldfish	minnow				
sfe	Fyke	600			
sfe	Fyke	550			
sfe	Fyke	650			
sfe	Fyke	800			
sfe	Fyke	800			
sfe	Fyke	800			
sfe	Fyke	800			
sfe	Fyke	500			
sfe	Fyke	800			
sfe	Fyke	750			
sfe	Fyke	700			
sfe	Fyke	650			
sfe	Fyke	650			
sfe	Fyke	400			
sfe	Fyke	650			
sfe	Fyke	600			
sfe	Fyke	500			
sfe	Fyke	500			

perch	Ctrammel	440	1389.126	female, lots eggs MT stomach	
perch	Ctrammel	430	1247.378	female, lots eggs MT stomach	
perch	Ctrammel	380	907.184	male, milt present, MT stomach	
SEINING	17.04.2010				
		smallest			
commons	15	as above			
goldfish	2				
Mysid	many				

SITE F	Matthews Lagoon				
DATE	18.04.2010				
LOCAL ENV	deep muddy bottom with submerged wood. Submerged macrophytes (hornwort, potamageton sp) abundant raupo and open water. Sparse azolla, duckweed, riccipcarpus natans				
COMMENTS	rudd not caught in cotton trammel but lots caught in mono trammel. May be why we caght no rudd in Boggy Pond ie they are present				
SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
common	minnow	20			
common	minnow	60			
common	minnow				
goldfish	minnow	50			
sfe	minnow	95			
sfe	Fyke				
sfe	Fyke	400			
sfe	Fyke	500			
sfe	Fyke	500			
sfe	Fyke	650			
sfe	Fyke	500			
sfe	Fyke	500			
sfe	Fyke	400			
sfe	Fyke	500			
sfe	Fyke	400			
sfe	Fyke	450			
sfe	Fyke	650			
sfe	Fyke	400			

sfe	Fyke	400			
sfe	Fyke	340			
sfe	Fyke	550			
sfe	Fyke	550			
sfe	Fyke	400			
sfe	Fyke	400			
sfe	Fyke	400			
sfe	Fyke	450			
sfe	Fyke	500			
sfe	Fyke	350			
sfe	Fyke	350			
sfe	Fyke	350			
sfe	Fyke	600			
sfe	Fyke	500			
sfe	Fyke	600			
sfe	Fyke	500			
sfe	Fyke	600			
sfe	Fyke	500			
sfe	Fyke	600			
sfe	Fyke	500			
sfe	Fyke	500			
sfe	Fyke	550			
sfe	Fyke	300			
sfe	Fyke	500			
sfe	Fyke	400			
sfe	Fyke	400			
sfe	Fyke	300			
sfe	Fyke	550			
sfe	Fyke	450			
sfe	Fyke	400			
sfe	Fyke	600			
sfe	Fyke	600			
sfe	Fyke	400			
sfe	Fyke	650			
sfe	Fyke	350			
sfe	Fyke	450			
sfe	Fyke	350			
sfe	Fyke	450			
sfe	Fyke	450			
sfe	Fyke	400			
sfe	Fyke	400			
sfe	Fyke	350			
sfe	Fyke	400			
sfe	Fyke	400			

sfe	Fyke	700			
sfe	Fyke	350			
sfe	Fyke	550			
sfe	Fyke	500			
sfe	Fyke	400			
sfe	Fyke	350			
perch	Ctrammel	360	680.388	female	
perch	Mtrammel	400	935.5335	female	
perch	Mtrammel	390	963.883	male	
perch	Mtrammel	360	765.4365	female	
perch	Mtrammel	310	510.291	male	
perch	Mtrammel	410	907.184	female	
perch	Mtrammel	320	453.592	female	
perch	Mtrammel	290	396.893	female	
perch	Mtrammel	320	481.9415	female	
perch	Mtrammel	310	453.592	female	
perch	Mtrammel	350	623.689	female	
rudd	Mtrammel	330	538.6405	female	eggs just visible for all these rudd
rudd	Mtrammel	340	737.087	female	
rudd	Mtrammel	300	425.2425	female	
rudd	Mtrammel	310	566.99	female	
rudd	Mtrammel	330	595.3395	female	estimated length (partially eaten)
rudd	Mtrammel	310	425.2425	female	
rudd	Mtrammel	280	311.8445	m?	
rudd	Ctrammel	270	283.495	female	
rudd	Ctrammel	260	198.4465	?	estimated length (partially eaten)
rudd	Ctrammel	300	453.592	female	
Seining	18.04.2010				
	number	minlength mm			
common	22	as above			
goldfish	1	35			

SITE G	Lake Onoke West			
DATE	09.05.2010			
LOCAL ENV	sand with submerged woody debris			
COMMENTS				

SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
triplefin	minnow	40			
triplefin	minnow	90			
triplefin	minnow				
triplefin	minnow				
triplefin	minnow				
common	minnow	70			
decapod shrimp (marine)	minnow				
decapod shrimp (marine)	minnow				
H cren	minnow				
YE mullet	fyke				
YE mullet	fyke (gate)	140			
YE mullet	fyke (gate)	170			
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
YE mullet	fyke (gate)				
sfe	fyke	300			
YE mullet	Ctrammel	320			
YE mullet	Mtrammel	190			
YE mullet	Mtrammel	220			
YE mullet	Mtrammel	210			
YE mullet	Mtrammel	160			
YE mullet	Mtrammel	160			
brown trout	Mtrammel	300			
black flounder	Mtrammel	210			
black flounder	Mtrammel	260			

black flounder	Mtrammel				
black flounder	Ctrammel	210			
YB flounder	Ctrammel	140			
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Ctrammel				
YB flounder	Mtrammel	120			
YB flounder	Mtrammel	320			
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
YB flounder	Mtrammel				
plus 20 H crenulatus in cotton trammel and 3 in mono trammel					

seining					
	number	minlength mm			
ye mullet	2	40			
triplefin	1	40			

SITE H	Lake Onoke East				
DATE	18.06.210				
LOCAL ENV	sand and submerged woody debris. No plants				
COMMENTS					
SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
triplefin	minnow	40			
sfe	fyke	800			
h cren	fyke				
YE mullet	Mtrammel	210			
smelt	Mtrammel	130			
black flounder	Mtrammel	250			
seining					
flounder sp	1	20mm			
mysid shrimp	1				

SITE I	Lake Pounui				
DATE	24.05.2010				
LOCAL ENV	cobble bottom, turf plants and numerous native submerged macrophytes. Emergent reed species on verges. Mostly open water, suspended algae and small amount of filamentous algae collected when seining				
COMMENTS					
SP	**TRAP**	**TLENGTH mm**	**WEIGHT g**	**SEX**	**NOTES**
common	minnow	22			
common	minnow	45			
common	minnow				
common	minnow				
common	minnow				

common	minnow				
common	minnow				
common	minnow				
sfe	fyke	600			
sfe	fyke	500			
sfe	fyke	450			
lfe	fyke	600			
lfe	fyke	1200			
lfe	fyke	550			
lfe	fyke	600			
lfe	fyke	600			
lfe	fyke	600			
lfe	fyke	600			
lfe	fyke	500			
perch	fyke (in mesh holes, not gate)	100	28.3495	Male	milt
perch	fyke (in mesh holes, not gate)	110	28.3495	?	
perch	Ctrammel	280	283.495	F	eggs well developed
brown trout	Ctrammel	440		F	eggs well developed
brown trout	Mtrammel	470		Male	milt
giant kokopu	Ctrammel	270			
plus 2 scaup in Mono trammel					
seining					
	number	minlength mm			
common	21	as above			