Whole-lake Fish Removal – Fact Sheet

Linking lake restoration with end users for positive environmental outcomes

LERNZ
Lake Ecosystem Restoration New Zealand

Whole-lake Carp Removal

A central objective of our lake restoration research was to remove invasive fish from 5 lakes of >5 ha in area to restore indigenous biodiversity. We chose a variety of lakes with dominant invasive fish species ranging from goldfish to perch and koi carp (Figure 1 and Table 1). Because of the priority accorded to Lower Karori Reservoir by end users we relaxed the original criterion of > 5 ha lake area. We fished with a variety of fishing methods (boat electrofishing, fyke and seine netting, and feeder (pod) trapping).

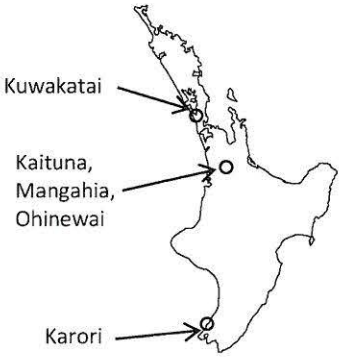

Figure 1. Location of lakes in the North Island, NZ.

Table 1. Areas and depths of lakes with biomass determinations.

Lake	Area (ha)	Maximum depth (m)	Survey date
Lake Kaituna	15	1.3	29 Sep-4 Nov 2010
Lake Mangahia	10	1.5	25 Mar-23 Apr 2010
Lake Kuwakatai	28-36	15	Nov 2011-Jan 2012
Lake Ohinewai	16.9	4.5	2011-2014
Lower Karori Reservoir	2.34	20	2007 - 2009

Lake Kuwakatai

Lake Kuwakatai is a dune lake northwest of Auckland that has had a wide variety of invasive fish that were illegally released into it. Because of this, its water quality is degraded and it has frequent algal blooms (Figure 2A). Rudd is one of the most abundant invasive fish in the lake (Figure 2B) and were found to be highly susceptible to pod traps. We removed 913 kg of invasive fish, which was 26% of the estimated total of 4.97 tonnes (138 kg/ha, Table 2).

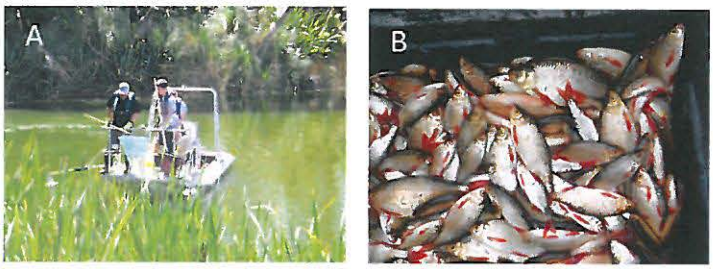

Figure 2. Lake Kuwakatai: A. Algal bloom, B. part of the rudd catch.

Figure 3. Pod trap with a feeder in Lake Kuwakatai.

Table 2. Population and biomass estimates of invasive fish in five North Island lakes. * actual catch as mark-recapture estimate was not possible. For more information see Hicks et al. 2015 New Zealand invasive fish management handbook, LERNZ. Pp 116-122, Section 6.2.

	Kuwakatai		Mangahia		Kaituna		Ohinewai		Karori	
Species	Population estimate	Biomass (kg/ha)	Population estimate	Biomass (kg/ha)	Population estimate	Biomass (kg/ha)	Population estimate	Biomass (kg/ha)	Population estimate	Biomass (kg/ha)
Catfish			4,875	66	923	12	1,559	15		
Goldfish	9,324	26	24,245	556	2,727	46	878	8		
Koi carp	780	33	25*	1.4*	619	77	8,549	374		
Perch	2,513	8							21,081	344
Rudd	28,934	28	63*	0.7*	302	3.3	102	0.92		
Tench	12,676	43								
Total invasive fish	56,628	138	29,208	625	4,571	138	11,087	398	21,081	344

Whole-lake Fish Removal – Fact Sheet Continued

LERNZ
Lake Ecosystem Restoration New Zealand

Lake Mangahia

Lake Mangahia is a 10-ha shallow, hypertrophic Waikato peat lake in a predominantly pastoral catchment. We estimated that it had an original biomass of 6.3 tonnes of invasive fish (625 kg/ha, Table 2), and we removed 655 kg, or 10% of the total invasive fish biomass.

Lake Kaituna

Lake Kaituna is a 15-ha shallow, hypertrophic Waikato peat lake in a predominantly pastoral catchment. Its original biomass of invasive fish was 2.1 tonnes (138 kg/ha), of which we removed 0.41 tonnes, or about 20%.

Lake Ohinewai

Lake Ohinewai is a 16.9-ha shallow, hypertrophic Waikato riverine lake in a predominantly pastoral catchment. We estimated that it had an original biomass of 6.7 tonnes of invasive fish (398 kg/ha, Table 2), 94% of which were koi carp. We removed about half (3.5 tonnes) of this biomass between 2011 and 2014.

Karori Reservoir

The Lower Karori Reservoir is an artificially constructed lake behind an earth dam that was once part of Wellington City's water supply. Perch were introduced into the reservoir in 1878, and the population is dominated by small, juvenile fish.

We estimated the fish population in 2007 by removal methods as 21,081 perch, with several longfin eels that were introduced recently. Using gills nets and boat electrofishing between 2007 and 2009 we removed 14,890 perch (382 kg). This is 47% of the original perch biomass, but perch were breeding during the period of capture so the amount that remained is uncertain. Hydroacoustic surveys before and after fish removal suggest that fishing removed 46% of the perch.

Cost effectiveness

Catch rates of invasive fish in this comparison are highly variable, depending on water depth and morphology of the littoral habitat, and methods need to be highly targeted to different species. Boat electrofishing is a highly effective method for koi carp and goldfish, but is less effective for catfish, which are readily caught with fyke nets. Fyke netting and gill netting are more expensive to use than boat electrofishing, offsetting the cheaper cost of nets than an electrofishing boat (Table 3). Costs ranged from $3-40/kg and varied depending on target species and method.

Conclusion

Fishing using a variety of different methods is required to give a complete view of a lake's fish abundance, but fishing methods alone are inadequate to control invasive fish in most lakes.

Table 3. Cost effectiveness of boat electrofishing, fyke netting, gill netting and pod trapping for invasive fish. For more information see Hicks et al. 2015 New Zealand invasive fish management handbook, LERNZ. Pp 123-132, Section 6.3.

Fishing method	Species	Fish/ person-day	Weight (kg/ person-day)	Cost ($/fish)	Cost ($/kg)
Boat electrofishing	koi carp	206	685	5	3
Boat electrofishing	rudd, perch, goldfish, koi carp, tench	519	92	1	7
Boat electrofishing	perch	798	40	1	27
Fyke netting	catifsh, rudd, perch, goldfish, koi carp, tench	203	12	5	40
Gill netting	perch	305	14	2	35
Pod trapping	rudd, perch, goldfish, koi carp, tench	415	21	1	23