Goldfish: the "new" pest fish.
Evidence presented in support of CBER's submission to Environment Waikato's Draft Regional Pest Management Strategy

CBER Contract Report 61

A report prepared for
Environment Waikato

by

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Goldfish currently have no legal status in New Zealand, but I believe that they should be recognised a pest fish species within the Waikato Region. I built and developed the first successful electrofishing boat in New Zealand, and with this boat we have caught about 10,000 fish in three years. I lead a pest fish management research programme at the University of Waikato, and I here present evidence from boat electrofishing of the abundance goldfish in the Waikato basin.

Among the introduced fish of the Waikato basin, goldfish (*Carassius auratus*) are among the most widespread and numerous (Tables 1 and 2). I have found relative abundances of goldfish similar to Lake Waahi (Table 1) in lakes Whangape, Kimihia, and Waikare and the Hikutaia Cut, lower Waihou River. I have reason to believe they exist in most water bodies in the region. In addition, juvenile goldfish can be found at most times of the year, suggesting that they do not have the same temperature limitations as koi carp (*Cyprinus carpio*), a recognised pest fish. Because of their size, koi carp dominate the fish biomass at most Waikato locations, but goldfish generally outnumber koi carp. Goldfish breed freely, and they hybridise with koi carp. About 1% of our koi carp catch in the Waikato is hybrids, though we have no evidence that such hybrids are fertile.

Table 1. Number of fish caught in 10 minutes of boat electrofishing in Lake Waahi in March 2007.

Species	Catch rate (fish caught in 10 min)
Goldfish	32
Shortfin eel	17
Koi carp	3
Bully	3
Rudd	2
Catfish	2
Perch	1
Gambusia	1
Inanga	0
Smelt	0
Sum	61

Table 2. Biomass of fish in the Waikato River by boat electrofishing in February 2005.

Species	Biomass (g fresh weight m^{-2})			
	Zone 1	Zone 2	Zone 3	Zone 4
Koi carp	4.0	14.8	30.8	18.3
Goldfish	0.0	2.0	1.6	1.9
Shortfin eel	2.6	1.2	0.8	0.9
Grey mullet	2.3	1.7	0.5	3.0
Rudd	0.0	0.8	0.4	0.1
Catfish	0.0	0.0	0.1	0.3
Brown trout	7.3	0.0	0.0	0.0
Rainbow trout	0.6	0.0	0.0	0.0
Sum all species	17.2	20.5	34.6	24.8

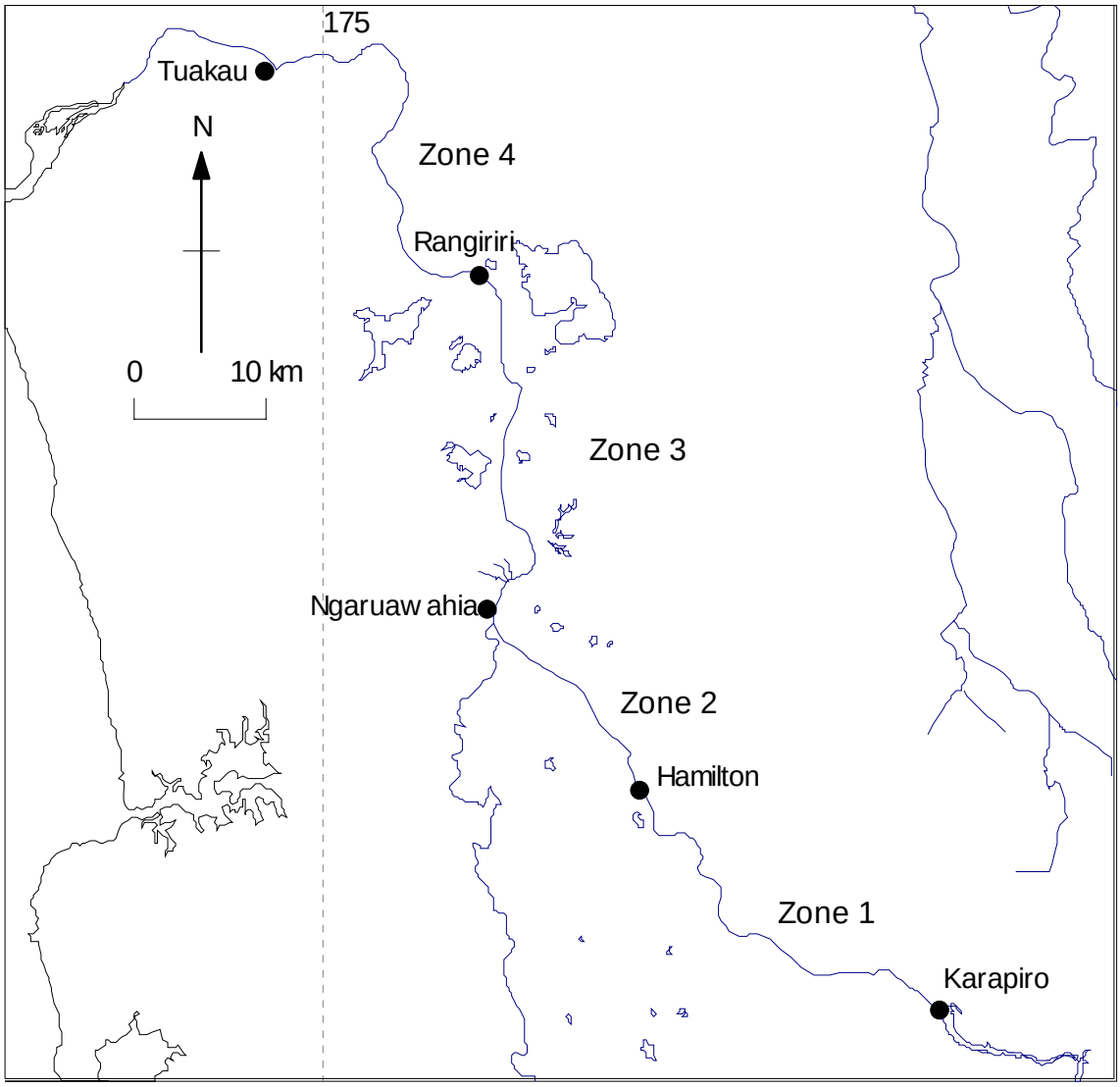

Figure 1. Zones of the Waikato River fished in February 2005 by boat electrofishing by the University of Waikato (Hicks et al. 2005).

There is gathering evidence of the detrimental effects of goldfish water quality (e.g., Richardson et al. 1995; Rowe 2007), and by implication, on the biodiversity of native fish species. In a Canadian study, Richardson et al. (1995) found that goldfish generated high levels of turbidity during foraging in mud pools and caused extensive grazing damage on aquatic plants. Feral goldfish reached 15–17,000 individuals ha^{-1}, and were benthic herbivores, causing a visible increase in turbidity and decrease in aquatic vegetation. Rowe (2007) showed that exotic fish reduced water clarity in New Zealand lakes (Fig. 2).

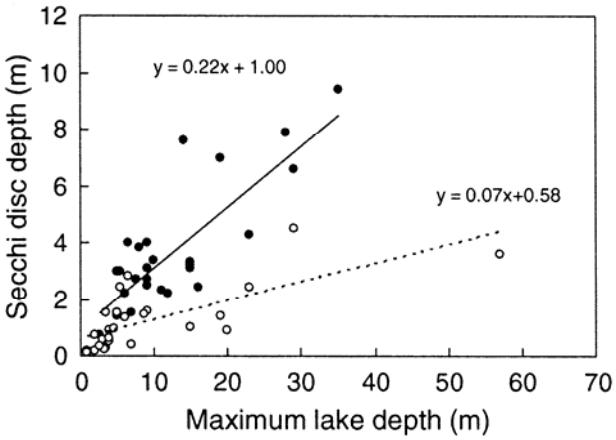

Fig. 2 Relationship between maximum lake depth and mean summer secchi disc depth for lakes containing introduced exotic fish (open circles, dashed line) and lakes where such fish are absent (closed circles, solid line)

Source: Rowe (2007)

Conclusion

The status of goldfish should be re-evaluated in the light of recent evidence. Though goldfish were not recognised as pest fish in the 2001 DOC workshop on pest fish (Munro 2003), the results of boat electrofishing in the Waikato River and its lakes and wetlands by The University of Waikato, and documentary evidence of the impact of goldfish on water quality, strongly support the status of goldfish as a pest fish in EW's Regional Pest Management Strategy.

References

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Richardson, M. J., F. G. Whoriskey, and L. H. Roy 1995. Turbidity generation and biological impacts of an exotic fish *Carassius auratus*, introduced into shallow seasonally anoxic ponds. *Journal of Fish Biology 47*: 576–585.

Rowe, D. K. 2007. Exotic fish introductions and the decline of water clarity in small North Island, New Zealand lakes: a multi-species problem. *Hydrobiologia online*.

Appendix 1. Abstract from Richardson et al. (1995): Turbidity generation and biological impacts of an exotic fish *Carassius auratus*, introduced into shallow seasonally anoxic ponds. *Journal of Fish Biology 47*: 576–585.

Abstract

Over the last decade, goldfish *Carassius auratus* L., have been introduced into lakes and ponds in the Montreal region. Controlled experiments compared the impact of goldfish in both mud-and gravel-bottomed outdoor pools, with either caged or non-caged vegetation. High levels of turbidity were generated by foraging goldfish in mud pools ($P<0.01$). All non-caged submersed plants (*Potamogeton*) showed extensive grazing damage and all of the unprotected submersed and emergent forms were uprooted. Data from Stoneycroft pond where a feral goldfish population reached 15–17,000 individuals ha^{-1}, confirmed the experimental findings showing goldfish to be benthic herbivores, causing a visible increase in turbidity and decrease in aquatic vegetation. Gut analysis revealed goldfish to have little diet overlap with native amphibians. High turbidity should reduce the success of predators feeding on goldfish, and may decrease the foraging success of other competitors. The sporadic distribution of goldfish in Canada may be linked to site characteristics, specifically the susceptibility of the area to turbidity generation.

Appendix 2. A sample of New Zealand lakes with exotic coarse fish that also have goldfish. (Source: Rowe 2007).

Table 2 Exotic coarse fish species in northern New Zealand lakes (1, breeding population present; 0, not present; *, present but breeding unconfirmed; –, status unknown)

No.	Lake name	Presence/absence of exotic fish						Data sources
		Perch	Rudd	Tench	Catfish	Goldfish	Koi carp	
1	Wahakari	0	0	0	0	0	0	5
2	Rotokawau	0	0	0	0	0	0	1,5
3	Waiparera	0	0	0	0	0	0	5
4	Rotoroa	0	0	0	0	0	0	1
5	Ngatu	0	1	0	0	1	0	1,5
6	Shag	0	0	0	0	0	0	1
7	Waikere	0	0	0	0	0	0	1,5
8	Taharoa	0	0	0	0	0	0	1,5
9	Kai iwi	0	0	0	0	0	0	1,5
10	Omapere	0	0	0	*	1	0	5
11	Owhareiti	0	0	0	0	0	0	1
12	Tauanui	1	0	0	0	0	0	1
13	Rotopouua	0	0	0	0	0	0	1
14	Karaka	0	0	0	0	0	0	1
15	Humuhumu	0	0	0	0	0	0	1
16	Roto-otuauru	0	0	0	0	0	0	1
17	Rotokawau	0	0	0	0	0	0	1
18	Waingata	0	0	0	0	0	0	1
19	Kanono	0	0	0	0	0	0	1
20	Kahuparere	0	0	0	0	0	0	1
21	Taharoa	0	0	0	0	0	0	7
22	Numiti	0	0	0	0	0	0	7
23	Wainui	0	0	0	0	0	0	1,8
24	Kapoai	0	1	*	0	0	0	1,8
25	Parawanui	0	1	1	0	0	*	1,8
26	Rototuna	0	1	0	0	0	0	1
27	Ototoa	1	1	*	0	1	0	2
28	Kuwakatai	1	1	1	-	1	1	5
29	Kereta	*	1	1	0	1	1	5
30	Kawaupaka	0	1	1	0	0	0	13
31	Wainamu	1	1	1	1	1	0	2,5
32	Tomorata	–	1	*	–	–	–	8
33	Spectacle	–	1	1	–	–	–	5
34	Pupuke	1	1	1	*	1	1	5
35	Whangape	0	1	0	1	1	1	3,5,6
36	Rotongaro	–	–	–	1	–	1	3,5
37	Rangiriri	–	–	–	1	1	–	3
38	Waikare	–	1	–	1	1	1	5
39	Rotokawau	–	–	–	1	1	–	3
40	Ohinewai	–	–	–	1	1	–	3
41	Okowhao	0	0	0	1	1	0	3,4
42	Waahi	1	1	0	1	1	1	5,6
43	Kimihia	0	1	0	1	1	0	3,4
44	Hakanoa	1	1	–	1	1	1	3,12
45	Hotoananga	–	–	–	1	1	–	3,5
46	Rotokauri	–	–	–	1	1	–	3,5
47	Rotoroa	1	1	1	1	1	0	9
48	Rotomanuka	–	1	–	1	1	–	3,5,10
49	Ngaroto	–	1	–	1	1	–	3,5,11

Data sources: [1]Rowe & Chisnall (1997), [2]Rowe et al. (2005), [3]Boswell et al. (1985), [4]Chisnall et al. (1991), [5]New Zealand Freshwater Fish Database, [6]Hayes et al. (1992), [7]Strickland (1985), [8]Gibbs, M., personal communication, [9]Hicks (1994), [10]Speirs & Barnes (2002), [11]Schipper (1979), [12]Auckland-Waikato Fish & Game Society records, [13]Author's unpublished data