

# Appendix 1—Prioritising control of invasive freshwater fish

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## 1. INTRODUCTION

McDowall (2000) reports a total of 19 species of freshwater fish that have successfully established breeding populations in New Zealand. An additional two species, grass and silver carp are found in the wild but are not thought to be able to breed in New Zealand (Table 1).

TABLE 1. INVASIVE FRESHWATER FISH OF NEW ZEALAND.

COMMON NAME	SCIENTIFIC NAME	DISTRIBUTION	RANGE STATUS
<b>Family Cyprinidae</b>			
Tench	<i>Tinca tinca</i>	Localised, North and South Is	Expanding
Goldfish	<i>Carassius auratus</i>	Widespread North I., localised South I.	Unknown
Koi carp	<i>Cyprinus carpio</i>	North I., widespread only in north	Expanding
Rudd	<i>Scardinius erythrophthalmus</i>	Becoming widespread, North and South Is	Expanding
Grass carp	<i>Ctenopharyngodon idella</i>	Localised, non breeding, North and South Is	Expanding
Silver carp	<i>Hypophthalmichthys molitrix</i>	Localised, non breeding, North I.	Expanding
Orfe	<i>Leuciscus idus</i>	Localised, Auckland region	Unknown
<b>Family Italuridae</b>			
Catfish	<i>Ameiurus nebulosus</i>	North and South Is, widespread in north of North I.	Expanding
<b>Family Poecillidae</b>			
Mosquitofish	<i>Gambusia affinis</i>	North and South Is, widespread in north of North I.	Expanding
Guppy	<i>Poecilia reticulata</i>	Localised central North I.	Stable
Sailfin molly	<i>Poecilia fluviatulus</i>	Localised central North I.	Stable
Sword tail	<i>Xiphophorus helleri</i>	Localised central North I.	Stable
Caudo	<i>Phalloceros caudimaculatus</i>	Localised northern North I.	Stable
<b>Family Percidae</b>			
Perch	<i>Perca fluviatilis</i>	Widespread North and South Is	Expanding
<b>Family Salmonidae</b>			
Brown trout	<i>Salmo trutta</i>	Widespread North and South Is	Stable
Atlantic salmon	<i>Salmo salar</i>	Localised, South I.	Declining
Rainbow trout	<i>Oncorhynchus mykiss</i>	Widespread North and South Is	Stable
Chinook salmon	<i>Oncorhynchus tshawytscha</i>	Eastern South I., limited numbers in west of South I., rare North I.	Expanding
Sockeye salmon	<i>Oncorhynchus nerka</i>	Localised, South I.	Declining
Brook char	<i>Salvelinus fontinalis</i>	Widespread South I., localised North I.	Stable
Mackinaw	<i>Salvelinus namaycush</i>	Localised, South I.	Stable

## 2. PRIORITISATION EXERCISE

Limited science capacity and funding within New Zealand necessitates that species and issues are prioritised for research attention. An exercise to rank all introduced fish species and six native species that could be considered invasive in some situations (see Table 2) was carried out at the end of all oral papers on day 2 of the workshop. Species were ranked to give an indication of which species pose the greatest threat to New Zealand freshwater species and ecosystems to help prioritise research effort.

Workshop participants were divided into the following groups—Australian experts, policy makers, Department of Conservation operational staff, regional councils, scientists (two groups) and sport fishery managers. Each group ranked all introduced fish present in New Zealand and six native fish species (considered to be potentially invasive) using a set of standardised criteria.

TABLE 2. POTENTIALLY INVASIVE NATIVE FRESHWATER FISH IN NEW ZEALAND CONSIDERED IN THE RANKING EXERCISE.

POTENTIAL NATIVE NEW ZEALAND INVASIVE SPECIES	ISSUE
<b>Family Anguillidae</b>	
Longfin eel	<i>Anguilla australis</i>
Shortfin eel	<i>Anguilla dieffenbachii</i>
Aust. Longfin eel	<i>Anguilla reinhardtii</i>
All three species are potentially being spread into areas that were naturally free of eels	
<b>Family Retropinidae</b>	
Smelt	<i>Retropinna retropinna</i>
Has historically been spread as a forage fish species for salmonids	
<b>Family Galaxiidae</b>	
Koaro	<i>Galaxias brevipinnis</i>
Non-migratory galaxiids	<i>Galaxias</i> spp.
Range extension above artificial impoundments. Water diversion raceways have introduced koaro and previously separate populations of non-migratory species, leading to exclusion, hybridisation and loss of genetic diversity	

## 3. CRITERIA FOR PRIORITISING SPECIES

Each species was scored on its potential ecological impacts, economic impacts, dispersal ability, fecundity and environmental tolerance. The effects of a fish species on native and introduced species were given a score out of six to differentiate between impacts on valued introduced species and native species. A score of six would be a high impact species such as a major predator or a species that significantly affected various trophic levels. Economic impacts on biological components (e.g. whitebait, eels, trout) and physical values (e.g. water quality, stop banks, structures) were also scored on a one to six scale. The dispersal criteria was a combination of a species' ability to spread naturally (1–3) and the likelihood of it being spread by people (1–3). Fecundity was used in part to represent the ability of a species to establish a population and also its ability to withstand removal. It was scored on a 1–3 scale with three for highly fecund species and one being low fecundity. Environmental tolerance was also scored on a one to six scale, and was used to represent a species' ability to tolerate a range of water quality, temperature, habitat and salinity—hence it

TABLE 3. SUMMARY OF SCORES FOR EACH CATEGORY.

Native	6
Introduced	6
Biological	6
Physical	6
Dispersal	3+3
Fecundity	3
Tolerance	6
Total	39

reflected its ability to colonise a wide range of habitats types throughout New Zealand (potential extent of its impacts). Fish species were then ranked by totaling their scores across each criteria with a potential maximum of 39 (Table 3).

#### 4. RESULTS

Despite the range of backgrounds, and functional responsibility present, there was a general consensus on the species of greatest concern. Koi carp, catfish, rudd, perch, brown trout and *Gambusia* (Table 4) were identified as the species posing the greatest threat to New Zealand’s biodiversity. The result was very similar to that produced by the one expert panel of New Zealand freshwater scientists that completed the process with the same six introduced fish ranked as priorities for investigation and management action. Rainbow trout was also reasonably consistently chosen as the next introduced fish of concern.

Most participants, owing to the lack of knowledge of orfe’s and caudo’s biology and distribution in New Zealand did not rank them. However, they agreed that because orfe has an apparently highly localised distribution, and was illegally introduced, it was a priority for management action.

TABLE 4. AVERAGE RANK AND SCORE FOR TOP TEN SPECIES, ALL FUNCTIONAL GROUPS COMBINED.

PRIORITY ORDER	PRIORITY ORDER BASED ON AVERAGE SCORE ALL GROUPS	SCORE (RANGE)
1	<b>Koi carp</b>	<b>29.6 (26–35)</b>
2	<b>Catfish</b>	<b>26.9 (23–29)</b>
3	<b>Rudd</b>	<b>26.1 (23–29)</b>
4	<b>Perch</b>	<b>25.9 (22–33)</b>
5	<b>Brown trout</b>	<b>22.5 (18–27)</b>
6	<b><i>Gambusia</i></b>	<b>22.1 (23–31)</b>
7	New Zealand longfin eel	19.0 (16–22)
8	New Zealand shortfin eel	19.0 (16–22)
9	Rainbow trout	18.0 (14–24.5)
10	Australian longfin eel	17.0 (13–22)

#### 5. CONCLUSIONS

Workshops participants’ views of the relative threats each species posed to freshwater ecosystems and biodiversity in New Zealand were gauged following 2 days of presentations on the species biology, impacts and management actions being undertaken in Australia and New Zealand. A set of subjective criteria were used to differentiate between species based upon their ecological characteristics and potential impacts. We divided participants into functional groups as it was thought that this might influence perceptions of potential impacts and value judgements. The combined results therefore should represent a cross-section of community interests ranging from managers of sport fisheries to freshwater conservation staff.

There was consensus among all participants that koi carp, catfish, rudd, perch, brown trout (in certain situations) and *Gambusia* were the highest priorities for research and management actions. That these views were shared across a range of functional groups with different interests, including two groups of New Zealand fisheries ecologists, suggests that they represent a cross-section of values held by the New Zealand public and are backed up by our current ecological understanding of these species.

## 6 . REFERENCES

McDowall, R.M. 2000: The Reed field guide to New Zealand freshwater fishes. Reed Publishing, New Zealand. 224 p.