

## Foreword

# Invasive species: fish and fisheries Workshop overview, then and now

JOHN D. KOEHN

Cooperative Research Centre for Freshwater  
Ecology  
Arthur Rylah Institute for Environmental Research  
123 Brown St, Heidelberg  
VIC 3084, Australia  
email: john.koehn@dse.vic.gov.au

ROBERT M. McDOWALL

National Institute of Water and Atmospheric  
Research Limited  
P.O. Box 8602  
Christchurch, New Zealand

**Keywords** Australia; New Zealand; invasive  
fishes; protocols; management; impacts

**Abstract** This short paper provides an overview of the “Invasive species: fish and fisheries Workshop” held in Wellington, New Zealand, 2003, with a retrospective comparison to a similar workshop held in 1989. The “then and now” comparison provides some insights into progress (or lack of it) on invasive fish issues over that 14-year period. The workshop also highlighted the degree of commonality on this issue between Australia and New Zealand.

Biological exchange is a greater threat to the biodiversity of freshwater ecosystems than to other ecosystems because of the intentional and unintentional release of organisms (Sala et al. 2000; Kolar & Lodge 2001) causing the integrity of aquatic ecosystems to be challenged worldwide (Moyle & Light 1996). The papers on invasive species relating to fish and fisheries appearing in this issue of *New Zealand Journal of Marine and Freshwater Research* are derived from the 2003 Australian Society for Fish Biology (ASFB) workshop entitled “Invasive species: fish and fisheries”. Held in Wellington, New Zealand on 30 June and 1 July 2003, the workshop was attended by over 70 participants with a total of 32 presented papers. The

workshop focused on science and management, and demonstrated common concerns between Australia and New Zealand.

The issue of invasive species is of course not a new one and indeed a similar workshop entitled “Introduced and translocated fishes and their ecological effects” was also hosted by ASFB in 1989 at Magnetic Island in Australia (Pollard 1990a). These two ASFB workshops are symptomatic of a local expression of global concerns about the ecosystem effects of introduced species. Moreover, additional workshops have been held at which both Australian and New Zealand fisheries ecologists were present, viz one in 1996 at which the threat to Australian ecosystems of massively invasive carp (*Cyprinus carpio* L.) was examined (Roberts & Tilzey 1997), and another that reviewed the New Zealand situation with regard to exotic fishes (Department of Conservation 2003). The attendance at all of these workshops by scientists from both countries indicates the seriousness of the actual and potential problems relating to invasive fish species, the fact that these problems have commonalities in both countries, and the benefits of shared experience in dealing with them. It is therefore instructive to compare the issues considered in the papers presented and the general discussions from the two ASFB workshops as a gauge of progress of invasive species management over this 14-year period.

The 1989 workshop arose from discussions and resolutions passed at the Annual General Meeting of the 1985 ASFB conference and threatened fishes workshop and included particular concerns regarding: (1) proposals to introduce non-indigenous fish species to Papua New Guinea; (2) trade in non-indigenous aquarium fishes within Australia; and (3) the proposed introduction of Nile perch (*Lates niloticus* (L.)) into Australia.

These concerns provided core themes around which more general workshop papers were based. The workshop comprised 21 presented papers and 7 posters. With the exception of one marine and estuarine paper, the remaining papers all related to fresh waters. Papers on individual introduced species

included weatherloach (*Misgurnus anguillicaudatus* Cantor), various cichlids (f. Cichlidae), gambusia (*Gambusia holbrooki* Girard) (3), carp, and Nile perch. The potential introduction of Nile perch into Australia was topical at the time (see Barlow & Lisle 1987) and it was later resolved that this introduction would not proceed. One session (four papers) was devoted to introductions into Papua New Guinea and one paper covered introductions into New Zealand (McDowall 1989). As the title of the 1989 workshop included translocated native species as well as introduced species, one session was devoted to translocation of native species, which included genetic implications. Several papers described range expansions of relatively recent introductions.

At the 2003 ASFB workshop, many of the same issues were addressed. It is fair to say that the papers presented in 2003 were more detailed than those of 1989, and many outlined considerable additional range expansions for species identified as invaders in 1989. Of the 32 papers presented, eight concerned marine organisms. Species-specific papers were presented on weatherloach, gambusia (3), carp (4), and trout (*Salmo trutta* L. and *Oncorhynchus mykiss* (Walbaum)) (2), coarse fish, and aquarium imports. Overall there are many consistent themes from these workshops, with many issues that still need to be addressed, such as: the serious potentially invasive nature of aquarium species; the potential for invasive species to have serious impacts in natural ecosystems and on as yet undescribed biodiversity; quantification of alien species impacts; increases in distributions of new invaders and the need for response actions; integration of alien fish into other natural resource management programmes; a role for the community and stakeholders in the management of alien fish; acceptance of fish as vertebrate pests; and the costs of alien fish and appropriate resources needed for their management.

The increase in papers at the 2003 workshop relating to marine issues only partially reflects the heightened attention this issue has received in recent times (see Environment Australia (EA) ([www.ea.gov.au/coasts/imps](http://www.ea.gov.au/coasts/imps)) and Centre for Research on Introduced Marine Pests (CRIMP) ([www.crimp.marine.csiro.au](http://www.crimp.marine.csiro.au))). The formation in Australia of a National Taskforce on the Prevention and Management of Marine Pest Incursions outlines a coordinated approach to a range of actions in relation to marine invasions (NTFPMPI 1999). Although progress has been made with some aspects of freshwater alien species, a similar management approach is sorely needed (see Koehn & Mackenzie

2004). There are similar concerns in New Zealand, where there are growing numbers of exotic marine incursions by a growing diversity of animal and plant species, often thought to be driven by releases of contaminated ballast water from ships plying the oceans of the world (Francis & Evans 1992; Cranfield et al. 1998; Francis et al. 2003). As with aquarium fishes, New Zealand's latitudinal range is much less than that of Australia, and this means that the more tropical and subtropical invaders have reduced chances of establishment. Nevertheless, the problem remains.

In both countries, there are serious issues relating to different community sectors adopting different views on whether introduced species are valuable or invasive. Problems posed by different sets of values and uses being assigned to introduced species are a serious concern in both Australia and New Zealand. Table 1 provides an informal summary of the situations in both countries relating to freshwater fish issues in different utility categories. Of particular relevance is the availability of species of fish and crustacean in Australia being significant contributors to all sorts of "fisheries" values (albeit that many native commercial fisheries have been closed in recent years), whereas in New Zealand introduced salmonids are the chief contributors to most uses. Australia has notably significant fishes for the global aquarium trade (rainbowfishes of the family Melanotaeniidae), whereas this is not true of New Zealand. A corollary of this difference is that Australia's greater dependence on indigenous fishes and crustaceans does expose the country's ecosystems to a greater threat from translocation of native species around the countryside.

New Zealand depends, therefore, substantially more than Australia on introduced species for diverse aspects of freshwater fisheries, aquaculture, and use in aquaria. A critical aspect of this distinction, however, is that New Zealand has a much narrower latitudinal range than Australia, and lacks waterways of tropical and subtropical character. This means that, at least for the aquarium trade, species that might be regarded as potentially seriously invasive in Australia are of less concern in New Zealand. The risk of establishment for subtropical species currently imported may grow for both countries if global warming raises water temperatures.

Though there has been improvement in the range of strategies (see Koehn & Mackenzie 2004) and biosecurity measures (in New Zealand) that may be implemented (Hewitt et al. 2004; Wotton & Hewitt 2004), on-ground actions remain limited in many

**Table 1** Informal ranking of various uses of freshwater fishes and crustaceans in Australia and New Zealand (size of X reflects level of usage).

	Australia			New Zealand		
	Aquaculture	Commercial exploitation	Recreational fishing	Aquaculture	Commercial exploitation	Recreational fishing
Native fish	X	X	X		X	X
Native crustaceans	X	X	X	x		x
Introduced salmonids	X		X	X		X
Introduced coarse fish	x	x	X		X	x
Introduced aquarium fish	X			X		X

instances. Many issues have not really progressed, and indeed some areas relating to alien fish species management appear to have regressed. A particular New Zealand concern is the limited number of techniques that existing laws permit to be applied for dealing with invasive species when they are first encountered. Although that is also partly true in Australia, of greater concern is the lack of consistency in legislation and application of policy across State, Commonwealth, and different Departmental jurisdictions. Although there is still a lack of viable control options currently available for established invaders, new technologies such as genetically modified “daughterless” fish, the use of radio tagged “Judas” fish, the physical removal of weeds, and the potential use of pheromones were discussed.

There was a noticeably limited attendance by fisheries and natural resource managers at the 2003 workshop, so the question of transforming “new” science efficiently into effective management remains. Apart from one paper presented on the bioeconomics of pest fish removal (Choquet et al. 2004), political and social issues were conspicuous by their absence. A range of papers presented, however, recognised the importance of these issues if the problems of invasive species are to be addressed, especially given the importance of human transfer (Lintermans 2004). Little progress appears to have been made in the quantification of the interactions of invasive species with habitat and native species. The issue of fish diseases raised in 1989 however was not considered for freshwater species in 2003, further highlighting a lack of progress and indeed a loss of expertise in this area. This is despite it being recognised as a threat in the Murray-Darling Basin (Murray-Darling Basin Commission 2004). Genetic contamination from translocated stocks was not considered in 2003, but clearly remains an issue (Phillips 2003). Similarly, although the issue of translocated native organisms was raised, few data were available and it appears that they have largely been forgotten since 1989. The existence of a National Translocation Policy (Ministerial Council on Forestry, Fisheries and Aquaculture 1999) in Australia was recognised, but its adherence across all States was questioned. The issue of native species invasions through inter-basin water transfers was not considered at the current workshop but has recently been highlighted by several workers (Allibone 2000; Esa et al. 2000; Waters et al. 2000; Todd et al. 2002). Importantly, papers on the impacts of popular trout angling species were highlighted in 2003 (Jackson et al. 2004).



Striped triplefin *Forsterygion varium*.



Oriental weatherloach *Misgurnus anguillicaudatus*. Photo: Neil Armstrong.



Tasmanian robust triplefin *Grahamina gymnota*.

Progress on risks of invasion through the aquarium industry is also somewhat clouded. A keynote address in 1989, plus one other paper, addressed the role of the Australian Advisory Committee on Live Fish (ACOLF). With the charter to advise on all aspects of live fish (health, disease, aquarium trade, etc), this committee appeared to provide a coordinating mechanism for dealing with invasive fish. ACOFL was disbanded in the early 1990s (A. McNee pers. comm.) with its role being taken by Commonwealth Environment agencies under the Wildlife Protection Act. This has led to a dissipation of functions among a variety of independent agencies rather than their being coordinated by one body. Negotiations for a more strategic approach to the management of alien fish in Australia are currently underway (A. McNee pers. comm.). Several recommendations from the 1989 workshop for handling invasive species issues in Australia (Kailola 1990; Pollard 1990b) were again raised in 2003, indicating a lack of progress in these areas. These included recommendations that: endemic native fish species should be used for stocking wherever possible; a national noxious fishes list should be prepared, endorsed, and acted on by all States; contingency plans be prepared for rapid eradication of problem species should they be inadvertently released into the wild (e.g., Braysher 2001); the urgent need for further work on the ecological effects of introductions; the need for increased education of aquarists, anglers (especially regarding live bait), aquaculturists, politicians, and the general public on the adverse ecological effects of introductions; the registration of pet fish dealers; and the need for monitoring of the spread of introduced species.

Many of the issues identified for Australia and New Zealand (see Department of Conservation 2003) in terms of invasive species are similar. Collaboration between Australia and New Zealand can provide opportunities for sharing experience and streamlining ways of managing invasive fish issues. This latest workshop was an important step in continuing that collaboration. Broader collaboration has benefits, and attendance at the workshop by Greg Ruiz, Cynthia Kolar, and Peter Sorensen brought an international perspective on invasive fish issues. Dr Ruiz outlined the risk of disease and parasite transfer in the marine environment by shipping. Dr Kolar discussed the application of modelling processes in assisting with the identification of potentially invasive species (Kolar & Lodge 2001). Dr Sorensen discussed the possibility that pheromones and kin

recognition may be useful in helping to minimise the impacts of invasive fishes by the use of such chemicals in attracting invasive species to capture sites (Vrieze & Sorensen 2001).

There is a real need to raise awareness at political, departmental/bureaucratic, and community levels of the importance and potential serious environmental problems associated with invasive species relating to fish and fisheries. Although there is still much work to be done, there are numerous priority recommendations identified in papers in this issue (e.g., Koehn & Mackenzie 2004; Lintermans 2004; McDowall 2004) and other publications (see Koehn & Mackenzie 2004) that can be undertaken to improve the management of invasive fishes in Australia and New Zealand.

#### ACKNOWLEDGMENTS

We thank the organising committee of the workshop (Richard Allibone, Lindsay Chadderton, Tracie Dean, and Gerry Closs); the workshop sponsors; all workshop speakers and participants; Richard Allibone, Richard Tilzey, and Jim Barrett for comments on the manuscript; and Alex McNee for the history of ACOFL.

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