

# GLOBAL RE-INTRODUCTION PERSPECTIVES

*Re-introduction case-studies from around the globe*



**Edited by  
Pritpal S. Soorae**



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**Cover photo:** Clockwise starting from top-left:

- Formosan salmon stream, Taiwan
- Students in Madagascar with tree seedlings
- Virgin Islands boa

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## Re-introduction of trout cod into the Murray-Darling River Basin, Australia

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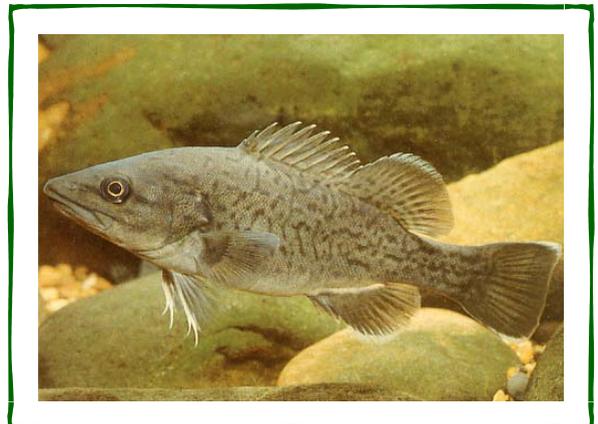
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### Introduction

The trout cod (*Maccullochella macquariensis* Cuvier) (Percichthyidae), is a large, predatory, freshwater fish that was formally widespread throughout the more southerly tributaries of the Murray-Darling River basin of inland south east Australia. Currently one natural breeding population in the Murray River between Yarrowonga and Barmah, and two translocated populations (Seven Cks and Cataract Dam), remain. Declines in distribution and abundance have been attributed to a range of factors including habitat degradation (river management works associated with irrigation, flood mitigation and hydro-electricity generation, and pollution), over-fishing and impacts of introduced species. In Australia trout cod is listed nationally as endangered under the **Environment Protection and Biodiversity Act** (1999), and endangered by the the Australian and New Zealand Environment and Conservation Council and the Australian Society for Fish Biology. The species is listed as Endangered (C2a) by the IUCN. Since the trout cod was formally described as a species in 1972, and concerns over its conservation status raised, regulations and legislation in NSW, ACT and Victoria, including bans on its capture by anglers, have been introduced to protect the species. Captive breeding and re-introduction programs, which aimed to produce juvenile fish for release into rivers across the species former range, were established by state governments in NSW and Victoria in the mid-1980's. Both programs are on-going.

### Goals

- Goal 1: Secure populations of trout cod in captivity for species preservation purposes in the event that wild populations become extinct,
- Goal 2: Develop captive-breeding techniques to allow the production of juvenile fish for re-introduction purposes.
- Goal 3: Increase the distribution and abundance of trout cod within its former natural range.
- Goal 4: Increase the number of



Trout cod (*Maccullochella macquariensis*)



**Releasing trout cod fingerlings  
Into the Bendora Dam 031**

self-maintaining populations of trout cod within its former natural range.

- **Goal 5:** Support objectives and activities of state and national recovery plans for trout cod.

### Success Indicators

- **Indicator 1:** Populations of broodstock maintained in captivity.
- **Indicator 2:** Large numbers of juvenile trout cod are reliably and routinely produced from captive broodstock.
- **Indicator 3:** Large numbers of juvenile trout cod are released into rivers in the species' former natural range.
- **Indicator 4:** Re-introduced trout cod establish viable self-maintaining populations, as indicated by natural recruitment.

### Project Summary

**Feasibility:** In the mid-1980's, in response to concerns over the species' threatened status,

two state fisheries agencies (NSW and Victoria) commenced captive breeding and re-introduction programs for trout cod, which preceded the development of recovery plans for the species. The first national funded Recovery Plan, and Victorian Action Statement for the species were prepared in the early 1990s. Both programs would be established at existing government hatcheries where facilities and expertise were available. Wild fish caught from the single remaining natural population (Murray River), would be used as broodstock, and the genetics of these fish and their progeny were considered when developing the breeding and stocking plans. In particular, only wild fish would be used as broodstock and these would be regularly replaced with fresh wild stock. Hatchery-bred stock would not be used as broodstock. The breeding programs were also viewed as an opportunity to undertake additional research on the biology, reproduction and early life history of the species. In addition, a small independent breeding program was also established by Native Fish Australia (NFA) in Victoria.

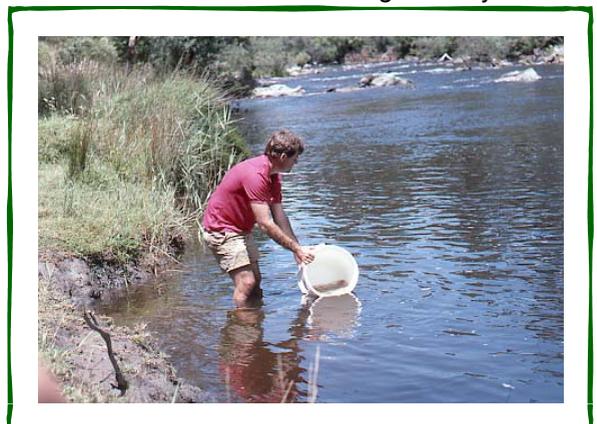
**Implementation:** Procurement of broodstock from the wild (Murray River population) commenced in the early 1980s. Fish were held in large earthen ponds (up to 0.3 ha), under semi-wild conditions, at two hatcheries, one in Victoria and one in NSW. There has been some exchange of broodstock between the two programs, but most new broodstock are still derived from the Murray River population. Breeding trials commenced in 1985, and the first successful spawning of captive trout cod occurred in the spring of 1986 when hormone injections were used to induce ovulation. Since then, the captive breeding of trout cod has been refined and become reliable and routine. After hatching fry are usually stocked into fertilized earthen ponds and reared on plankton and other aquatic invertebrates that bloom in the ponds. Stocking sites for re-introduction of trout

cod were selected and prioritized on the basis that they were within the former historic range of the species and consideration of habitat condition (size, type, water supply, water quality, temperature, altitude, etc.), land use, fish species present and angler accessibility. These sites are expected to provide conditions suitable for trout cod to complete its entire life cycle. The first re-introduction of trout cod occurred in January 1987 when 1,000 hatchery-produced juvenile fish were released into the upper Murray River. To date, 984,600 fingerlings (30 - 50 mm in length) have been released, 13,000 - 151,000 fish annually. Trout cod have been re-introduced into 32 sites in eight river catchments (Vic. 10 sites in 5 river catchments, NSW & ACT, 22 sites in 4 river catchments). In addition, 11,700 trout cod yearlings and 2-year olds (>130 mm), which have been intensively on-grown in tanks, have also been released.

Fish and data produced by the breeding programs have assisted other trout cod research activities, including studies on water quality and environmental preferences, genetics, diet and nutrition, movement and dispersal, and population modeling, and have supported captive breeding programs for other *Maccullochella* species. Re-introduction is a feature in all recovery plans developed for the species to date. However it is emphasized it is not the sole answer to recovery of trout cod. Other important recovery actions have included legislation and regulations, habitat protection and improvement, monitoring and research on existing populations, both natural and translocated, and community awareness and education about trout cod. These activities have had a positive affect on trout cod. In particular, the one remaining natural population in the Murray has extended its range downstream over the past decade.

**Post-release monitoring:** Monitoring of stocked populations is on-going by state fisheries and conservation agencies in NSW, the ACT and Victoria. Although it has been recommended that stocked sites be monitored at least annually, due to limited resources this has been variable with some populations being monitored more rigorously than others, and some sites have yet to be surveyed for evidence of recruitment. In addition to these surveys, anecdotal reports by anglers have also provided information on survival. Stocked trout cod are surviving in many of the stocked sites and to date, natural recruitment has been confirmed in four rivers (lower Murrumbidgee R., Ryans Ck., Goulburn R. and Cotter R.) and suspected in another three rivers (upper Murrumbidgee R., Ovens R. and Upper Murray R). At least three stocking sites in Victoria have failed with no reported captures for fish in recent years.

Since the early 1990s hatchery produced fish have been chemically marked (alizarin or



Releasing fingerlings in the Mitta Mitta River

oxytetracycline) prior to release to assist in distinguishing them from naturally spawned fish. This, combined with length frequencies and otolith aging of captured fish at stocking sites is used to identify natural recruitment.

## Major difficulties faced

- During the initial stages of establishing captive-breeding populations, catching suitable stock was difficult due to their rarity in the wild.
- Trout cod is closely related, and similar in appearance, to the more common Murray cod (*Maccullochella peelii peelii*), which occurs sympatrically with trout cod in some areas. Public awareness of the difference between the two species and the endangered status of trout cod was required in areas where trout cod were being stocked.
- On-going stocking of trout cod, and establishment of self-recruiting populations in some areas has increased the catch of trout cod by recreational anglers. As a result, there is increasing community pressure to review conservation status of the species and to allow some take by anglers.
- In recent years fish stocking programs have come under scrutiny due to concerns over potential detrimental impacts on receiving populations and environments. In particular, genetic identity and diversity of stocked fish and transfer of diseases and unwanted species from hatcheries to the wild. Trout cod breeding programs have incorporated genetics guidelines since the outset, and more stringent stocking practices are being introduced (such as imposed by national and state translocation guidelines, and hatchery quality assurance guidelines).

## Major lessons learned

- Evidence of natural recruitment in stocked populations was expected to occur shortly after the initial stocked fish reached maturity (five years). However, it has taken a decade for natural recruitment to be observed in several of the stocked populations.
- Yearling and sub-adult, trout cod are highly susceptible to angling, which has been implicated in the failure of one stocking site. This problem, together with the knowledge that some stocked populations are becoming well-established and known to anglers, indicates the need to maintain community awareness about trout cod.
- Small numbers of hatchery-reared yearling and sub-adult trout cod have been re-introduced during the programs. However, recent telemetry studies have indicated that survival of fish that have been on-grown in hatcheries for more than a year is generally poor. It is suggested that these fish lack survival skills due to the nature of their upbringing.

### Success of project

Highly Successful	Successful	Partially Successful	Failure
	√		

#### Reasons for success/failure:

- Since commencement of stocking activities, 996,300 trout cod have been re-introduced into 32 sites in 8 river catchments across the Murray-Darling Basin.
- Stocked trout cod are surviving in many of the stocked sites and to date, natural recruitment has been confirmed in four rivers and suspected in another three rivers.
- Due to the success of these stockings, and pressure from angling groups, state fisheries agencies in NSW and Victoria are considering changes to regulations to allow limited take by recreational anglers in some areas.