

ACTION PLAN No.13

In accordance with section 21 of the *Nature Conservation Act 1980*, the **Macquarie Perch (*Macquaria australasica*)** was declared an **endangered** species on 27 December 1996 (formerly Instrument No. 1 of 1997 and currently Instrument No. 192 of 1998). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Macquarie Perch *Macquaria australasica*

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the Minister for the Environment, Land and Planning and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication *Threatened Species and Communities in the ACT* July 1995.

In making its assessment of the Macquarie Perch, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required in response to each declaration. It must include proposals for the identification, protection and survival of a threatened species or ecological community, or, in the case of a threatening process, proposals to minimise its effect.

While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

- 1.2 The species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the near future, as demonstrated by:
 - 1.2.1 Current severe decline in population or distribution from evidence based on:
 - 1.2.1.1 direct observation, including comparison of historical and current records.
 - 1.2.1.2 severe decline in rate of reproduction or recruitment; severe increase in mortality; severe disruption of demographic or social structure.
 - 1.2.1.3 severe decline in quality or quantity of habitat.
 - 1.2.1.4 very high actual or potential levels of exploitation or persecution.
 - 1.2.1.5 severe threats from herbivores, predators, parasites, pathogens or competitors.

Links with other Action Plans

Measures proposed in this Action Plan complement those proposed in the Action Plans for other threatened aquatic species, such as the Two-spined Blackfish (*Gadopsis bispinosus*), Trout Cod (*Maccullochella macquariensis*) and Murray River Crayfish (*Euastacus armatus*). Action Plans are listed at the end of this document.

Species Description and Ecology

Macquarie Perch *Macquaria australasica* is a member of the Percichthyidae which contains the Australian freshwater basses and cods. Other species in the family include the well known Murray Cod and the nationally endangered Trout Cod. The genus *Macquaria* contains the popular angling species Golden Perch (*M. ambigua*), Australian Bass (*M. novemaculeata*) and Estuary Perch (*M. colonorum*).

DESCRIPTION

M. australasica is a moderately-sized, deep-bodied, laterally-compressed fish with large white eyes (Figure 1). The predominant body colour is grey to black on the dorsal and lateral surfaces with a whitish ventral surface. Colouration is variable between populations with some coastal populations being quite mottled (McDowall 1980; Merrick and Schmida 1984). The lateral line is obvious and there are conspicuous open pores on the lower jaw. Adult specimens possess a distinct "humped back" and the tail is rounded.

The maximum size is 3.5 kg but fish over 1 kg are uncommon.

HABITAT

The preferred habitat is cool, shaded, upland streams with deep rocky pools and substantial cover. The species will also survive well in impoundments with suitable feeder streams in which to breed. The species now seems to be confined to the upper reaches of catchments (Cadwallader 1981) which are more pristine and less affected by agriculture and sedimentation.

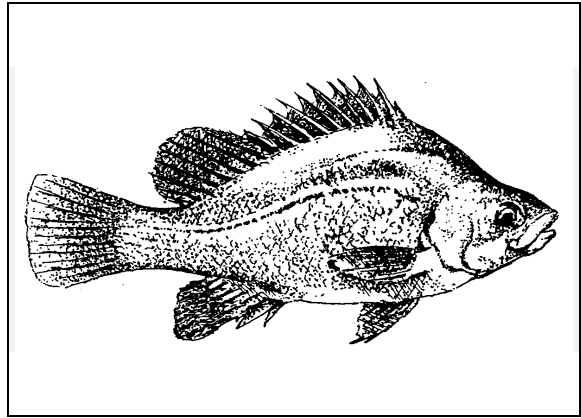


Figure 1: Macquarie Perch (*Macquaria australasica*). Scale: Approximately one quarter natural size.

BEHAVIOUR AND BIOLOGY

Macquaria australasica are reported to live for up to 10 years (Battaglione 1988). Males reach sexual maturity at two years of age and 210 mm total length, and females at three years and 300 mm total length (Harris and Rowland 1996). Fish in reservoirs undertake a spawning migration into inflowing rivers. Fish gather in schools before spawning which can last several weeks (Battaglione 1988). Spawning occurs in late spring/summer when water temperatures reach approximately 16.5°C with fish depositing eggs above riffles or fast-flowing sections of river. The eggs are then washed downstream where they lodge in gravel or rocky areas until hatching.

Fecundity is approximately 31,000 eggs per kilogram of fish weight (Cadwallader and Rogan 1977), with females carrying up to 110,000 eggs (Battaglione 1988). Mature eggs are 1 to 2 mm in diameter and cream coloured. After fertilisation the eggs swell to approximately 4 mm diameter and are amber coloured (Battaglione 1988). Larvae hatch in 10-11 days at water temperatures of 15-17°C (Gooley 1986) with the larvae being about 7 mm long upon hatching (Battaglione 1988).

The diet of *M. australasica* consists predominantly of small benthic aquatic insect larvae, particularly mayflies, caddisflies and midges. Shrimps, yabbies, dragonfly larvae and molluscs are also eaten (McKeown 1934; Cadwallader and Eden 1979; Butcher 1945; Battaglione 1988; Lintermans unpubl. data).

DISTRIBUTION

M. australasica is typically found in the cooler, upper reaches of the Murray-Darling river system in Victoria, New South Wales and the Australian Capital Territory. The species was introduced into some coastal drainages in the late 1800s and early 1900s. There are also some natural coastal populations in New South Wales, notably the Nepean, Hawkesbury and Shoalhaven rivers. A morphometric and genetic study in the mid 1980s suggested that there were three distinct stocks of *M. australasica*, with the Murray-Darling populations being distinct from a Shoalhaven stock and a Hawkesbury stock (Dufty 1986). It was considered that these three stocks were distinct species (Dufty 1986). This study has never been published and so the conservation status of *M. australasica* has been unclear for some years. **This Action Plan only relates to the Murray-Darling stock of *M. australasica*, and does not deal with the two coastal forms.**

In the ACT, *M. australasica* is restricted to four rivers, the Murrumbidgee, Molonglo, Paddys and Cotter rivers. In the Cotter River, the species is restricted to the lower section of the river from its junction with the Murrumbidgee up to Vanitys Crossing (including Cotter Reservoir). Anecdotal reports indicate that the species did occur further upstream on the Cotter but has now disappeared from this area and appears unable to pass the high concrete causeway built at Vanitys Crossing in the late 1970s (Lintermans 1991a). In 1985 a total of 41 individuals was removed from Cotter Reservoir as it was drained for maintenance of the dam wall. These fish were released into Bendora Reservoir but this translocation attempt appears to have failed (Lintermans unpubl. data).

Records from the Molonglo River are scarce and in recent times have only been from the lower end of the river below Lake Burley Griffin. The discharge of treated effluent from the Lower Molonglo Water Quality Control Centre since 1978 is likely to provide a chemical barrier which discourages dispersal of some native fish species from the Murrumbidgee to the Molonglo River. Scrivener Dam now prevents upstream movement of fish species from the lower Molonglo and effectively restricts access to the majority of the Molonglo River. It is likely that *M. australasica* historically occurred in the middle to upper reaches of the river but was almost certainly eliminated along with almost all other fish species due to heavy metals pollution from the Captains Flat mines. A fish survey in 1992-93

of the Molonglo River catchment from above Captains Flat to Lake Burley Griffin failed to locate the species (Lintermans unpubl. data).

The species has been recorded from along the entire length of the Murrumbidgee River in the ACT (Greenham 1981; Environment ACT unpubl. data) although more recent fish surveys by Environment ACT recorded no individuals in 1994, one in 1996 and one in 1998 (Lintermans 1995, 1997, 1998, unpubl. data).

The status of *M. australasica* in Paddys River is unknown as the only records from this stream are based on the results of angler interviews summarised in Greenham (1981). Environment ACT has not yet surveyed this catchment, however it is considered unlikely that a significant population occurs in this drainage given the lack of any angler records since the early 1980s.

In the Canberra region, *M. australasica* is also known from five other locations. These are:

- A small remnant population in the Queanbeyan River immediately upstream of Googong Reservoir.
- A population of unknown size in Burrinjuck Dam and the lower Goodradigbee River.
- A small population in the Lachlan River near Wyangla Dam.
- A population of unknown size in the Abercrombie River below Crookwell.
- A population of unknown size in the Murrumbidgee River near Cooma.

The locations of current and unconfirmed records of *M. australasica* in the ACT region are shown in Figure 2.

Conservation Status

M. australasica is recognised as a threatened species in the following sources:

International

Insufficiently known. - IUCN Red List of Threatened Animals 1994 (Groombridge 1993).

The definition of *insufficiently known* was "Taxa that are suspected but not definitely known to belong to any of the other categories (extinct, endangered, vulnerable or rare), because of lack of information"

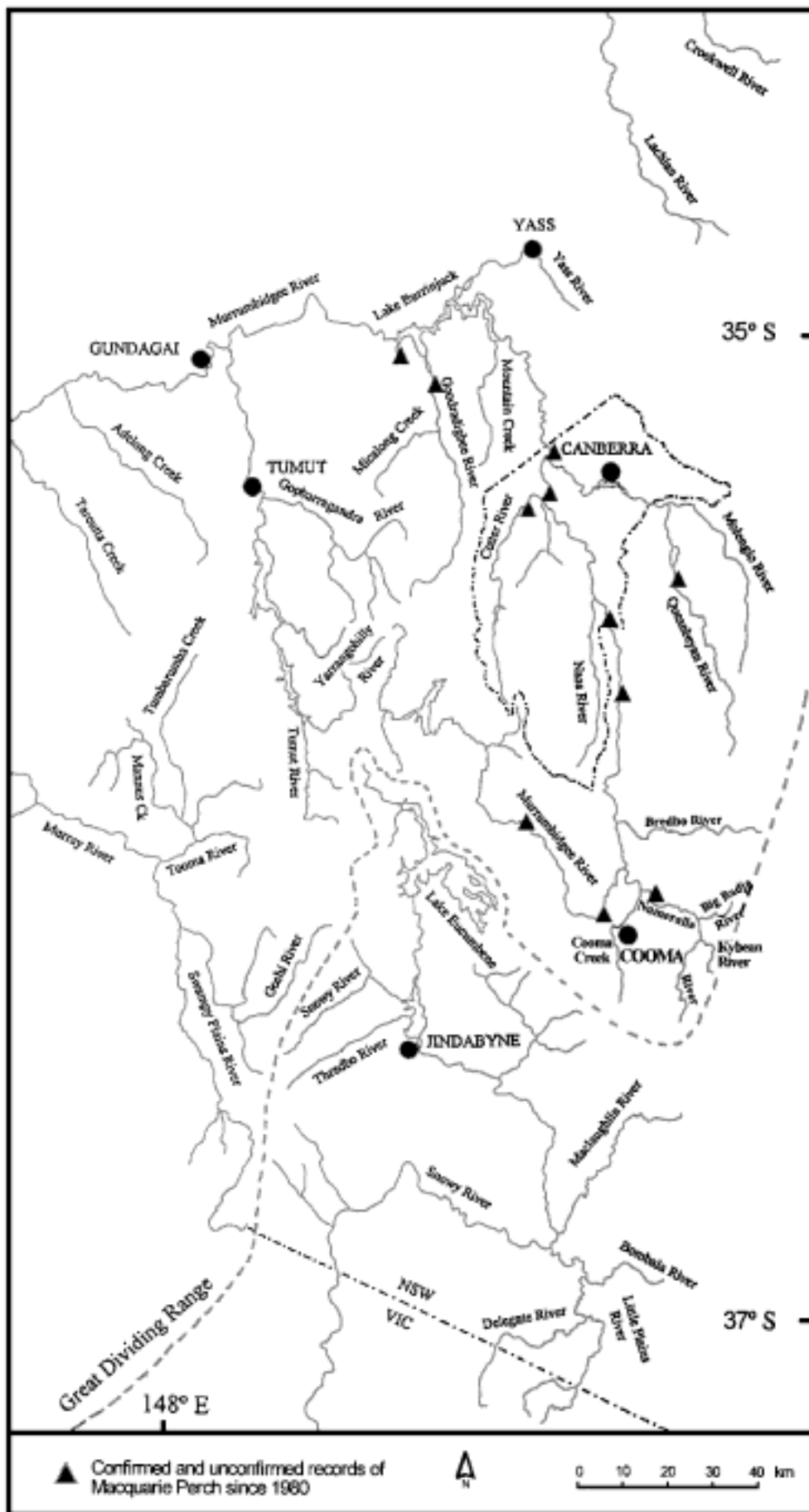


Figure 2 Locations of current and unconfirmed records of Macquarie Perch in the ACT Region.

Produced by Wildlife Research and Monitoring, Environment ACT.

National

Concern over the decline in distribution and abundance of the species was first raised by Lake (1971) who rated it as one of the four most seriously threatened species. There have been several reviews of its National conservation status (Burbidge and Jenkins 1984; Michaelis 1985; Harris 1987; Wager and Jackson 1993). In 1998, the Australian Society for Fish Biology reclassified the Murray-Darling stock of *M. australasica* as *vulnerable*.

Australian Capital Territory

Endangered - Section 21 of the *Nature Conservation Act 1980*, Instrument No.192 of 1998 (formerly Instrument No.1 of 1997).

Special Protection Status Species - Schedules 6 and 7 of the *Nature Conservation Act 1980*, Instrument No. 197 of 1998.

New South Wales

The species is currently under consideration for listing in the threatened species schedules under the recent addition of Part 7A to the *Fisheries Management Act 1994*. A determination is expected in mid 1999. In the meantime, the conservation status listing of the Australian Society for Fish Biology is being used. Klippel (1992) lists the species as *indeterminate*.

Victoria

Threatened taxon - Schedule 2 of the *Flora and Fauna Guarantee Act 1988*.

Cadwallader *et al.* (1984) listed *M. australasica* as *vulnerable* in Victoria and this categorisation was retained by Koehn and Morison (1990) when they reviewed the conservation status of Victorian fish.

Threats to Populations in the ACT Region

The major threats to the continued survival of native fish species in freshwater habitats are habitat alteration, overfishing, and introduced fish species. All three threats are considered to have had an impact on populations of *M. australasica* nationally and locally.

HABITAT DESTRUCTION OR MODIFICATION

Alteration or destruction of fish habitat is widely regarded as one of the most important causes of native fish decline in Australia (Cadwallader 1978; Koehn and O'Connor 1990a,b; Lintermans 1991a; Hancock 1993) and overseas (Moberly 1993; Maitland 1987).

Habitat modifications occur in many forms but the major classes are:

- barriers to fish passage,
- reduction in floodplain habitat,
- alteration to flow regimes below impoundments,
- reduction of instream habitat, and
- reduction in water quality (Lawrence 1991).

OVERFISHING

Overfishing is cited as one of the contributing factors in the decline of *M. australasica* (Cadwallader 1978; Harris and Rowland 1996) and has been shown to be important in the decline of other native fish species such as Trout Cod (*Maccullochella macquariensis*) (Douglas *et al.* 1994; Berra 1974) and Murray Cod (*M. peelii peelii*) (Rowland 1989; Jackson *et al.* 1993). *Macquaria australasica* is sought after as an angling species providing both good sport and firm white, tasty flesh. It is considered one of the very best eating freshwater fish (Battaglione 1988). A recent review of recreational fishing practices (ACT Parks and Conservation Service 1995) proposed a total ban on taking the species and this proposal received widespread community support (ACT Parks and Conservation Service 1996).

Even though *M. australasica* has been totally protected in New South Wales since 1991, illegal fishing pressure which particularly targets the spawning run of this species continues. In Victoria in 1959 and 1960, it was estimated that between two and three tonnes of this fish were removed from the inflowing rivers to Lake Eildon by recreational anglers in the first week of the fishing season. This does not include the illegal take which would have occurred prior to the opening of the season (Cadwallader and Rogan 1977).

Recent surveys of the *M. australasica* population in the Queanbeyan River showed that the abundance of the species increased with increasing distance from public access, suggesting that this population is still being illegally fished (Lintermans unpubl. data).

CONSTRUCTION OF DAMS AND WEIRS

Construction of dams and weirs prevents recolonisation of streams by preventing fish passage. Consequently, the construction of Scrivener Dam to form Lake Burley Griffin in 1963 effectively isolated the Molonglo and Queanbeyan rivers from the Murrumbidgee River and has prevented any recolonisation. The construction of Cotter Dam in 1915 also isolated the Cotter River population from the Murrumbidgee River stock. The Cotter River

now has three major impoundments on it. *M. australasica* is now only found in the Cotter Reservoir and along a 5.5 km stretch of river immediately above the backed-up waters. The species appears to be unable to traverse the concrete ford constructed at Vanitys Crossing in the late 1970s (Lintermans unpubl. data). The construction of the three dams on the Cotter River also probably resulted in the flooding of suitable spawning areas.

M. australasica is dependent on high quality habitat, with access to spawning gravels in flowing waters essential for successful reproduction. The construction of Googong Reservoir flooded the majority of suitable spawning areas in the Queanbeyan River. Regular monitoring of fish stocks within the impoundment showed that the species was not recruiting. Consequently in 1980, 57 individuals were captured and translocated past a natural barrier on the Queanbeyan River above the impoundment. This translocation is the basis of the remnant population now present in the Queanbeyan River.

The construction of dams also has a severe effect on the quality of fish habitat through the modification of the natural flow regimes and water quality of rivers below impoundments. The species responds to increasing water temperature associated with late spring/early summer flows as a cue to commence spawning (Llewellyn and MacDonald 1980; Cadwallader and Backhouse 1983). The effect of some impoundments (e.g. Corin Reservoir) on downstream river flows is to partially reverse the seasonal nature of flows as water from spring and autumn rains is collected and stored for release in summer.

Koehn *et al.* (1995) found that two separate populations of *M. australasica* in the Mitta Mitta River have disappeared since the construction of Dartmouth Dam from 1973-80. The demise of the species in this river is attributed to the effects of coldwater releases from the dam during the spawning season.

Other impoundments such as Bendora, Cotter and Googong reservoirs and Lake Burley Griffin have a different impact in that insufficient water is released to maintain suitable environmental conditions in the river downstream.

The quality of water released is also a problem in that it may be released from the lower levels of the reservoir and be much colder than the surface waters. The release of a cold slug of water during the breeding season is thought to inhibit spawning behaviour of *M. australasica* and other native fish species.

SEDIMENTATION

Sediment addition to the Murrumbidgee River is another factor which has resulted in severe decline of habitat quality and quantity of *M. australasica*. The species deposits adhesive demersal eggs amongst rocks and gravel. In such situations, sediment can either smother the spawning beds rendering them unsuitable, or smother the eggs themselves. Increased sediment loads have probably also affected benthic invertebrate communities, the primary food source of the species. Poor land management practices in the mid to late 1800s in the upper Murrumbidgee catchment resulted in extensive erosion and sediment addition to the river (Starr 1995; Olley 1997). This sediment is still working its way through the river system and is slowly filling the deeper pools on the river which are important as refuges for the larger native fish species such as cod and perch. The establishment of several sand and gravel extraction facilities on the river upstream of the ACT also exacerbates the problem by destabilising river channels and resuspending fine sediments into the water column.

A more recent source of sediment addition has been from urban development immediately adjacent to the Murrumbidgee River. A study of the effects of sediment addition in the Tuggeranong Creek catchment in 1987-88 found that platypus and aquatic invertebrate communities were noticeably depleted downstream of the confluence of Tuggeranong Creek with the Murrumbidgee (Hogg and Norris 1991). A follow up study of invertebrates in 1993 revealed that there has been little or no recovery in invertebrate numbers and that fine inorganic sediments still are a major component of the downstream sites (Grimes 1993). This is despite the incidence of several large flushing flows in the intervening years which would have removed the prior accumulations of fine inorganic material.

HEAVY METAL POLLUTION

The collapse of slimes dumps at the Captains Flat mine in the 1938 and again in 1943 released large quantities of heavy metals including zinc, copper and lead, which virtually removed the entire fish population in the Molonglo River downstream of the mine (Anon. 1974). In 1992-93 this river was still unable to support fish life for at least 15 km downstream of Captains Flat (Lintermans unpubl. data), an area that would almost certainly have supported populations of *M. australasica* prior to the collapse.

REDUCTION OF INSTREAM HABITAT

There has probably been little direct removal of instream habitat (such as the removal of logs from rivers and channelisation) as has occurred in lowland streams. Indirect causes of instream habitat reduction include sedimentation (see above) and the narrowing of stream channels below impoundments. Streams are often narrower and shallower below dams due to the storage capacity of the impoundments.

REDUCTION IN WATER QUALITY

The major reductions in water quality which are most likely to have affected the species in the Canberra region are sediment addition (see above) and changes to thermal regimes, either from the operation of impoundments or the clearing of riparian vegetation which shades streams.

INTRODUCTION OF EXOTIC SPECIES

The establishment of introduced fish species is often cited as a cause of native fish decline in Australia although much of the evidence is anecdotal. This is because the majority of introduced species became established in the mid to late 1800s when the distribution and abundance of native fish was poorly known or documented. The main interactions between trout and native species are thought to be predation and competition for feeding, spawning or territorial requirements. Brown Trout (*Salmo trutta*) were first introduced into the Canberra region in 1888, being one of the first areas of New South Wales to be stocked (National Trust of Australia 1980). Rainbow Trout (*Oncorhynchus mykiss*) were first introduced into Australia and New South Wales in 1894 (Faragher 1986), so both trout species have been established in south-eastern NSW for a century or more.

The diets of *M. australasica* and the introduced trout species are very similar and competition is thought to occur (Jackson 1981; Cadwallader 1978; Butcher 1945). Trout are also known to prey upon *M. australasica* juveniles (Butcher 1967 cited in Cadwallader 1978; NSW Fisheries unpubl. data). Other introduced fish species such as Carp (*Cyprinus carpio*) and Redfin Perch (*Perca fluviatilis*) may also compete for food with *M. australasica* (Battaglene 1988; Cadwallader 1978).

Another potentially serious impact of introduced species is their capacity to introduce or spread foreign diseases and parasites to native fish species. *C. carpio* or *P. fluviatilis* are considered to be the source of the Australian populations of the parasitic copepod

Lernaea cyprinacea (Langdon 1989a). *C. carpio*, Goldfish (*Carassius auratus*) or Mosquitofish (*Gambusia holbrooki*) are probably implicated as the source of the introduced tapeworm *Bothriocephalus acheilognathi* which has recently been recorded in native fish species (Dove *et al.* 1997). This tapeworm causes widespread mortality in juvenile fish overseas.

The most serious threat from introduced fish species to *M. australasica* may lie in the impacts of an exotic disease Epizootic Haematopoietic Necrosis Virus (EHNV). This virus, unique to Australia, was first isolated in 1985 on the introduced fish species *P. fluviatilis* (Langdon *et al.* 1986). It is characterised by sudden high mortalities of fish displaying necrosis of the renal haematopoietic tissue, liver spleen and pancreas (Langdon and Humphrey 1987).

Experimental work by Langdon (1989a,b) demonstrated that *M. australasica* was one of several species found to be extremely susceptible to the disease. EHNV was first recorded from the Canberra region in 1986 when an outbreak occurred in Blowering Reservoir near Tumut (Langdon and Humphrey 1987). Subsequent outbreaks have occurred in Lake Burrinjuck in late 1990, Lake Burley Griffin in 1991 and 1994, Lake Ginninderra in 1994 and Googong Reservoir, also in 1994. The spread of EHNV has been aided by its relatively resistant characteristics and the ease with which it can be transmitted from one geographical location to another on nets, fishing lines, boats and other equipment. Langdon (1989b) found that the virus retained its infectivity after being stored dry for 113 days. Once EHNV has been recorded from a water body it is considered impossible to eradicate.

The Murrumbidgee and the Googong Reservoir populations of *M. australasica* have been exposed to the virus and it is highly likely the Queanbeyan River population has also been exposed through the movement of infected adult trout between the reservoir and the river. It is now speculated that the sudden and severe depletion of the Lake Eildon *M. australasica* population may have in part been due to EHNV (Langdon 1989b).

Major Conservation Objectives

The major conservation objective of this Action Plan is to maintain in the long term, viable, wild populations of *M. australasica* as a component of the indigenous biological resources of the ACT and as a contribution to regional and

national conservation of the species. This includes the maintenance of the species' potential for evolutionary development in the wild.

The objective is to be achieved through the following strategies:

- Improving understanding of the biology and ecology of the species as the basis for managing its habitat.
- Protecting sites and habitats that are critical to the survival of the species.
- Managing activities in the Murrumbidgee and Cotter River catchments in the ACT to minimise or eliminate threats to fish populations.
- Increasing community awareness of the need to protect fish and their habitats.

Conservation Issues and Intended Management Actions

GENERAL ISSUES

Habitat Rehabilitation

The majority of riverine ecosystems in eastern Australia have been affected by human impact with a resultant substantial modification of aquatic habitats. Significant effects on the rivers of the ACT region include irrigation extraction, dam construction and agricultural practices. Poor land management practices in the mid to late 1800s in the upper Murrumbidgee catchment resulted in extensive soil erosion and sediment addition to rivers. Also, clearing of the riparian zone removed nearly all the large eucalypts which were previously common, hence, there remains no source of large woody debris (snags) to provide structural complexity and habitat diversity for both fish and invertebrate populations.

⇒ Environment ACT will investigate options for rehabilitating critical fish habitats. These options include the selective removal of sand to restore critical pool/riffle habitats and provision of additional cover such as snags or boulders.

Environmental Flows

Increasing attention worldwide is being focussed on the need to provide water allocations for the environment. When the three impoundments on the Cotter River were constructed, little thought was given to how the abstraction or diversion of water would affect the animals living in the river. It is now known that to stimulate breeding activity, many native fish species require environmental stimuli or

triggers such as an increase in water flow and water temperature. Reservoirs have severely disrupted downstream flow and temperature patterns, with consequent deleterious impacts for fish communities.

In order to address these issues, the ACT Government has developed Environmental Flow Guidelines which prescribe minimum flows to be achieved in the Cotter River above and below Bendora Reservoir, and include provisions for baseline flows as well as providing higher flows in spring to encourage fish spawning. ACTEW is responsible for the operation of ACT water supply reservoirs and the release of water from them.

There is no evidence to suggest that the translocation of *M. australasica* into Bendora Reservoir from Cotter Reservoir in 1985 has been successful. There have been occasional captures of the adults but no evidence of recruitment. This failure to spawn may be partly related to the artificial flow regime imposed by Corin Dam upstream.

Similarly, the apparent inability of the population in the Cotter Reservoir to move upstream past Vanitys Crossing may be a result of the artificially low flows below Bendora Dam providing insufficient water to drown out this crossing. Provision of additional water and a more natural flow regime under the Environmental Flows Guidelines should enhance the population in the Cotter River.

⇒ Environment ACT will liaise with ACTEW to ensure that the appropriate flows under the Environmental Flows Guidelines are released from Corin and Bendora reservoirs.

Protection of the Cotter River Catchment from invasion by introduced fish species.

The Cotter River contains three threatened fish species: Trout Cod (*Maccullochella macquariensis*), Macquarie Perch (*M. australasica*), Two-spined Blackfish (*Gadopsis bispinosus*), and is one of the few rivers in the eastern Murray-Darling drainage which does not have Carp (*C. carpio*) or Redfin Perch (*P. fluviatilis*) established. Both of these introduced fish species are now widespread in the basin and the Canberra region. The construction of Cotter Dam in 1912 provided a barrier preventing invasion from the Murrumbidgee River of these two fish species. *C. carpio* were first recorded from the ACT in 1974 and *P. fluviatilis* became widely established in 1983 (Lintermans *et al.* 1990; Lintermans 1991b), long after the dam was completed.

Cotter Reservoir is not regularly used for the supply of domestic water to Canberra, with the water usually drawn from Corin and Bendora reservoirs. However it is foreseeable that as the population of Canberra grows, there will be a need to augment existing water storages. One possibility is that Cotter Reservoir could be increased in volume through either raising the height of the existing dam or demolition and construction of a new dam wall. It is important that any evaluation of options for the future of Cotter Reservoir recognise the significance of the barrier posed by the existing structure.

⇒ Environment ACT will highlight the importance of maintaining the integrity of the Cotter Dam barrier to upstream fish colonisation in the event of reconstruction/augmentation of Cotter Dam.

Similarly, Bendora Dam acts as a barrier to the colonisation of the upper and middle Cotter catchment by Brown Trout (*Salmo trutta*).

⇒ Environment ACT will highlight the importance of maintaining the integrity of the Bendora Dam barrier to upstream fish colonisation.

Another mechanism for the unwanted introduction of exotic fish species is the use of live fish as bait. This is thought to be how the introduced Oriental Weatherloach (*Misgurnus anguillicaudatus*) became established in the Cotter River and Lake Eucumbene (Lintermans 1993). It is illegal to use live fish as bait under the *ACT Fishing Act 1967*, however discouraging bait fishing of any kind will provide further safeguards against “bait-bucket” introductions. The designation of the Cotter River as a “trout water” with only artificial fly or lures allowed as a fishing method assists in the prevention of establishment of unwanted fish. Similarly, the stocking of fish species in the Cotter catchment is not supported as the introduction of additional species will encourage bait fishing and potentially impose further stress on threatened fish populations (ACT Government 1997).

The 1997 review by the ACT Environment Advisory Committee of the recreational usage of Cotter Reservoir recommended that the reservoir should remain closed to recreational fishing because of the threat posed to native fish species by the establishment of introduced fish. This recommendation was accepted by the Minister for Environment, Land and Planning in August 1997.

⇒ Environment ACT will continue the policy of maintaining the Cotter River below Bendora Dam as a declared “trout water” for artificial

fly or lure fishing only (under the *ACT Fishing Act 1967*).

⇒ Environment ACT will maintain the policy of not stocking fish for recreational purposes in streams of the ACT or water supply reservoirs in the Cotter River catchment as outlined in the ACT Fish Stocking Plan (ACT Government 1997).

⇒ Environment ACT will maintain the existing ban on recreational angling in Cotter Reservoir as recommended by the ACT Environment Advisory Committee and accepted by the Minister for Environment, Land and Planning in August 1997.

Expansion of the Species Distribution in the Cotter River

The barrier to *M. australasica* posed by Vanitys Crossing effectively limits the Cotter River population to the Cotter Reservoir and approximately 5.5 km of stream above it. Anecdotal reports indicate that the species were once present upstream of the crossing but now no longer occur there. Translocation of the species from below to above the crossing would increase the length of stream available to the species by approximately 20 km. Translocation of the species to re-establish populations is a recommended management action in the Action Plan for Australian Freshwater Fishes (Wager and Jackson 1993).

⇒ Environment ACT (Wildlife Research and Monitoring (WR&M)) will investigate the feasibility of translocating *M. australasica* past the barrier posed by Vanitys Crossing. Existing fish passage options for Vanitys Crossing are not cost effective at present.

⇒ Environment ACT will evaluate cost effective techniques for fish passage at Vanitys Crossing. Continuing developments in fish passage techniques will be monitored and future cost effective measures will be investigated for this site.

SURVEY

Knowledge of the distribution and abundance of *M. australasica* in the upper Murrumbidgee catchment is incomplete. There are anecdotal reports from a number of locations but these need confirmation. The status of the Burrinjuck population has not been assessed since the mid 1980s when concerns were expressed about the impacts of an expanding Redfin (*P. fluviatilis*) population (Burchmore and Battaglione 1990). Further investigation is necessary to place the ACT populations into a regional context.

⇒ Environment ACT (WR&M) will conduct a survey of the upper Murrumbidgee River

catchment to assess the distribution and status of *M. australasica* populations outside the ACT.

The status of the species in Paddys River is unknown as the only records from this stream are based on the results of angler interviews summarised in Greenham (1981).

⇒ Environment ACT (WR&M) will conduct a survey of the Paddys River catchment to assess the distribution and status of *M. australasica* in this catchment.

The geographical extent of the *M. australasica* population in the Queanbeyan River is currently unknown. Previous sampling by Environment ACT has shown that it occupies the entire length of the river contained within Googong Foreshores (approximately 5.5 km) but how far upstream it extends is unknown. This information may be important in managing the Queanbeyan River population. Similarly, it is unknown whether the species is present in the Queanbeyan River below Googong Reservoir.

⇒ Environment ACT (WR&M) will conduct a survey of the Queanbeyan River outside the Googong Foreshores area to assess the distribution and status of *M. australasica*.

⇒

MONITORING

The decline of *M. australasica* in the Murrumbidgee River and the small distribution and population sizes in the Queanbeyan and Cotter rivers raises concerns about the long-term viability of these sub-populations. A long-term monitoring program capable of detecting changes in distribution and abundance of the species which are outside the normal variation in these parameters expected in natural populations is required. To enable the results from the ACT monitoring program to be placed in a regional context, it is proposed that a small number of sites be monitored concurrently in adjacent waters of NSW.

⇒ Environment ACT (WR&M) will establish a monitoring program for the Cotter, Murrumbidgee and Queanbeyan River sub-populations of *M. australasica*.

A number of populations of *M. australasica* in adjacent areas of NSW will be monitored. Potential streams include the Goodradigbee River/Lake Burrinjuck, and the Murrumbidgee River near Cooma.

⇒ Environment ACT (WR&M) will monitor a small number of additional sites in adjacent NSW waters. This work will be based on the results of the upper Murrumbidgee survey.

⇒ Environment ACT (WR&M) will liaise with Victorian and NSW fisheries agencies to ensure that there is exchange of relevant information on the species.

RESEARCH

There is some existing information on the biology and ecology of *M. australasica*, although much of it remains unpublished. Distribution, diet and reproduction have all been studied to some degree. However, there are still some critical knowledge gaps which need addressing.

⇒ Environment ACT will encourage research into a number of priority areas with key information gaps. These include resolution of the taxonomic status, effects of introduced trout and Redfin, and effects of EHN Virus in the wild.

Resolution of the Taxonomic Status

There now appears to be broad acceptance in the scientific community that the inland and coastal populations of the species are separate taxa but there is still no formal resolution of the species identity.

Effects of Introduced Trout and Redfin

Dietary competition between *M. australasica* and Brown and Rainbow Trout (*S. trutta* and *O. mykiss*) has been proposed but not adequately tested. Similarly there have been concerns expressed over the predatory impacts of *S. trutta* and Redfin (*Perca fluviatilis*) but there have been no studies to quantify the level of predation, or which life stages of *M. australasica* are involved.

Effects of EHN Virus in the Wild

Redfin in the Canberra region are known to be infected with EHN Virus. This virus has been shown to cause 100% mortality of *M. australasica* in laboratory experiments but there have been no studies of how this virus affects wild populations.

EDUCATION AND LIAISON

Large sections of the general community are unaware of the reasons for the decline of native fish, and the actions that can help to halt this. Provision of such information will enhance community understanding and engender community support for research and management actions. Options for providing this information include the internet (Environment ACT homepage, ACT Native Fish Information System), development of curriculum materials, as well as pamphlets and signs.

Some anglers cannot discriminate between threatened and non threatened fish species. Consequently some individuals of threatened species are not returned unharmed to the water after accidental capture. On-site identification aids at locations where threatened fish are likely to be caught would reduce the incidence of mis-identification of threatened fish species.

A 1995 review of the *Fishing Act 1967* proposed the appointment of a dedicated fisheries officer. This officer could deliver targeted education programs to anglers, fishing clubs, school children etc. The Government is drafting a new Fishing Act in response to the 1995 review.

- ⇒ Environment ACT will investigate options for the provision of information to the public on the reasons for fish declines.
- ⇒ Environment ACT is providing signage along the Murrumbidgee and Cotter rivers in the ACT to assist anglers identify threatened fish species.

Protection

Prior to its declaration as an endangered species in the ACT, *M. australasica* was unprotected. There were reports of the species being targeted by anglers in Cotter Reservoir (a water closed to fishing), but insufficient resources were available to deal with this issue. In a review of recreational fishing in the ACT (ACT Parks and Conservation Service 1995), it was proposed to create a dedicated Fisheries Officer position in an effort to curb illegal fishing and better protect the ACT's fish resources. This proposal received widespread public support (ACT Parks and Conservation Service 1996) and the ACT Government is examining how this proposal might be implemented.

Socio-economic Issues

The main social benefit of conserving representative populations of *M. australasica* is meeting community concerns that further loss or extinction of native species be prevented.

Management of the Cotter River in Namadgi National Park for water supply purposes has resulted in minimal gross water quality degradation through turbidity, considerable reduction of nutrient transport through land disturbance and prevention of large scale introductions of human pathogens, such as *E. coli*, *Giardia* and *Salmonella*.

Management of the Cotter catchment for conservation of threatened fish species, including provision of environmental flows, is of concern to ACTEW in terms of the security of water supply and pricing of domestic water. Compliance with environmental flow guidelines may have some impact on the urban water supply potential of the Cotter catchment. This may result in greater use of the higher cost water from Googong Dam which currently supplements water supply from the Cotter catchment during periods of high demand.

Legislative Provisions

The following legislation is relevant to conservation of flora and fauna in the ACT region:

AUSTRALIAN CAPITAL TERRITORY

Nature Conservation Act 1980

The Nature Conservation Act provides a mechanism to encourage the protection of native plants and animals (including fish and invertebrates), the identification of threatened species and communities, and the management of Public Land reserved for nature conservation purposes. Specified activities are managed via a licensing system.

Native plants and animals may be declared in recognition of a particular conservation concern and increased controls and penalties apply. Species declared as endangered must be declared as having special protection status (SPS), the highest level of statutory protection that can be conferred.

As an endangered species, *M. australasica* must be declared a SPS species and any activity affecting such a species is subject to special scrutiny. Conservation requirements are a paramount consideration and only activities related to conservation of the species

or serving a special purpose are permissible. The Conservator of Flora and Fauna may only grant a licence for activities affecting a species with SPS where satisfied that the act specified in the licence meets a range of stringent conditions. Further information can be obtained from the Licensing Officer, Compliance and Quarantine Services, Environment ACT, telephone (02) 6207 6376.

Fishing Act 1967

Amendments to the Fishing are currently being prepared to make it more consistent with the corresponding NSW fishing legislation. Amendments to the Act could strengthen the powers of the Act to protect native fish species by providing for bag, size and gear limits as well as being able to declare closed seasons or total protection for fish species.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan, which identifies nature reserves, national parks and wilderness areas within the Public Land estate.

The Territory Plan also provides for flora and fauna guidelines which list criteria for the assessment of the potential impact of a land use proposal. These focus on a range of aspects of the ACT's ecological resources, including the protection of vulnerable and endangered species along with their habitats. The conservation requirements of threatened species and their habitats are considered specifically during this process.

The Act also establishes the Heritage Places Register. Places of natural heritage significance may be identified and conservation requirements specified.

Environmental Assessments and Inquiries may be initiated in relation to land use and development proposals.

NEW SOUTH WALES

Fisheries Management Act 1994

A new Part 7A covering threatened species conservation provisions relating to fish and marine vegetation was added via the *Fisheries Management Amendment Act 1997*, which came into effect on 1 July 1998. These provisions cover the identification, assessment and proclamation of endangered species, populations and ecological communities, vulnerable species and key threatening processes. They also provide for identification of critical habitat, mandatory impact assessment in the land use planning process and active recovery management. Under the

Fisheries Management Act, the species is soon to be formally considered for listing as being threatened.

Consultation and Community Participation

In 1995, a discussion paper on recreational fishing in the ACT was widely circulated for public comment (ACT Parks and Conservation Service 1995). The purpose of the paper was to outline current fisheries management in the ACT and present a series of proposed changes to management practices. One proposal was to totally protect *M. australasica*. A total of 194 submissions representing the views of 1290 individuals was received on the discussion paper with 96% of respondents supporting the protection of the species (ACT Parks and Conservation Service 1996). The Fish Stocking Plan for the ACT (ACT Government 1997) was also circulated for public comment in 1996. This document outlined that protection of threatened fish species and management strategy for the Cotter system water quality were the main reasons for not stocking the water supply reservoirs on the Cotter River. No adverse comments were received on this management strategy for the Cotter system.

Representatives from Environment ACT (WR&M; ACT Parks and Conservation Service) maintain regular contact with officers from Planning and Land Management in the Department of Urban Services, fishing clubs and the ACT Sport and Recreational Fishing Council to raise awareness of issues involving fish communities.

A number of land management practices have the capacity to adversely affect fish populations, especially urban development, agricultural pursuits and forestry operations. These can generate soil erosion which leads to habitat destruction and deterioration in water quality. Environment ACT representation on appropriate intra- and interdepartmental committees and working groups will continue to provide opportunities for liaison on these matters.

⇒ Environment ACT will encourage community groups such as fishing clubs and the Australia New Guinea Fishes Association (ANGFA) to assist in the conservation of ACT fish populations and their habitats. Anglers will be encouraged to report any catches of threatened fish.

Implementation, Evaluation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT (WR&M; ACT Parks and Conservation Service; Conservation and Land Management) have responsibility for coordinating implementation of this Action Plan. Specific actions on Territory Land will be subject to the availability of Government resources. Primary responsibility for conservation and management of the species on Territory Land will rest with Environment ACT.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. NSW participation will be critical in some cases. The Action Plan will be reviewed after three years. The review will comprise an assessment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species; development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);
- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide an opportunity for Environment ACT and the Flora and Fauna Committee to assess progress, take account of developments in nature conservation knowledge, policy and administration, and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

- ⇒ completion of surveys in the upper Murrumbidgee River catchment where the species could occur;
- ⇒ establishment of a monitoring program to allow the detection of trends in relative population size at a number of sites;

- ⇒ commencement of a research program, especially on priority research topics; and
- ⇒ putting in place protection measures.

Acknowledgments

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The illustration of the species (Figure 1) was provided by the Murray-Darling Basin Commission.

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List of Action Plans - February 1999

In accordance with Section 23 of the *Nature Conservation Act 1980*, the following Action Plans have been prepared by the Conservator of Flora and Fauna:

- No. 1: Natural Temperate Grassland - an endangered ecological community.
- No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.
- No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicollis*) - an endangered species.
- No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.
- No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.
- No. 6: Northern Corroboree Frog (*Pseudophryne pengilleyi*) - a vulnerable species.
- No. 7: Golden Sun Moth (*Synemon plana*) - an endangered species.
- No. 8: Button Wrinklewort (*Rutidosis leptorrhynchoides*) - an endangered species.
- No. 9: Small Purple Pea (*Swainsona recta*) - an endangered species.
- No. 10: Yellow Box - Red Gum Grassy Woodland - an endangered ecological community (draft).
- No. 11: Two-spined Blackfish (*Gadopsis bispinosus*) - a vulnerable species.
- No. 12: Trout Cod (*Maccullochella macquariensis*) - an endangered species.
- No. 13: Macquarie Perch (*Macquaria australasica*) - an endangered species.
- No. 14: Murray River Crayfish (*Euastacus armatus*) - a vulnerable species.

- No. 15: Hooded Robin (*Melanodryas cucullata*) - a vulnerable species (draft).
- No. 16: Swift Parrot (*Lathamus discolor*) - a vulnerable species (draft).
- No. 17: Superb Parrot (*Polytelis swainsonii*) - a vulnerable species (draft).
- No. 18: Brown Treecreeper (*Climacteris picumnus*) - a vulnerable species (draft).
- No. 19: Regent Honeyeater (*Xanthomyza phrygia*) - an endangered species (draft).
- No. 20: Painted Honeyeater (*Grantiella picta*) - a vulnerable species (draft).
- No. 21: Perunga Grasshopper (*Perunga ochracea*) - a vulnerable species (draft).
- No. 22: Brush-tailed Rock-wallaby (*Petrogale penicillata*) - an endangered species (draft).
- No. 23: Smoky Mouse (*Pseudomys fumeus*) - an endangered species (draft).
- No. 24: Tuggeranong Lignum (*Muehlenbeckia tuggeranong*) - an endangered species (draft).

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

Environment ACT Homepage:
<http://www.act.gov.au/enviro>

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