

ACTION PLAN No.11

In accordance with section 21 of the *Nature Conservation Act 1980*, the **Two-spined Blackfish (*Gadopsis bispinosus*)** was declared a **vulnerable** 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:

Two-spined Blackfish *Gadopsis bispinosus*

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 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 Two-spined Blackfish, 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

2.2 The species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the medium-term future, as demonstrated by:

2.2.1 Current serious decline in population or distribution from evidence based on:

2.2.1.1 direct observation, including comparison of historical and current records.

2.2.2 Imminent risk of serious decline in population or distribution from evidence based on serious threat from predators, parasites or competitors.

2.2.4 Seriously fragmented distribution for a species currently occurring over a moderately small range or having a moderately small area of occupancy within its range.

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 Trout Cod (*Maccullochella macquariensis*), Macquarie Perch (*Macquaria australasica*) and Murray River Crayfish (*Euastacus armatus*). Action Plans are listed at the end of this document.

Species Description and Ecology

The Two-spined Blackfish *Gadopsis bispinosus* is a member of the family Gadopsidae, commonly known as blackfish, which is endemic to south-eastern Australian freshwater habitats. The Gadopsidae contains a single genus, *Gadopsis*, which has two species currently described; the Two-spined Blackfish *G. bispinosus* and the River Blackfish *G. marmoratus*. *G. bispinosus* can be distinguished from *G. marmoratus* (Richardson 1848) by the presence of only two (range 1-3) instead of 11 (range 6-13) dorsal fin spines (Sanger 1984). *G. bispinosus* also has a distinct white edge on the dorsal, anal and caudal fins which *G. marmoratus* lacks.

DESCRIPTION

G. bispinosus is a small to medium sized species with a relatively large head with rounded snout (Figure 1). The maximum total length for *G. bispinosus* is 300-350 mm. Most specimens in the Canberra region are less than 250 mm total length (Lintermans 1998). *G. bispinosus* has a large mouth with fleshy lips, with the upper jaw overhanging the lower. The body is narrow and slightly compressed with long, low dorsal and anal fins. The pelvic fins are reduced to single bifid rays and are angular in position. The scales are very small and the body heavily coated in slime. The colouration is variable, usually a yellowish-brown at the base, with two to three rows of dark brown blotches running the entire body length and extending onto the dorsal, anal and caudal fins. The ventral surface is uniformly pale to the origin of the anal fin. The outer edge of the dorsal, anal and caudal fins are pale or white, and are often bordered by an intense dark stripe (Jackson *et al.* 1996). Sexes are generally indistinguishable except during the breeding season when gravid females have eggs visible through the body wall.

HABITAT

G. bispinosus only occurs in inland drainages of south-eastern Australia, where it is restricted to cool, clear upland or montane streams with abundant instream cover, usually in the form of boulders and cobble (Sanger 1984; Koehn 1987, 1990; Lintermans 1998). In contrast, *G. marmoratus* occurs in slower-flowing lowland streams and has a requirement for log debris for spawning. *G. bispinosus* is more often found in the medium to larger streams where there is greater water depth and lower stream velocity. It is not found in the smallest headwater streams (Lintermans and Rutzou 1990a, 1990b; Lintermans unpubl. data). *G. bispinosus* is generally found in forested

catchments, where there is little sediment input to the stream from erosion or land management practices.

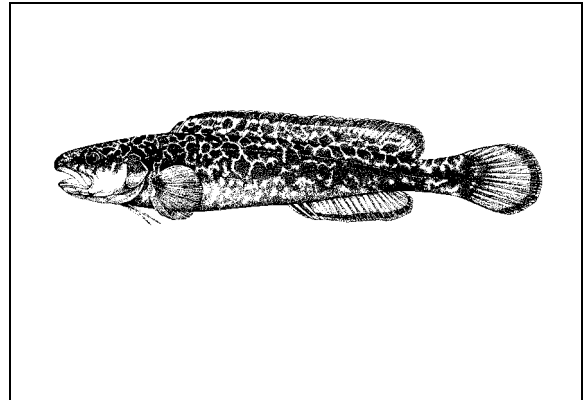


Figure 1: Two-spined Blackfish (*Gadopsis bispinosus*). Scale: Approximately one third natural size.

BEHAVIOUR AND BIOLOGY

There has been little published on the behaviour or biology of *G. bispinosus* with most information residing in an unpublished thesis (Curmi 1996) or ongoing research projects (J. Kalish, Division of Botany and Zoology, ANU). Most of the information for the Canberra region comes from a post-graduate research project recently completed (Lintermans 1998). Life history information is difficult to gather for fish species as they are not easily observed in their aquatic habitats. The dark colouration and patterning of *G. bispinosus* makes it difficult to observe, even in shallow clear streams.

The diet is characterised by a predominance of aquatic insect larvae, particularly mayflies, caddisflies and midges. Terrestrial insects also make up a significant part of the diet, indicating the importance of intact riparian vegetation communities as a food source, for their associated insect fauna which falls onto the water. Young-of-year and juvenile blackfish eat proportionally more mayfly and midge larvae than adult fish, which consume larger items such as caddisfly larvae and terrestrial invertebrates.

Movement of *G. bispinosus* is extremely limited with home-range of adult fish estimated at approximately 15 metres. Home-ranges are maintained from year to year, with fish thought to avoid the high velocity winter flows by sheltering amongst the rocks and boulders on the stream bed. Home-range in *G. marmoratus* is also limited and is estimated at approximately 20 metres (Koehn 1986).

Breeding is seasonal with egg laying commencing in November, probably induced by a relatively rapid rise in water temperature.

Fecundity is low and is positively correlated with fish length. Females are thought to commence breeding in their second or third year. Between 80 and 420 eggs are laid (Sanger 1986, 1990; Lintermans 1998) in a single egg mass but the natural spawning sites are unknown. *G. bispinosus* will lay eggs inside PVC pipes placed into streams, and it is thought that all eggs are released at once, and that each egg mass is from a single female (Lintermans 1998). It is suspected that the natural spawning site is on the underside of boulders or cobble (Lintermans 1998).

The eggs are large (~3.5 mm diameter), yolky and adhesive, and are guarded by the male fish until the larvae have almost fully exhausted the yolk reserves and are free-swimming. Hatching occurs after approximately 16 days at a water temperature of 15 °C, with the large yolk sac remaining inside the ruptured egg membrane, effectively tethering the young to the spawning substrate until the yolk has been consumed (Lintermans 1998). The larvae have almost fully consumed the yolk after approximately three weeks and then leave the spawning site, with the male guard fish also leaving.

In the upper Cotter River, *G. bispinosus* is known to be host to a small (~5mm) Glossiphonid leech of unknown species. Numerous small red bite marks are often observed on mature fish, although the leeches are rarely seen (Lintermans unpubl. data). Leeches are extremely rare on Australian freshwater fish species with only one other instance of leech attack documented (Cadwallader 1978b). *G. bispinosus* in the upper Cotter River are also known to carry the native parasitic fluke *Phyllodistomum magnificum* (Cribb 1987) which has been recorded in the bladder of infected animals (Lintermans unpubl. data).

DISTRIBUTION

There is little information on the historical distribution of *G. bispinosus* owing to the relatively recent description of the species. All descriptions made prior to 1984 referred to "blackfish", with no distinction being made between *G. bispinosus* and *G. marmoratus*. Museum collections have revealed only four specimens of *G. bispinosus* collected prior to the late 1970s, all being from the Canberra region. Two were collected from the Goodradigbee River catchment in 1931, one from the Geehi River in Kosciuszko National Park in 1975, and the other from the

Murrumbidgee River (ACT) in 1962 (Lintermans 1998).

HISTORICAL DISTRIBUTION

There is little historical information to assess whether the species' distribution has changed over time. However, the distinct and different habitat preferences of the two inland blackfish species (*G. bispinosus* and northern *G. marmoratus*) facilitate interpretation of some of the old literature records of "blackfish".

The records of blackfish from the Snowy River system (Llewellyn 1983; Tuma c1963; Tilzey 1969) can be assumed to be southern *G. marmoratus* as this is the only blackfish species found in coastal drainages. Both Stead (in Ogilby 1913) and Whitley (1964) note that blackfish were reportedly introduced into the Snowy River system but the origin of these introductions (and hence the species involved) were not mentioned.

Macleay (1885) commented on a specimen of *Gadopsis* sp. collected from the "Little River near Yass". The Little River is a local name for the Goobarragandra River where *G. bispinosus* was collected recently (Lintermans 1998). Stead (1908) records the distribution of blackfish in NSW as "the upland streams of the southern highland" but does not provide precise localities. However, some years later (in Ogilby 1913) Stead lists the "Yarrangobilly River, Jounama Creek, Goobarragandra River, Adjungbilly Creek and other feeders of the Tumut River, the Tumut itself, the Upper Murrumbidgee, the Upper Snowy and its feeders.....". All of these streams with the exception of the upper Snowy and its tributaries would probably refer to *G. bispinosus*.

There are anglers' records of blackfish captures, probably of *G. bispinosus*, from the Yarrangobilly River prior to the early 1960s (Lintermans 1998). Recent surveys in the Yarrangobilly River failed to locate any blackfish.

Similarly, there were a number of anglers' records of blackfish from the Goodradigbee drainage, with two specimens of *G. bispinosus* (collected in 1931) lodged in the Australian Museum. Four sites on the Goodradigbee River itself were sampled (Lintermans 1998) but no blackfish were caught. A further five sites on tributary streams were sampled with *G. bispinosus* recorded in low numbers at one site on Micalong Creek, the collection locality of the 1931 specimen. As with the Yarrangobilly River, the Goodradigbee River contains excellent habitat for *G. bispinosus* but the

species now appears to be largely absent or present in low numbers only.

Blackfish were known to be present in the Murrumbidgee River in the ACT until the 1960s (Jorgensen 1983; Greenham 1981) although their specific identity was unknown (Lintermans 1991a). The last reported capture of a blackfish in the Murrumbidgee in the ACT was in the mid 1970s (Lintermans 1998). The only blackfish specimen known from the Murrumbidgee River in the ACT is of *G. bispinosus* and this is the only blackfish species known from the ACT and immediate surrounds. It is reasonable to assume that this was the only blackfish species present in the Murrumbidgee. No blackfish have been recorded in the Murrumbidgee River in the ACT since the mid 1970s, although the species still occurs in the headwaters of the river (NSW Fisheries unpubl. data).

PRESENT DISTRIBUTION

The present distribution of the species covers a narrow band from north-eastern Victoria, extending through south-eastern NSW to the ACT, which is at the northern extremity of its range (Koehn 1990; Lintermans and Rutzou 1990a; Lintermans 1998) (Figure 2).

An extensive survey of the NSW southern highlands (Lintermans 1998) located *G. bispinosus* in the following stream systems:

- the upper Murray, including the lower reaches of the Swampy Plains, Tooma and Geehi Rivers;
- the upper Tumut system, including the lower reaches of the Goobarragandra River;
- the Goodradigbee River;
- Mountain Creek; and
- the upper Murrumbidgee River between Yaouk and Cooma.

In the ACT, the species is now found only in the Cotter River catchment upstream of the Cotter Dam.

Conservation Status

G. bispinosus is recognised as a threatened species in the following sources:

Australian Capital Territory

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

New South Wales

The *Fisheries Management Amendment Act 1997* allows declaration of fish species threatened in New South Wales. The species is currently not listed. Klippel (1992) lists the species as *Insufficiently Known*.

Victoria

A recent review of the conservation status of Victorian fish lists *G. bispinosus* as *Restricted* (Koehn and Morison 1990). The species is not listed as threatened under the *Flora and Fauna Guarantee Act 1988*.

Threats to Populations in the ACT Region

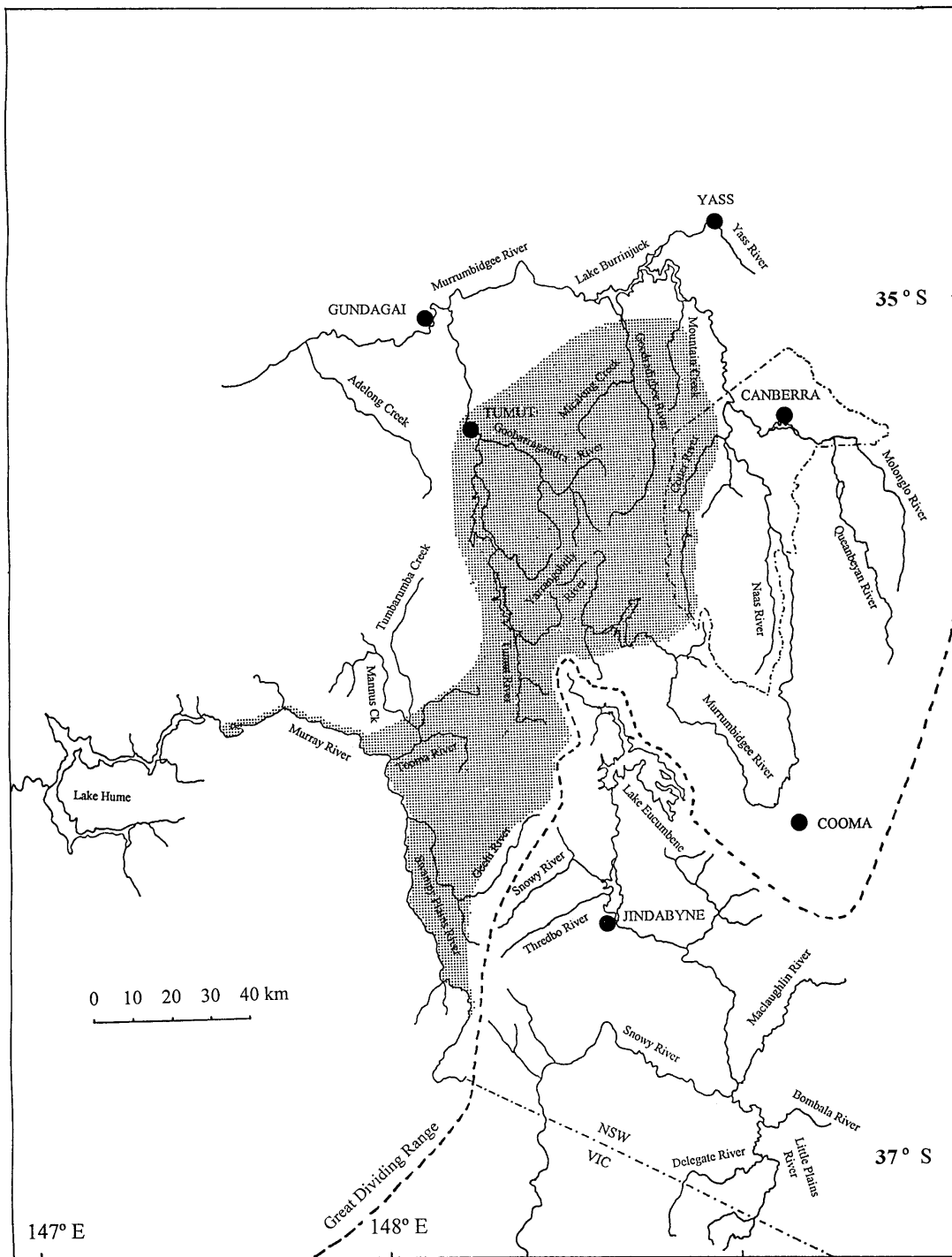
The reasons for the apparent decline in *G. bispinosus* populations in the region are not known, although the major threats to the continued survival of native fish species generally in freshwater habitats are overfishing, habitat alteration and introduced fish species.

HABITAT DESTRUCTION OR MODIFICATION

Alteration or destruction of fish habitat is widely regarded as one of the most important causes of native fish declines in Australia (Cadwallader 1978a; 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).





 Current distribution of
Two-spined Blackfish

Figure 2 Current distribution (1998) of Two-spined Blackfish in the ACT region.
Produced by Wildlife Research and Monitoring, Environment ACT 1998 (Redrawn from Lintermans 1998).

Blackfish are not a migratory species and so barriers to movement are unlikely to have played a substantial role in the declines of *G. bispinosus*. Similarly, loss of floodplain habitat is unlikely to have been a contributing factor as *G. bispinosus* is an inhabitant of upland streams where floodplains are mostly absent or have little importance as fish habitat.

Alterations to flow regimes in conjunction with reductions of instream habitat and water quality may be implicated in the demise of the Murrumbidgee River populations of *G. bispinosus*. General land degradation from overclearing and inappropriate land management, rabbit plagues in the 1920s, a proliferation of extractive industries and urban development within the upper Murrumbidgee catchment have undoubtedly contributed to general siltation of the Murrumbidgee River.

The construction of Tantangara Dam probably also contributed substantial amounts of sediment to the river. Deposited sediment from the construction of the Thompson Dam in Victoria was shown to have filled the interstitial space between stones to a depth of at least 60 cm (Davey *et al.* 1987). These interstitial spaces appear to be extremely important to *G. bispinosus*, both as cover and possible spawning sites. Addition of sediment to rivers is particularly detrimental to fish which lay adhesive eggs on the substrate (Cadwallader 1978a), as *G. bispinosus* does, as the sediment smothers the eggs, and may prevent attachment of eggs to the substrate.

Butcher (1945) considered that changes in environmental conditions following deforestation and erosion have played a significant part in the decline of blackfish in Victoria. Doeg and Koehn (1994) reported a 93% reduction in population density of *G. marmoratus* immediately below a site of sediment addition in a small Victorian stream. They recorded reductions in blackfish numbers for all age classes but noted that greater reductions were apparent in the younger age classes. Increased sedimentation is also known to be very damaging to benthic macroinvertebrate communities (Doeg and Koehn 1990a,b) which form the majority of the dietary items of *G. bispinosus*.

Forestry activities such as clearfelling of hardwoods or harvesting of exotic softwoods are also likely to impact on *G. bispinosus* through increasing sedimentation of streams, both from the felling activities themselves and from the construction of roads and tracks which have been shown to contribute significant sediment loads (Richardson 1985; Campbell and Doeg 1989). Sedimentation and

the associated increase in turbidity are likely to affect visual feeders like blackfish more severely, as both the abundance and diversity of prey items are reduced, and feeding success declines because of lowered water clarity.

The construction of Tantangara Dam on the upper Murrumbidgee River in 1960 has reduced the frequency of winter flooding and increased the occurrence of low flows (<1000 megalitres/day) in winter (Jorgensen 1983). This has possibly led to the continued accumulation of sediments in the river as there are now fewer and smaller high flow events which previously would have scoured the finer sediments out of the river bed. The effects of the three dams on the Cotter River in the ACT on seasonal flow patterns and channel morphology could be expected to have been similar to that of Tantangara in that there are no substantial tributaries to the Cotter River to restore flow regimes below impoundments.

OVERFISHING

Overfishing was cited as one of the contributing factors in the decline of blackfish in Victoria in the late 1800s (Lewis 1917; Roughley 1953) 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), Macquarie Perch (*Macquaria australasica*) (Cadwallader 1978a) and Murray Cod (*Maccullochella peelii peelii*) (Rowland 1989; Jackson *et al.* 1993). However, *G. bispinosus* is unlikely to have been affected by overfishing as its small size means it is generally not sought by anglers. A questionnaire circulated to fishing clubs in New South Wales in 1991 indicated that the great majority of captures of blackfish in NSW were accidental (Lintermans unpubl. data). Under the provisions of the ACT *Fishing Act 1967* fishing is prohibited in the Cotter River catchment above Bendora Dam, thus providing some protection for *G. bispinosus*.

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 *G. bispinosus* are

addition of sediment (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 declines 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. However, there is convincing evidence of the Galaxiidae being adversely affected by the presence of both Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) (Tilzey 1976; Frankenberg 1966, 1974; Fletcher 1979; Cadwallader 1979; Cadwallader and Backhouse 1983; Jackson 1981; Jackson and Williams 1980; Lintermans and Rutzou 1990b).

The main interactions between trout and native species are thought to be predation and competition for feeding, spawning or territorial requirements. *G. bispinosus* was invariably found associated with trout in the Canberra region (Lintermans and Rutzou 1990b; Lintermans 1998) and Koehn (1990) found Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) at 95 and 50 percent respectively of sites in Victoria where *G. bispinosus* was recorded. He did not state whether there were any sites where *G. bispinosus* was recorded without trout being present. *S. 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). *O. 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. It appears that *G. bispinosus* can coexist in its preferred habitat with trout, although its ability to do so in sub-optimal habitats is unclear.

Another potentially serious impact of introduced species is their capacity to introduce or spread foreign diseases and parasites to native fish species. Carp (*Cyprinus carpio*) or Redfin Perch (*Perca fluviatilis*) are considered to be the source of the Australian populations of the parasitic copepod *Lernaea cyprinacea* (Langdon 1989a). This copepod has been recorded on introduced trout species and Goldfish (*Carassius auratus*) as well as a number of native fish species in the Murray Darling Basin including Murray Cod (*Maccullochella peelii peelii*), Golden Perch (*Macquaria ambigua*), Silver Perch (*Bidyanus bidyanus*) (Langdon 1989a), Macquarie Perch

(*Macquaria australasica*), and Mountain Galaxias (*Galaxias olidus*) (Lintermans unpubl. data). *Lernaea* has not yet been recorded on *G. bispinosus* but the potential is real as it has been recorded on the closely related River Blackfish (*G. marmoratus*) (Langdon 1989a). Carp (*Cyprinus 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 high levels of mortality in juvenile fish overseas.

Of more concern is the recent identification in Australia of the 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). The disease also affects trout species which can act as vectors. Experimental work by Langdon (1989a,b) has demonstrated that a number of native fish species are extremely susceptible to the disease but Gadopsids have not been examined.

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 and Googong Reservoir 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.

Major Conservation Objectives

The major conservation objective of this Action Plan is to maintain in the long term, viable, wild populations of *G. bispinosus* as a component of the indigenous biological resources of the ACT region. This includes the maintenance of the species' potential for evolutionary development in the wild.

The objective is to be achieved through the following strategies:

- Participating in research, monitoring and experimental management aimed at identifying the cause of the continuing population decline, and preventing it.
- Protecting sites and habitats that are critical to the survival of the species. This includes the upper Cotter River in the ACT, which is nationally recognised as an important site for *G. bispinosus* (Lintermans and Ingwersen 1996).
- Managing activities in the upper and middle Cotter River catchment to minimise or eliminate threats to fish populations.
- Increasing community awareness of the need to protect native fish and their habitats.

Conservation Issues and Intended Management Actions

GENERAL ISSUES

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.

⇒ 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 (*M. macquariensis*), Macquarie Perch (*M. australasica*), Two-spined Blackfish (*G. bispinosus*), and is one of the few

river in the eastern Murray-Darling drainage which does not have Carp (*C. carpio*) or Redfin (*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* was 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*, although 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.

SURVEY

Knowledge of the distribution of *G. bispinosus* in the upper Murrumbidgee catchment is incomplete. Some survey work has been carried on the major streams but further investigation is necessary to place the ACT populations into a regional context.

- ⇒ Environment ACT (Wildlife Research and Monitoring (WR&M)) will complete the survey of the upper Murrumbidgee River catchment to locate potential populations of *G. bispinosus* outside the ACT.

There have been unconfirmed reports of blackfish from small streams in the Gunning and Dalton area in the upper Lachlan River catchment, north of the ACT. It is not known whether the species involved is the River Blackfish (*G. marmoratus*) or *G. bispinosus*. The specific identity needs to be confirmed.

- ⇒ Environment ACT (WR&M) will investigate the specific identity of blackfish from the Gunning/Dalton area.

MONITORING

The disappearance of *G. bispinosus* from the Cotter River below Cotter Dam and the Murrumbidgee River in the ACT raises concerns as to whether other sub-populations of the species are declining. A long-term monitoring program capable of detecting changes in distribution and abundance of *G. bispinosus* which are outside the normal variation in these parameters is required to evaluate these concerns. 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 at a representative suite of sites in the Cotter River catchment.
- ⇒ Environment ACT (WR&M) will monitor the fish population in the Murrumbidgee River in the ACT. Monitoring techniques will include those suited to detecting the presence of *G. bispinosus*.
- ⇒ Environment ACT (WR&M) will liaise with NSW Fisheries in the Canberra region to ensure that there is exchange of relevant information on *G. bispinosus*.
- ⇒ Environment ACT (WR&M) will encourage monitoring of populations of *G. bispinosus* in adjacent areas of NSW. Potential streams include the Goodradigbee River, Micalong Creek, Mountain Creek and the Murrumbidgee River near Yaouk.

RESEARCH

There is considerable existing information on the biology and ecology of *G. bispinosus*, although much of it is as yet unpublished. Distribution, diet, reproduction and home range have all been studied to some degree. However, there are still some critical knowledge gaps which need addressing.

- ⇒ Environment ACT (WR&M) will encourage research into a number of priority areas with key information gaps. These include longevity, spawning requirements, effects of introduced species, population genetics and habitat management.

Longevity

Some preliminary estimates of age structure in the upper Cotter River population were documented by Lintermans and Rutzou (1990b) but these need to be confirmed with more reliable techniques. *G. marmoratus* is thought to live for up to 13 years but the lifespan of *G. bispinosus* is suspected to be only around 4-6 years. The longevity of *G. bispinosus* could have profound implications for management and further information is required.

Spawning Requirements

Whilst the basic reproductive ecology of *G. bispinosus* is known, the spawning site has not been located. Protection of spawning sites of a low fecundity species like *G. bispinosus* is critical.

Effects of Introduced Species

The lack of information on the historical distribution of *G. bispinosus*, coupled with the absence of streams where the species exists without trout, means that the impacts of trout on *G. bispinosus* are unknown. It is also not known whether *G. bispinosus* has changed its habitat preferences or utilisation patterns (as galaxids have done) in response to the presence of trout. *G. bispinosus* is currently only found at sites where introduced trout species also occur. It has not been recorded at any site where trout are absent. This seems to indicate that trout species and *G. bispinosus* have very similar habitat requirements.

Both Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) are known to prey on *G. bispinosus* (Sanger 1990; Lintermans 1991b, 1998) and it is possible that *G. bispinosus* can only exist with trout in optimal habitats with abundant refuges such as those provided by the interstitial spaces in cobble and boulder substrates. If sites can be found where *G. bispinosus* occurs without trout, it would be worthwhile investigating whether the dietary niche and habitat preferences of *G. bispinosus* are similar to those at sites where trout are present.

Population Genetics

The fragmented nature of the populations of *G. bispinosus* in the Canberra region has implications for the regional management of the species. Nothing is known of the genetic structure of the species or whether inter-population translocation can be used to augment small populations or re-establish other populations.

⇒ Environment ACT (WR&M) will cooperate with other agencies in a coordinated study of the population genetics of the sub-populations of *G. bispinosus* in the Canberra region, including those in the Cotter River, Goodradigbee River, Goobarragandra River, upper Murrumbidgee River and Mountain Creek.

Habitat Management

Some knowledge exists on the broad habitat requirements of *G. bispinosus* but little is known of microhabitat selection or the effects of surrounding land use on preferred habitat. Research into habitat management needs to focus on the following:

- seasonal use of microhabitat by different age classes of fish;
- the effect of forestry practices (both logging and roading) on the habitat of the species; and

- the effects of the operation of Corin and Bendora dams on the ecology of the species.

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

Gadopsis bispinosus is relatively secure in the upper and middle Cotter catchment due to the remoteness of these sub-catchments and the ban on recreational angling above Bendora Dam in Namadgi National Park. The species is not protected in the lower Cotter catchment and although not sought after as an angling species, it is readily kept in aquaria and its popularity as an aquarium species is likely to increase. There is currently no requirement for a permit to keep the species, and the number kept in aquaria in the ACT is unknown. Declaration of the species as a protected fish under the provisions of Section 17 of the *Nature Conservation Act 1980* will enable the keeping of the species under permit. This will

provide a means of monitoring the demand for the species, which at present can only be met by taking from the wild.

⇒ Environment ACT will declare *G. bispinosus* to be a protected fish under the *Nature Conservation Act 1980*.

⇒ Environment ACT will maintain closure to fishing under the *Fishing Act 1967* in the Cotter River catchment above Bendora Dam.

Socio-economic Issues

The main social benefit of conserving representative populations of *G. bispinosus* 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, the highest level of statutory protection that can be conferred.

Fishing Act 1967

Amendments to the Fishing Act are currently being prepared to make it more consistent with the corresponding NSW fishing legislation. These amendments will 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. It is anticipated that these amendments will be in force in the near future.

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.

Consultation and Community Participation

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

This Action Plan draws on unpublished postgraduate research work, particularly work undertaken by Environment ACT's Senior Aquatic Ecologist, Mark Lintermans.

The illustration of the species (Figure 1) was prepared for Environment ACT by Marjorie Crosby-Fairall.

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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 pinguicolla*) - 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/envirom>

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