The Status of Fish in the Australian Capital Territory: A Review of Current Knowledge and Management Requirements

Mark Lintermans

Technical Report No. 15
March 2000
The Status of Fish in the Australian Capital Territory: 
A Review of Current Knowledge and Management Requirements

MARK LINTERMANS

ISSN 1320–1069

Wildlife Research & Monitoring
PO Box 144
Lyneham ACT 2602

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A report funded by the Cooperative Research Centre for Freshwater Ecology and Environment ACT.

The Cooperative Research Centre exists to improve the health of Australia’s rivers, lakes and wetlands through ecological research, education and knowledge exchange.

The Cooperative Research Centre for Freshwater Ecology was established under the Australian Government’s Cooperative Research Centres Program in 1993 and is a collaborative venture between:

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Murray-Darling Basin Commission
Murray-Darling Freshwater Research Centre
NSW Fisheries
Sydney Water Corporation
University of Canberra
Wimmera-Mallee Rural Water
ACKNOWLEDGEMENTS

This report draws on considerable body of published and unpublished information from the Wildlife Research and Monitoring Unit of Environment ACT. Many staff have contributed to the collection and processing of fish and data over the years and I thank them for their contributions. David Shorthouse, Peter Greenham and Mark Jekabsons provided helpful comments on a draft manuscript.
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ABSTRACT

The fish fauna of the Canberra region is relatively depauperate with only 12 native finfish species recorded, of which two species (Shortfinned Eel and Freshwater Catfish) are present as a result of translocation from other drainages. The Canberra region also has nine exotic finfish species present although only seven have established reproducing populations, with Atlantic Salmon and Brook Char being maintained by stocking.

The distribution, abundance and general ecology of these native and exotic finfish species (as well as the large crustacean Murray River Crayfish) is presented, along with information on conservation status (National and local), species declines, potential threats, survey and monitoring requirements and management actions required. A summary of stocking locations is also provided where applicable.

The existing fish monitoring programs conducted by Environment ACT are outlined and objectives and a potential structure for future monitoring programs identified.

The report also contains an annotated bibliography of fish studies for the upper Murrumbidgee River catchment.
1. **INTRODUCTION**

Fish are the most diverse group of vertebrates with more than 30,000 species world-wide (Maitland 1987; Tudge 1990). Australia (including its surrounding marine waters) has one of the largest fish faunas in the world with an estimated 3,600 species (Paxton et al. 1989). However the vast majority of these species are marine, with only a small proportion of freshwater species. The Australian freshwater fish fauna is often referred to as depauperate or impoverished with approximately 200 species described (Wager & Jackson 1993, McDowall 1996), most of which are derived from marine ancestors. For such a large land-mass as Australia, this is a very small number of species with much smaller countries such as Japan (127 species (Okada 1960)) and New Guinea (316 species (Allen 1991)) having freshwater fish faunas of comparable size. The relatively low number of Australian freshwater fish species is related to this country's long isolation, historical climate and aridity (McDowall 1981; Allen 1989). The largest river system in Australia, the Murray-Darling, has only 35 or so native fish species, whereas the Mississippi-Missouri system has 373 native species (Courtenay 1990) and the Amazon Basin some 1300 species described so far (Cadwallader and Lawrence 1990).

The Australian freshwater fish fauna is also notable in that it has a significant proportion of exotic species. There are approximately 25 species of exotic fish (McDowall 1996), with many introduced for recreational fishing purposes in the 1800s. Such fish include the trouts and salmons, Redfin Perch, Carp, Tench and Roach. A more recent wave of introductions has seen a number of ornamental and aquarium species establish such as Oriental Weatherloach, Sailfin Molly, Swordtail, Platy and Guppy (Arthington & Blühdorn 1995). Many of these aquarium species are restricted to tropical or sub-tropical waters, but some such as Oriental Weatherloach, are rapidly spreading through the cooler, temperate regions (Linternams et al. 1990a,b; Linternams 1993a,b; Linternams & Burchmore 1996). The Murray-Darling system has a high proportion of exotic species with 11 of the 45 or so fish species being exotic (Cadwallader & Lawrence 1990). The number of exotic fish species (~ 24 species) in Australia is similar to the number of exotic mammals (~23 species) and birds (~20 species) but much higher than for the other two vertebrate groups in Australia, with reptiles (2 species) and amphibians (1 species) (Thompson et al. 1987) both having a substantially lower exotic component. The high exotic component of the Australian fish, mammal and bird faunas is largely due to deliberate introductions for hunting or sport, with reptiles and amphibians largely excluded from such pastimes. Recent studies in New South Wales have revealed that exotic fish now form up to 70% numerically and 80–90% of the biomass in many rivers (Faragher & Linternams 1997; Brown 1996). A similar situation exists in the Canberra region where recent studies have found that exotic species comprise up to 96% numerically of the total catch in the Murrumbidgee, Molonglo and Queanbeyan rivers (Linternams 1995, 1997, 1998a,b).

Although no Australian freshwater fish species has become extinct since European settlement, approximately 8% of the Australian fish fauna is now considered threatened (Australian Society for Fish Biology 1998), with around 25% of species having either suffered a significant decline in distribution or are only found in restricted areas. (Wager & Jackson 1993).
The most often cited causes for declines in fish abundance and distribution are habitat destruction or modification, overfishing, and introduction of exotic 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 1978; Koehn & 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

The presence of dams and weirs on rivers prevents fish moving from one section of stream to another. Such movements may be essential for feeding, breeding or other reasons. Dams and weirs also prevent recolonisation of streams by fish after local "catastrophes' or depletion. An example is the construction of Scrivener Dam to form Lake Burley Griffin in 1963 which effectively isolated the Molonglo and Queanbeyan rivers from the Murrumbidgee 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. Several native fish species use increasing water temperature associated with late spring/early summer flows as cues to commence spawning (McDowall 1996a; Cadwallader & Backhouse 1983). The effect of some impoundments on downstream river flows is to partially reverse the seasonal nature of flows as water from spring and autumn rains are collected and stored for release in summer. 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 can inhibit the upstream spawning migrations of native fish, and if these releases of cold water are regular and persistent, breeding of native fish may not occur.

**Overfishing**
Overfishing has been shown to be important in the decline of several freshwater native fish species such as Trout Cod (Douglas et al. 1994), Macquarie Perch (Cadwallader 1978), Murray Cod (Rowland 1989; Jackson et al. 1993) and blackfish (Lewis 1917; Roughley 1953). Overfishing is generally not involved in the decline of smaller species, although the harvesting of some small species as bait fish may lead to localised declines.
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 were poorly known or documented. However, there is convincing evidence of the Galaxiidae being adversely affected by the presence of both Brown Trout and Rainbow Trout (Tilzey 1976; Frankenberg 1966; Fletcher 1979; Cadwallader 1979b; Cadwallader & Backhouse 1983; Jackson 1991; Jackson & Williams 1980; Lintermans & Rutzou 1990). The main interactions between trout and native species are thought to be predation and competition for feeding, spawning or territorial requirements. Brown Trout 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 were first introduced into Australia and New South Wales in 1894 (Faragher 1986), so both trout species have been established in south-eastern New South Wales for a century or more. In the Canberra region both Brown Trout and Rainbow Trout are known to prey on Mountain Galaxias and Two-spined Blackfish (Sanger 1990; Lintermans 1991b, 1998d), with Brown Trout also known to prey on Macquarie Perch and Trout Cod (NSW Fisheries unpublished data). Similarly, in the Canberra region Redfin Perch are known to prey on Western Carp Gudgeon and Murray Cod and are suspected to prey on Macquarie Perch.

Another potentially serious impact of introduced species is their ability to introduce or spread foreign diseases and parasites to native fish species (Stewart 1991; Dove 1998). Carp Cyprinus carpio or Redfin Perch Perca fluviatilis are considered to be the source of the Australian populations of the parasitic copepod Lernaea sp. (Langdon 1989a). This copepod has been recorded on introduced trout species and Goldfish as well as a number of native fish species in the Murray Darling Basin including Murray Cod, Golden Perch, Silver Perch, River Blackfish (Langdon 1989a), Macquarie Perch, and Mountain Galaxias (Lintermans unpublished data). This parasite has recently also been recorded on a native frog species, Perons Tree Frog Litoria peronii in the Cotter River in the ACT (Lintermans unpublished data).

Carp or Mosquitofish Gambusia holbrooki are also considered the source of the Asian fish tapeworm Bothriocephalus acheilognathi which has recently been recorded from the native fish species Western Carp Gudgeon Hypseleotris kunzingeri in the Canberra region (Dove et al. 1997). This is the first record of this parasite in Australia which is known to cause high levels of mortality in juvenile fish overseas, and may have similar effects on local native species. This species has a low host-specificity at both stages of its life cycle with the adult stage recorded from at least 50 species of fish in five taxonomic orders (Dove et al. 1997).

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 Redfin Perch (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 & 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 were extremely susceptible to the disease, but gadoids have not been examined.

EHNV was first recorded from the Canberra region in 1986 when an outbreak occurred in Bowering Reservoir near Tumut (Langdon & 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 ease of transmission 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 virus.

1.1 Purpose of this Review

An essential first step in the management of any fauna is the documentation of the distribution and abundance of individual species. Once the baseline distribution and abundance of a species is known, changes over time can provide an indicator of the need for management actions. Much of the existing information on the distribution and abundance of freshwater fish in the ACT is anecdotal or has been collected on an ad-hoc basis. Consequently, good baseline datum does not exist for some species and/or localities. For other species and/or river systems, baseline surveys have been carried out over the last 10–20 years.

This report draws together both published and unpublished data on the freshwater fish faunas of the ACT. Where information is available for surrounding areas in the upper Murrumbidgee catchment, this information has also been incorporated to provide a regional perspective of the species in question. This report also includes information on the Murray River Crayfish which whilst taxonomically is a crustacean, for the purposes of this report is considered a native fish.

2. METHODS

The information on the distribution and abundance of freshwater fish of the ACT that underpins this report has been drawn from an array of sources. The majority of information comes from both the published and unpublished work of the Wildlife Research and Monitoring (WR&M) unit of Environment ACT. Unpublished information from WR&M consists of the results of both regular and irregular monitoring of fish populations in the rivers and urban lakes of the ACT. For some water bodies, survey/monitoring has been funded by agencies other than Environment ACT. Monitoring of Lake Burley Griffin after 1993 has been funded by the National Capital Authority, the 1994–97 monitoring of the Murrumbidgee/Molonglo rivers was funded by ACTEW Corporation, and the 1998 survey of the Queanbeyan River was supported by the National Fishcare Program. Information is also included from the first year of a threatened fish survey of the upper Murrumbidgee catchment, which is jointly funded by Environment ACT and the Cooperative Research Centre for Freshwater Ecology. Unpublished
information has also been sourced from a number of undergraduate and postgraduate theses completed at the Australian National University.

The broad distribution for each species is outlined, but is not intended to be an exhaustive list of locations where the species can be found. Information on the biology and ecological requirements of each species is summarised from the scientific literature. Potential threats to individual species are outlined (where known) and potential management actions to deal with such threats are discussed. The research and monitoring requirements of each species is discussed where appropriate.

The conservation status of each species is reviewed at both a national and local scale. An annotated bibliography of local studies on freshwater fish is presented as an appendix to the main body of the report.

Nomenclature follows that of McDowall (1996). Alternative common names are indicated where applicable.

2.1 The Study Area

The ACT lies wholly within the upper Murrumbidgee catchment (Figure 1) which for the purposes of this report is defined as the catchment upstream of Burrunjuck Dam.

Major Streams

There are seven rivers in the ACT with the major river being the Murrumbidgee. The Murrumbidgee River rises in the Fiery Range in Kosciuszko National Park at an altitude of around 1500 m where snow commonly occurs between June and October.

From its source, the Murrumbidgee River flows southeast for approximately 140 km towards Cooma, near where the river turns north and flows for some 70 km before turning northwest and entering the ACT at Angle Crossing. The Murrumbidgee River flows for approximately 68 km through the ACT in a northerly direction until it exits near Camp Sturt. The river enters Burrunjuck Reservoir at an altitude of around 370 m approximately 40 km downstream of the ACT.

The historic flow patterns in the Murrumbidgee River have been altered by the construction of Tantangara Reservoir in 1960. This reservoir is part of the Snowy Mountains Hydroelectric Scheme and diverts approximately 99% of the average natural flow (ANF) in the upper catchment through a tunnel to Lake Eucumbene on the headwaters of the Snowy River (Pendlebury 1997). Inflow from tributaries downstream of Tantangara slowly restores the stream to a more natural flow regime with 54% ANF downstream of the Numeralla River confluence and 84% ANF by the time the river enters Burrunjuck Reservoir (Pendlebury 1997).
Figure 1: Waters of the upper Murrumbidgee catchment.
Major tributaries of the Murrumbidgee River upstream of the ACT include the Kybean, Big Badja, Numeralla and Bredbo rivers, as well as the Queanbeyan River which joins the Molonglo River near Canberra. North of the ACT, the major tributaries are the Yass and Goodradigbee rivers which flow into Burrinjuck Reservoir.

The majority of the streams in the upper Murrumbidgee catchment can be characterised as relatively narrow, upland, rocky streams. Floodplains where they occur, are narrow, localised and confined. The Bredbo River is an exception in that it is a shifting, sand bed stream, whereas the Numeralla River has changed significantly from a narrow, shallow, pebbly-bottomed stream with a well developed pool/riffle or pool/rock bar sequence to a broad, deeply incised, depositional stream characterised by extensive sand deposits (Starr 1995; Starr et al. 1997). Such sand deposits are now common in the upper Murrumbidgee and are slowly moving downstream reducing fish habitat and filling previously deep holes.

Within the ACT there are eight tributary rivers of the Murrumbidgee River. These are:

- Molonglo River;
- Queanbeyan River;
- Cotter River;
- Paddys River;
- Tidbinbilla River;
- Orroral River;
- Naas River; and
- Gudgenby River.

The Orroral/Naas/Gudgenby system enters the Murrumbidgee River near Tharwa, whilst the Tidbinbilla/Paddys and Cotter systems enter near Casuarina Sands (Figure 1). All these tributary rivers are contained within the ACT except for the Molonglo River, which rises in New South Wales near Captains Flat to the southeast of Canberra, and the Queanbeyan River which rises in New South Wales in the Tinderry Ranges near Michelago.

_Lakes and Reservoirs_

There are nine major impoundments and a number of minor impoundments in the upper Murrumbidgee catchment. The major impoundments (and the streams they impound) are Burrinjuck and Tantangara (Murrumbidgee River), Corin, Bendorra, Cotter (Cotter River), and Googong (Queanbeyan River) reservoirs, and Lake Burley Griffin (Molonglo River), Lake Ginninderra (Ginninderra Creek) and Lake Tuggeranong (Tuggeranong Creek). The capacities of these reservoirs are listed in Table 1. Burrinjuck, Tantangara and Googong reservoirs all lie outside the ACT. The majority of these impoundments have been stocked with fish either by NSW Fisheries or the ACT Government, with the fishery in Googong being jointly managed by the ACT and NSW. The only major
Impoundments which have not been stocked are Corin and Bendoro reservoirs. Further information on the ACT Government’s fish stocking program is presented below.

Table 1: Storage capacities of major impoundments in the upper Murrumbidgee catchment.

<table>
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<th>Impoundment</th>
<th>Year Completed</th>
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<td>Tantangara</td>
<td>1961</td>
<td>254</td>
</tr>
<tr>
<td>Corin</td>
<td>1968</td>
<td>76</td>
</tr>
<tr>
<td>Bendoro</td>
<td>1961</td>
<td>11</td>
</tr>
<tr>
<td>Cotter</td>
<td>1912 &amp; 1951</td>
<td>4.7</td>
</tr>
<tr>
<td>Lake Burley Griffin</td>
<td>1964</td>
<td>33</td>
</tr>
<tr>
<td>Googong</td>
<td>1978</td>
<td>125</td>
</tr>
<tr>
<td>Lake Ginninderra</td>
<td>1974</td>
<td>3.7</td>
</tr>
<tr>
<td>Lake Tuggeranong</td>
<td>1968</td>
<td>2.6</td>
</tr>
<tr>
<td>Burrinjuck</td>
<td>1907–27 &amp; 1956</td>
<td>1,026</td>
</tr>
</tbody>
</table>

Smaller impoundments in the ACT include Gungahlin Pond, and Yerrabi Pond (Ginninderra Creek). All of these impoundments have been stocked with fish by the ACT Government.

The majority of impoundments have been constructed since the 1960’s, the two exceptions being Burrinjuck (1907) and Cotter reservoirs (1912). The three reservoirs on the Cotter River and Googong Reservoir were all constructed for domestic water supply purposes. Burrinjuck is used primarily to supply irrigation water to the downstream Murrumbidgee Irrigation Area (MIA). Tantangara diverts water into Lake Eucumbene where it is used primarily for hydro-electric power generation. Lake Burley Griffin and the smaller impoundments were constructed primarily for aesthetic and sediment retention purposes to protect downstream waters from the effects of urban development.

The majority of these impoundments have significantly altered the downstream in-stream conditions. Flows have been significantly altered, in their quantity, quality and timing. Most of the dams do not have multiple level offtakes, consequently water releases are generally from the lower levels of impoundments resulting in lower water temperatures and oxygen levels than are desirable. Many native fish species are known to use rising water temperatures and an increase in water level as cues for the initiation of spawning activity. Consequently, the disruption from impoundments to natural flow regimes has resulted in lowered reproductive success in native fish populations.

*Land Use*

Much of the upper catchment of the Murrumbidgee River is forested with substantial areas reserved for nature conservation purposes as Kosciuszko National Park, Namadgi National Park, Tinderry Nature Reserve, Googong Foreshores and Tidbinbilla Nature Reserve. More than 60% of the ACT is protected as nature conservation reserves in one form or another. The full length of the Murrumbidgee
River in the ACT is managed primarily for nature conservation purposes as the Murrumbidgee River Corridor (Environment ACT 1998a).

Pastoral enterprises are common along the Murrumbidgee River from the Cooma area down to Burrianjuck Reservoir with sheep grazing predominating. Some irrigated cropping is carried out on the small floodplains of the Molonglo River near Canberra, and around the confluence of the Numeralla and Murrumbidgee rivers.

The Cotter River originates in the granitic Scabby Range at an altitude of 1760 m and flows north for about 70 km along the Cotter Fault through granite and Ordovician sediments before entering the Murrumbidgee River at an altitude of 460 m. Mean annual discharge for the Cotter River above Corin Reservoir is 46.9 gigalitres (1963–1987) with maximum discharges occurring from August to September and minimum discharge in February/March. The Cotter catchment supplies approximately 85–90% of Canberra’s domestic water supply. Mean annual rainfall at Cotter Hut in the upper catchment is 945 mm (1932–1987) with maximum rainfall occurring from August to October. The waters of the study area are clear, slightly alkaline and of low conductivity.

The primary use of the upper and middle Cotter catchment since 1912 has been supply of domestic water to Canberra. Much of the Cotter catchment is covered with native forest with the ridgetop vegetation consisting mainly of sub-alpine woodland dominated by Snow Gum, *Eucalyptus pauciflora*, Montanae and sub-alpine heaths and grasslands, herb fields, sphagnum bogs, fens and swamps are also found. (Helman et al. 1988; Lintermans & Ingwersen 1996). Some land clearing was undertaken in the upper catchment for early grazing leases in the 1830’s but there has been virtually no stock grazing in the catchment since its acquisition by the Commonwealth government. Approximately 3600 ha of the lower Cotter catchment are covered by pine plantations, with planting commencing in 1926. These forests are managed mainly as production forests. Hardwood logging was carried out in the lower catchment from 1930–38 and 1947–62. (ANU Department of Forestry 1973).

The Paddys River catchment covers 24,600 ha and is drained by the Paddys and Tidbinbilla rivers. The Paddys River originates in the Mt Tennant area at an altitude of approximately 1400 m and flows northwest through predominantly rural land for about 40 km before joining the Cotter River just before its confluence with the Murrumbidgee. The headwaters are forested and contained within Namadgi National Park, but the majority of the land has been cleared for grazing. Approximately 65% of the catchment is forested with the remainder rural lands. Approximately 3000 ha is developed as *Pinus* plantations. Stream flow is seasonal with maximum discharges occurring in spring.

The Naas-Gudgenby catchment covers some 72,000 ha and is drained by the Naas, Gudgenby and Orroral Rivers. Mean annual discharge of the Gudgenby River at Mt Tennant is 72.4 gigalitres (1964–85) and streamflows for all three rivers are seasonal with maximum discharge occurring from August to October. Many of the smaller streams cease to flow during late summer, either drying or forming a series of pools (Jones et al. 1990). The majority of the catchment is mountainous and is covered by a
mosaic of wet and dry sclerophyll forest, montane woodland and savannah woodland (National Capital Development Commission 1984).

The Molonglo River rises at an altitude of approximately 1100 m and flows for about 50 km through predominantly grazing land until it enters the ACT at Burbong. Mean annual discharge is 55 gigalitres with seasonal streamflows peaking between September and November. Aquatic life was almost totally eliminated from the river as a consequence of heavy metal pollution from the Captains Flat mine. Mining for copper, gold, lead and zinc had first commenced at Captains Flat in 1882 but was abandoned at about the turn of the century. Full scale mining recommenced in 1939. Collapse of mine waste dumps at Captains Flat in 1939 and again in 1942 and 1945 resulted in mine waste contamination of the stream and floodplain (Weatherley et al. 1967; Joint Government Technical Committee on Mine Waste Pollution of the Molonglo River 1974). Prior to the collapse of these waste dumps, the river had supported good numbers of cod and perch. Heavy metal contamination of the stream and floodplain persists, even after extensive remediation works (Norris 1986; Dames & Moore 1993).

The Queanbeyan River rises at an altitude of approximately 1300 m in the Tinderry Range southeast of Canberra and flows for some 90 km before entering the ACT just before its confluence with the Molonglo River. The total catchment area of the river is approximately 96 000 ha (Queanbeyan City Council 1998). The river flows through predominantly dry sclerophyll forest in the upper catchment, with grazing becoming more common as the stream approaches Queanbeyan. The mean annual flow of the river is approximately 114 gigalitres. The construction of a number of weirs in the Queanbeyan township in the 1920s and 1930s has restricted upstream fish passage from the Molonglo River. The Queanbeyan River was originally known as the Fish River and supported good numbers of cod and perch (National Trust of Australia 1980). The river was impounded in 1978 by the construction of Googong Reservoir, approximately 5 km upstream of Queanbeyan.

2.2 ACT Government Fish Stocking Program

The majority of impoundments in the ACT and Googong Reservoir have been regularly stocked with a variety of both native and introduced fish species. The aim of the stocking program is to provide a range of recreational fishing opportunities close to the population centres of Canberra, and by providing such opportunities, decrease the fishing pressure on the more fragile riverine environments. Details of the species and number stocked into each impoundment are summarised in Table 2. The rivers in the ACT are not stocked except for conservation reasons, such as the reintroduction of the nationally endangered Trout Cod.

Fish populations in the rivers are considered to be a valuable biological indicator of the health of aquatic environments and to augment these populations artificially by stocking would compromise the value of such an indicator (ACT Government 1997).
Table 2: Species and number of fish stocked into Canberra's lakes between 1981 and 1998.

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Murray Cod</th>
<th>Golden Perch</th>
<th>Silver Perch</th>
<th>Rainbow Trout</th>
<th>Brown Trout</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981–83</td>
<td>LAKE BURLEY GRIFFIN</td>
<td>7000</td>
<td>86 500</td>
<td>27 500</td>
<td>1 000</td>
<td>1 000</td>
</tr>
<tr>
<td></td>
<td>LAKE GINNINGDERA</td>
<td>14 700</td>
<td>38 000</td>
<td>23 000</td>
<td>100 000a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOOGONG RESERVOIR</td>
<td>20 000</td>
<td>36 000</td>
<td>100 000a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1984–86</td>
<td>LAKE BURLEY GRIFFIN</td>
<td>20 000</td>
<td>30 000</td>
<td>3 000</td>
<td>3 000</td>
<td>30 000</td>
</tr>
<tr>
<td></td>
<td>LAKE GINNINGDERA</td>
<td>7 000</td>
<td>30 000</td>
<td>3 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOOGONG RESERVOIR</td>
<td>32 000</td>
<td>50 000</td>
<td>26 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987–89</td>
<td>LAKE BURLEY GRIFFIN</td>
<td>18 180</td>
<td>40 000</td>
<td>75 000</td>
<td>1 000</td>
<td>28 000</td>
</tr>
<tr>
<td></td>
<td>LAKE GINNINGDERA</td>
<td>17 280</td>
<td>100 000a</td>
<td>30 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOOGONG RESERVOIR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>COTTER RESERVOIR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990–92</td>
<td>LAKE BURLEY GRIFFIN</td>
<td>45 670</td>
<td>16 000b</td>
<td>15 000</td>
<td>10 000a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAKE GINNINGDERA</td>
<td>9 000</td>
<td>16 000</td>
<td>15 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAKE TUGGERANONG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOOGONG RESERVOIR</td>
<td>13 330</td>
<td>15 000</td>
<td>10 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993–95</td>
<td>LAKE BURLEY GRIFFIN</td>
<td>29 000c</td>
<td>20 000</td>
<td>15 000c</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAKE GINNINGDERA</td>
<td>11 000</td>
<td>40 000</td>
<td>15 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAKE TUGGERANONG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GUNGAHLIN POND</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOOGONG RESERVOIR</td>
<td>20 000a</td>
<td>63 000a</td>
<td>30 000a</td>
<td>20 000a</td>
<td></td>
</tr>
<tr>
<td>1996–98</td>
<td>LAKE BURLEY GRIFFIN</td>
<td>30 000c</td>
<td>50 000c</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAKE GINNINGDERA</td>
<td>30 000</td>
<td>30 000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAKE TUGGERANONG</td>
<td>15 000</td>
<td>15 000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GUNGAHLIN POND</td>
<td>15 000</td>
<td>15 000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>YERRABY POND</td>
<td>5 000</td>
<td>10 000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOOGONG RESERVOIR</td>
<td>23 000</td>
<td>60 000a</td>
<td>10 000a</td>
<td>30 000a</td>
<td>5 000a</td>
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<tr>
<td>TOTAL</td>
<td></td>
<td>367 160</td>
<td>799 500</td>
<td>336 500</td>
<td>123 000</td>
<td>54 000</td>
</tr>
</tbody>
</table>

a = Stock provided by NSW Fisheries
b = Stocked in conjunction with Tuggeranong Valley Fishing Club
c = Stock provided by National Capital Authority

2.3 Long-term Fish Monitoring in the ACT

There have been a number of long-term fish monitoring programs in the ACT, most of which commenced in the late 1970s. These programs provide useful baseline data against which present and future fish populations can be compared.
The urban lakes monitoring program has documented the relative abundance of angling species in Canberra's urban lakes and Googong Reservoir. This monitoring program is still active with these water bodies monitored regularly, although the sampling frequency has changed over the years. Data is available for Lake Burley Griffin from 1976, Lake Ginninderra from 1978, Googong Reservoir from 1978, Lake Tuggeranong from 1992 and Gungahlin Pond from 1995. This program relies on gill netting as the sampling technique and has documented the spread of Redfin Perch and the decline of trout species in urban lakes.

Fish populations in the Murrumbidgee River have been monitored since 1979 with irregular sampling conducted at a number of sites including Angle Crossing, Tharwa Sandwash, Point Hut Crossing, Pine Island, Kambah Pool, Casuarina Sands and Retallacks Hole (see Figure 2). Originally this monitoring program concentrated on the larger fish species targeted by anglers. However, in 1994 the program was modified to include smaller fish species as well. The decline in numbers of Macquarie Perch in the Murrumbidgee River is clearly evident (Table 3). This program originally relied on gill netting as the major sampling technique but since 1994 employs an array of sampling methods including electrofishing, fyke netting, spotlighting and bait traps as well as gill nets. This monitoring program was last conducted in 1998 with six sites monitored biennially.

Table 3: Captures of Macquarie Perch in gill nets at three sites on the Murrumbidgee River in the ACT (Retallacks Hole, Casuarina Sands, Kambah Pool) between 1979 and 1998.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NUMBER OF NET/NIGHTS</th>
<th>NUMBER of MACQUARIE PERCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1979</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>1980</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>1981</td>
<td>36</td>
<td>19</td>
</tr>
<tr>
<td>1982</td>
<td>32</td>
<td>20</td>
</tr>
<tr>
<td>1984</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>1985</td>
<td>24</td>
<td>–</td>
</tr>
<tr>
<td>1986</td>
<td>20</td>
<td>–</td>
</tr>
<tr>
<td>b1987</td>
<td>15</td>
<td>–</td>
</tr>
<tr>
<td>c1988</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>1994</td>
<td>18</td>
<td>–</td>
</tr>
<tr>
<td>1996</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>1998</td>
<td>18</td>
<td>–</td>
</tr>
</tbody>
</table>

a= Only 1 site sampled (Retallacks Hole)
b= Only 2 sites sampled (Casuarina Sands, Kambah Pool)
c= Only 1 site sampled (Kambah Pool)
Figure 2: Location of long-term fish sampling sites on the Murrumbidgee River in the ACT.
Another monitoring program on the Murrumbidgee River was based at Casuarina Sands where a weir was fitted with a fishway and trap. The trap was operated from 1980 until 1991 when the weir and associated structures were removed. The trap was monitored on a weekly or twice-weekly basis during the spring to autumn period. This provided important information on fish movements and relative abundance at this site, and provides evidence of a general decline in native fish species in the early to mid 1980s. A summary of the information from the fish trap is provided in Table 4. It can be seen that species such as Macquarie Perch and Murray Cod were rarely recorded after 1983, whilst the abundance of Carp and Redfin Perch increased dramatically.

Table 4: Summary of fish captures from a permanent fish trap in the Murrumbidgee River at Casuarina Sands between 1980 and 1991.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Murray Cod</td>
<td>7</td>
<td>23</td>
<td>9</td>
<td>7</td>
<td></td>
<td></td>
<td>5</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Golden Perch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Silver Perch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>252</td>
<td>10</td>
<td>42</td>
<td>4</td>
</tr>
<tr>
<td>Macquarie Perch</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carp</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td>5</td>
<td>61</td>
<td>38</td>
<td>51</td>
</tr>
<tr>
<td>Redfin</td>
<td></td>
<td>31</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td>1931</td>
<td>248</td>
<td>1367</td>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. THE FUTURE FOR FISH SURVEYS AND FISH MONITORING IN THE ACT

Effective management of natural resources requires accurate and timely information on the distribution, abundance and change over time of our biodiversity. Information on distribution and abundance is generally collected by inventory or survey programs and this task has been largely completed for fish species in the ACT. A series of stream surveys between 1986 and 1998 has documented the fish fauna of the major catchments in the ACT (Table 5). The only major catchment yet to be sampled is the Paddys River catchment although the expected fish fauna of this catchment can be confidently predicted from previous surveys of adjacent catchments.

The requirement for information on change over time of fish populations can only be met by rigorous, long-term monitoring programs. The existing fish monitoring programs in the ACT provide information for both recreational and conservation based management at a number of key locations. The management requirement for such information is unlikely to change in the foreseeable future with the ACT Nature Conservation Strategy (ACT Government 1998) emphasising the need to "establish a series of long-term biodiversity sampling sites in key and representative habitat types". The development of an integrated long-term fish monitoring program for the ACT will be an important step in the preparation of an ACT biodiversity monitoring program, which has been identified as a high priority (Environment ACT 1998b). The spread of introduced fish species is also of concern in inland waterways, particularly where there is potential for adverse interactions with threatened species, and a comprehensive fish monitoring program will provide important information on the spread of introduced
species. Whilst general aquatic biodiversity monitoring may provide sufficient information on the spread of certain species, other introduced species (e.g. Oriental Weatherloach) may require a targeted monitoring program. Recovery from disturbance or catastrophic events is another example of a management information requirement which can be met by an integrated monitoring program. The Molonglo River which was contaminated in the 1930s and 1940s by heavy metals from the Captains Flat mines is an example of an aquatic system which needs monitoring. Such monitoring need not be resource intensive or frequent, but needs to be factored into an integrated monitoring program. It is proposed that the existing monitoring of the urban lakes fisheries and the Murrumbidgee River fishery should form part of the long-term fish monitoring program for the ACT, but that the program needs to be expanded and formalised to include monitoring of threatened species, introduced species and recovery monitoring. The essential elements of the existing urban lakes and Murrumbidgee River monitoring programs are outlined in Appendix 1. The potential for the increased use of boat electrofishing in both these programs will be investigated, with a view to decreasing the reliance on gill nets as a sampling technique.

<table>
<thead>
<tr>
<th>Catchment</th>
<th>No. of sites sampled</th>
<th>Year sampled</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naas/Gudgenby/Orroral rivers</td>
<td>22</td>
<td>1986–87</td>
<td>Jones et al. 1990</td>
</tr>
<tr>
<td>Ginninderra Creek</td>
<td>21</td>
<td>1988</td>
<td>Lintermans et al. 1990a</td>
</tr>
<tr>
<td>Upper Cotter River</td>
<td>28</td>
<td>1988–89</td>
<td>Lintermans &amp; Rutzou 1990b</td>
</tr>
<tr>
<td>Middle Cotter River</td>
<td>14</td>
<td>1989–90</td>
<td>Lintermans Unpublished data</td>
</tr>
<tr>
<td>Lower Cotter River</td>
<td>31</td>
<td>1990</td>
<td>Lintermans Unpubl data</td>
</tr>
<tr>
<td>Molonglo River</td>
<td>23</td>
<td>1992–93</td>
<td>Lintermans Unpubl data</td>
</tr>
<tr>
<td>Tidbinbilla River</td>
<td>16</td>
<td>1992</td>
<td>Rutzou et al. 1994</td>
</tr>
<tr>
<td>Lower Cotter/Lower Paddys rivers</td>
<td>16</td>
<td>1992</td>
<td>Lintermans 1993b</td>
</tr>
<tr>
<td>Middle Queanbeyan River</td>
<td>3</td>
<td>1996–97</td>
<td>Lintermans 1999</td>
</tr>
<tr>
<td>Lower Queanbeyan River</td>
<td>3</td>
<td>1998</td>
<td>Lintermans 1998b</td>
</tr>
<tr>
<td>Upper Murrumbidgee catchment</td>
<td>20</td>
<td>1998–99</td>
<td>Lintermans Unpubl data</td>
</tr>
</tbody>
</table>

3.1 Objectives of the Fish Monitoring Program

The objectives of the ACT fish monitoring program are to:

**Urban Lakes**

1. Assess recreational fishing opportunities by monitoring species composition and relative abundance of recreational fish species in urban lakes.

2. Assess the performance of the ACT Government Fish Stocking Plan by monitoring survival, growth and reproductive status of stocked species in urban lakes.
Aquatic Communities

3. Contribute to the ACT biodiversity monitoring program by establishing long term fish monitoring sites which are representative of aquatic communities in the ACT.

Threatening Processes

4. Monitor the spread of introduced fish species.

Threatened Species

5. Assess the progress of threatened fish management in the ACT by monitoring change in the distribution and relative abundance of threatened fish species.

The structure of the proposed fish monitoring program is shown in Table 6 although the monitoring programs for threatened fish species have yet to be finalised. For example, where there are a number of populations of a threatened species in the Canberra region, the monitoring program may be staged over a number of years. An example may be Macquarie perch where the Cotter River populations are monitored one year and the Googong Foreshores population is monitored the following year, with the species on a four-year monitoring cycle as a whole.

3.2 Design of Fish Monitoring Programs

Some animal groups which are highly visible e.g. (birds and some mammals) or highly audible (e.g. frogs and birds) can be relatively easily monitored using simple, non-destructive monitoring techniques based on simple observation. However such techniques are generally not applicable for fish monitoring due to the underwater habitats of this animal group. Consequently nearly all fish monitoring programs rely on a range of capture techniques, some of which can be stressful or injurious to the fish concerned or to non-target animals such as Platypus.

Table 6: Draft long-term fish monitoring program for the ACT.

<table>
<thead>
<tr>
<th>Urban Lakes</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
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* Monitoring frequency yet to be finalised
The potentially adverse effects of capture are a major consideration when working with threatened fish species. Also, capture techniques are usually more expensive than observational techniques as traps, nets etc. have to be set, left for a period of time and then checked and removed, with different gear types often requiring specific seasonal or environmental conditions for their effective use. These ethical and budgetary constraints mean that fish sampling programs are often restricted in their sampling frequency and coverage.

The ACT Government currently has a number of ongoing fish monitoring programs in place, with the major sampling technique being gill nets. Special operating procedures are used where threatened fish species or platypus are likely to be present but occasionally injury or mortality occurs. Recent advances in fish sampling have led to the development of, and increasing reliance on, new techniques such as electrofishing. Whilst electrofishing can still cause some adverse reactions in fish, its use by experienced and trained operators has great potential in fish monitoring programs. Electrofishing is now governed by the Australian Code of Electrofishing Practice (NSW Fisheries 1997) and all fish sampling programs now subject to the ACT Animal Welfare Act 1992, and scrutiny by an animal ethics and experimentation committee. The ACT Government and other fishing authorities are increasingly using electrofishing as a major sampling technique. In a recent study of fish in NSW rivers using a variety of nets traps and electrofishing, electrofishing captured approximately 50% of all individuals and more than 90% of species captured (Faragher & Rogers 1997). However it is not the most effective technique for all situations and fish species and should not be relied upon as the sole technique for fish monitoring. For example, a recent survey for Macquarie Perch in the upper Murrumbidgee catchment resulted in only 3% of the total Macquarie Perch captured being taken by electrofishing, with 7% captured in gill nets and 91% captured in fyke nets (Lintemans unpublished data).

Monitoring programs for individual species must also take account of any special requirements of the species involved. For example, the Two-spined Blackfish lays eggs on the river substrate between November and December, with the male fish guarding the eggs and newly hatched young for 5–6 weeks (Lintemans 1998), so monitoring should not be carried out at this time to avoid disturbing spawning fish and eggs.

The design of a monitoring program will also be influenced by the location and rationale of the monitoring. A monitoring program of stocked fish populations in urban lakes, where there is little chance of capturing platypus, may utilise different techniques and gear to a program to monitor threatened fish species in a platypus-rich river.
3.3 Development of New Fish Monitoring Programs

The Action Plans for the four threatened fish species in the ACT (Macquarie Perch, Trout Cod, Two-spined Blackfish and Murray River Crayfish) all identify the need for species specific monitoring programs. These are in the process of being established and will include consideration of:

- The timing of monitoring (season)
- Suitability of sampling methods
- Frequency of monitoring (annual, biennial, triennial?)
- Number of monitoring sites required
- Inclusion of monitoring sites in adjacent areas of NSW for comparison and regional context purposes

4 RECOMMENDATIONS

1. An integrated, long-term fish monitoring program for the ACT should be developed and implemented. The rationale for the program should include monitoring fish populations for recreational, biodiversity and conservation management information needs.

2. The increased use of electrofishing as a sampling technique should be investigated.

3. Monitoring should not be reliant on a single technique, but a range of sampling methods should be utilised including nets, boat electrofishing and backpack electrofishing as appropriate. Sampling techniques should be capable of sampling a range of fish sizes as well as species.

4. The monitoring program should encourage a regional perspective of ACT fish resources, and should consider inclusion of monitoring sites in adjacent areas of NSW.

5. The existing urban lakes and Murrumbidgee River fishery monitoring programs should form part of the integrated long-term fish monitoring program.

6. The results of fish monitoring should be made available to both resource managers and the community on a regular basis. Short, written summary reports would be an appropriate method of communicating these results.
5. **SPECIES ACCOUNTS**

Presented below is a summary of:
- the basic ecology of each fish species present in the Canberra region
- the known distribution of each fish species in the Canberra region and any evidence of change
- the conservation status and threats to each fish species
- the monitoring and management requirements for each species
- A bibliography of both general and local references for each fish species

5.1 **Native species**

There are 11 species of native fish from 8 families which have been recorded from the Canberra region. Some of these fish are not considered native to the region but have been translocated from adjacent areas or are rare vagrants. Also present in the region are five species of freshwater crayfish although only one (Murray River Crayfish) is considered further in this report. There are four fish or crayfish species which are considered threatened nationally, with a further species (Two-spined Blackfish) considered locally threatened (Table 7). Two native fish species (Murray Cod and Golden Perch) form the basis of important recreational fisheries.

**Table 7:** Conservation status of threatened fish in the Canberra region. Conservation listings used include:

- the Australian Society for Fish Biology (ASFB) Threatened Species list;
- the Action Plan for Australian Freshwater Fishes by Wager & Jackson (1993);
- the IUCN (1998) red list of threatened animals;
- the ANZECC (1999) list of threatened fauna;
- the reviews of the conservation status of invertebrates by Horwitz (1990a, 1995); and
- the list of ACT threatened species and communities.

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<th>Trout Cod</th>
<th>Macquarie Perch</th>
<th>Two-spined Blackfish</th>
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The known distribution of both native and exotic species is summarised below (Table 8).

Table 8: Known distribution of fish species in the Canberra region.

| River/Location                     | Murray Cod | Perch | Mullet | Bream | Silver perch | Murray Cod Garnet | Freshwater Catfish | Murray Cod Gravello | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon | Murray Cod Gudgeon |
|------------------------------------|------------|-------|--------|-------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Waters within the ACT              |            |       |        |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Murrumbidgee River                 | x          | x     |        |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Above Ginninderry Gorge            |            |       |        |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Gillan’s Gorge to Camp Start       | x          | x     | x      | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Camp Start to Burrenhead            | x          | x     | h      | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Molonglo River                     | s*         | h     | h      | s     | h            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Above Molonglo Gorge               |            |       |        |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Below LGD                          | x          | h     | x      |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Queanbeyan River                   | Below Grooping wall | x | x     | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Cotter River                       | Above Cotter Dam | s | s     |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Corin to Bendaara Dam              | x          |       | x      |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Bendaara to Cotter Dam             | x          | s     | h     | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Below Cotter dam                   | x          | x     | x      | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Tuggeranong River                  | x          | h     | x      | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Ginninderra Creek                  | e          | s     | h     | a     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |

| Waters outside the ACT             |            |       |        |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Murrumbidgee River (above Angle Crossing) | s          | h     | x      | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Queanbeyan River (above Grooping wall) | s          | s     | s     | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Queanbeyan River (above Tiderry Crossing) | x          |       |       |       |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Goodrington River                  | x          | x     | s     | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Bredbo River                       | x          |       | x     | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Numeralla River                    | x          |       |       | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Kybean River                       | x          |       |       | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Yass River                         | x          | x     | s     | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |
| Reeds River                        | x          |       |       | x     | x            |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |

Key: * = stocked by NSW Fisheries
s = stocked by ACT Government
x = confirmed occurrence
t = translocated individuals
h = historic record (pre ~1980)
5.1.1 *Family Percichthyidae: Australian Freshwater Cods and Basses*

The Percichthyidae contains a total of seven described species and one subspecies in two genera in Australian freshwaters, of which four taxa are recognised as nationally threatened. There are four species found in the ACT and surrounding area, Murray Cod, Trout Cod, Golden Perch and Macquarie Perch.

**Common Name:** Murray Cod

**Scientific Name:** *Maccullochella peelii peelii* (Mitchell 1838)

**Other common names:** Cod, Codfish, Goodoo

**Other scientific names:** *Maccullochella peelii, Maccullochella macquariensis*

**Biology and Habitat:**
The largest Australian freshwater fish (reaching 1800 mm length and 113.5 kg), this species is the basis of a popular recreational fishery in southeastern Australia. Murray Cod are generally associated with deep holes in rivers and prefers habitats with instream cover such as rocks, stumps, fallen trees or undercut banks. A "sit and wait" predator, its diet contains fish, crayfish and frogs. The species matures at 4–5 years of age and spawns in spring and early summer when water temperatures exceed about 20 °C. Eggs are large (3–3.5 mm diameter), adhesive and usually deposited onto a hard surface such as logs, rocks or clay banks. The male guards the eggs during incubation with the eggs hatching after 5–7 days. The larvae are about 5–8 mm long upon hatching and have a large yolk sac.

**Distribution, abundance and evidence of change:**
Formerly widespread in the Murrumbidgee, Molonglo and lower Queanbeyan rivers. Murray Cod were eliminated from the Molonglo River by heavy metal contamination from the Captains Flat mines. Anecdotal evidence from anglers indicates that Murray Cod abundance has declined in rivers of the ACT. Records from the Casuarina Sands fish trap (1980–1991) show that Murray Cod were not recorded after 1983, indicating that numbers had declined. Information on the abundance of Murray Cod in local waterways is scanty because of the inadequacy of standard netting techniques in capturing this species. The species is rarely captured in gill nets, the major technique used in fisheries monitoring in the ACT since the late 1970s. Angling is more efficient at sampling this predatory species but no standardised catch-for-effort data is available for the local region. Murray Cod have been recorded from the Murrumbidgee River as far upstream as Tharwa.

**Conservation Status:**

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Fishing Pressure Directed at this Species:
Heavy: targeted by anglers particularly in the urban lakes, Googong and the Murrumbidgee River.

Stocking locations:
- Lake Burley Griffin (1979–1998);
- Lake Tuggeranong (1998);
- Lake Ginninderra (1979–2000);
- Gungahlin Pond (1997);
- Googong Reservoir (1983–1998);
- Lake Burrinjuck (NSW Fisheries);
- Lake George (NSW Fisheries);
- Captains Flat Reservoir (NSW Fisheries).

Potential Threats:
- overfishing, particularly in the breeding season when fish are aggressive and easily caught;
- habitat destruction through sedimentation; and
- this species has been greatly affected in the lower reach of the Murray Darling system by river regulation and removal of snags (large woody debris).

Requirements for Survey and Monitoring:
- continue routine monitoring of stocked populations in urban lakes and Googong; and
- continue biennial fisheries monitoring of the Murrumbidgee River.

Specific Management Actions Required:
- introduction of a closed season during breeding period (September -- November);
- introduction of bag and size limits;
- continue stocking program for urban lakes and Googong to divert fishing pressure from riverine populations; and
- investigate development of a standardised angler-based monitoring system for local waters.

ACT Conservation Reserves where the species has been recorded:
- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Googong Foreshores; and
- Lower Molonglo Nature Reserve.

General References:
Lake 1967a,b,c; Harris & Rowland 1996; Berra & Weatherley 1972; Rowland 1983, 1989; Merrick & Schmida 1984; Anderson et al. 1992a; Koehn & O’Connor 1990a; Koehn & Nicol 1998

Local References:
National Trust of Australia 1980; Greenham 1981; Burchmore et al. 1988; Kukolic & Rutzou 1989
Common Name: Trout Cod

Scientific Name: *Maccullochella macquariensis* (Cuvier & Valenciennes 1829)

Other common names: Blue Nose Cod

Other scientific names: *Maccullochella mitchelli*

**Biology and Habitat:**
Only formally recognised as a separate species from Murray Cod in 1972, the biology of Trout Cod is poorly known. The maximum recorded size is 850 mm and 16 kg but most are less than 5 kg. The species is usually associated with deeper water (pools) and instream cover such as logs and boulders. Sexual maturity is reached at 3–5 years of age with spawning occurring in spring. Eggs are large (2.5–3.6 mm diameter), adhesive, and probably deposited on hard substrates such as logs and rocks. Hatching occurs after 5–10 days with larvae about 6–9 mm long on hatching. Diet includes fish, crustaceans and aquatic insect larvae. In Bendorra Reservoir the diet includes Two-spined Blackfish, yabbies, mudeyes and freshwater prawns (*Macrobrachium* sp.).

**Distribution, abundance and evidence of change:**
There are now only two self-sustaining populations of Trout Cod remaining in the wild. The largest is in the Murray River between Yarrawonga and Tocumwal, with a small translocated population present in the upper reaches of Sevens Creek near Euroa in Victoria. Formerly widespread in the Murrumbidgee River in the Canberra region, the last records from the ACT were in the mid 1970s from the Gigerline Gorge near Tharwa. In an early study of this species, Berra (1974) concluded that “the population of trout cod in the Murrumbidgee River is probably so diffuse as to be unreliable as a source of survival”. He was right.

The species has been reintroduced at two sites in the ACT in recent years. These fish were artificially bred by NSW Fisheries with a total of 8750 stocked into Bendorra Reservoir in 1989 and 1990 and 30,000 stocked into the Murrumbidgee River at Angle Crossing between 1996 and 1999. Trout cod have also been stocked in adjacent waters of NSW at two sites near Cooma and a site near Adaminaby, all on the Murrumbidgee River.

**Conservation Status:**

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<td>Critically Endangered (NRE 1999)</td>
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</table>
Fishing Pressure Directed at this Species:

Stocking locations:

- Bendora Reservoir (1989–1990);

Potential Threats:
- interactions with introduced species such as trout and Redfin; and
- habitat modification such as desnagging, sedimentation, clearing of riparian vegetation.

Requirements for Survey and Monitoring:
- continue regular monitoring of stocked populations to detect if natural recruitment occurs; and
- continue regular monitoring of Murrumbidgee fishery to examine dispersal away from stocking sites.

Specific Management Actions Required:
- retain the status of Trout Cod as a species with Special Protection Status under the Nature Conservation ACT 1980;
- maintain the closure to fishing under the Fishing ACT 1967 in the Cotter River above Bendora Dam;
- continue education program to enable anglers to distinguish Trout Cod from Murray Cod and release accidentally caught individuals;
- declare a total closure to fishing of the Murrumbidgee River from Angle Crossing to the Gundgenby River confluence to protect stocked population;
- continue liaison with Victorian and NSW fisheries agencies to ensure that there is exchange of relevant information on the species; and
- prevent upstream fish colonisation of the Cotter River by introduced species such as Carp and Redfin Perch by maintaining the integrity of Cotter Dam.

ACT Conservation Reserves where the species has been recorded:

- Namadgi National Park
- Gigerline Nature Reserve

General References:

Local References:
Common Name: Macquarie Perch (Murray-Darling Form)

Scientific Name: *Macquaria australasica* (Cuvier & Valenciennes 1830)

Other common names: Mountain Perch, Bream, Black Bream, White-eye, Silvereye,

Other scientific names: None

Biology and Habitat:
It is now considered that there are at least two species contained within Macquarie Perch, one of which occurs in the western rivers (the Murray Darling form) and one in the eastern or coastal rivers (the coastal form). This report deals only with the Murray Darling form as this is the species which is found in the Canberra region. This moderately sized fish (maximum length 460 mm, maximum weight 3.5 kg) is typically found in the cooler, upper reaches of the Lachlan, Murrumbidgee and Murray catchments. Males reach sexual maturity at 2 years of age and approximately 210 mm total length, and females at 3 years of age and 300 mm total length. Spawning occurs in October/November with the spawning site at the foot of pools with the eggs drifting downstream and lodging amongst gravel and cobble in riffles. Hatching usually occurs after 10–11 days at water temperatures of 15–17 °C with the larvae being about 7 mm long upon hatching. A quiet and docile species, Macquarie Perch generally feed on shrimps and small benthic aquatic insect larvae, particularly mayflies, caddisflies and midges.

Distribution, abundance and evidence of change:
Macquarie Perch are typically found in the cooler, upper reaches of the Murray-Darling river system in Victoria, New South Wales and the Australian Capital Territory. 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 Vanietys 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 Vanietys Crossing in the late 1970s. 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 Bendoro Reservoir but this translocation attempt appears to have failed.

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.

The species has been recorded from along the entire length of the Murrumbidgee River in the ACT but the species has declined noticeably in abundance since the mid 1980s (see earlier section on Long-term fish monitoring).

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 still 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 Burraga 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; and
- A population in the Murrumbidgee River near Cooma.

A recently completed survey of the upper Murrumbidgee catchment has failed to locate this species in the Yass, Bredbo, Numeralla, Kybean, and Big Badja rivers. The species was recorded in extremely low numbers in the Goodradigbee River with reasonable numbers captured in the Murrumbidgee River from Cooma to Yaouk. There is also a small population in the Murrumbidgee near Michelago. Upstream of Yaouk the Murrumbidgee River is degraded by sedimentation and diversion of flows by Tantangara Reservoir, and Macquarie Perch were absent. The total length of the Queanbeyan River in which Macquarie Perch are found is estimated to be approximately 16 km, with a substantial waterfall preventing further spread upstream. No Macquarie Perch are found below Googong Reservoir.

### Conservation Status:

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<td>Endangered</td>
<td>Vulnerable (angling prohibited)</td>
<td>Endangered (NRE 1999) (Angling permitted)</td>
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<td>IUCN Endangered</td>
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<td>ANZECC Endangered</td>
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**Fishing Pressure Directed at this Species:**
A moderately sought after species because of its good eating qualities, is now protected in New South Wales and the ACT.

**Stocking locations:**
Nil, but has been translocated past a natural barrier in the Queanbeyan River.
Potential Threats:
- interactions with introduced species such as trout and Redfin, exposure to EHNV;
- habitat modification such as sedimentation, clearing of riparian vegetation, construction of dams and weirs which act as barriers to migration and recolonisation, cold water discharges from dams which prevent successful breeding; and
- recreational fishing of small, remnant populations although illegal, may still be a threat.

Requirements for Survey and Monitoring:
- continue regular monitoring of remnant populations in the Queanbeyan and Cotter rivers and adjacent NSW populations (Goodradigbee and upper Murrumbidgee rivers);
- continue regular monitoring of the Murrumbidgee River fishery in the ACT; and
- determine the status of the species in the Paddys River catchment.

Specific Management Actions Required:
- prevent upstream fish colonisation of the Cotter River by introduced species such as Carp and Redfin Perch by maintaining the integrity of Cotter Dam;
- minimise the risk of introducing fish by maintaining the Cotter River below Bendoora dam as a declared "trout water" for artificial fly or lure fishing only (under the ACT Fishing Act 1967);
- protection from recreational fishing should continue;
- continue education program to enable anglers to distinguish Macquarie Perch from other perch species and release accidentally caught individuals;
- total closure to fishing of the Murrumbidgee River from Angle Crossing to the Gudgenby River will allow recolonisation from remnant upstream population;
- 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;
- maintain the existing ban on recreational angling in Cotter Reservoir;
- investigate the feasibility of translocating *M. australasica* past the barrier on the Cotter River posed by Vantisys Crossing; and
- continue liaison with Victorian and NSW fisheries agencies to ensure that there is exchange of relevant information on the species.

ACT Conservation Reserves where the species has been recorded:

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<tr>
<th>Gigerline Nature Reserve;</th>
<th>Stony Creek Nature Reserve;</th>
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<tr>
<td>Woodstock Nature Reserve;</td>
<td>Googong Foreshores;</td>
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<tr>
<td>Bullen Rango Nature Reserve;</td>
<td>Lower Molonglo Nature Reserve.</td>
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General References:
Dulty 1986; Gooley 1986, Cadwallader & Rogan 1977; Cadwallader 1981; Cadwallader & Eden 1979; McKeown 1934; Butcher 1945; Wager & Jackson 1993; Merrick & Schmida 1984; Koehn & O'Connor 1990a; Langdon 1999b.

Local References:
Common Name: Golden Perch

Scientific Name: *Macquaria ambiguca* (Richardson 1845)

Other common names: Yellowbelly, Callop, Perch, Murray Perch, White Perch,

Other scientific names: *Plectrolltes ambiguus*

Biology and Habitat:
This species is widespread throughout the Murray Darling Basin, with a genetically distinct but closely related species recently identified from the Lake Eyre and Bulloo drainages in central Australia. A moderate to large fish (maximum length 760 mm and maximum weight 23 kg) which is predominantly found in the lowland, warmer, turbid, slow-flowing rivers. Golden Perch are reproductively mature at 3–4 years and spawn in floods during spring and summer when water temperature exceeds about 23 °C. Adults and juveniles are migratory with extensive upstream movements of thousand of kilometres recorded. Upstream movements are stimulated by rises in streamflow. Eggs are semi-buoyant and hatching occurs in 1–2 days with newly-hatched larvae about 3.5 mm long. Breeding has been recorded in Googong Reservoir and Lake Burley Griffin, but does not occur often as suitable spawning conditions are largely absent. The diet of adult fish consists mainly of shrimps, yabbies, small fish and benthic aquatic insect larvae.

Distribution, abundance and evidence of change:
In the Canberra region the species would formerly have been widespread in the Murrumbidgee, Molonglo and lower Queanbeyan rivers. The species was probably eliminated from the Molonglo River by the collapse of mine dumps at Captains Flat, and effectively disappeared from the upper Murrumbidgee catchment above Lake Burrimjuck. Development of methods for artificial breeding and the commencement of stocking by NSW Fisheries of Lake Burrimjuck in the early 1970s saw the return of the species to the catchment. In the upper Murrumbidgee catchment the species appears to have its upstream limit at an altitude of approximately 570 m near Tharwa. The species is not present in the Cotter River above Cotter Reservoir or the Queanbeyan River above Googong. The species has not been recorded in the Naas/Gudgenby catchment or Tidbinbilla River (apart from individuals stocked in a farm dam).

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Fishing Pressure Directed at this Species:
There is substantial fishing pressure for Golden Perch in the urban lakes and Murrumbidgee River. Along with Murray Cod, is probably the most sought after native species.
Stocking locations:
Widely stocked in reservoirs and lakes of the Canberra region:

- Lake Burley Griffin (1973–1999);
- Lake Ginninderra (1977–1998);
- Lake Tuggeranong (1991–1998);
- Gungahlin Pond (1995–1999);
- Yerrabi Pond (1998);
- Lake Burrinjuck (NSW Fisheries);
- Lake George (NSW Fisheries);
- Captains Flat Reservoir (NSW Fisheries);
- Googong Reservoir (1981–1999);

Potential Threats:
River regulation has disrupted migrations and spawning behaviour.

Requirements for Survey and Monitoring:
- continue regular monitoring of the Murrumbidgee River fishery; and
- continue regular monitoring of stocked populations in the urban lakes and Googong Reservoir.

Specific Management Actions Required:
- continue to stock urban lakes to divert fishing pressure away from the more fragile riverine habitats; and
- review the ACT Fishing Act to introduce size and bag limits for the species.

ACT Conservation Reserves where the species has been recorded:

- Googong Foreshores;
- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Gigerline Nature Reserve; and
- Lower Molonglo Nature Reserve.

General References:
Lake 1967a,b,c; Harris & Rowland 1996; Merrick & Schmida 1984; Anderson et al. 1992b; Koehn & O'Connor 1990a; Mallen-Coooper et al. 1995.

Local References:
5.1.2 Family Terapontidae: Freshwater Grunters or Perches

The Terapontidae contains a total of about 22 species in eight genera in Australian freshwaters, of which one species is recognised as nationally threatened. Many terapontids occur in northern Australian streams. There is one species found in the ACT and surrounding area, the Silver Perch.

**Common Name:** Silver Perch

**Scientific Name:** *Bidyanus bidyanus* (Mitchell 1838)

**Other common names:** Bidyan, Black Bream, Silver Bream,

**Other scientific names:** *Terapon bidyanus*

**Biology and Habitat:**
A moderate to large fish (maximum length ~500 mm and maximum weight 8 kg) found in similar habitats to Murray Cod and Golden Perch, i.e. lowland, turbid, slow-flowing rivers. This species is bred artificially in a number of government and commercial hatcheries and is widely stocked in farm dams and reservoirs. The species is currently the subject of considerable interest as its potential as an aquaculture species (Klibria et al. 1998). Fish mature at 3–5 years and spawn in spring and summer after an upstream migration. Silver perch school in large numbers during the upstream migration. Their diet is omnivorous containing aquatic plants, snails, shrimps and aquatic insect larvae. Reports that the species becomes mainly herbivorous once they reach lengths of 250 mm are incorrect, at least for lake populations as their diet in Googong Reservoir shows little change with fish size (Linternmans unpublished data).

**Distribution, abundance and evidence of change:**
Formerly widespread over much of the Murray Darling Basin (excluding the cooler upper reaches), the species has declined over most of its range. Numbers of Silver Perch moving through a fishway at Euston Weir on the Murray River have declined by 93% between 1940 and 1990 (Mallen-Cooper 1993). The ACT probably represented the upstream limit of the species distribution in the Murrumbidgee catchment. In the Canberra region the species has been recorded from the Murrumbidgee River where numbers recorded in the fish trap at Casuarina Sands between 1980 and 1991 declined noticeably from the mid 1980s. Formerly a “run” of Silver Perch from Lake Burragorang migrated upstream to the lower reaches of the Murrumbidgee River in the ACT in spring/summer, but this migration has not been recorded since the late 1970s/early 1980s. Silver Perch have not been recorded further upstream than Kambah Pool in the ACT. Greenham (1981) reported anecdotal angler records of Silver Perch from the Molonglo River in the 1940s and 1950s but no contemporary records are known from this river (other than stocked fish). There is no record of Silver Perch from the Paddys, Naas, or Gudgenby rivers. There are occasional angler records of Silver Perch from the Queanbeyan River below Googong Reservoir but these fish are assumed to be of stocked fish displaced.
downstream from the reservoir.

**Conservation Status:**

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<td>Vulnerable (angling prohibited in rivers)</td>
<td>Critically Endangered (NRE 1999)</td>
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**Fishing Pressure directed at this Species:**
Formerly moderate, except for the annual migration up the Murrumbidgee from Lake Burragorang when fishing could be intense.

**Stocking locations:**

- Lake Burley Griffin (1974–1983);
- Lake Ginninderra (1976–1982);
- Googong Reservoir (1983–1997);
- Cotter Reservoir (1987);
- Lake Burragorang (NSW Fisheries);
- Lake George (NSW Fisheries);
- Captains Flat Reservoir (NSW Fisheries).

**Potential Threats:**

- river regulation has severely impacted this species through disruption of migration and reproductive behaviour; and
- interactions with introduced species (possibly Carp) are also suspected to be a threat.

**Requirements for Survey and Monitoring:**

- continue biennial monitoring of Murrumbidgee River to detect local population recovery; and
- continue regular monitoring of stocked population in Googong Reservoir.

**Specific Management Actions Required:**

- consider nomination as a threatened species in the ACT; and
- review recreational angling regulations for riverine populations.

**ACT Conservation Reserves where the species has been recorded:**

- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve; and
- Googong Foreshores.

**General References:**

**Local References:**
5.1.3 Family Gadopsidae: Freshwater Blackfish

The Gadopsidae contains two described species in a single genus in Australian freshwaters, of which one species is recognised as locally threatened. There is thought to be an undescribed species complex consisting of two species within *Gadopsis marmoratus*. Gadopsids are restricted to southeastern Australia. There is one species found in the ACT and surrounding area, the Two-spined Blackfish.

**Common Name:** Two-spined Blackfish

**Scientific Name:** *Gadopsis bispinosus* (Sanger 1984)

**Other common names:** Slippery, Slimy, Greasy, Tailor, Marbled Cod, Nikki, Nikki Long Tom

**Other scientific names:** None (previously included in *Gadopsis marmoratus*)

**Biology and Habitat:**
*G. bispinosus* occurs only 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. *G. bispinosus* is found more 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 and is generally found in forested catchments, where there is little sediment input to the stream from erosion or other land management practices.

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 that intact riparian vegetation communities and their associated insect fauna which falls onto the water are important sources of food. Young-of-year and juvenile blackfish eat proportionally more mayfly and midge larvae than adult fish who 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.

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 in a single egg mass. Whilst the natural spawning site is unknown, it is suspected it is on the underside of boulders or cobbles. *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. The eggs
are large (~3.5 mm diameter), yolky and adhesive and are guarded by the male fish until the larvae have almost fully utilised 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 utilised. The larvae have almost fully utilised the yolk after approximately three weeks and then leave the spawning site, with the male guard fish also leaving.

**Distribution, abundance and evidence of change:**
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 the River Blackfish *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 Kosciusko National Park in 1975, and the other from the Murrumbidgee River (ACT) in 1982. Recent surveys in the Canberra region have recorded Two-spined Blackfish from the Goodradigbee, Goobarragandra and Cotter rivers, and Jounama and Mountain creeks. A small population has been recently located in the upper Murrumbidgee River above Yaouk. In the ACT the species is now only present in the Cotter River, although they were formerly present in the Murrumbidgee and Paddys rivers, and are suspected of being historically present in the Naas/Gudgenby system.

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**Fishing Pressure Directed at this Species:**
Slight

**Stocking locations:**
NIL

**Potential Threats:**
- habitat destruction through sedimentation which smother eggs and spawning sites; and
- interactions with trout, particularly predation and competition for food.

**Requirements for Survey and Monitoring:**
- continue biennial monitoring of Murrumbidgee River fishery to detect recolonisation (if any);
- commence monitoring of Cotter River and adjacent NSW populations (Goobarragandra & Goodradigbee rivers) to detect any changes in abundance; and
- complete the survey of the upper Murrumbidgee River catchment to locate potential populations of *G. bispinosus* outside the ACT.
Specific Management Actions Required

- prevent upstream fish colonisation of the Cotter River by introduced species such as Carp and Redfin Perch by maintaining the integrity of Cotter Dam;
- minimise the risk of introducing fish by 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);
- maintain the existing ban on recreational angling in Cotter Reservoir;
- continue education program to enable anglers to distinguish Two-spined Blackfish from other fish species and release accidentally caught individuals; and
- 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 Conservation Reserves where the species has been recorded:

| Stony Creek Nature Reserve | Namadgi National Park |

General References:


Local References:

Macleay 1885; Lintermans & Rutzou 1990a,b; Lintermans 1998c,d; Waters et al. 1994; Keilish et al. 1998; ACT Government 1999a
5.1.4 *Family Retropinnidae: Southern Smelts*

The Retropinnidae contains two described species in a single genus in Australian freshwaters, none of which are considered threatened. Retropinnids are restricted to southeastern Australia with one species on the mainland and one in Tasmania. There is one species found in the ACT and surrounding area, the Australian Smelt.

**Common Name:**
Australian Smelt

**Scientific Name:**
*Retropinna semoni* (1895)

**Other common names:**
Smelt

**Other scientific names:**
*Retropinna victoriae*

**Biology and Habitat:**
A small species (average length 35–50 mm) which is often recorded from slow moving or still water where it can be found in large schools. Upstream migrations of juvenile smelt have been recorded during daylight hours at Torrumberry fishway on the Murray River. Both sexes mature towards the end of their first year and may live for two or more years. Spawning occurs when water temperatures reach about 15 °C with the eggs being about 1 mm diameter, demersal and adhesive. Hatching occurs in about 10 days with the larvae being less than 5 mm long. Diet contains a variety of small aquatic insects and crustaceans.

**Distribution, abundance and evidence of change:**
One of the most widespread species in southeastern Australia, very few records are known from the Canberra region. This is probably due to the lack of suitable sampling techniques as the species has been recorded at a number of sites on the Murrumbidgee and Molonglo rivers in recent years. All recent records have come from mid-water habitats and have been caught by spotlighting. The species has not been recorded upstream of Kambah Pool despite extensive sampling in recent years. The lack of historical records in the local area makes detection of declines difficult but there is no evidence to suggest the species is threatened within its range.

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**Fishing Pressure Directed at this Species:**
NIL
Stocking locations:
NIL

Potential Threats:
None known.

Requirements for Survey and Monitoring:
Continue regular monitoring of Murrumbidgee River fishery.

Specific Management Actions Required:
None

ACT Conservation Reserves where the species has been recorded:

| Woodstock Nature Reserve; | Bullen Range Nature Reserve; |
| Stoney Creek Nature Reserve; | Lower Molonglo Nature Reserve. |

General References:

Local References:
Lintemans 1995b, 1997a, 1998a
5.1.5 Family Anguillidae: Freshwater Eels

The Anguillidae consists four described species in a single genus in Australian freshwaters, none of which are considered threatened. Two species occur to southeastern Australia, one in north-western Australia and one in north Queensland. There is one species found in the ACT and surrounding area, the Shortfinned Eel.

**Common Name:** Shortfinned Eel

**Scientific Name:** *Anguilla australis* (Richardson 1841)

**Other common names:** Silver Eel

**Other scientific names:** None

**Biology and Habitat:**
A large (maximum length 1100 mm, maximum weight 3.2 kg), elongate fish of the coastal streams of south-eastern Australia, this species occurs in a variety of habitats from rivers to lakes. This species migrates to sea to spawn, possibly near the Coral Sea, with the larval eels then washed down the east Australian coast by sea currents. The larval eels then metamorphose and attain the typical eel shape before entering fresh water and migrating upstream to the upper reaches of rivers. Eels may remain in fresh waters for 20 years before migrating to the sea to breed and die. Their diet includes a variety of fish, crustaceans, molluscs and insects, with the species being a nocturnal predator.

**Distribution, abundance and evidence of change:**
Primarily a fish of coastal streams, there are occasional records from inland streams with at least three records from the ACT including the Murrumbidgee River, the Australian National Botanic Gardens, and Lake Burley Griffin. Most local records are assumed to be of fish translocated from the coastal streams by anglers. However there is a suggestion that eels may have passed from Lake Eucumbene to Tantangara Reservoir via the Snowy Mountains Scheme and then escaped into the Murrumbidgee River. Should be considered a rare vagrant in the ACT.

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**Fishing Pressure Directed at this Species:**
Moderately sought after, particularly by Europeans and Asians.
Stocking locations:
NIL (but has been illegally translocated into a number of ornamental ponds).

Potential Threats:
None known.

Requirements for Survey and Monitoring:
No special requirements.

Specific Management Actions Required
Educate anglers of the environmental hazards of translocating fish species.

ACT Conservation Reserves where the species has been recorded:
Woodstock Nature Reserve.

General References:
Beumer 1979, 1996; Merrick & Schmida 1984; Koehn & O'Connor 1990a

Local References:
Lintermans & Rutzou 1990c
5.1.6 *Family Galaxiidae: Galaxiids*

The Galaxiidae is one of the most diverse of the Australian freshwater families, containing a total of about 20 described species in three genera in Australian freshwaters. Seven species are considered nationally threatened, most of which occur in Tasmania. Galaxiids are mostly restricted to southeastern Australia with 17 of the 20 species occurring here. The remaining species are restricted to the southwest of Western Australia. There is one species found in the ACT and surrounding area, the Mountain Galaxias.

**Common Name:** Mountain Galaxias

**Scientific Name:** *Galaxias olidus* (Günther 1866)

**Other common names:** Ornate Mountain Galaxias, Mountain Trout, Mountain Minnow

**Other scientific names:** Has been redescribed many times as *Galaxias schomburgki*, *G. ornatus*, *G. bongbong*, *G. findlayi*, *G. kayi*, *G. oconnori*, *G. fuscus*. Some consider *G. fuscus* to be a separate species (the Brown Galaxias) but it has not formally been separated from *G. olidus*.

**Biology and Habitat:**
A small, (maximum size 140 mm, average size 70–80 mm) stocky fish found in a variety of habitats from small creeks to large rivers. Normally observed in schools in slower flowing or pool habitats, but may be restricted to very shallow habitats where trout are abundant. Not restricted to high altitudes (as its name might suggest), this species is found at all altitudes in the Canberra region. Fish mature at the end of their first year or in their second year. Spawning occurs mainly in spring and early summer although a small proportion of fish may spawn in autumn. Between 50 and 400 eggs are laid on the underside of stones at the head of pools and in riffles. Eggs are approximately 2.5 mm in diameter and hatch in about 3 weeks, with larvae about 10 mm long upon hatching. The diet consists mainly of aquatic insect larvae but also terrestrial insects which fall onto the water from overhanging vegetation.

**Distribution, abundance and evidence of change:**
Widely distributed throughout south-eastern Australia from southern Queensland through to South Australia. In the Canberra region galaxiids are found in all the major streams including Murrumbidgee, Paddys, Molonglo, Cotter, Naas, Gudgenby and Queanbeyan rivers and Ginninderra and Tuggeranong creeks. Where trout are present their abundance is greatly reduced in lowland streams and they are eliminated from upland streams in the Cotter catchment. In such situations galaxiids are only found above waterfalls or swamps which prevent trout access. An experiment to remove Rainbow Trout from a section of Lees Creek has resulted in the recolonisation by galaxiids of the trout free section of stream. Where trout are still present, galaxiids are absent (Lintemans 2000b). There is some preliminary evidence that the Oriental Weatherloach *Misgurnus anguillicaudatus* may adversely
impact galaxiids in urban streams, but there are so many pressures on urban streams that separating out the effects of weatherloach is difficult.

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**Fishing Pressure directed at this Species:**

Nil

**Stocking locations:**

Nil

**Potential Threats:**

Continued spread of introduced species, particularly trout and possibly Oriental Weatherloach.

**Requirements for Survey and Monitoring:**

- continue regular monitoring of Murrumbidgee River fishery; and
- investigate status in lowland streams to clarify interactions with Oriental Weatherloach.

**Specific Management Actions Required:**

- maintain existing barriers to trout access in selected streams; and
- maintain policy of not stocking trout into streams in the ACT.

**ACT Conservation Reserves where the species has been recorded:**

- Namadgi National Park;
- Lower Molonglo Nature Reserve;
- Woodstock Nature Reserve;
- Stoney Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Gigerline Nature Reserve;
- Googong Foreshores;
- Molonglo Gorge Nature Reserve;
- Tidbinbilla Nature Reserve;
- Canberra Nature Park.

**General References:**

Frankenberg 1966, 1974; Cadwallader et al. 1980; Fletcher 1979; Koehn & O'Connor 1990a;

**Local References:**

5.1.7 Family Plotosidae: Eel-tailed Catfishes

The Plotosidae contains a total of about 12 described species in four genera in Australian freshwaters, however it is generally accepted that there are a number of undescribed species. One of the described species is considered nationally threatened (Neosilurus gloveri Dalhousie Catfish) and there is currently concern about the decline in riverine populations of the Freshwater Catfish Tandanus tandanus. Plotosids are common in northern Australia with the majority of species occurring there. There is one species found in the ACT and surrounding area, the Freshwater Catfish.

Common Name: Freshwater Catfish

Scientific Name: Tandanus tandanus (Mitchell 1838)

Other common names: Tandan, Dewfish, Jewfish, Eeltail Catfish, Kenaru

Other scientific names: None

Biology and Habitat:
A moderately sized species (maximum length 900 mm and maximum size 7 kg) the preferred habitat of which is slow flowing streams and lakes. Fish are sexually mature at 3–5 years of age and spawn in spring and summer when water temperatures are between 20 and 24 °C. The species build a circular to oval nest between 0.6 and 2.0 m diameter with the nest constructed from pebbles and gravel. The eggs are non-adhesive and take up to 7 days to hatch with the male parent fish remaining with the nest to fan, clean and guard the eggs. Larvae are about 7 mm long upon hatching. This species shows very limited movement compared to cod and perch species, with most individuals moving less than 5 km. The diet consists mainly of shrimps, freshwater prawns and yabbles, with aquatic insects, snails and small fishes also important.

Distribution, abundance and evidence of change:
This species is widespread throughout the Murray-Darling basin, but generally in the lower, slow-flowing rivers. Is not native to the Canberra region with the nearest natural population being in Wyangla reservoir on the Lachlan River. Catfish were stocked unsuccessfully into Lake Burley Griffin and Lake Ginninderra between 1978 and 1980 but were never recaptured in the annual monitoring program. Occasional angler reports have been received from the Queanbeyan River below Queanbeyan, but these have never been confirmed. The species has been stocked into farm dams by a private landholder in the Tharwa area, but the species has never been detected in the Murrumbidgee River fish monitoring program. In the early to mid 1990s a population became established in a pond at the Yowani golf course, and is breeding successfully. It is believed this population is the result of an illegal translocation by anglers.
### Conservation Status:

<table>
<thead>
<tr>
<th>National</th>
<th>ACT</th>
<th>NSW</th>
<th>VIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>not listed, but concern expressed about the status of riverine populations</td>
<td>not listed</td>
<td>not listed</td>
<td>Vulnerable (NRE 1999)</td>
</tr>
</tbody>
</table>

### Fishing Pressure Directed at this Species:
Slight

### Stocking locations:
- Lake Burley Griffin (1978)

### Potential Threats:
- Concern has been expressed about the potential impacts of carp on riverine populations of freshwater catfish. Populations in reservoirs do not appear to be under threat.

### Requirements for Survey and Monitoring:
- Continue regular monitoring of the Murrumbidgee River fishery to detect escapees/illegal stocking.

### Specific Management Actions Required:
- Educate anglers of the environmental hazards of translocating fish species.

### ACT Conservation Reserves where the species has been recorded:
None

### General References:
Merrick & Schmida 1984; Pollard et al. 1996; Davis 1977a,b,c,d; Koehn & O’Connor 1990a, Clunie & Koehn 1998.

### Local References:
Lintermans & Rutzou 1990d; Lintermans & Rutzou 1991a
5.1.8 Family Gobiidae: Gobies and Gudgeons

The Gobiidae is one of the most diverse freshwater families in Australia, containing about 40 species (a number of which are undescribed) in 14 genera in Australian freshwaters. The Gobiidae contains five subfamilies, four of which occur in Australia. The subfamily Eleotridinae was formerly considered to warrant family status as the Eleotridae. One species of gudgeon (Flinders Ranges Gudgeon, *Mohurnda* sp.) is considered nationally threatened. Gudgeons are widespread and common throughout much of Australia. There are two gudgeon species found in the ACT and surrounding area, the Western Carp Gudgeon and the Dwarf Flathead Gudgeon.

**Common Name:** Western Carp Gudgeon

**Scientific Name:** *Hypseleotris klunzingeri* (Ogilby 1898)

**Other common names:** None. Much of the early literature on Western Carp Gudgeon probably includes information on two new species, Lake's Carp Gudgeon and Midgely's Carp Gudgeon with all three species easily confused.

**Other scientific names:** *Carassiops klunzingeri*

**Biology and Habitat:**
A small species (maximum length 45 mm) which is found in slow-flowing or still waters, normally associated with macrophyte beds or other aquatic vegetation. Early studies of reproduction in "carp gudgeons" recorded that spawning occurred when water temperature exceeded 22.5 C. Eggs are adhesive and about 0.5 mm diameter with spawning occurring in shallow water. Hatching occurs after approximately 50 hours, giving rise to larvae between 1.76 and 2.1 mm long. It is unknown which species of carp gudgeon this reproductive data refers to as it was gathered before the taxonomic status of the group was clarified. Western Carp Gudgeon in Lake Burley Griffin are primarily a midwater carnivore although some benthic feeding also occurs. Important dietary items include copepods, aquatic insects, cladocerans and ostracods, with chironomids the most often consumed aquatic insect.

**Distribution, abundance and evidence of change:**
This species is widespread and common at lower altitudes having been recorded from the Molonglo, Murrumbidgee, lower Queanbeyan and lower Cotter rivers, and Ginninderra Creek. It is not found in the Molonglo River upstream of Molonglo Gorge or in the Murrumbidgee River upstream of Tharwa, or the Cotter River upstream of Cotter reservoir. The species is abundant in Lake Burley Griffin, Lake Ginninderra and Gogong Reservoir where it can form a substantial portion of the diet of Golden Perch, Redfin Perch and Brown Trout. The population in Lake Burley Griffin appears to have increased following the depletion of the Redfin Perch population by the EHN virus. The population in Lake Burley Griffin is characterised by an annual die-off in late autumn or early winter of juvenile fish of between 12 and 20 mm length. The cause of the mortality is suspected to be related to stress linked
to the onset of low water temperatures and infestation of fish by an introduced cestode *Bothriocephalus acheilognathi*.

Not recorded from the Naas, Gudgenby, Orroral or Tidbinbilla rivers.

**Conservation Status:**

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<th>ACT</th>
<th>NSW</th>
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<tr>
<td>not listed</td>
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**Fishing Pressure directed at this Species:**
NIL.

**Stocking locations:**
NIL.

**Potential Threats:**
- infestation with the introduced tapeworm *Bothriocephalus acheilognathi*.

**Requirements for Survey and Monitoring:**
- continue regular monitoring of the Murrumbidgee River fishery.

**Specific Management Actions Required:**
None.

**ACT Conservation Reserves where the species has been recorded:**
- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Lower Molonglo Nature Reserve;
- Googong Foreshores.

**General References:**
Larson & Hoeso 1996; Merrick & Schmida 1984; Cadwallader & Backhouse 1983; Koehn & O'Connor 1990a

**Local References:**
Common Name: Dwarf Flathead Gudgeon

Scientific Name: *Philympodon* sp. (undescribed)

Other common names: Has been confused with *Philympodon grandiceps* and some references to *P. grandiceps* prior to 1980 probably include Dwarf Flathead Gudgeon.

Other scientific names: see other common names.

Biology and Habitat:
A small species (rarely more than 45 mm length) which prefers relatively calm waters and occurs over mud and rock substrates or in weedy areas. Nothing is known of the reproductive biology of the species. It feeds mainly on insects and their larvae and also on crustaceans.

Distribution, abundance and evidence of change:
Dwarf Flathead Gudgeons are found in coastal streams from southern Queensland to eastern South Australia. They are also recorded from a few localities in the Murray River in New South Wales and South Australia, with a record from the Bathurst area also. First recorded from the Canberra region in 1993 and only known from a small number of creeks flowing into Lake Burrinjuck. The species has never been recorded from the ACT. Nothing is known of former or present abundance in Lake Burrinjuck.

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<th>Conservation Status:</th>
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<tbody>
<tr>
<td>National</td>
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<tr>
<td>not listed</td>
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</tbody>
</table>

Fishing Pressure directed at this Species:
NIL

Stocking locations:
NIL

Potential Threats:
None Known

Requirements for Survey and Monitoring:
No special requirements.

Specific Management Actions Required:
None
ACT Conservation Reserves where the species has been recorded:
None

General References:
Merrick & Schmida 1984; Allen 1989; Larson & Hoese 1996

Local References:
Lintermans 1993a
5.1.9 *Family Parastacidae* Freshwater crayfishes

The family Parastacidae forms a diverse group of yabbies and crayfish with more than 100 species in nine genera known from Australia. There are approximately 24 species considered nationally rare or threatened (Horwitz 1990a) There are five species in the ACT, the common Yabby *Cherax destructor*, the spiny crayfish *Eustaccus crassus* and *E. rieki*, the Murray River Crayfish *E. armatus* and a burrowing crayfish *Engaeus cymus*. One species, *E. armatus*, is considered threatened in the ACT.

**Common Name:** Murray River Crayfish (von Martens 1866)

**Scientific Name:** *Eustaccus armatus*

**Other common names:** Murray Cray, Murray Lobster

**Other scientific names:** *Astacus serratus*, *Astacopsis serratus*, *Eustaccus serratus*, *Eustaccus elongatus*

**Biology and Habitat:**

The Murray River Crayfish is the largest member of the genus *Eustaccus* with specimens up to 3 kg recorded. It is reportedly the second largest freshwater crayfish in the world, the largest being the Tasmanian giant freshwater crayfish *Astacopsis gouldii* which has been reported to reach 4.5 kg. *E. armatus* inhabits large and small streams in a variety of habitats including cleared pasture and dry and wet sclerophyll forests at altitudes from close to sea level to over 700 m ASL. The species prefers faster flowing cool water habitats of the main channels of rivers, in contrast to the Yabby, which prefers slow warm water and billabongs.

*E. armatus* individuals do not reach sexual maturity until they are quite large (15 to 20 cm total length) and between six and nine years old. The larger individuals previously caught in the Murray River may have been from 20–50 years of age, but fishing pressure makes it unlikely that individuals will survive to that age now.

In lowland rivers such as the Murray and lower Murrumbidgee, the species constructs burrows in the clay river banks for shelter. In the upland rivers with stony beds such as the Tumut, Goobarragandra and upper Murrumbidgee, the species tends to use the interstitial spaces between boulders and cobbles on the river bed for shelter.

**Distribution, abundance and evidence of change:**

The Murray River Crayfish has the largest geographic range of any of the spiny crayfish in Australia. While most spiny crayfish are restricted to the cooler, montane streams, Murray River Crayfish have extended their range into the warmer, lower reaches of the Murray-Darling Basin. Prior to the 1950s the species was found in the Murray River for most of its length in South Australia and
New South Wales as well as occurring in its major tributaries in Victoria and New South Wales (with the exception of the Darling River). Its range extended over 800 km east-west and approximately 450 km north-south with the most northerly record of the species near Kandos 160 km west of Newcastle. Murray River Crayfish are now extremely rare in the Murray River downstream of Mildura and are classified as endangered in South Australia. New South Wales populations in the Edwards, Kyalite, Wakool and Neimur Rivers have also declined and it is now considered rare in these rivers where it was once plentiful.

Within the ACT, *E. armatus* is mainly found in the Murrumbidgee River. The only other streams in the ACT in which the species has been reported are the lower Cotter River and lower Paddys River, with a single record from the lower Gudgenby River. The report of this species from small montane streams in the ACT (National Capital Development Commission 1984) is most likely to be an error and probably refers to the closely-related *E. crassus.* *E. armatus* is still known to occur in the section of the Cotter River below Cotter Dam. A report of the species being caught at Bracks Hole, upstream of Cotter Dam in the mid 1970s is unconfirmed and no recent reports are known from this area. Another spiny freshwater crayfish *E. crassus* is known to occur in the Cotter system (Lintemans unpublished data) and misidentification of the two species by anglers is possible.

In recent years in the ACT, it is suspected that *E. armatus* has been illegally translocated by anglers into a number of lakes and ponds. Water bodies in which it is suspected that the species has been introduced include Lake Ginninderra, Lake Burley Griffin, dams at the Canberra racecourse and ponds at Technology Park in Bruce. It is also likely that Murray River Crayfish have been translocated into the Yass River near Sutton in NSW. The origin of stock for most of these translocations appears to be impoundments on the Tumut River, particularly Blowing Reservoir and Jounama Pondage. In the Canberra region, *E. armatus* is known to inhabit the Tumut, Goobarragandra and Goodradigbee river systems. A single newspaper report from 1991 (Queanbeyan Age, 6 May 1991) records them from the Queanbeyan River. The species was historically present in the Yass River (Bennett 1834), although its current status in this waterway is unknown. The species is also known from Lake Burrinjuck on the Murrumbidgee River downstream from Canberra.

A survey of the distribution and abundance of *E. armatus* in the Murrumbidgee River in 1988/89 found the abundance and size of *E. armatus* at individual sites to be inversely proportional to the ease of recreational access (and hence fishing pressure). At one site it is known that one or two anglers had virtually removed all the large crays in a 12 month period. The absence of larger individuals during the 1988–89 survey is a strong indication of high levels of fishing pressure. The population was resurveyed in 1998 with the slight recovery evident in the distribution and abundance of the species.

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<tr>
<th>Conservation Status:</th>
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<tbody>
<tr>
<td>National</td>
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<tr>
<td>Indeterminate (Horwitz 1990a)</td>
</tr>
</tbody>
</table>
Fishing Pressure directed at this Species:

- formerly moderate in the ACT but now protected under the *Nature Conservation Act 1930*.
- moderate fishing pressure in surrounding areas of NSW.

Stocking locations:

Nil (Illegally translocated into Lake Ginninderra).

Potential Threats:

- overfishing can quickly deplete local populations;
- sedimentation may smother refuge habitats on the river bed; and
- introduction of diseases and parasites through translocation of other crayfish species into the ACT.

Requirements for Survey and Monitoring:

- continue to monitor status in Murrumbidgee River;
- investigate the distribution and abundance of the species in the Paddys River catchment; and
- continue to liaise with Victorian and NSW fisheries authorities and other research institutions to ensure there is exchange of relevant information on the species.

Specific Management Actions Required:

- continue to prohibit the taking of the species in the ACT;
- continue education of anglers of the threatened status of ACT populations;
- develop an ACT Government policy on the interstate trade and movement of freshwater crays; and
- investigate the possibility of re-introducing the species into the Cotter River at Cotter Dam

ACT Conservation Reserves where the species has been recorded:

- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Gigerline Nature Reserve.

General References:

Morgan 1986; Morison 1988; Horwitz 1990a;b, 1995; Geddes 1990; Barker 1990; Merrick 1995, McKinnon 1995; Asmus 1999

Local References:

Bennett 1834; Morgan 1986; Lintermans 1992c, 1993c, 2000c; Lintermans & Rutzou 1991b; ACT Government 1999d
5.2 *Exotic Species*

There are nine species of exotic fish from five families which have established populations in the Canberra region. The majority were introduced in the late 1800s and early 1900s, but a few have only recently become established. Some of the exotic species form important recreational fisheries, others are derived from the aquarium trade.

5.2.1 *Family Salmonidae: Salmons, Trouts and Chars*

The Salmonidae are native to cool waters in the Northern Hemisphere but have been widely introduced to other parts of the world by recreational angling and aquaculture interests. There are five species in three genera which have been introduced to Australia. Salmonids are widespread and common throughout much of montane and slopes waters in southeastern Australia. There are four species found in the ACT and surrounding area, Rainbow Trout, Brown Trout, Atlantic Salmon, and Brook Trout.

**Common Name:** Rainbow Trout

**Scientific Name:** *Oncorhynchus mykiss* (Walbaum)

**Other common names:** Steelhead

**Other scientific names:** *Salmo gairdneri, S. irideus*

**Biology and Habitat:**
A moderately sized fish (maximum weight 10 kg, commonly 1–4 kg) of cool, upland streams and lakes. They have a slightly higher thermal tolerance than Brown Trout with water temperatures above about 27 °C causing severe mortality. Other aspects of the species ecology are very similar to Brown Trout, with the diet containing aquatic insect larvae, crustaceans, snails, small fish and wind-blown terrestrial insects. In the Canberra region there is a tendency for Rainbow Trout to feed at the water surface more than Brown Trout. The species spawns from July – October with fish maturing at 2–3 years of age. The female constructs a nest in gravel where the slightly adhesive, demersal eggs are deposited. The eggs are large (4–5 mm diameter) and hatch in 3–12 weeks depending on water temperature. Rainbow trout have had a significant impact on the distribution and abundance of the native Mountain Galaxias. In the upper Cotter catchment the two species have an almost mutually exclusive distribution with galaxiids unable to survive in the presence of Rainbow Trout. An experimental removal of Rainbow Trout from a section of Lees Creek in the lower Cotter catchment has resulted in rapid recolonisation by Mountain Galaxias. However there has been no recolonisation of the creek sections where Rainbow Trout are still present. Mountain Galaxias can still survive in locations where trout access is prevented by waterfalls, swamps etc. Rainbow Trout are often found
with the parasitic copepod \textit{Lerneae sp.} attached, particularly around the fins. During times of heat stress, the species is prone to heavy infestation from this parasite, with large red sores from secondary infection obvious.

**Distribution, abundance and evidence of change:**

Rainbow Trout are native to the western coastal drainages of North America. They were first introduced to Australia in 1894, from New Zealand where the species had been introduced from California. They are present in the ACT, New South Wales, Victoria, Tasmania and South Australia. They were first introduced to the Canberra region in the 1890s and are now established in the majority of rivers of the ACT and surrounding NSW. Recorded from Paddys, Cotter, Naas, Gudgenby, Orroral, Murrumbidgee, and Molonglo rivers as well as Ginninderra, Tuggeranong, and Jerrabomberra creeks in the ACT. Recorded from the Goodradigbee, Yass, Bredbo, Numeralla, Kybean, Big Badja, and Queanbeyan rivers in adjacent areas of NSW. The species is usually found throughout the catchments in which it occurs and can occupies even the smallest headwater streams. Populations in Lake Ginninderra and Lake Burley Griffin have declined since the mid 1980s to the point where they are no longer stocked as survival is poor. Both of these lakes are marginal habitat for Rainbow Trout due to the high summer water temperatures often recorded. Prior to this they provided a successful recreational fishery in both lakes with rapid growth rates and good returns for anglers. The population in Googong Reservoir, after declining in the late 1980s, appears to have picked up again and is still regularly stocked by NSW Fisheries.

**Fishing Pressure directed at this Species:**

High

**Stocking locations:**

<table>
<thead>
<tr>
<th>Lake Burley Griffin (1965–1985, 1995);</th>
<th>Lake Burrinjuck (NSW Fisheries);</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Ginninderra (1977–1988);</td>
<td>Captains Flat Reservoir (NSW Fisheries).</td>
</tr>
<tr>
<td>Googong Reservoir (1984–1999);</td>
<td>Also stocked in numerous rivers in NSW by acclimatisation groups and angling clubs.</td>
</tr>
</tbody>
</table>

**Requirements for Survey and Monitoring:**

- continue regular monitoring of the Murrumbidgee River fishery; and
- continue regular monitoring of the Googong fishery.

**Specific Management Actions Required:**

- continue policy of not regularly stocking this species in Canberra's urban lakes.
ACT Conservation Reserves where the species has been recorded:

- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Gigerline Nature Reserve;
- Lower Molonglo Nature Reserve;
- Molonglo Gorge Nature Reserve;
- Tidbinbilla Nature Reserve;
- Namadgi National Park;
- Googong Foreshores.

General References:
Pidgeon 1981; Jackson & Williams 1980; Merrick & Schmida 1984; Fletcher 1986; Davies & McDowall 1996

Local References:
Common Name: Brown Trout

Scientific Name: *Salmo trutta* (Linnaeus 1758)

Other common names: Sea Trout, Englishman

Other scientific names: *Salmo fario*

**Biology and Habitat:**
A moderately sized fish (maximum weight 20 kg, commonly 1–4 kg) of cool upland streams and lakes. The diet contains a wide variety of aquatic insect larvae, crustaceans, small fish, snails and wind-blown terrestrial arthropods. There is a tendency for Brown Trout to become the dominant species in impoundments where both Rainbow and Brown Trout are present. Brown Trout spawn earlier than Rainbow Trout with spawning occurring between April and August. Like Rainbow Trout, the eggs are deposited in a gravel nest in flowing water constructed by the female. The eggs are large (4–5 mm diameter) and hatch in 6–20 weeks depending on water temperature. Brown Trout are slightly less tolerant than Rainbow Trout of warm water, preferring temperatures below 25 °C. Brown Trout are often found with the parasitic copepod *Lernaeae sp.* attached, particularly around the fins.

**Distribution, abundance and evidence of change:**
Brown Trout are native to Europe and western Asia and were first introduced to Australia in 1864. They were first successfully introduced into NSW and the Canberra region in 1888 when a number were released into the Cotter, Naas, Molonglo and Queanbeyan rivers. Earlier local releases had apparently been unsuccessful. The species is now found in most suitable streams in the ACT with records from the Paddys, Cotter, Naas, Gudgenby, Orroral, Murrumbidgee, and Molonglo rivers as well as Ginninderra, Tuggeranong, and Jerrabomberra creeks in the ACT. It has been recorded from the Goodradigbee, Yass, Bredbo, Numeralla, Kybean, Big Badja, and Queanbeyan rivers in adjacent areas of NSW. Brown Trout are not found upstream of Bendora Dam in the Cotter catchment and do not seem to be as prevalent as Rainbow Trout in the small headwater streams of the ACT. The urban lakes are considered marginal habitats for Brown Trout because of their high summer water temperatures. The population in Googong Reservoir, after declining in the late 1980s, appears to have picked up again and is still regularly targeted by anglers, with specimens in excess of 4 kg regularly taken. As with Rainbow Trout, Brown Trout have had a serious impact on the distribution and abundance of the native Mountain Galaxies in the ACT and southeastern Australia. Brown Trout are suspected of having deleterious impacts on a number of native threatened fish species such as Trout Cod and Macquarie Perch. Consequently they are no longer stocked in Googong Reservoir or streams of the upper Murrumbidgee catchment where threatened species are known to be present.

**Fishing Pressure directed at this Species:**
High, along with Rainbow Trout.
Stocking locations:

- Lake Burley Griffin (1965–1981, 1987, 1997);
- Lake Ginninderra (1977–1981, 1996);
- Googong Reservoir (1993–1997) (no longer stocked);
- Lake Burrinjuck (NSW Fisheries);
- Captains Flat Reservoir (NSW Fisheries).

Also stocked in numerous rivers in NSW by acclimatisation groups and angling clubs.

Requirements for Survey and Monitoring:

- continue regular monitoring of the Murrumbidgee River fishery;
- monitor potential adverse interactions with Macquarie Perch in the Queanbeyan and Cotter river catchments; and
- continue regular monitoring of the Googong fishery.

Specific Management Actions Required:

- continue policy of not stocking this species in Googong Reservoir or dam in the Cotter catchment.

ACT Conservation Reserves where the species has been recorded:

- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Gigerline Nature Reserve;
- Lower Molonglo Nature Reserve;
- Molonglo Gorge Nature Reserve;
- Tidbinbilla Nature Reserve;
- Namadgi National Park;
- Googong Foreshores.

General References:

Local References:
Common Name: Atlantic Salmon

Scientific Name: Salmo salar (Linnaeus 1758)

Other common names: None

Other scientific names: None

Biology and Habitat:
A moderately sized species (maximum weight 38 kg in Europe, commonly 1–3 kg in Australia) of cool streams and lakes which has not established significant populations in Australia. Their ecology is very similar to Brown Trout although very little has been published on their habits in Australia.

Distribution, abundance and evidence of change:
Native to rivers draining to the North Atlantic ocean, Atlantic Salmon were first introduced to Australia between 1864 and 1870 when it was released in Tasmania and Victoria, but with little success. Eggs were imported from Canada in 1963 and the species is now regularly stocked into Lake Burranjuck and Lake Jindabyne. The species continued presence in these water bodies is thought to be wholly dependant on the stocking program, with no natural recruitment occurring. There have been occasional angler reports of this species from the Murrumbidgee River in the ACT, but they are unconfirmed. Confusion in identification between Atlantic Salmon and Brown Trout is likely.

Fishing Pressure directed at this Species:
Slight

Stocking locations:
- Lake Burranjuck (NSW Fisheries).

Requirements for Survey and Monitoring:
None

Specific Management Actions Required:
- continue policy of not stocking this species in the ACT.

ACT Conservation Reserves where the species has been recorded:
None

General References:

Local References:
Common Name: Brook Char

Scientific Name: *Salvelinus fontinalis* (Mitchill 1815)

Other common names: Brook Trout, Fontinalis

Other scientific names: None

Biology and Habitat:
A moderately sized (maximum length 850 mm, maximum weight 6.5 kg) cool-water species of clear streams and lakes, this species does not coexist well with other salmonids. Only a single self-sustaining population is known for mainland Australia (New England tablelands) although self-sustaining populations are present in Tasmania. Breeding is similar to that of Brown Trout. Diet contains aquatic insects, crustaceans, molluscs and terrestrial insects as well as small fish.

Distribution, abundance and evidence of change:
Brook Char are native to the east coast of North America and were introduced to Australia in the 1870s. Brook Char were stocked in the Canberra region in the 1970s but did not establish reproducing populations. Sometimes disparagingly referred to as 'soluble trout' because of their reputation for disappearing when added to water. A number of individuals were captured from Lake Ginninderra in 1993 after an illegal release of unwanted fish from a backyard swimming pool.

Fishing Pressure directed at this Species:
Minimal

Stocking locations:
- Lake Ginninderra (1979);
- Lake Burley Griffin (1974–1978);
- Lake Burrunjuck and Yass River (NSW Fisheries).

Requirements for Survey, Monitoring and Management:
None

Specific Management Actions Required
- educate anglers of the hazards of translocating fish species; and
- continue policy of not stocking this species in the ACT.

ACT Conservation Reserves where the species has been recorded:
None


Local References: Lintermans 1991b.
5.2.2 *Family Cyprinidae: Carps, Minnows etc.*

The Cyprinidae is one of the largest fish families with more than 1700 species world-wide. There are no native cyprinids in Australia. A number of cyprinids have been widely introduced to other parts of the world with four species in four genera which have been introduced to Australia. There are two species found in the ACT and surrounding area, Carp and Goldfish.

**Common Name:** Carp

**Scientific Name:** *Cyprinus carpio* (Linnaeus 1758)

**Other common names:** European Carp, Common Carp, Koi Carp

**Other scientific names:** None

**Biology and Habitat:**
Carp are usually associated with warm, slow-flowing lowland rivers or lakes, and are rarely found in clear, cool swift-flowing streams. Carp are tolerant of a wide range of environmental conditions and are able to survive extremely low levels of dissolved oxygen. Males are sexually mature at 2 to 3 years (300 mm) and females at 3 to 4 years (360 mm). Spawning occurs usually in spring and summer when water temperatures are between 17 and 25 °C. Spawning fish congregate in shallow water with egg-laying often heralded by much churning and splashing as fish break the water surface with their back and tail. Eggs are adhesive and laid in clumps on aquatic vegetation, logs and submerged grass. Eggs are 0.5 mm diameter and hatch in 2 to 6 days depending on water temperature. Carp feed by "mumbling" in the sediment on the bottom or banks of water bodies. This involves sucking in sediment, sorting the edible items from the inedible sediment, and expelling the sediment through the gill openings. This feeding mechanism has led to considerable concern that carp may be increasing turbidity levels in waterways, and undermining river banks. Dietary items include zooplankton, aquatic insect larvae, crustaceans, molluscs and to a lesser extent plant material. Carp carry the parasitic copepod *Lernaea sp.* which infects a range of native fish species in the Canberra region. Species affected include Mountain Galaxias, Golden Perch, Macquarie Perch, Murray Cod, Oriental Weatherloach, Brown Trout, Rainbow Trout, Goldfish and Redfin Perch.

**Distribution, abundance and evidence of change:**
Carp are native to central Asia and were first introduced into Australia sometime between 1850 and 1870 but remained in two relatively confined locations (Sydney and the Murrumbidgee Irrigation Area) until the early 1960s. Those two populations were different strains of the one species and showed no sign of spreading. In the early 1960s a third strain, (the Boolarra strain), was illegally introduced by a fish farmer in Victoria. Legislation was introduced to prevent the cultivation and sale of these fish but it was too late as fish had already been sold and stocked into a number of farm dams. A large
eradication program was mounted but it was unsuccessful and it is the Boolarra strain which has rapidly colonised watercourses throughout Australia. A recent genetic study of Carp in Australia has identified a fourth strain (the Koi strain) which is present in Lake Burley Griffin and has been recently illegally introduced to two Tasmanian lakes. This Koi strain is unlike the usual Koi carp seen in aquarium establishments in that it lacks the bright colouring (usually red, orange, black or white) and looks identical to the Boolarra strain.

Carp were first detected in the ACT in 1976 when several individuals were captured in Lake Burley Griffin. It is thought these fish may have been introduced as a contaminant of fish stockings of other species (trout, Murray Cod and Golden Perch). Carp are now present in all of Canberra’s urban lakes but have not yet established in Googong Reservoir. Carp are present in the majority of ACT Rivers and creeks with the exception of the Tidbinbilla, Naas, Orroral rivers, the Cotter River (upstream of Cotter dam) and the Queanbeyan River (upstream of Googong dam). Two large Carp were captured in Googong Reservoir 1990 and there were unconfirmed angler reports of Carp from this water body in May 1999, but Carp are not yet established in this water body. They are present in the Murrumbidgee River up to and above Cooma, the Bredbo, Numeralla, Yass, Kybean and Gooodradigbee rivers in the Canberra region. Carp comprise around 70% of the biomass in the Murrumbidgee River in the ACT and between 70 and 90% of the biomass in Canberra’s urban lakes.

**Fishing Pressure directed at this Species:**
Enthusiastically sought after by anglers of Asian and European descent, they are poorly regarded by most Australian anglers.

**Stocking locations:**
NIL

**Requirements for Survey and Monitoring:**
- continue regular monitoring of urban lakes fisheries and Googong Reservoir;
- continue regular monitoring of Murrumbidgee River fishery;
- continue monitoring of the Queanbeyan River above Googong to detect invasion by this species; and
- monitor the Cotter River above Cotter Reservoir to detect invasion by this species.

**Specific Management Actions Required:**
- educate anglers of the hazards of translocating fish species; and
- maintain the integrity of the barrier to colonisation of the Cotter River formed by Cotter Dam.
**ACT Conservation Reserves where the species has been recorded:**

- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Gigerline Nature Reserve;
- Molonglo Gorge Nature Reserve;
- Lower Molonglo Nature Reserve;
- Googong Foreshores.

**General References:**

**Local References:**
Common Name: Goldfish

Scientific Name: *Carassius auratus* (Linnaeus 1758)

Other common names: Common Carp, Crucian Carp, Prussian Carp,

Other scientific names: None

Biology and Habitat:
Goldfish, like Carp are usually associated with warm, slow-flowing lowland rivers or lakes. Goldfish are often found in association with aquatic vegetation. Goldfish spawn during summer with fish maturing at 100–150 mm length. Eggs are laid amongst aquatic plants and hatch in about one week. The diet includes small crustaceans, aquatic insect larvae, plant material and detritus. Goldfish in the Canberra region are often heavily infected with the parasitic copepod *Lernaea* sp. A consignment of goldfish from Japan to Victoria is believed to be responsible for introducing the disease "Goldfish ulcer", which also affects salmonid species such as trout. Apart from the introduction of this disease, the species is generally regarded as a "benign" introduction to Australia, with little or no adverse impacts documented.

Distribution, abundance and evidence of change:
Goldfish are native to eastern Asia and were first introduced into Australia in the 1860s when it was imported as an ornamental fish. Goldfish were introduced to the Canberra region in 1888 when 20 were released into Cotter, Queanbeyan and Molonglo and Naas rivers.

Goldfish are widespread in the Canberra region occurring in the Molonglo, Cotter, Paddys, and Murrumbidgee rivers and Ginninderra, Jerrabomberra and Tuggeranong creeks. Goldfish are often present in substantial numbers in the early phases of Canberra's urban lakes. In Lake Tuggeranong they formed 50 to 70% of the catch in the early 1990s but by 1999 have declined to negligible levels. Similarly they were abundant in Lake Burley Griffin soon after filling, but declined to negligible levels. Such declines in relative abundance are due to the stocking of predatory species such as Murray Cod, Golden Perch and trout, which consume large numbers of goldfish. Goldfish are present in Cotter Reservoir but not in the river upstream. Goldfish have not been recorded in the Tidbinbilla, Gudgenby, Naas, or Orroral rivers.

Goldfish are common throughout the upper Murrumbidgee catchment and have been recorded from the Kybean, Bredbo, Numeralla, Yass and Queanbeyan rivers. They have been recorded in the Murrumbidgee River as far upstream as Adaminaby.

Fishing Pressure directed at this Species:
NIL
Stocking locations:
NIL

Requirements for Survey and Monitoring:
• continue regular monitoring of urban lakes fisheries and Googong Reservoir; and
• continue regular monitoring of the Murrumbidgee River fishery.

Specific Management Actions Required:
• educate anglers of the hazards of translocating fish species.

ACT Conservation Reserves where the species has been recorded:

| Woodstock Nature Reserve; | Molonglo Gorge Nature Reserve; |
| Stony Creek Nature Reserve; | Lower Molonglo Nature Reserve; |
| Bullen Range Nature Reserve; | Googong Foreshores. |
| Gigerline Nature Reserve; |

General References:
Hume et al. 1983b; Merrick & Schmid 1984; Brumley 1996.

Local References:
National Trust of Australia 1980; Lintermans & Rutzou 1990c; Lintermans & Kleber 1995; Dove & Ernst 1998.
5.2.3 Family Percidae: Freshwater Perches.

The Percidae is a small family native to the cool-temperate waters of the Northern Hemisphere. There are no native percids in Australia. A single species, Redfin Perch, has been introduced to Australia. This species is found in the ACT and surrounding area.

**Common Name:** Redfin Perch

**Scientific Name:** *Perca fluviatilis* (Linnaeus 1758)

**Other common names:** Redfin, English Perch, European Perch

**Other scientific names:** None

**Biology and Habitat:**
A moderate-sized fish (maximum weight 10 kg, commonly 1–2 kg) which mainly occurs in slow-flowing or still water habitats, especially where aquatic vegetation is abundant. Fish are generally mature after 2–3 years, but males may mature at the end of the first year. A characteristic of the species is the propensity to 'stunt' under conditions of poor food availability or overcrowding, with individuals maturing at a very small size (approx. 120 mm length). Spawning occurs in spring when water temperature reaches 12 °C, with thousands of eggs laid as gelatinous ribbons amongst acuatic vegetation. Eggs are 2–3 mm diameter and hatch in 1–2 weeks with juvenile fish forming large schools. The diet includes crustaceans, zooplankton and small fish with Western Carp Gudgeon and Mosquitofish often recorded in the diet in Canberra's urban lakes. Redfin Perch are the main host for a virus, Epizootic Haematopoietic Necrosis Virus (EHNV). This virus, unique to Australia, was first isolated in 1985 on Redfin Perch. It is characterised by sudden high mortalities of fish displaying necrosis of the renal haematopoietic tissue, liver, spleen and pancreas. Experimental work has demonstrated that Macquarie Perch are one of several species found to be extremely susceptible to the disease. Macquarie Perch were held in aquaria and exposed to low concentrations of EHNV in water with all ten fish in two separate trials dying within five days.

EHNV was first recorded from the Canberra region in 1986 when an outbreak occurred in Blowering Reservoir near Tumut. Subsequent outbreaks have occurred in Lake BurriNJuck in late 1990, Lake Burley Griffin in 1991 and 1994, Lake Ginninderra and Googong Reservoir in 1994.

**Distribution, abundance and evidence of change:**
Redfin Perch were first introduced to Tasmania in 1862 and to Victoria in 1868. This species is widely distributed throughout the temperate portion of the Murray-Darling Basin, being absent from the colder headwaters and the hotter reaches of the Darling drainage. Their distribution is largely explained by their temperature tolerance, being able to survive in water temperatures up to about 31 °C. Redfin
Perch were first introduced to the Canberra region when 50 were released into the Queanbeyan, Molonglo, Naas and Cotter rivers in 1888. However, this introduction was apparently unsuccessful as no further mention is made of the species until they were stocked by NSW Fisheries into Lake George in 1959. Here they remained until a sequence of events led to them colonising Lake Burley Griffin in mid-1983 (see Lintermans et al. 1990b). They were first detected in both Lake Ginninderra and Googong Reservoir in 1988 and are also present in Lake Tuggeranong and Gungahlin Pond. They rapidly increased in numbers in the urban lakes and by 1989 formed 58% of the total catch in Lake Burley Griffin. The numbers of Redfin Perch in both Lake Burley Griffin, Lake Ginninderra and Googong Reservoir all declined dramatically after the outbreak of EHN Virus in these water bodies in the early to mid 1990s. Redfin now comprise around 10–15% of the catch in Lake Burley Griffin.

Redfin Perch were first recorded in the Murrumbidgee River at the Casuarina Sands fishtrap in 1986, with generally only 2–3 fish captured at any one time. In October 1988, a total of 1100 small Redfin Perch (average length 135 mm) were removed from the fishtrap on a single day. Six days later another 510 Redfin were removed form the trap and one week later another 291 were removed. Such high numbers were never again encountered until the removal of the trap and weir in 1991.

Redfin Perch have comprised between 0.5 and 15% (by number) of the catch during the biennial monitoring of the Murrumbidgee River fish populations in 1994, 1996 & 1998. Redfin Perch have not been recorded in the Naas, Gudgenby, or Orroral rivers, or the Murrumbidgee River above Thurra. A recent observation of the species in Queanbeyan River above Googong Reservoir is of concern as a small but thriving population of Macquarie Perch is located there. This record needs confirmation.

**Fishing Pressure directed at this Species:**
Moderate. A sought after species in the urban lakes, although stunted individuals may dominate some fisheries.

**Stocking locations:**
NIL

**Requirements for Survey and Monitoring:**
- continue regular monitoring of urban lakes fisheries and Googong Reservoir;
- continue regular monitoring of Murrumbidgee river fishery;
- continue monitoring of the Queanbeyan River above Googong to detect invasion by this species; and
- monitor Cotter River above Cotter Reservoir to detect invasion by this species

**Specific Management Actions Required:**
- educate anglers of the hazards of translocating fish species; and
- maintain the integrity of the barrier to colonisation of the Cotter River formed by Cotter Dam.
ACT Conservation Reserves where the species has been recorded:

- Woodstock Nature Reserve;
- Stony Creek Nature Reserve;
- Bullen Range Nature Reserve;
- Gigerline Nature Reserve;
- Molonglo Gorge Nature Reserve;
- Lower Molonglo Nature Reserve;
- Googong Foreshores.

General References:
Merrick & Schmida 1984; McDowall 1996c; Faragher & Lintermans 1997; Weatherley 1963, 1977;

Local References:
National Trust of Australia 1980; Lintermans & Rutzou 1990d, 1991a; Lintermans & Kleber 1995;
Lintermans et al. 1990b; Lintermans 1991b, 1992a,b, 1995a,b,c, 1996, 1997a,b, 1998a,b, 1999;
5.2.4  *Family Poeciliidae: Livebearers.*

The Poeciliidae are popular aquarium fish that give birth to live young rather than laying eggs. Swordtails, mollies and guppies are three well known examples. There are no native poeciliids in Australia. A number of poeciliids have been widely introduced to other parts of the world for either mosquito control or as aquarium species. Six species in four genera have become established in Australia. There is a single species found in the ACT and surrounding area, Eastern Gambusia.

**Common Name:**  Eastern Gambusia

**Scientific Name:**  *Gambusia holbrooki* (Girard 1859)

**Other common names:**  Gambusia, Mosquitofish, Top Minnow, Plague Minnow

**Other scientific names:**  *Gambusia affinis*

**Biology and Habitat:**  
A small fish (maximum length 60 mm) which is commonly found in lakes or still or slow flowing streams, mostly around the edges or in aquatic vegetation. Gambusia are mature at about 25 mm long, and do not lay eggs but produce live young. The fertilised eggs develop inside the female with the young being a few millimetres long when born. Maturity can be reached after only 2 months and individuals can breed several times a year. Breeding occurs during the warmer months with a female producing about 50 young in each batch, with up to nine batches per year. Gambusia are tolerant of a wide range of water temperatures, oxygen levels, salinity’s and turbidity’s, and because of their ability to breed rapidly, have assumed plague proportions in many habitats. Often referred to as Mosquitofish, they were introduced for mosquito control in the 1920s but unfortunately mosquito larvae do not figure prominently in their diet. Gambusia are primarily carnivorous with the diet containing a range of small aquatic invertebrates and wind-blown terrestrial insects. They are an aggressive species which will chase and fin-nibble fish much larger than themselves. They also prey on the eggs of native fish and amphibians. Gambusia are implicated in the decline of some 30 fish species worldwide, at least 9 of which occur in Australia. They have just been listed as a key threatening process for amphibian populations in NSW, and are implicated in the decline of more than 10 species of frogs in Australia.

**Distribution, abundance and evidence of change:**  
Native to rivers draining to the Gulf of Mexico, Gambusia were introduced into Australia in 1925. Further introductions were made by health authorities in the 1930s and the species was distributed to many military camps during World War 2. The species is now widely distributed throughout Australia. Gambusia are widespread throughout the warmer lowland waters in the Canberra region and have been recorded in the Molonglo, Murrumbidgee, lower Cotter, lower Paddys, and Queanbeyan rivers as
well as Ginninderra, Jerrabomberra and Tuggeranong creeks. They are commonly found in farm dams and shallow wetlands.

Not recorded from higher, cooler waters in the ACT including the Naas, Gudgenby, Orroral, Tidbinbilla rivers. Not recorded in the Cotter River upstream of Cotter Reservoir. They can however survive in such waters if they are introduced, with the species recorded from the Snowy Mountains at an altitude of 1300 m.

Fishing Pressure directed at this Species:
NIL

Stocking locations:
NIL

Requirements for Survey and Monitoring:
None

Specific Management Actions Required:
• educate anglers of the hazards of translocating fish species.

ACT Conservation Reserves where the species has been recorded:

| Woodstock Nature Reserve; | Molonglo Gorge Nature Reserve; |
| Stony Creek Nature Reserve; | Lower Molonglo Nature Reserve; |
| Bullen Range Nature Reserve; | Googong Foreshores; |
| Gigerline Nature Reserve; | Canberra Nature Park. |

General References:

Local References:
5.2.5 Family Cobitidae: Loaches.

The Cobitidae is a large family native to Europe and Asia and are popularly kept as aquarium fish. A single species, Oriental Weatherloach, has been widely introduced to other parts of the world including Australia. This species is found in the ACT and surrounding area.

Common Name: Oriental Weatherloach

Scientific Name: Misgurnus anguillicaudatus (Cantor 1842)

Other common names: Japanese Weatherloach, Japanese Weatherfish, Japanese Loach, Mud Loach, Weatherfish, Dojo,

Other scientific names: Misgurnus fossilis anguillicaudatus, Cobitis fossilis, Cobitis anguillicaudatus

Biology and Habitat:
A small (maximum length 250 mm), elongate, bottom-dwelling fish which was first detected in the wild in Australia in 1984. A popular aquarium fish, the species is native to Europe and Asia. Commonly found in slow-flowing or still water with sand or mud substrates into which it can burrow to escape predation or aestivate. Occurs in a range of habitats from degraded urban and rural streams and ponds to relatively pristine headwater streams. Can utilise atmospheric oxygen by ‘gulping’ air and passing it through a highly vascularised hindgut. The species is eurythermal and thrives in water temperatures from 2-30 °C and has been recorded in thermal springs at temperatures up to 38 °C. The species can move overland to disperse and colonise new water bodies. Weatherloach are multiple spawners, laying 4–8000 eggs per spawning with the spawning site being aquatic vegetation or mud. Eggs are approximately 1.5 mm diameter. Fish are mature at approximately 100 mm total length and may live for up to 13 years. Spawning occurs in summer with eggs hatching after 2–3 days.

The diet in the ACT consists of aquatic insect larvae, rotifers, algae, micro-crustaceans and detritus, with significant dietary overlap recorded with the native fish species Galaxias olidus. Prey is sensed using a combination of chemical and tactile cues.

Distribution, abundance and evidence of change:
This species has established feral populations in six mainland states of the USA as well as Hawaii, Palau, and the Phillipines. The species is now established in Australia in the ACT, New South Wales, Victoria and Queensland. First recorded in the ACT in 1980 when a single individual was captured in Lake Burley Griffin. A population became established in Ginninderra Creek by 1986 and this population has now colonised almost the entire length of the creek above and below Lake Ginninderra.
It has also spread into the Murrumbidgee River and is established in Lake Burrier. Additional populations have been detected in the Cotter River above and below Cotter Reservoir, Tuggeranong Creek, Paddys River, Molonglo River above Lake Burley Griffin, Queanbeyan River below Queanbeyan weir, and Lake Eucumbene. Illegal use as live bait by anglers is thought to be a significant factor in their spread between drainage systems in the Canberra region. Regular monitoring of ACT populations indicates that this species does not easily spread upstream.

**Fishing Pressure directed at this Species:**
Harvested and used illegally as a bait fish.

**Stocking locations:**
NIL

**Requirements for Survey and Monitoring:**
- continue regular monitoring of ACT populations to monitor spread.

**Specific Management Actions Required**
- educate anglers of the hazards of translocating fish species; and
- amend the Fishing Act to ban the use of live finfish as bait.

**ACT Conservation Reserves where the species has been recorded:**

<table>
<thead>
<tr>
<th>Gigerline Nature Reserve;</th>
<th>Bullen Range Nature Reserve;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodstock Nature Reserve;</td>
<td>Molonglo Gorge Nature Reserve.</td>
</tr>
</tbody>
</table>

**General References:**

**Local References:**
Lintermans *et al.* 1990a,b; Lintermans 1993a,b,1995b, 1997a, 1998a,b; Rutzou 1991; Swales 1992; Dove & Ernst 1996; Dove 1999.
6. REFERENCES


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4, ACT Parks and Conservation Service, Canberra.

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National Botanic Gardens. Internal report 90/12, ACT Parks and Conservation Service.

report 90/13, ACT Parks and Conservation Service.

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Linternans, M. and Rutzou, T. 1991b. The status, distribution and management of the Murray crayfish
Euastacus armatus in the Australian Capital Territory. Research Report 6 ACT Parks and
Conservation Service.

Linternans, M., Rutzou, T. and Kukolic, K., 1990a. The status, distribution and possible impacts of the
oriental weatherloach Misgurnus anguillicaudatus in the Ginninderra Creek catchment.

range expansions. In: D. Pollard (ed.), Australian Society for Fish Biology Workshop:
Introduced and Translocated fishes and their Ecological effects. Bureau of Rural Resources

Llewellyn, L. C. 1983. The Distribution of Fish in New South Wales. Australian Society for Limnology
Special Publication No. 7.

agent or a pest. Pp 7–25 in Kitching, R. L. (ed.) The ecology of exotic animals and plants:
some case histories. Wiley, Brisbane.

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Appendix 1: Outline of existing fish monitoring programs conducted by Environment ACT.

Urban Lakes Fisheries Monitoring Program

Aims:

1. To monitor species composition and relative abundance of recreational fish species.
2. To monitor survival and growth of stocked species, and
3. To monitor reproductive status of selected fish species.

Fisheries Monitored:
- Lake Ginninderra;
- Lake Tuggeranong;
- Gungahlin Pond;
- Yerrabi Pond; and
- Googong Reservoir.

Number of sites monitored:
- Lake Ginninderra 3;
- Lake Tuggeranong 1;
- Gungahlin Pond 1;
- Yerrabi Pond 1; and
- Googong Reservoir 5.

Frequency of Monitoring:  Biennial

Timing of monitoring:
- Lake Ginninderra Feb–April;
- Lake Tuggeranong Feb–April;
- Gungahlin Pond Feb–April;
- Yerrabi Pond Feb–April; and
- Googong Reservoir Oct–Nov

Methods:
Multifilament, floating gill nets. 8 nets, each 35 m long, of mesh sizes 25–200 mm (stretch mesh).
Appendix 1. (continued)

Murrumbidgee River Fishery Monitoring Program

Aims:

1. To establish long term monitoring sites which are representative of aquatic communities in the Murrumbidgee River in the ACT and of habitat for species of concern (threatened species or nuisance species).

2. To record changes in the presence/absence/abundance of aquatic vertebrates in the Murrumbidgee River over time.

3. To obtain baseline data on presence/absence at selected sites to allow monitoring of the impact of unforeseen events (introduction of alien organisms/pollution/change of landuse).

Number of sites monitored: Six:

- Angle Crossing;
- Tharwa Sandwash;
- Point Hut Crossing;
- Kambah Pool;
- Casuarina Sands; and
- Retallicks Hole.

Frequency of Monitoring:

Biennial

Timing of monitoring:

Oct–Nov

Methods:

- Multifilament, floating gill nets. 6 nets, each 35 m long, of mesh sizes 50, 75, 100, 125, 150 & 200 mm (stretched mesh);
- Six single-winged fyke nets (15 mm mesh);
- Ten bait traps (for collection of smaller forage fish and juveniles);
- Backpack electrofisher (for collection of smaller forage species); and
- 20 minutes spotlighting from a boat in midstream to capture small or juvenile fish not accessible from the shore.
Appendix 2: Annotated bibliography of reports containing information on fish of the Canberra region.

This bibliography predominantly lists those reports which contain primary data on fish distribution, abundance or ecology in the Canberra region. Included also are some reports which contain anecdotal or historical information on local fish. As with all bibliographies, there will inevitably be omissions and readers are asked to contact the author and provide details of omitted reports which can then be included in any subsequent versions of this bibliography.


ACT Government 1997. Fish Stocking Plan for the Australian Capital Territory. Environment ACT, Canberra. Contains details of the fish stocking program for the ACT


Anon, 1907. *The Fisheries of New South Wales*. New South Wales Government Printer. Includes information for what is now the ACT.


Bennett, G. 1834. *Wanderings in New South Wales, Batavia, Pedir Coast, Singapore and China*. Being the journal of a naturalist in these countries during 1832, 1833 and 1834. Richard Bentley, London. 2 volumes. Includes records of Murray River Crayfish from the local region.


Lake, J. S. 1967. Freshwater Fish of the Murray Darling River System. State Fisheries Research Bulletin Number 7, Chief Secretary's Department, New South Wales. Includes information on growth rate of Macquarie Perch from Lake Burrinjuck.


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National Environmental Consulting Services 1997. Queanbeyan River Corridor Study. Includes limited information on fish in the Queanbeyan River.
National Trust of Australia 1980. *Murrumbidgee River valley study*. A report prepared for the National Trust of Australia, Canberra. **Historical records of early fish releases in the ACT.**


Rowland, S., Dirou, J. and Selosse, P. 1983. Production and stocking of golden and silver perch in NSW. *Australian Fisheries* 42(9): 
Includes information on Googong Reservoir and Lake Burrinjuck.


Includes summary on fish in the upper Murrumbidgee catchment.


Contains information on carp and macrophyte cover in Lake Burley Griffin and Lake Ginninderra.


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