National Recovery Plan for the Dwarf Galaxias *Galaxiella pusilla*

Stephen Saddlier, Jean Jackson and Michael Hammer

Australian Government

Government of South Australia
Department for Environment and Heritage

State Government Victoria
Department of Sustainability and Environment

Inland Fisheries Service

Prepared by Stephen Saddlier (Department of Sustainability and Environment, Victoria), Jean Jackson (Inland Fisheries Service, Tasmania) and Michael Hammer (University of Adelaide, South Australia).

Published by the Victorian Government Department of Sustainability and Environment (DSE) Melbourne, February 2010.

Authorised by the Victorian Government, 8 Nicholson Street, East Melbourne.

ISBN 1 74152 363 X

This is a Recovery Plan prepared under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, with the assistance of funding provided by the Australian Government.

This Recovery Plan has been developed with the involvement and cooperation of a range of stakeholders, but individual stakeholders have not necessarily committed to undertaking specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge.

An electronic version of this document is available on the Department of the Environment, Water, Heritage and the Arts website www.environment.gov.au

For more information contact the DSE Customer Service Centre 136 186

Citation: Saddlier, S., Jackson, J. and Hammer, M. 2010. National Recovery Plan for the Dwarf Galaxias *Galaxiella pusilla*. Department of Sustainability and Environment, Melbourne.

Cover photograph: Dwarf Galaxias *Galaxiella pusilla* (male above, female below) by Michael Hammer.

Table of Contents

Summary

The Dwarf Galaxias *Galaxiella pusilla* is a tiny freshwater fish endemic to south-eastern Australia, where it occurs in Tasmania, South Australia and Victoria. The species is listed as Vulnerable under the Australian Government *Environment Protection and Biodiversity Conservation Act 1999*, and is also designated as Vulnerable on the IUCN Red List of Threatened Animals (IUCN 2003) and on the Australian Society for Fish Biology threatened species list (ASFB 2001). In Victoria the Dwarf Galaxias is listed as Threatened under the Victorian *Flora and Fauna Guarantee Act* 1988, and is also considered Vulnerable (DSE 2007). In Tasmania it is classified as Vulnerable under the Tasmanian *Threatened Species Protection Act 1995* and is considered a 'priority species requiring consideration' under the Tasmanian Regional Forest Agreement (1997). In South Australia the species has been proposed as Vulnerable under the 'Review of the Status of Threatened Species in South Australia' (DEH 2003).

The Dwarf Galaxias is still widely distributed, but populations are fragmented and patchy across the landscape. It is likely that the species has suffered a significant decline in abundance due to habitat changes to shallow freshwater wetlands, especially wetland drainage. This decline appears to be continuing, as several populations have become extinct in recent decades. Major threats to the Dwarf Galaxias include wetland drainage, climate change, habitat damage through grazing and lack of regeneration, and feral fish competitors and predators. This is the first national Recovery Plan for the Dwarf Galaxias, and details its distribution, habitat, conservation status, threats, and recovery objectives and actions necessary to ensure its long-term survival.

Species Information

Description

The Dwarf Galaxias *Galaxiella pusilla* (Mack) is a tiny, slender, freshwater fish growing to a maximum length of about 40 mm for females and 34 mm for males. Like other members of the family Galaxiidae, it has all soft-rayed fins, a body lacking scales, and a single dorsal fin positioned well back on the body. The body depth is greatest mid-abdomen, tapering to both head and tail, while the lateral line follows the dorsal profile. The head is short and blunt with large eyes, while the mouth is small, terminal and oblique, with jaws roughly equal in length. The dorsal and anal fins are opposite, short-based and rounded. The caudal fin is long and rounded, with fleshy flanges extending forward almost to the bases of the dorsal and anal fins. A fleshy abdominal keel (more pronounced in males) extends from the pelvic fin base posteriorly to the vent. Body colour is olive–amber on the dorsal surface and sides, with a silvery-white belly, while the fins are transparent. The species is sexually dimorphic, with males being smaller and more slender than females, and having three longitudinal black stripes along each side of the trunk, and a distinct orange stripe between the mid and lowest black stripe. The black stripes are less distinct or absent in females (description from Cadwallader & Backhouse 1983; McDowall 1996).

The Dwarf Galaxias is a mid-water, free-swimming species, and the entire life cycle is completed in freshwater. Diet consists primarily of a range of tiny aquatic invertebrates including chironomid larvae, copepods, cladocerans and ostracods, as well as terrestrial insects that fall on the water surface (Humphries 1986). The species spawns in late winter–spring. Females lay from 65–250 adhesive eggs, one at a time, over a period of 7–14 days. The eggs are attached usually on the underside of aquatic vegetation or on a hard surface such as a rock or timber. The female may be attended by up to three males, which pass over the eggs to fertilise them, before moving off in search of other spawning females. Larvae hatch after 2–3 weeks and are about 4.5 mm in length. Only one year-class has been observed, suggesting that the Dwarf Galaxias is an annual species. This is supported by observations of adults dying after spawning (Humphries 1986).

Distribution

The Dwarf Galaxias is endemic to south-eastern Australia (Fig. 1). On the mainland, it occurs from the Mitchell River Basin in central Gippsland, Victoria, to the Cortina Lakes, near the Coorong in South Australia. The species also occurs in Tasmania, where it is restricted to lowland areas in the far north-

west and far north-east of the State, as well as on Flinders Island. Distribution of populations is generally disjunct and patchy, due to the nature of its lowland, shallow, swampy habitat.

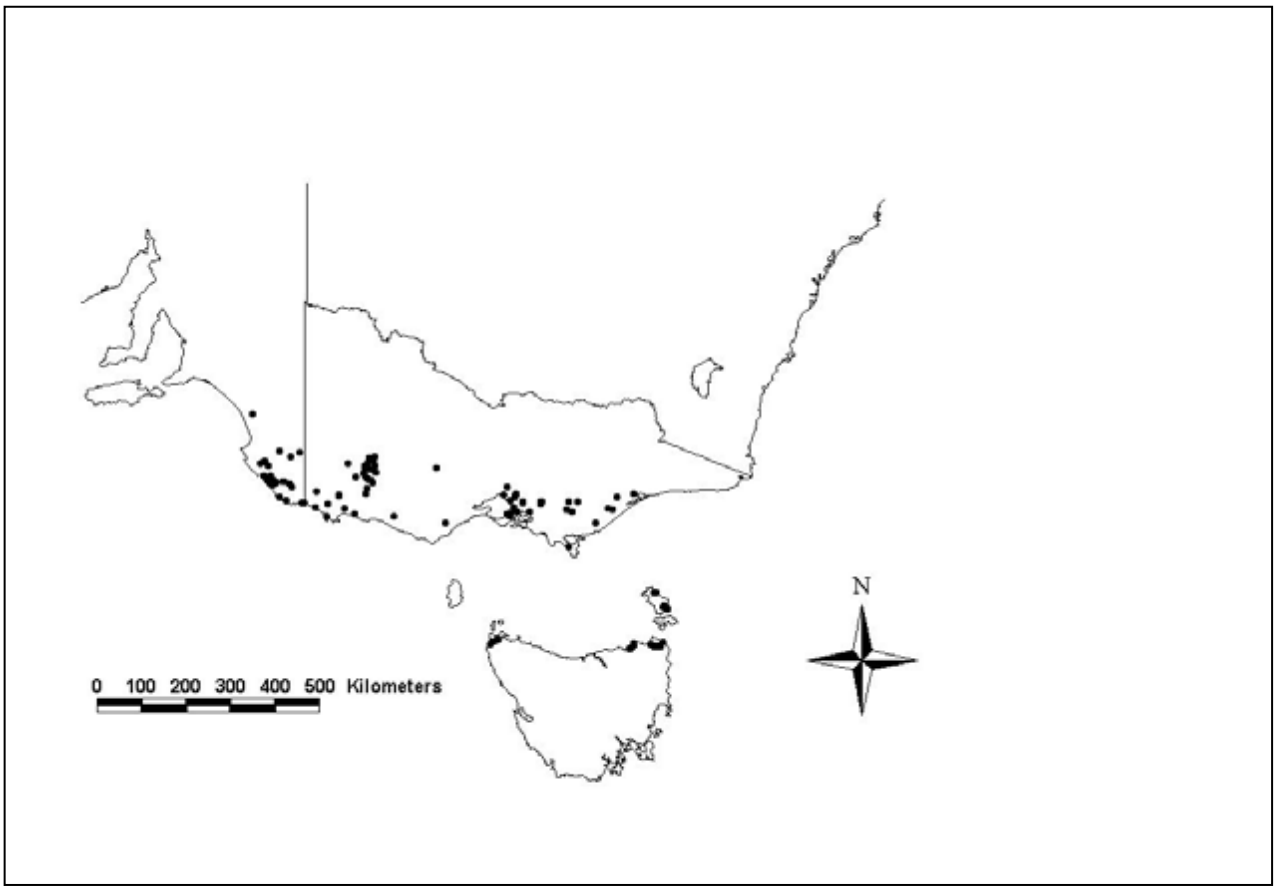

Figure 1. Distribution of the Dwarf Galaxias

Habitat

The Dwarf Galaxias typically occurs in slow flowing and still, shallow, permanent and temporary, freshwater habitats such as swamps, drains and the backwaters of streams and creeks, often (but not always) containing dense aquatic macrophytes and emergent plants (Cadwallader & Backhouse 1983; McDowall 1996; Hammer 2002). In larger pools, the species is usually found amongst marginal vegetation. Some wetlands where it occurs may partially or completely dry up during summer (Humphries 1986), and such wetlands rely on seasonal flooding plus linkages to other sites where the species occurs, for habitat and population replenishment. The Dwarf Galaxias is often found in association with burrowing freshwater crayfish (*Engaeus* spp.), with the crayfish burrows apparently providing refuge from predators and dry conditions (Beck 1985; McDowall 1996). In ephemeral wetlands it is not clear if the Dwarf Galaxias is capable of aestivation over dry summer months, or if it relies on refuges such as freshwater crayfish burrows to survive until the waterbodies fill the following autumn and winter. The natural degree of wetland connectivity to a more permanent waterbody (such as river or creek) may also be vital to their long-term survival (particularly during extended dry conditions) and must therefore be considered as part of the habitat requirement critical to survival. Recovery actions include habitat assessments to further identify habitat critical to survival of the Dwarf Galaxias.

Population Information

The Dwarf Galaxias is currently known from about 110 populations distributed across its range (Appendix 1). Some populations are tiny, occurring in extremely limited ephemeral habitat, while others are quite large and extensive and occur in permanent waterways. Only 16 populations occur in

some form of reserve: 10 in national parks; 2 in coastal parks; I in a metropolitan park; 3 in other reserves. An additional site is listed in the 'Directory of Important Wetlands' (DEH 2001). Many populations occur on private land or public land managed for purposes other than nature conservation. For instance, in Tasmania, land in catchments in which this species occurs is managed by private landholders (51%), Forestry Tasmania (30%), Department of Primary Industries, Parks and Water (DPIPW) (13%) and the Parks and Wildlife Service (6%). Recent extensive sampling in South Australia identified 28 locations where the species occurred (about 10% of sites surveyed) (Hammer 2002; Hammer unpublished data), with most sites occurring on private land or in drainage easements running through private property.

Populations have been ranked for management priority, on the basis of one or more of the following criteria:

- Populations at the extremes of the range.
- Populations are of a high density.
- Populations are isolated within their range from other populations.
- Populations are in an area of high conservation significance (eg. conservation reserve, in 'Directory of Important Wetlands').
- Populations of other threatened fish species occur at the site.

Decline and Threats

Although there is no evidence of a reduction in the range of the Dwarf Galaxias, the species was almost certainly once more widespread and abundant, but populations have probably been substantially fragmented and depleted historically by wetland drainage and modification. The impact of European settlement on shallow freshwater wetlands, the preferred habitat of the Dwarf Galaxias, has been severe. Many wetlands have been lost, and much of what remains has been affected by one or more degrading processes. The main process contributing to wetland loss and degradation in Victoria (which constitutes the bulk of the species' range) has been total or partial drainage, and 37% of the State's natural wetland area has been lost in this way. This decline has been especially severe in shallow wetlands, the preferred habitat of the Dwarf Galaxias, with over 90% of this habitat type being lost in some parts of the State, and the loss has been especially severe on private land (NRE 2000). This decline is almost certainly continuing, especially on private land. Distribution of populations is now generally disjunct and patchy, due to the fragmented nature of the remaining lowland shallow freshwater wetland habitat.

The Dwarf Galaxias is a short-lived species and probably has poor dispersal ability. The fragmented and patchy nature of its remaining habitat across the landscape, and variability of this habitat between seasons and years, makes the species extremely vulnerable to local extinctions. Reduced flooding and loss of habitat linkages greatly reduce the ability to recolonise habitats.

The species is thought to have become extinct at several locations in the last few decades, including Blind, Bruthen, Corhanwarrabul, Langwarren, Little Tea Tree and Watson Creeks (Vic) and Marrawah (Tas) (Appendix 1). Several small populations have been established, usually in artificially created wetlands, through translocation (Appendix 1). Populations supporting high densities of individuals can still be found in some locations, particularly within the Glenelg and Bunyip River basins in Victoria.

The major current and suspected threats are detailed as follows:

Degradation and loss of habitat
The nature of the lowland, shallow freshwater habitat of the Dwarf Galaxias means it is especially susceptible to a range of practices that result in its degradation and loss, especially where this habitat occurs on private land. Considerable areas of shallow freshwater wetlands have been drained for agriculture, urban and industrial development, and wetlands are still being lost in some areas, especially on the outer urban fringe. Many sites on private property are threatened by damage from unrestricted stock access. Stock access and trampling has a major impact on these wetlands, through disturbance and removal of instream and riparian habitat. Physical damage to instream vegetation directly removes a key habitat component. A reduction in riparian vegetation quality often results in a decrease in water quality through increased nutrient run-off, sedimentation and summer water temperatures. Further effects include a reduction in bank stability, leading to increased erosion and sedimentation, and decreased organic input, required by many macroinvertebrates which in turn are a food source for the Dwarf Galaxias. Further physical disturbance of wetlands may occur through

practices such as ploughing when wetlands are dry. Stock damage through trampling to freshwater crayfish burrows may also degrade vital refuge habitat in dry conditions. Application of agricultural pesticides may also be a threat to burrowing crayfish and further reduce refuge habitat.

Alteration to flow regime
Appropriate hydrological conditions that regularly replenish the shallow freshwater habitats are essential for the survival of the Dwarf Galaxias, and the natural degree of wetland connectivity to a more permanent waterbody (such as river or creek) may also be vital to their long-term survival (particularly during extended dry conditions). Changes to natural flood and drying cycles, particularly in swamps and shallow creeks, through activities such as catchment clearing, establishing extensive plantations, construction of dams and direct abstraction of water, pose threats to Dwarf Galaxias habitat . These activities may alter natural seasonal water levels at critical times of the year or may result in complete loss or permanent alteration of wetland habitats. Changes in the level of local water tables may also affect the hydrology of swamps and the ability to seek refuge in crayfish burrows. Populations occurring in Balcombe Creek/Tuerong Creek on the Mornington Peninsula are threatened by water abstraction, particularly in areas of vineyard development (W. Koster DSE pers. comm.).

Extensive plantations of eucalypts and pines in south-eastern South Australia and south-western Victoria pose a major threat to habitat through lowering ground water levels and decreasing runoff into waterways. More wide-scale clearing of catchment vegetation may lead to elevated agricultural run-off that may directly affect water quality (through increased input of sediment, pesticides/herbicides etc) or increase the risk of algal blooms through increased water nutrient levels and sedimentation. Catchment clearing and subsequent tree plantation establishment are also likely to cause altered hydrological regimes (Vertessy 2000) resulting in reduced catchment water yield and direct aquatic habitat loss.

Climate change
Climate change poses a substantial medium to long term threat to the survival of the Dwarf Galaxias. A predicted major impact of climate change in south-eastern Australia will be a decline in overall rainfall, increasing temperatures, and increasing evaporation, with subsequent increasing dryness (Pittock 2003; Pook 2001). This scenario is expected to result in a reduction in the shallow freshwater habitats favoured by the Dwarf Galaxias, through increased drying and decreasing flooding cycles. Decreased flooding will also decrease chances of recolonisation after local extinctions, further fragmenting and isolating remaining populations.

Introduced Aquatic Species
Wager and Jackson (1993) note that predation by Redfin Perch *Perca fluviatilis* may be implicated as a factor contributing to the decline of the Dwarf Galaxias, while damage to aquatic vegetation by Common Carp *Cyprinus carpio* may also impact on habitat critical to the survival of this species. Although there is no direct evidence of impacts on Dwarf Galaxias by Brown Trout *Salmo trutta* or Rainbow Trout *Oncorhynchus mykiss*, there is much documented evidence of their impacts on a wide variety of galaxiid species through both predation and dietary overlap (Arthington & McKenzie 1997). It is therefore likely that these impacts also apply to Dwarf Galaxias. Competition/aggressive behaviour particularly from Eastern Gambusia *Gambusia holbrooki* pose direct threats to the Dwarf Galaxias (Wager & Jackson 1993). The Common Yabby *Cherax destructor* has been introduced to Tasmania, where it is considered a potential threat to the Dwarf Galaxias through degradation of habitat. The Common Yabby has been declared a Controlled Fish under the *Tasmanian Inland Fisheries Act* 1995.

Illegal collection
Anecdotal information suggests that unauthorised collection of Dwarf galaxias (as well as other small threatened fish species) is currently occurring throughout Victoria (including sites in the Bunyip River system and areas in the west of the state). This unregulated collection and trading of individuals by enthusiastic aquarists has the capacity to undermine the genetic integrity of natural populations if specimens are released back into different natural populations.

Populations Under Threat

Virtually all populations of Dwarf Galaxias are under threat to some degree. The type of threats applying to particular populations depend largely on land tenure and management, with populations on private land most at risk. Only 16 populations occur in some form of reserve (see 'Population Information'). The majority of populations therefore occur at sites that have little or no formal

protection from many of the threats listed, and those that do are exposed to broader threats affecting shallow freshwater habitats.

Recovery Information

Program Implementation

The Recovery Plan will be managed by the Department of Sustainability and Environment (Victoria), the Inland Fisheries Service (Tasmania) and the Department for Environment and Heritage (South Australia). Implementation of individual actions will remain the responsibility of the relevant agencies and organisations identified in the Recovery Plan (subject to available resources), who will be responsible for obtaining resources, preparing work plans and monitoring progress toward recovery within their own jurisdiction. A Dwarf Galaxias Recovery Team will be formed consisting of scientists, land/water managers and community organisations with relevant technical, scientific and habitat management skills, to coordinate recovery actions, circulate information and facilitate a review and evaluation of this Recovery Plan at its termination. Any technical, scientific, habitat management or education issue requiring skills not available within the Recovery Team will be referred to specialist organisations and individuals as appropriate. State/regional teams will be responsible for preparing work plans and monitoring progress toward recovery. The Recovery Team will meet regularly (at least once per year) and communicate at least twice per year to review and assess progress of plan implementation, and review the effectiveness of actions in improving the conservation status of the Dwarf Galaxias.

Program Evaluation

The Recovery Team will be responsible for annual assessments of progress towards recovery. This Recovery Plan will be reviewed within five years of the date of its adoption under the EPBC Act.

Recovery Objectives

The long-term objective of recovery is to minimise the probability of extinction and ensure long-term survival of Dwarf Galaxias in the wild and to increase the probability of important populations becoming self-sustaining in the long term. Within the life span of this Recovery Plan, the **Specific Objectives** of recovery are to:

- Determine the distribution and abundance of the Dwarf Galaxias.
- Determine the genetic and taxonomic status of Dwarf Galaxias populations.
- Determine Dwarf Galaxias habitat characteristics and requirements.
- Identify and manage potentially threatening processes impacting on Dwarf Galaxias conservation.
- Protect key populations across the range of the Dwarf Galaxias.
- Determine population trends at key sites.
- Investigate key aspects of biology and ecology of the Dwarf Galaxias.
- Establish a captive breeding population of Dwarf Galaxias.
- Undertake translocations to establish new populations of Dwarf Galaxias.
- Undertake community education and communication to increase awareness and involvement.

Recovery Objectives, Performance Criteria and Actions

Recovery Objective	Performance Critera	Actions
1. Determine the distribution and abundance of the Dwarf Galaxias.	Increases in knowledge of population numbers and distribution in all regions.	1.1 Develop targeted survey techniques. 1.2 Undertake field surveys and mapping in Victoria, South Australia, Tasmania.
2. Determine the genetic and taxonomic status of Dwarf Galaxias populations.	Understanding of population genetic and taxonomic partitioning, and information incorporated into recovery management.	2.1 Determine levels of genetic partitioning between populations and regions. 2.2 Determine taxonomic implications of population partitioning.
3. Determine Dwarf Galaxias habitat characteristics and requirements.	Habitat use at different life history stages and across total range determined, and information used for recovery management.	3.1 Investigate habitat requirements at different life history stages and across total range and determine habitat critical to survival. 3.2 Develop and test a predictive habitat model. 3.3 Develop management strategies to maintain, enhance or restore essential habitat requirements.
4. Identify and manage potentially threatening processes impacting on Dwarf Galaxias conservation.	Increasing understanding and effectiveness of threat abatement so that there is an increase in the numbers of animals and area of occupancy of target populations.	4.1 Identify current and potential threats at each population site. 4.2 Prepare and implement a threat abatement plan for all priority sites. 4.3 Prioritise protection and restoration of habitat at sites supporting the species.
5. Protect key populations across the range of the Dwarf Galaxias.	Key Dwarf Galaxias populations are identified and protected across all bioregions and incorporating the genetic/taxonomic variation of species.	5.1 Protect populations on public land/waters by negotiating relevant instruments: Vic – Public Authority Management Agreements (under the *FFG Act* (1988) and Special Protection Zones in State Forest Sth Aust – Land covenants under the SA Sanctuary Scheme (DEH) Tas – Public Authority Management Agreements, Special Management Zones with Forestry Tasmania under the Management Decision Classification (MDC) scheme for State Forests. 5.2 Liaise with statutory bodies responsible for the management of water affecting Dwarf Galaxias populations to ensure species requirements are considered during planning and management activities. 5.3 Protect populations on private land/waters by initiating private land management agreements in consultation with private land-owners under: Vic – *Victorian Conservation Trust Act 1972*; Land for Wildlife program SA –Heritage Agreement Scheme; Sanctuary Scheme Tas –Private Property Conservation Program; Protected Areas on Private Land Program; Land for Wildlife Program. 5.4 Liaise with landholders whose land borders or lies immediately upstream of populations to encourage appropriate protection and general awareness of species requirements.

6. Determine population trends at key sites.	A network of monitored populations is established and long-term monitoring of population trends undertaken to assess the impact of threats and effectiveness of recovery actions.	6.1 Develop standardised population monitoring techniques. 6.2 Establish a network of sites within each bioregion where population monitoring will occur. 6.3 Conduct population monitoring at selected sites to investigate recruitment/mortality levels and determine population viability.
7. Investigate key aspects of biology and ecology of the Dwarf Galaxias.	Information on key aspects of biology and ecology is gained and used in conservation management of the species.	7.1 Determine the conditions for spawning and recruitment of the Dwarf Galaxias. 7.2 Investigate summer refuge use and aestivation ability of the Dwarf Galaxias. 7.3 Determine the diet of the Dwarf Galaxias.
8. Establish a captive breeding population of Dwarf Galaxias.	Dwarf Galaxias successfully established at one or more locations in captivity, breeding and recruiting young.	8.1 Establish and maintain populations in captivity (eg. zoos, aquaria, universities, institutes) to safeguard against loss of wild populations and genetic diversity.
9. Establish new populations of Dwarf Galaxias.	At least one new demographically robust population established in secure habitat.	9.1 Evaluate and select suitable translocation sites. 9.2 Prepare a translocation plan and protocols to ensure appropriate genetic diversity in translocated populations. 9.3 Prepare site(s) to achieve maximum survival of translocated individuals and implement translocation plan. 9.4 Maintain and monitor translocated populations.
10. Increase awareness and involvement.	Community and stakeholder understanding of and support for Dwarf Galaxias conservation is increased.	10.1 Identify opportunities for community involvement in the conservation of the Dwarf Galaxias. 10.2 Provide information about threats to and recovery management of the Dwarf Galaxias to land and water managers, other stakeholders and the general public.

Cost of the Recovery Plan

The estimated cost of implementing the Recovery Plan is $2.22 million over five years.

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Totals	**$274,000**	**$382,000**	**$487,000**	**$535,500**	**$543,500**	**$2,222,000.00**

See Appendix 2 for detailed costs by Action and by Year.

Benefits to other species/ecological communities

The Recovery Plan includes a number of potential biodiversity benefits for other species and ecological communities (Appendix 3 lists a range of native freshwater fish species known to occur with Dwarf Galaxias). Of particular importance is the potential benefit to other threatened fish species such as the Yarra Pygmy Perch *Nannoperca obscura*. Principally, this will be through the protection and management of aquatic and riparian habitat where Dwarf Galaxias occur and on adjacent land. The adoption of broad-scale management techniques and collection of baseline data will also benefit other aquatic species occurring in association with Dwarf Galaxias, particularly those species with similar habitat requirements and life cycles. In addition, implementation of the recovery plan will increase public awareness of this and other freshwater species and their conservation requirements.

Additional fish species will also benefit from conservation measures aimed at conserving Dwarf Galaxias populations. Many of these species are migratory, requiring access to estuaries or the marine environment to complete their life cycle. These species include the Australian Grayling *Prototroctes maraena* (a species listed as vulnerable under the EPBC Act) which is known to pass through habitat occupied by the Dwarf Galaxias (DSE 2005).

The Recovery Plan will also provide an important public education role as threatened fish have the potential to act as 'flagship' species for highlighting broader nature conservation issues in aquatic habitats, such as habitat degradation, barriers to migration and invasive species.

Affected Interests

The Dwarf Galaxias occurs across a variety of land/water tenures and managers, including national parks, urban reserves, state forest, heritage rivers and private land. Consequently, management is the responsibility of a range of agencies, organisations and individuals (Table 1). Populations are considered reserved if they are contained within parks/reserves or other protected areas established with nature conservation (as defined under relevant state/territory legislation) as a primary or major aim of management, eg. in national and state parks, nature reserves etc.

This Recovery Plan has the support of State government agencies, land/water managers including Catchment Management Authorities, Melbourne Water and community groups involved in nature conservation in general and native fish conservation in particular (eg. Native Fish Australia). This draft plan has been endorsed by the Tasmanian Galaxias Recovery Team, which includes representatives of the following stakeholder groups:

- Inland Fisheries Service
- Threatened Species Section, DPIPW
- World Wildlife Federation Threatened Species network
- Tasmanian Farmers and Graziers Association
- Forest Practices Authority
- Biodiversity representatives from the North and North-West Natural Resource Management Committees.

Table 1. Affected Interests

Organisation	Type
National/Regional	
WWF – Threatened Species Network	Community Group
Australia and New Guinea Fish Association	Community Group
Native Fish Australia	Community Group
South Australia	
Dept. for Environment and Heritage	State Government
South Australian Research and Development Institute	State Government
Dept. of Water, Land and Biodiversity Conservation	State Government
Conservation Council of South Australia	State Government
Department for Water Resources	State Government
South East Catchment Management Board	State Government
South Australian Environmental Protection Agency	State Government
PIRSA Fisheries	State Government
Forestry SA	State Government
SE Water Conservation and Drainage Board	Regional Authority
South Australian Recreational Fishing Advisory Council	Community group
Native Fish Australia (SA)	Community group
Landcare South Australia	Community group
Victoria	
Department of Sustainability and Environment	State Government
Department of Primary Industries	State Government
Parks Victoria	State Government
Victorian Environmental Protection Agency	State Government
Glenelg-Hopkins Catchment Management Authority	Regional Authority
Corangamite Catchment Management Authority	Regional Authority
Port Phillip & Westernport Catchment Management Authority	Regional Authority
Glenelg Shire Council	Local Government
Southern Grampians Shire Council	Local Government
Moyne Shire Council	Local Government
Colac-Otway Shire Council	Local Government
East Gippsland Shire Council	Local Government
Wellington Shire Council	Local Government
South Gippsland Shire Council	Local Government
Mornington Peninsula Shire Council	Local Government
Frankston City Council	Local Government
Casey City Council	Local Government
Knox City Council	Local Government
Cardinia Shire Council	Local Government
Victorian Threatened Species Network Coordinator	Community group
Tasmania	
DPIPW	State Government
Inland Fisheries Service	State Government
Rivers and Water Supply Commission	State Government
Office of Aboriginal Affairs (Hobart)	State Government
Tasmanian Environmental Protection Agency	State Government
Hydro Tasmania	State Government
Forestry Tasmania	State Government
Cradle Coast Water Authority	Regional Authority
Circular Head Council	Local Government
Dorset Council	Local Government
Tasmanian Farmers and Graziers Association	Industry group
Freshwater Anglers Council of Tasmania (FACT)	Community group

Role and interests of indigenous people

Indigenous communities on whose traditional lands the Dwarf Galaxias occurs are being advised, through the relevant regional indigenous facilitator, of this draft Recovery Plan. Indigenous communities will be invited to be involved in the implementation of the Recovery Plan.

Social and economic impacts

The implementation of this Recovery Plan is unlikely to cause significant adverse social and economic impacts, although there may be low-level impacts associated with protection of populations on private land. Because most populations are on private land, habitats potentially affected by the impacts of riparian clearing, drainage, stock access or water abstraction may require controls on their use. For this reason, potential negative on-farm impacts may include foregone grazing, and costs associated with fencing and establishing alternative watering points (LWRRDC 1991). However, affected areas are likely to be generally small. There are substantial benefits associated with improved riparian management, including improved stock control, opportunity for income diversification (farm forestry in riparian zone), improved water quality, reducing stream bank erosion, improved aesthetics, improved farm biodiversity and improved farm capital value. Protection on private land will be achieved through negotiation with land owners/managers. Incentives are available through natural resource management programs, and protection of habitat for the Dwarf Galaxias will be included as an objective in high priority areas.

Management Practices

Management practices that should be adhered to by land and water managers in order to avoid threatening processes believed to be responsible for the decline in the Dwarf Galaxias:

- No direct loss of habitat through wetland drainage on either public or private land.
- No physical alteration to Dwarf Galaxias habitat as a consequence of incidental works on land adjoining Dwarf Galaxias habitat.
- Applications for water abstraction or dam construction do not compromise flow regimes for Dwarf Galaxias.
- Habitat and adjoining riparian habitat are fenced off to stock access.
- Off-stream watering points are provided for stock.
- No further damage to riparian vegetation.
- Damaged or depleted riparian vegetation is protected and (if necessary) supplemented by active revegetation works.
- Plans to clear vegetation lying adjacent to Dwarf Galaxias habitat will not impact upon water quality (no increase in sedimentation/nutrient levels/pesticides/herbicides etc).
- Plans to revegetate with plantation timber/crops will not impact upon overall water yield (and subsequently flow regime of Dwarf Galaxias habitat).
- Proposals to translocate aquatic species into Dwarf Galaxias habitat are subject to relevant risk management processes according to relevant national and State guidelines.

Acknowledgments

For assistance in the preparation of this Recovery Pan, including the provision of data, help with mapping and providing comments on drafts, we thank the following people: Andrew Corrick, Peter Griffeon, Petina Pert, Tarmo Raadik and Michael Scroggie (DSE).

References

Arthington, A.H. and McKenzie, F. 1997. *Review of the impacts of displaced/introduced fauna associated with inland waters*: State of the Environment Technical Paper Series (Inland Waters), Department of the Environment, Canberra.

ASFB 2001. *Conservation Status of Australian Fishes 2001*. Australian Society for Fish Biology

Beck, R.G. 1985. Field Observations of the Dwarf Galaxias *Galaxiella pusilla* (Mack) (Pisces: Galaxiidae) in the south-east of South Australia, Australia. *South Australian Naturalist* 60:12–22.

Cadwallader, P.L. and Backhouse, G.N. 1983. *A Guide to the Freshwater Fish of Victoria*. Government Printer, Melbourne.

DEH 2000. Revision of the Interim Biogeographic Regionalisation of Australia (IBRA) and the Development of Version 5.1. - Summary Report. Department of the Environment and Heritage, Canberra.

DEH 2001. *A Directory of Important Wetlands in Australia, 3rd ed.* Department of the Environment and Heritage, Canberra.

DEH 2003. *Review of the Status of Threatened Species in South Australia – Discussion Paper*. Department for Environment and Heritage, Adelaide.

DSE 2005. Department of Sustainability and Environment, Aquatic Fauna Database.

DSE 2007. Advisory List of Threatened Vertebrate Fauna in Victoria 2007. Department of Natural Resources and Environment, Melbourne.

Hammer M. 2002. The South East fish inventory: distribution and conservation of freshwater fishes of south east South Australia. Native Fish Australia (SA) Inc., Adelaide.

Humphries, P. 1986. Observations on the ecology of Galaxiella pusilla (Mack) (Salmoniformes:Galaxiidae) in Diamond Creek, Victoria. *Proc. Roy. Soc. Vic.* 98:133-137.

IUCN 2003. IUCN Red List Categories Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland.

Jackson, J.E. 2003. Draft Tasmanian Galaxiidae Recovery Plan 2003-2007. Inland Fisheries Service, Hobart.

LWRRDC 1991. Riparian Vegetation Management Demonstration Sites Far South Coast NSW, LWRRDC report no. BVS1, December 1999.

McDowall, R.M. 1996. *Freshwater Fishes of South-Eastern Australia.* Reed Books, Sydney.

NRE 1997. *Victoria's biodiversity: directions in management*. Department of Natural Resources and Environment, East Melbourne.

NRE 2000. *Victoria's Biodiversity: Directions in Management*. Department of Natural Resources and Environment, Victoria.

Pittock, B. (ed) 2003. Climate change: An Australian Guide to the Science and Potential Impacts. Australian Greenhouse Office, Canberra.

Pook, M. 2001. Tasmania's Climate and Projections for the Century. Water Development Plan for Tasmania Project. Department of Primary Industries, Water and Environment, Tasmania (available on www.dpiw.tas.gov.au).

Wager, R. and Jackson, P. 1993. *The Action Plan for Australian Freshwater Fishes*. Australian Nature Conservation Agency, Endangered Species Program Project No. 147, Canberra.

Vertessy, R.A. 2000. Impacts of plantation forestry on catchment runoff. *Plantations, farm forestry and water - Proceedings of a National Workshop*. Melbourne, Australia, July 21–22 (2000).

Appendix 1. Population location information for the Dwarf Galaxias

Sources: IFS unpublished data; DSE 2004; Hammer 2002

State	Location	Catchment	Bioregion *	Abundance (N fish/ 100m) V. Low <6 Low 6-10 Med 11-20 High 21-30 V. High >30	Surveyed Year methods D Dip net S Seine net B Bait trap L Light trap E Electrofishing	Comments/(Land tenure-Land Manager) P Private land NP National Park CP Coastal Park SP State Park R Metropolitan park or reserve	Mgt Priority	Map	Grid Reference easting & northing
SA	Bakers Range Drain	Millicent Coast	NCP	V. High	2001-2004	Fenced (P)	1	6923	451600 5903800
SA	Blackfellows Cave swamp	Millicent Coast	NCP	Low	2001-2004	Coastal wetland (isolated), fenced	1	6922	453000 5802000
SA	Blue Tea Tree Swamp trib	Millicent Coast	VVP	Med	2001-2004	Reserve (R)	3	7022	457466 5837227
SA	Bool Lagoon	Millicent Coast	NCP	V. Low	2001-2004	Game Reserve (R); co-occurs with Yarra Pigmy Perch *Nannoperca obscura*	2	7023	472494 5891687
SA	Bray Drain	Millicent Coast	NCP	V. Low	2001-2004	Grazing- light (P)	1	6923	418767 5876980
SA	Bray Drain	Millicent Coast	NCP	Med	2001-2004	Grazing- light (P)	1	6923	418800 5876950
SA	Cortina Lakes	Millicent Coast	NCP	V. Low	2001-2004	Roadside (R)	1	6825	402654 5986773
SA	Dismal Swamp- isolated	Millicent Coast	NCP	High	2001-2004	Subject to light grazing (P)	1	7022	471197 5831366
SA	Drain 29	Millicent Coast	NCP	V. Low	2001-2004	Urban area (P); co-occurs with Yarra Pigmy Perch *Nannoperca obscura*	1	6922	442200 5838900
SA	Drain 32	Millicent Coast	NCP	V. High	2001-2004	Vacant land (P)	1	6922	441900 5838300
SA	Drain 36	Millicent Coast	NCP	V. Low	2001-2004	Grazing- light (P)	1	6922	446607 5835087
SA	Drain BR45	Millicent Coast	NCP	V. Low	2001-2004	Grazing- light (P)	1	6923	421243 5879983
SA	Drain into Lake Letty	Millicent Coast	VPP	Med	2001-2004	Roadside (R)	1	7022	461100 5838100
SA	Hatherleigh Drain	Millicent Coast	NCP	V. High	2001-2004	Road side (R)	1	6923	435907 5850495
SA	Lake Bonney	Millicent Coast	NCP	Med	2001-2004	Fenced (P)	1	6922	435092 5834999
SA	Lake Bonney	Millicent Coast	NCP	V. Low	2001-2004	Recreation (R)	1	6922	439500 5829700
SA	Lake Bonney floodplain	Millicent Coast	NCP	V. Low	2001-2004	Recreation (R)	1	6922	439200 5829800
SA	Mosquito Creek	Millicent Coast	NCP	V. Low	2001-2004	Subject to heavy grazing (P); co-occurs with Yarra Pigmy Perch *Nannoperca obscura*	1	7023	488606 5901102
SA	Mullins Swamp	Millicent Coast	NCP	Low	2001-2004	Subject to light grazing (P)	1	6922	424800 5848600
SA	Narrow Neck Drain 1B	Millicent Coast	NCP	Low	2001-2004	Vacant land (P)	1	6922	428900 5843700
SA	Pick's Swamp	Millicent Coast	NCP	V. Low	2001-2004	Grazing- heavy (P)	1	7021	491268 5789939
SA	Reedy Creek Mt Wilmont Drain	Millicent Coast	NCP	V. Low	2001-2004	Conservation Park (R)	3	6923	431200 5872300
SA	Reedy Creek Mt Wilmot Drain	Millicent Coast	NCP	V. Low	2001-2004	Grazing- heavy (P)	1	6923	426488 5882529
SA	Unnamed drain	Millicent Coast	NCP	V. High	2001-2004	Subject to light grazing (P)	1	6922	431288 5840377
SA	Unnamed drain	Millicent Coast	NCP	Low	2001-2004	Subject to heavy grazing (P)	1	7021	465300 5793400
SA	Unnamed swamp	Millicent Coast	VVP	V. High	2001-2004	Isolated, subject to light grazing (P)	1	7022	473300 5825450
SA	Hammerhead Lagoon	Glenelg	NCP	Med	2001-2004	Conservation Park (R)	3	7021	495966 5788613
SA	Unnamed swamp	Glenelg	NCP	Med	2001-2004	Conservation Park (R)	3	7021	495200 5788900

State	Location	Catchment	Bioregion *	Abundance (N fish/ 100m) V. Low <6 Low 6-10 Med 11-20 High 21-30 V. High >30	Surveyed Yr methods D Dip net S Seine net B Bait trap L Light trap E Electrofishing	Comments/(Land tenure-Land Manager) P Private land NP National Park CP Coastal Park SP State Park R Metropolitan park or reserve	Mgt Priority	Map	Grid Reference easting & northing
VIC	Big Swamp	Glenelg River	VM	V. High (53)	1979 D	Grampians National Park (NP-Parks Vic)	3	7323	605500-5807500
VIC	Bryan Swamp	Glenelg River	VVP	Unknown	1979/1990	Large pop over large area (P)	1	7322	610900-5841800
VIC	Crawford River	Glenelg River	VVP	V. Low-V. High (3-40)	1994/2002 E	Relatively isolated, extends >20 km (P); co-occurs with Yarra Pigmy Perch *Nannoperca obscura*	2	7222	557500-5803000 to 569200-5811000
VIC	Dundas River	Glenelg River	VM	V. Low (1)	1990 E	Relatively isolated (P)	2	7322	588500-5846300
VIC	Dwyer Creek	Glenelg River	VM	Unknown	1979 E	Very little data available (P)	2	7323	624200-5857000 to 623300-5858600
VIC	Glenelg River	Glenelg River	VM	V. High (80)	1979/2000 S/E	extends >60km, through Grampians National Park (NP-Parks Vic) & private land (P); co-occurs with Yarra Pigmy Perch *Nannoperca obscura*	2	7223 /7323	574900-5877200 to 614300-5863500
VIC	Green Creek	Glenelg River	VM	Unknown	1974-1976 D	Small area, Grampians National Park (NP-Parks Vic)	3	7323	623300-5870200 to 624000-5869000
VIC	Kangaroo Creek	Glenelg River	VVP	Low-V. High (7-50)	1999/2002 E	Isolated population (P)	1	7222	558800-5806900
VIC	Lake Linlithgow	Glenelg River	VM	Unknown	1971 Unknown	isolated; in Directory of Important Wetlands (P)	1	7322	607000-5820000
VIC	Lake Monibeong	Glenelg River	NCP	Unknown	1979	Possibly extinct; Discovery Bay Coastal Park (CP-Parks Vic); co-occurs with Yarra Pigmy Perch *Nannoperca obscura*	3	7121	515500-5779500
VIC	Lambing Hut Ck	Glenelg River	VM	Unknown	1979 E	Very little data available (P)	2	7323	622300-5857900
VIC	Little Tea Tree Ck.	Glenelg River	VM	Unknown	1979 E	Possibly extinct (P)	3	7323	603200-5854700
VIC	Moora Moora Reservoir	Glenelg River	VM	Unknown	1979 Unknown	Moderate area; Grampians National Park (NP-Parks Vic)	3	7323	612100-5887800 to 625900-5873900
VIC	Red Rock Ck	Glenelg River	VM	Unknown	1977 Unknown	Grampians National Park (NP-Parks Vic)	3	7323	611000-5879400
VIC	Rose Creek	Glenelg River	VM	Unknown	1979 Unknown	Small area; Grampians National Park (NP-Parks Vic)	3	7323	622600-5890900
VIC	Scott Creek	Glenelg River	VM	V. High (70)	1996 D	Grampians National Park (NP-Parks Vic)	3	7323	605800-5869400
VIC	Scott Creek	Glenelg River	VM	V. Low (3)	1990 E	Isolated, western extent of range (P)	1	7122	517800-5814200
VIC	Sheet of Water Swamp	Glenelg River	VM	Unknown	1994 D	Grampians National Park (NP-Parks Vic)	3	7323	620900-5884600
VIC	Unnamed swamp-Glenelg	Glenelg River	VM	Low (7)	1996 D	Grampians National Park (NP-Parks Vic)	3	7323	605000-5871300
VIC	Unnamed swamp-Glenelg	Glenelg River	VM	Unknown	1979 Unknown	Very little data available (P)	2	7322	616200-5838900
VIC	Victoria Lagoon	Glenelg River	VM	Unknown	1979 E	Small isolated area, ephemeral (P)	2	7323	603700-5862300
VIC	Wannon River	Glenelg River	VM	V.low-V.High (1-1000)	1999-2002 D/E	High density population (P)	1	7322	606200-5845900 to 619800-5835500
VIC	Wannon River	Glenelg River	VM	Unknown	1979 E	Very little data available (P)	2	7322	617800-5834100 to 621500-5837500
VIC	Bridgewater Lakes	Portland Coast	NCP	Unknown	1991 D	Large pop; Discovery Bay Coastal Park (CP-Parks Vic); co-occurs with Yarra Pigmy Perch *Nannoperca obscura*	3	7121	535000-5759400
VIC	Darlot Creek	Portland Coast	VVP/SCP	V.low-V.High 4-60	2000/1/2/3 D	Relatively isolated (P)	1	7221	568500-5776900 to 567800-5774100

State	Location	Catchment	Bioregion *	Abundance (N fish/ 100m) V. Low <6 Low 6-10 Med 11-20 High 21-30 V. High >30	Surveyed Yr methods D Dip net S Seine net B Bait trap L Light trap E Electrofishing	Comments/(Land tenure-Land Manager) P Private land NP National Park CP Coastal Park SP State Park R Metropolitan park or reserve	Mgt Priority	Map	Grid Reference easting & northing
VIC	Eumeralla River	Portland Coast	SCP	V. Low (1)	1990 E/D	Relatively isolated (P); co-occurs with Yarra Pigmy Perch *Nannoperca obscura*	1	7221 /7321	627-843 to 888-603
VIC	Fitzroy River	Portland Coast	NCP	V. low (1)	1999 E	No info.	2	7121	537500-5785500
VIC	Merri River	Hopkins River	VM	Low	2002 S	Recently discovered (P)	3	7421	733400-5862600
VIC	Mount Emu Creek	Hopkins River	VM	V. Low	1986-2002 S	Relatively isolated, low numbers (P)	2	7421 /7523	653800-5756600 to 718100-5853800
VIC	Gosling Creek	Barwon River	SCP	Low (9)	2002 E/D/S	only Otway coast population (P)	1	7621	745800-5741600
VIC	LaTrobe Uni wetland #1	Yarra River	SCP	Med-V.high (17-53)	1993/94 D (stocked)	Translocated population, small area (R-LaTrobe University)	3	7922	328500-5823600
VIC	LaTrobe Uni wetland #2	Yarra River	SCP	Unknown	1993/19 D (stocked)	Translocated population, small area (R-LaTrobe University)	3	7922	328600-5823700
VIC	Balcombe Creek	Bunyip River	SCP	V. Low–V.High (2-53)	1988/91 E/D/S	Good nos/connectivity, extends for ~15 km (P)	1	7921	328700-5762400 to 336100-5765200
VIC	Bittern Reservoir	Bunyip River	SCP	V. high (75)	2002 D	High density pop (R – Melbourne Water Corp.)	1	7921	335400-5758200
VIC	Blind Creek	Bunyip River	SCP	Low (7)	1995 D	Possibly extinct (surv. Since) (P)	3	7922	343900-5806700
VIC	Boggy Creek	Bunyip River	SCP	V. Low (2-4)	1992 D	Isolated population (P)	1	7921	340800-5778600
VIC	Cannibal Creek	Bunyip River	SCP	V.low-V.High (1-41)	2000 D/B/E	high density over large area, ~20 km (P)	1	8021	389200-5785900 to 379600-5789400
VIC	Cardinia Creek	Bunyip River	SCP	Mod-V. high (30-75)	1983 D/E	Possibly extinct (surv. since) Type locality (P)	3	7921	356700-5788800
VIC	Corhanwarrabul Creek	Bunyip River	SCP	V. Low (2)	1986 D	Possibly extinct (P)	3	7922	342300-5801100
VIC	Devil Bend Creek	Bunyip River	SCP	V. low-Med (1-12)	1997 D/E	High density, good connectivity (P)	1	7921	331800-5761900 to 329500-5762300
VIC	Diamond Creek	Bunyip River	SCP	Low-Mod (5-20)	2002 D/S/E	Good population (P)	2	8021	390700-5790200 to 389500-5791800
VIC	Dingo Creek	Bunyip River	SCP	V. Low (1)	1997 D/B	Low numbers (P)	2	8021	388600-5791500
VIC	Elsternwick Park Lake	Bunyip River	SCP	High (75)	2002 (stocked)	Translocated population (R)	2	7822	323300-5804500
VIC	Jells Park Wetland #6	Bunyip River	SCP	V. Low (5)	1997 D	Small area, isolated population (R – Melbourne Water)	2	7922	342000-5804000
VIC	Langwarren Creek	Bunyip River	SCP	Unknown	1964	Possibly extinct (P)	3	7921	346600-5769000
VIC	Tuerong Creek	Bunyip River	SCP	V.low-V.High (1-301)	1988-1999 D/B	High density, good connectivity, extends ~6km (P)	1	7921	331200-5761100 to 332100-5764000
VIC	Watson Creek	Bunyip River	SCP	Unknown	1964 Unknown	Possibly extinct (P)	3	7921	341000-5769500
VIC	Wetland, Braeside Park	Bunyip River	SCP	Moderate (75)	2002 (stocked)	Translocated population (R)	2	7922	335700-5793700
VIC	Wetland, Tirhatuan Park	Bunyip River	SCP	V.low-V.High (1-156)	1997/99 D/B	Small area, Tirhatuan Park (R – Melbourne Water Corp.)	2	7922	343500-5799200
VIC	Wetland on Blind Creek	Bunyip River	SCP	Low-High (7-21)	1997 D/B	Small, relatively isolated (P)	1	7922	343600-5806200
VIC	Wetland on Cardinia Ck	Bunyip River	SCP	V.low-High (1-27)	1997/99 D/B	Moderate density (R)	1	7921	357500-5789700
VIC	Yallock Creek	Bunyip River	SCP	Low – Mod (5-17)	1976-2004 D/E/L	Assumed moderate size population (P?)	2	8021	368900-5769000
VIC	Bruthen Creek	Sth Gippsland	SCP	Unknown	1979	Possibly extinct (surv. Since) (P)	3	8221	485400-5744400

State	Location	Catchment	Bioregion *	Abundance (N fish/ 100m) V. Low <6 Low 6-10 Med 11-20 High 21-30 V. High >30	Surveyed Yr methods D Dip net S Seine net B Bait trap L Light trap E Electrofishing	Comments/(Land tenure-Land Manager) P Private land NP National Park CP Coastal Park SP State Park R Metropolitan park or reserve	Mgt Priority	Map	Grid Reference easting & northing
VIC	Cotters Lake	Sth Gippsland	SCP	Mod-High (30)	2002 D	Very small area; Wilsons Prom Nat Park (NP-Parks Vic)	3	8120	439000-5691000
VIC	Drain near five mile Creek	Sth Gippsland	SCP	Unknown	1980 E	Isolated population (P)	2	8120	437400-5790600
VIC	Miranda Creek	Sth Gippsland	SCP	V. Low (1)	2002 D	Low density, Wilsons Prom Nat Park (NP-Parks Vic)	3	8120	453600-5791400
VIC	Boundary Creek	LaTrobe River	SCP	V. Low (2)	1993 E	Isolated population (P)	1	8321	514900-5774900
VIC	LaTrobe River	LaTrobe River	SCP	Mod (10)	2001 D	Isolated population (P)	1	8321	507300-5776700
VIC	Moe River	LaTrobe River	SCP	Mod (15)	2002 D	Isolated population (P)	1	8121	433700-5774700
VIC	Morwell River	LaTrobe River	SCP	Mod (11)	1998 E	Isolated population (P)	1	8121	443900-5768300
VIC	Perry River	Thomson River	SCP	Low (6)	2002 S/D	Isolated population (P)	1	8322	524100-5802700
VIC	Cobblers Creek	Mitchell River	SCP	Unknown	1988 E	Eastern extent of known range (P)	1	8422	553200-5810000
TAS	Logan Lagoon	Furneaux	FLI	Unknown	1992	(P)	1	5955	610000 5552000
TAS	Pool, Lackrana	Furneaux	FLI	Unknown	1992	(P)	1	5955	603000 5559900
TAS	Pool near Chew Tobacco Creek	Furneaux	FLI	Unknown	1992	(P)	1	5955	601000 5554900
TAS	Pool near Hogans Lagoon	Furneaux	FLI	Unknown	1992	(P)	1	5858	589900 5587800
TAS	Wingaroo	Furneaux	FLI	Unknown	1992	(P)	1	5858	586800 5588400
TAS	Great Musselroe River	Musselroe-Ansons	FLI	Unknown	1992	(P)	1	5846	591400-5467700
TAS	Icena Creek	Musselroe-Ansons	FLI	Unknown	1992	(P)	1	5847	593500 5470000
TAS	Icena Creek	Musselroe-Ansons	FLI	Unknown	1992	(P)	1	5846	596200 5466400
TAS	Pool, Mt William	Musselroe-Ansons	FLI	Unknown	1992	(P)	1	6047	600700-5478200
TAS	Big Waterhouse Lake wetlands	Boobyalla	FLI	Unknown	1992	(P)	1	5447	551600-5472800
TAS	Blackmans Lagoon	Boobyalla	FLI	Unknown	1992	(P)	1	5447	550200-5471000
TAS	Creek at Lowly	Boobyalla	FLI	Unknown	1992	(P)	1	5446	549100-5469100
TAS	Drain, Forester Lodge	Boobyalla	FLI	Unknown	1992	(P)	1	5446	544400-5462400
TAS	Nr Little Waterhouse Lake	Boobyalla	FLI	Possibly extinct?	1992	(P)	1	5447	552000-5475100
TAS	Pool, Forester Lodge	Boobyalla	FLI	Unknown	1992	(P)	1	5446	543000-5463600
TAS	Pool, Marengo	Boobyalla-Tomohawk	FLI	Possibly extinct?	1992	(P)	1	5446	547900-5466100
TAS	Lagoon, Gladstone	Ringarooma	FLI	Unknown	1992	(P)	1	5846	585000-5467200
TAS	Pool, Rushy Lagoon	Ringarooma	FLI	Unknown	1992	(P)	1	5647	579700-5473200
TAS	The Marsh Creek	Ringarooma	FLI	Possibly extinct?	1992	(P)	1	5847	583500 5470800
TAS	Blue Bog	Welcome	KING	Unknown	2000	(P)	1	3047	307900 5470100
TAS	Horsepiss Creek	Welcome	KING	Unknown	2000	(P)	1	3048	319900 5482000
TAS	Jims Plain	Welcome	KING	Unknown	2000	(P)	1	3047	314536 5478188
TAS	Pool near Marrawah	Welcome	KING	Extinct	2000	Population extinct (P)	3	3047	311000 5476900

* IBRA Bioregion (*sensu* DEH 2000): NCP = Naracoorte Coastal Plain; Victorian Volcanic Plain; VM = Victorian Midlands; SCP = South East Coastal Plain; FLI = Flinders; KING = King

Appendix 2: Priority, Feasibility and Estimated Costs of Recovery Actions

Action	*Description*	*Priority*	*Feasibility*	*Responsibility*	*Cost estimate*					
					Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	**Distribution & abundance**									
1.1	Survey techniques	1	100%	DSE, IFS, DEH	$10,000	$0	$0	$0	$0	$10,000.00
1.2	Field surveys	1	100%	DSE, IFS, DEH	$0	$40,000	$40,000	$49,000	$49,000	$178,000.00
2	**Genetic & taxonomic status**									
2.1	Genetic partitioning	2	100%	DSE, IFS, SA Museum	$0	$20,000	$20,000	$25,000	$0	$65,000.00
2.2	Taxonomic implications	1	100%	DSE, IFS, DEH	$0	$0	$0	$0	$10,000	$10,000.00
3	**Habitat requirements**									
3.1	Habitat investigation	1	100%	DSE, IFS, DEH	$20,000	$20,000	$22,000	$0	$0	$62,000.00
3.2	Predictive habitat model	2	90%	DSE, IFS, DEH	$0	$0	$0	$10,000	$10,000	$20,000.00
3.3	Habitat management strategies	2	75%	DSE, IFS, DEH	$0	$0	$0	$22,000	$22,000	$44,000.00
4	**Manage threats**									
4.1	Threat identification	1	75%	DSE, IFS, DEH	$8,000	$8,000	$0	$0	$0	$16,000.00
4.2	Threat abatement plan	1	75%	DSE, IFS, DEH	$0	$15,000	$0	$0	$0	$15,000.00
4.3	Protection and restoration	1	75%	DSE, IFS, DEH	$0	$15,000	$30,000	$0	$0	$45,000.00
	Control threats	1	75%	DSE, IFS, DEH, PV, CMAs	$150,000	$157,000	$165,000	$175,000	$182,000	$829,000.00
5	**Population protection**									
5.1	Public land protection	3	100%	DSE, IFS, DEH	$10,000	$10,500	$0	$0	$0	$20,500.00
5.2	Agency liaison	2	75%	DSE, IFS, DEH	$0	$3,000	$3,000	$3,500	$3,500	$13,000.00
5.3	Private land protection	1	50%	DSE, IFS, DEH	$40,000	$42,000	$44,000	$0	$0	$126,000.00
5.4	Landholder liaison	1	75%	DSE, IFS, DEH, PV, CMAs	$8,000	$8,000	$8,000	$8,000	$8,000	$40,000.00
6	**Population trends**									
6.1	Standardised monitoring techniques	2	100%	DSE, IFS, DEH	$8,000	$8,500	$0	$0	$0	$16,500.00
6.2	Population monitoring sites	2	100%	DSE, IFS, DEH	$10,000	$10,000	$0	$0	$0	$20,000.00
6.3	Population monitoring	2	100%	DSE, IFS, DEH	$0	$0	$45,000	$55,000	$70,000	$170,000.00

7	**Biology and ecology**										
7.1	Spawning and recruitment	2	75%	DSE, IFS, DEH		$0	$0	$60,000	$63,000	$0	$123,000.00
7.2	Refuge use and aestivation	1	75%	DSE, IFS, DEH		$0	$0	$30,000	$30,000	$45,000	$105,000.00
7.3	Diet	3	75%	DSE, IFS, DEH		$0	$0	$0	$10,000	$10,000	$20,000.00
8	**Captive population**										
8.1	Establish captive population	3	75	DSE, IFS, DEH		$0	$0	$0	$30,000	$30,000	$60,000.00
9	**New populations**										
9.1	Select sites	2	100%	DSE, IFS, DEH		$0	$10,000	$10,000	$0	$0	$20,000.00
9.2	Translocation plan	2	50%	DSE, IFS, DEH		$0	$5,000	$0	$0	$0	$5,000.00
9.3	Prepare site(s) and implement plan	2	50%	DSE, IFS, DEH		$0	$0	$0	$45,000	$47,000	$92,000.00
9.4	Maintain and monitor	2	50%	DSE, IFS, DEH		$0	$0	$0	$0	$47,000	$47,000.00
10	**Information, education**										
10.1	Community involvement	2	100%	DSE, IFS, DEH		$5,000	$5,000	$5,000	$5,000	$5,000	$25,000.00
10.2	Information, extension	2	100%	DSE, IFS, DEH		$5,000	$5,000	$5,000	$5,000	$5,000	$25,000.00
					Totals	**$274,000**	**$382,000**	**$487,000**	**$535,500**	**$543,500**	**$2,222,000.00**

Abbreviations: CMA- Catchment Management Authority; DEH – Department for Environment and Heritage (SA); DSE – Department of Sustainability and Environment (Vic); IFS – Inland Fisheries Service (Tas); PV – Parks Victoria

Appendix 3. Native freshwater fish co-occurring with the Dwarf Galaxias

Victorian sites: DSE 2005; South Australian sites: Hammer 2002

Scientific name	Common name	No. sampling events	
		Vic	SA
Nannoperca australis	Southern Pygmy Perch	49	14 (P)
Anguilla australis	Short-finned Eel	17	
Galaxias maculatus	Common Galaxias	16	5
Galaxias olidus	Mountain Galaxias	16	
[t]*Hypseleotris* spp.	Carp gudgeon complex	8	4
*Nannoperca obscura**	Yarra Pygmy Perch	7 (VU)	2 (P)
Gadopsis marmoratus	River Blackfish	6	
Galaxias truttaceus	Spotted Balaxias	4	
Philypnodon grandiceps	Flat-headed Gudgeon	4	3
Galaxias brevipinnis	Broad-finned Galaxias	3	
Pseudogobius olorum	Blue-spot Goby	3	
Anguilla reinhardtii	Long-finned Eel	2	
Geotria australis	Pouched Lamprey	2	
Retropinna semoni	Australian Smelt	2	
Atherinosoma microstoma	Small-mouthed Hardyhead	1	4
[t]*Macquaria ambigua*	Golden Perch	1	
[t]*Macquaria australasica**	Macquarie Perch	1	
Mordacia mordax	Short-headed Lamprey	1	
Pseudaphritis urvillii	Tupong		1 (C)
Tasmanogobius lastii	Lagoon Goby	1	

* denotes species listed as threatened under the EPBC Acts

[t] denotes species translocated to (and not naturally occurring in) the South East Coast Drainage Division

(P) denotes species that are Protected under the S.A Fisheries Act 1982.

(C) denotes species that are of Conservation concern (S.A Fisheries Act 1982).