Action statement No.65

Flora and Fauna Guarantee Act 1988

Barred Galaxias *Galaxias fuscus*

Department of Environment, Land, Water & Planning

State Government Victoria

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Barred Galaxias *Galaxias fuscus*

Description

The Barred Galaxias (*Galaxias fuscus*), is a small (up to 160 mm total length), scaleless fusi-form freshwater fish. The species exhibits a phenotype distinct from the normal appearance of the closely related Mountain Galaxias (*Galaxias olidus*). It can be distinguished by its bright orange-yellow base colouration, up to ten distinct, wide, black vertical bars on the sides of the body and a lack of the mottled pattern found on the Mountain Galaxias. It also possesses a more bulbous head, thicker caudal peduncle (Raadik 1995, 2006 a, b, 2011), and larger pectoral and pelvic fins.

Barred Galaxias was originally described as a distinct species (*Galaxias fuscus*) by Mack (1936) from two poorly preserved specimens deposited in the Museum of Victoria. In a taxonomic review of the family Galaxiidae, McDowall and Frankenberg (1981) placed Barred Galaxias as a junior synonym of the Mountain Galaxias. This was done without examining fresh specimens from the type locality (Rubicon River), though specimens were examined from a previously unknown site west of Kinglake.

A genetic study of the status of the Barred Galaxias by Rich (1986), again based on material from one site, was inconclusive, although it did consider that Barred Galaxias was at least a subspecies of the Mountain Galaxias. More recently, Allen (1989) and Allen *et al*. (2002) reinstated Barred Galaxias as a distinct species (*Galaxias fuscus*) separate from the Mountain Galaxias, though no formal systematic review was undertaken.

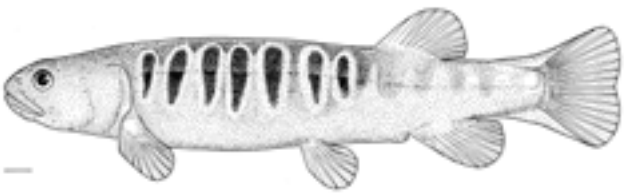
Despite its distinctive phenotype, the taxonomy of Barred Galaxias has remained uncertain, though the species was accepted as being genetically distinct from southern forms of the Mountain Galaxias (Rich 1986), and shown to exhibit ecological differences to this species (Shirley and Raadik 1997). More recently, the results of a detailed genetic (allozyme and mtDNA) and morphological (morphometric and meristic) study of the systematics of the Mountain Galaxias species complex (which includes Barred Galaxias) supported the re-elevation of Barred Galaxias as a distinct species (Raadik 2001, 2011, Adams *et al*. in press, Raadik submitted).

Investigations of population genetics indicated that gene flow is highly constrained between all extant populations (Ayres *et al*. 2012a). Further, genetic diversity within populations is very low, indicating likely extreme decreases in population size, and subsequent inbreeding (Ayres *et al*. 2012a).

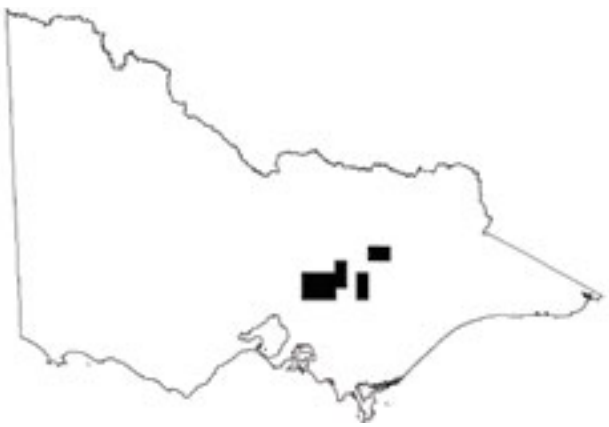
Distribution

The Barred Galaxias is endemic to a small upland area in the south-eastern portion of the Goulburn River system in central Victoria, on the northern side of the Great Dividing Range (Raadik *et al*. 1996, Raadik 2006b). Historical (pre-1936) distribution data is lacking, and the species is now only found in the upper reaches of headwater tributary streams above approximately 400 m in elevation, where it typically represents 100% of native fish diversity.

All remnant populations are highly fragmented and isolated from each other. The present distribution represents an estimated decline of over 95% of the species range, and fragmentation of a much wider and continuous distribution, which likely extended upstream from 300 m in elevation in the south-eastern portion of the Goulburn River system.



Barred Galaxias (Rhyll Plant)



Distribution in Victoria (DELWP, 2015)

Populations are found in the following catchments of the Goulburn River system:

- Delatite River
- Howqua River
- Goulburn River
- Big River
- Rubicon River
- Taggerty River
- Acheron River
- Murrindindi River
- Yea River
- Sunday Creek

At least five populations have become extinct since the species description in 1936 (Anon 2011). The majority of extant populations are small, consisting of fish in low to moderate abundance in short headwater sections, usually 1.5 to 2 km in length. Based on mtDNA analysis and morphological comparison, the population in the Sunday Creek is composed of putative hybrids between Barred Galaxias and Mountain Galaxias; no pure Barred Galaxias have been detected.

Habitat

The Barred Galaxias occur in small to medium-sized, moderately to fast flowing, fresh, clear, shallow, cool and highly oxygenated upland streams (Raadik *et al*. 1996, Reed *et al*. unpubl.). Substrate consists of a heterogeneous combination of bedrock, boulder, cobble, pebble, gravel and sand. The preferred instream habitat of adults is slow flowing pools adjacent to run/riffle sequences, while juveniles (less than 50 mm in length) are commonly found in shallower reaches.

Streams are usually well shaded by dense overhanging riparian vegetation. Water salinity is very low (less than 0.01 g/L). Water temperature is usually less than 15 degrees Celsius during summer and can be as low as 1 to 2 degrees Celsius during winter and early spring. Instream habitat consists of timber debris, rock material, tree roots, and undercut banks, with small amounts of aquatic vegetation (T. Raadik pers. comm. 2009).

Life History and Ecology

Barred Galaxias is non-migratory, completing its entire lifecycle in freshwater. Its diet is poorly known, but appears to consist of aquatic and terrestrial insects (Shirley and Raadik 1997, Raadik *et al*. 1996, Reed *et al*. unpubl.).
Gonad development commences as early as January, while spawning occurs during late winter to early spring (Raadik 1995, Raadik *et al*. 1996, Raadik *et al*. 2010, Stoessel et al. 2012). Fecundity is low (~500 eggs), and on extrusion, eggs are adhesive and relatively large (~2.2 mm in diameter) (Raadik 1995, Raadik *et al*. 1996, Shirley and Raadik 1997, Stoessel *et al*. 2012).

Eggs are laid on the underside of large rocks and hatch after about a month (Stoessel *et a*l. 2012). Newly hatched larvae are small (about 9 mm in length), growth rates are slow, and adults live to about 15 years of age (Raadik *et al*. 2010, Stoessel *et al*. 2012).

Conservation status

National conservation status

The Barred Galaxias has been listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Victorian conservation status

The Barred Galaxias is listed as threatened in Victoria under the *Flora and Fauna Guarantee Act 1988* (FFG Act).

The Barred Galaxias is considered critically endangered in Victoria (DSE 2013).

Threats

The most serious threat to Barred Galaxias is predation by, and, to a lesser degree, competition with, Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) (Raadik 1995, 1999, Raadik *et al*. 1996, 2003, 2004).

Existing populations are now restricted to the very upper reaches of smaller streams isolated by natural or man-made instream barriers (Saddlier and Raadik 1995 a, b). The risk of trout incursion and subsequent loss of Barred Galaxias populations is nevertheless high, with trout present downstream of barriers at all sites. The risk of barriers being breached by trout is exacerbated during short, localised but intense storm events (equivalent to a 50–100 year flow event) which can occur randomly in these upland catchments during any season. Stochastic events such as wildfire and drought increase population susceptability to decline. Furthermore, processes which can degrade aquatic habitat and damage aquatic systems, such as chemical input and clearing of riparian vegetation, also pose a threat. The major current and suspected threats are detailed as follows.

Standard threat	Source of threat	Explanation
Carnivory	Introduction of species to areas outside their range	Barred Galaxias are highly susceptible to predation by alien Brown Trout and Rainbow Trout. Introductions of even a small number of trout can completely eliminate Barred Galaxias populations in a short space of time (Raadik 2009). Trout initially quickly (3 - 4 months) eliminate smaller galaxiid individuals (first 4 - 5 age classes), then slowly (over 6 - 18 months) eat larger individuals as the trout grow in size. During this slower phase, the complete reproductive output from surviving Barred Galaxias is eliminated. Consequently, trout predation is the primary cause of population decline and inhibits population recovery and range expansion. Trout are also known to impact via predation and competition on other galaxiid species in Australia (Mountain Galaxias) and in New Zealand, as well as on frog species in Australia (Tilzey 1976, Glova 1989, McDowall 1990, 2003, 2006, Crowl *et al*. 1992, Raadik 1995, Raadik *et al*. 1996, Cadwallader 1996, Townsend 1996, Gillespie and Hero 1999, Gillespie and Hines 1999, Gillespie 2001, Lintermans 2000, Raadik and Kuiter 2002, Simon and Townsend 2003, Jackson *et al*. 2004). Trout may access Barred Galaxias sites naturally by colonising upstream during favourable conditions (such as high flow events which reduce effectiveness of existing barriers) or can be (and have been) illegally translocated upstream by humans (Raadik 2009).
Competition	Introduction of species to areas outside their range	Trout are known to compete with galaxiid species (see references above). Trout exclude Barred Galaxias from optimal feeding and resting habitat, leading to starvation, decline in reproductive output, and eventual extinction of a population.
Groundwater - quantity	Weather - flood, drought, storms	Remnant populations of Barred Galaxias occupy small headwater streams in which water is derived from surface run-off and groundwater inflow, with groundwater recharged from surface water infiltration. During prolonged drought, surface run-off can be dramatically reduced and the bulk of stream flow is derived from groundwater, which can diminish as drought continues and groundwater recharge falls. Barred Galaxias populations are therefore susceptible to high mortality from loss of surface water (Raadik 2007). This threat is compounded, particularly in small streams, if the generally heterogeneous substrate of rocks and cobbles has been smothered and in-filled with silt and coarse sand. Barred Galaxias are usually able to move down into rock/cobble substrates and so remain within the water table as it declines, but they cannot burrow into coarse sand substrates (T. Raadik, pers. comm. 2010). They are also unable to perform aerial respiration, even for short periods (1–2 hours) and quickly suffocate when out of water. Consequently they are particularly susceptible to mortality from even short periods of surface water loss in sand smothered streams if deeper pools which intersect the declining water table are absent or infilled.

Habitat damage or loss	Waterways - sedimentation or siltation	Stream substrates at Barred Galaxias sites are usually composed of a heterogeneous mix of cobbles and pebbles, with some boulder, gravel and sand. The substrate provides habitat for aquatic macroinverterbrates (an important food source), and resting, spawning and refuge habitat for fish (T. Raadik pers. comm. 2009; see also Lyon and O'Connor 2008). Smothering or infilling of substrate with silt and coarse sand may therefore prove catastrophic. Sites are particularly at risk after wild-fire events which may alter soil structure in the riparian zone, leaving soil loose and easily transported by rainfall.
Inappropriate fire regimes	Fire - wildfire	As remnant populations of Barred Galaxias are geographically isolated in heavily forested regions, the risk of wild-fire is significant. Virtually all populations have been affected by fire in recent years (Raadik 2009, Anon 2011, Lintermans *et al*. 2014). As Barred Galaxias have poor recolonisation abilities and are unable to disperse from isolated sites, the impacts of fires can be devastating. During a wildfire, elevated water temperature and ash and sediment input, drastically alter water quality, Fine (silt and sand) and coarse (gravel, pebble, cobble) sediment can suffocate or physically smother fish and high sediment loads can also smother the stream substrate, dramatically reducing or eliminating aquatic food supplies, spawning habitat and refuge habitat.
Surface water - quality	Waterways - sedimentation or siltation	Deteriorating water quality through increased sedimentation/ siltation is a major threat to the health of Barred Galaxias populations, particularly as the populations are small and isolated. Siltation can cause increased water turbidity and changes to water chemistry such as increased temperature and lower dissolved oxygen levels, particularly after sediment pulses. Poor water quality can lead to fish mortality (primarily eggs, larvae and young juveniles).
	Water - nutrients and chemicals	Input of toxins, such as herbicides from weed spraying, can be lethal to populations.
	Water - level/flow changes	During prolonged drought, surface run-off decreases dramatically, and if groundwater inflow is also reduced, particularly in silt or sand smothered streams, mortality of fish can occur (see Groundwater Quantity threat). Low stream flows can lead to large reductions in available habitat, which is particularly significant in these small streams. These threats are likely to be exacerbated by climate change. During winter, stream flows are elevated, and compensated by snow-melt at alpine sites. However, water extraction for snow making may partially or significantly reduce flow in small headwater tributaries above the snowline for short periods, potentially affecting key biological processes (e.g. fish spawning cues, selection of spawning sites) on a local scale or impacting on demersal fish eggs. This threat is likely to be exacerbated by climate change.

Important populations

Catchment	Location name	Land manager	Bioregion
GOULBURN-BROKEN	Brewery Gully, Woods Point	Department of Environment, Land, Water and Planning (DELWP)	Highlands - Northern Fall
	Falls/Baldy Creek, Mt Stirling	DELWP	Highlands - Northern Fall
	Fifteen Mile Creek (Taponga catchment)	DELWP	Highlands - Northern Fall
	Kalatha Creek, north-east of Toolangi	DELWP	Highlands - Northern Fall
	Koala Creek, Lake Mountain, partially Yarra Ranges NP	DELWP, Parks Victoria (PV)	Highlands - Northern Fall
	Little Rubicon River, north-east of Marysville	DELWP	Highlands - Northern Fall
	Luke Creek, north of Toolangi	DELWP	Highlands - Northern Fall
	Moonlight Creek, west of Gaffneys Creek	DELWP	Highlands - Northern Fall
	Morning Star Creek, Woods Point	DELWP	Highlands - Northern Fall
	Perkins Creek, Woods Point	DELWP	Victorian Alps
	Pheasant Creek, Woods Point	DELWP	Victorian Alps
	Plain Creek, north-west of Mt. Buller	DELWP	Highlands - Northern Fall
	Raspberry/Godfrey Creek, north of Woods Point	DELWP	Highlands - Northern Fall
	Robertson Gully, Marysville	DELWP	Highlands - Northern Fall
	Rubicon River, north-east of Marysville	DELWP	Victorian Alps
	S Creek, west of Buxton	DELWP	Highlands - Northern Fall

GOULBURN-BROKEN	Shaws Creek (upper Big River catchment)	DELWP	Highlands - Northern Fall
	Stanley, Bindaree and Falls creeks, east of Mt. Buller	DELWP	Highlands - Northern Fall
	Sunday Creek, Mt Disappointment	DELWP	Highlands - Northern Fall
	Taggerty River/Keppel Hut Creek, at Lake Mountain, Yarra Ranges NP	PV	Highlands - Northern Fall
	Torbreck River, upper tributary, east of Lake Mountain	DELWP	Highlands - Northern Fall

Past management actions

Action	Result explanation
Liaise with government agencies	Liaison has occurred with government agencies responsible for management activities in Barred Galaxias catchments with respect to the presence of the species and potentially threatening processes.
Undertake periodic surveillance monitoring of populations	Regular monitoring events have been conducted annually on all known Barred Galaxias populations since 1995. Monitoring has been conducted in conjunction with predator (trout) detection sampling. Information on total fish abundance and individual fish length and weight in addition to water quality parameters has been collected from established monitoring reaches. The absence of individuals from the first four to five age classes is a valuable 'early-warning' indication that predators are present in a system; especially when predators are undetected during sampling. This usually indicates that only a few predators are present, and, therefore, more intensive predator detection, followed by removal, can prevent predator numbers increasing due to successful breeding and becoming established and causing major mortality to the Barred Galaxias population.
Conduct survey to locate additional populations	Survey activities for Barred Galaxias have been undertaken in 'data-gap' areas between extant populations within and outside of the Goulburn River system. The surveys confirm that Barred Galaxias are restricted to the Goulburn River system, in which they are confined to the upper headwater reaches of the south-east portion, from the Delatite River system near Mt. Buller/Mt. Stirling south-west to near Mt. Disappointment east of Wandong. Since 1990 these surveys have located 18 additional populations and sub-populations, rediscovered a population in the river from which it was first described in 1936 (and thought to be extinct by 1966), confirmed the presence of Barred Galaxias at three previously known sites and recorded the extinction of four populations (Raadik 2000, 2002).

Liaise with stakeholder groups	Liaison has occurred with stakeholder groups responsible for recreational or management activities in Barred Galaxias catchments with respect to the presence of the species and potentially threatening processes. Community engagement, including presentations, signage and production of media articles undertaken as part of 2009 Natural Values Fire Recovery Program (Hames 2012).
Erect/maintain structures to restrict or control access	Access to logging coupes adjacent to the upper Rubicon River Barred Galaxias population was controlled via a locked gate and, between timber harvesting seasons, with the addition of large boulders and an earth mound blocking the access track.
Implement prescriptions and zoning in State forest	Expanded buffer strip widths along stream frontages at timber harvesting coupes, and increased sediment runoff mitigation works on roading to/ within coupes, have been implemented in the upper Rubicon, Steavenson and Murrindindi catchments.
Develop and update Fire Salvage Harvesting Prescriptions	Specific prescriptions for protection of Barred Galaxias catchments were developed and included in revision 2.0 of the Fire Salvage Harvesting Prescriptions (March 2008) and further modified in October 2009 (revision 3.0).
Maintain fish barriers for conservation	Artificial (log) barriers were built instream at three sites near Woods Point during 1994–1995 to prevent the upstream migration of predators (Brown Trout and Rainbow Trout). An additional natural rock barrier near Marysville was also modified to improve its effectiveness as a barrier to the upstream movement of trout (Saddlier and Raadik 1995 a, b). This barrier was repaired in 2009 after bushfires damaged it (Anon 2011). The condition of all barriers have been regularly inspected and maintained since.
Control introduced animals	Predators (Brown Trout and Rainbow Trout) were physically removed during 1994–1995 from upstream of natural and artificial barriers on seven streams to create predator-free sections into which Barred Galaxias populations could expand (Lintermans and Raadik 2003). Predators were also removed from an additional stream in 1994–1997 for the same purpose and a small number were removed from two streams on a few occasions during 1995–2004.
Prepare/revise action statement	A Flora and Fauna Guarantee action statement was published to direct Barred Galaxias management and conservation (Koehn and Raadik 1995).
Clarify/review taxonomy	A genetic and morphological review of Mountain Galaxias taxonomy concluded Barred Galaxias is a distinct species from the closely related Mountain Galaxias and re-instated it as a valid species (Raadik 2011, Adams *et al*. in press, Raadik submitted).
Salvage populations/ individuals	Following fires in 2006 and 2009 and ongoing drought, individuals from a number of impacted populations of Barred Galaxias were salvaged and temporarily maintained in captivity (Raadik *et al*. 2009). When catchment conditions had improved sufficiently, fish were returned to their natal streams. These populations were considered to be at a high risk of extinction due to post-wildfire impacts or loss of stream water.

Undertake threat monitoring	At each new Barred Galaxias site, or confirmed previous record site, an assessment of threats was undertaken. Threats included presence of predators within or immediately downstream of the Barred Galaxias population, security of the site from predator incursion (e.g. presence/ absence of instream barrier, type and nature of barrier, etc.) proximity of access tracks, risk and sources of sediment input, proximity to timber harvesting coupes, approximate length of available stream habitat, water quality and flow and condition of substrate with respect to sedimentation. During drought, stream-flow at all populations has been monitored, with fish temporarily removed if flow declined substantially. Catchment recovery (riparian vegetation regrowth and instream sediment decline) has also been monitored following fires to guide the process of releasing captive-held fish back into natal streams. Monitoring of riparian re-growth following fires has also informed decisions on whether replanting has also been required. Stream flow and catchment condition assessment conducted at 10 sites in 2007/2008 (Raadik *et al*. 2009), In 2008/2009, predator detection and barrier inspection/maintenance undertaken at 15 and 8 sites respectively (Raadik 2009).
Prepare/revise Recovery Plan	National Recovery Plan prepared (Raadik *et al*. 2010).
Restore habitat	Riparian habitat restoration (planting of native vegetation and debris removal) occurred along Leary's Creek in 2010 (Anon 2011).
Identify core habitat	Key spawning habitat confirmed as fast flowing, shallow, well oxygenated water in riffle sections immediately upstream of pools (Stoessel *et al*. 2012).
Prepare a plan for reintroduction/ reinforcement/ translocation	Guidelines for the translocation of Barred Galaxias developed 2010/11 (see Ayres *et al*. 2012b).
Identify potential sites for reintroduction/ translocation	In 2010/11, a total of 216 potential translocation sites were identified, of which 61 were surveyed and assessed for suitability based upon habitat threats, the presence of fish and physical barriers, and catchment size (Ayres *et al*. 2012a).
Establish and maintain a reintroduced/ translocated population	Two trial translocations were conducted 2010/11 (Ayres *et al.* 2012a). Subsequent surveys suggest that the trials have been successful.
Undertake genetic research	Genetic investigation of populations conducted in 2010/11 (Ayres *et al.* 2012a).
Develop Protocol for the Translocation of Fish in Victorian Inland Public Waters	All aquatic organisms that are stocked in Victorian inland waters must comply with the Protocol for the Translocation of Fish in Victorian Inland Public Waters. The Protocol specifically considers potential impacts to native species when stocking of non-native species is being considered. Waters (or a section of a waterway if barriers exist to prevent movement of fish) will not be stocked where there is reasonable evidence the released fish species may constitute an unacceptable risk to a threatened species or community (e.g. listed under FFG Act, EPBC Act).

Conservation objectives

Long term objective

To ensure that the Barred Galaxias can survive, flourish and retain its potential for evolutionary development in the wild.

Objectives of this Action Statement

- To increase the number of populations or individuals
- To secure populations or habitat from potentially incompatible land use or catastrophic loss
- To maintain or improve condition of habitat
- To increase knowledge of biology, ecology or management requirements

Intended management actions

The intended management actions listed below are further elaborated in DELWP's Actions for Biodiversity Conservation (ABC) system. Detailed information about the actions and locations, including priorities, is held in this system and will be provided annually to land managers and other authorities.

Standard objective	Objective explanation	
To increase the number of populations or individuals	Further increase the number of individuals and populations by translocation of individuals from key populations into suitable streams within the historical range of Barred Galaxias.	
Standard action	**Details**	**Responsible agents**
Identify potential sites for reintroduction/translocation	Continue targeted surveys to identify predator-free and/or headwater reaches of streams above instream barriers, which are, or can be modified to be, suitable for the translocation of Barred Galaxias populations. Further, assess suitability of potential sites (eg. catchment area, water supply security, predator presence/absence, site security from deliberate predator introduction under guidance of Recovery Team).	DELWP
Establish and maintain a reintroduction/translocated population	Where necessary, undertake reintroduction of extirpated populations, or establish additional populations to improve population number and viability and reduce the overall extinction threat.	DELWP
Obtain animals for captive breeding	Where required, collect fish for captive breeding from the wild. Following breeding, return fish to natal streams.	DELWP
Undertake captive breeding for reintroduction or reinforcement.	Where required, undertake captive breeding to provide sufficient numbers of fish to augment parent population or to establish new translocated population.	DELWP

Standard objective	Objective explanation
To secure populations or habitat from potentially incompatible land use or catastrophic loss	Planning scheme overlays and schedules updated to protect Barred Galaxias and their habitat. New overlays created where needed. Reduction in the deliberate release of alien trout into streams managed for Barred Galaxias by maintaining suitable access controls. Recovery actions implemented in an effective and timely manner under the supervision, guidance and input of Recovery Team. Forest plan prescriptions and post-fire salvage harvesting prescriptions updated and implemented to protect Barred Galaxias populations as required. Government agencies and stakeholder groups aware of Barred Galaxias presence, reducing the impact of their activities in Barred Galaxias catchments and supportive of recovery actions. Risk of impacts of fire to Barred Galaxias reduced by recognition of the species' needs in fire management and operation plans.

Standard action	Details	Responsible agents
Develop or amend planning scheme overlays and schedules	DELWP makes information on Barred Galaxias available to local government to use in planning schemes, e.g. to update existing planning scheme overlays and schedules, or to develop new overlays when needed to increase protection of Barred Galaxias populations.	DELWP
Erect/maintain structures to restrict or control access	Review access conditions at all existing Barred Galaxias catchments, including any future new locations, and restrict or control access where required. Undertake regular review of effectiveness of access control and revise if necessary, and undertake maintenance when required.	DELWP
Establish/maintain a working group	Maintain the existing working group of key researchers and DELWP regional staff to continue the effective and timely implementation of recovery actions for Barred Galaxias, including the sourcing of funds. Encourage other interested parties or individuals to participate in the working group.	DELWP
Implement prescriptions and zoning in State forest	Implement, and update when needed, forest management plan prescriptions and post-fire salvage harvesting prescriptions to protect Barred Galaxias catchments and populations in timber harvesting areas, particularly with respect to sedimentation amelioration, riparian vegetation, and access issues.	DELWP

Liaise with government agencies	Continue to liaise with government agencies responsible for management activities in Barred Galaxias catchments with respect to the presence of the species and potentially threatening processes.	DELWP
Liaise with stakeholder groups	Continue to liaise with and inform stakeholder groups responsible for management activities in Barred Galaxias catchments with respect to the presence of the species, potentially threatening processes, and progress/success of recovery actions.	DELWP
Provide input into regional fire management and operations plans	Ensure that existing and future Barred Galaxias catchment details are incorporated into the North-East regional fire management and operational plans, to increase protection for and reduce threats to Barred Galaxias populations.	DELWP
Salvage populations/ individuals	Where the risk of population loss is high due to stochastic events (e.g. post-wildfire impacts or loss of stream water) remove a proportion of individuals from the population and maintain in captivity in aquaculture facilities until threat(s) abate (temporary captive maintenance). Implement strict biosecurity, disease prevention and aquarium maintenance procedures to allow the return of fish to the population following abatement of the risk.	DELWP

Standard objective	**Objective explanation**	
To maintain or improve condition of habitat	Habitat condition would be improved by construction of artificial barriers if required and the maintenance of natural or artificial barriers that prevent movement of introduced trout into Barred Galaxias habitat. Barred Galaxias habitat monitored and introduced trout removed if found in these areas. The feasibility of temporary artificial, deep 'refuge' pools is to be determined.	
Standard action	**Details**	**Responsible agents**
Provide artificial habitat features	Investigate options for creating effective, temporary artificial, deep 'refuge' pools, particularly immediately below groundwater inflow areas. This will potentially provide temporary security from complete population loss in the event of a sudden but short-term loss of surface water (dewatering), allowing for salvage of surviving fish. Investigate providing artificial spawning structures into streams to bolster natural spawning following sedimentation events (e.g. following fires).	DELWP, PV

Control introduced animals	Monitor annually for the presence of predators in Barred Galaxias populations. If predators are found, remove them to downstream of the predator-free zone. If new Barred Galaxias populations are located and the presence of predators (trout) is considered a major threat to the survival of that population or its expansion in size, then undertake predator removal. Liaise with DELWP's Fish Translocation Evaluation Panel responsible for salmonid stocking regarding cessation of liberations into, or downstream of, Barred Galaxias catchments.	DELWP, PV
Erect/maintain fence to exclude introduced animals	If feasible and required, construct artificial barriers or modify existing ineffective barriers at new Barred Galaxias sites where the population needs to be protected from the upstream incursion of predators (trout).	DELWP, PV
Maintain fish barriers for conservation	Where instream barriers (e.g. natural or artificial) to prevent the incursion of predators into Barred Galaxias habitat exist, annual inspection of barrier integrity should be conducted, and maintenance undertaken when required, ensuring the continued effectiveness of the barrier.	DELWP, PV

Standard objective	Objective explanation
To increase knowledge of biology, ecology or management requirements	Where required, management of newly discovered Barred Galaxias sites is significantly improved by: • Identifying threats • Determining population abundance and extent • Monitoring abundance and health of Barred Galaxias as well as predators and other threats Barred Galaxias formally re-described as a valid species. Targeted surveys undertaken in un-sampled areas within historical range of species in order to locate additional populations. Populations monitored to determine their health, detect predators and determine other threats as quickly as possible, and determine populations from which translocations could be undertaken. Frequency and timing of predator monitoring changed in response to streamflow and water temperature changes. Research leads to achievement of a demonstrable increase in knowledge of the biology, ecology and management requirements of the Barred Galaxias.

Standard action	Details	Responsible agents
Assess threats	Undertake an assessment of threats following location of a new Barred Galaxias site.	DELWP
Conduct survey to determine abundance/extent of population	When new Barred Galaxias populations are found, undertake detailed surveys to define the upstream and downstream extent of the population within the catchment, including assessment of population abundance. This information should be entered into VBA and be considered by the DEPI Fish Translocation Evaluation Panel when assessing applications it receives.	DELWP
Conduct survey to locate additional populations	Undertake targeted surveys in unsampled areas within the historical range of Barred Galaxias to locate potential additional extant populations. Surveys will also assist in locating potential predator-free and/or secure sites above significant instream barriers which may be used for translocation activities. Surveys are difficult due to the steepness and remoteness of catchments, including extremely poor access.	DELWP
Undertake detailed population monitoring and collect demographic information	Continue detailed population monitoring (total fish abundance and individual fish length and weight) within established monitoring reaches at known Barred Galaxias sites, to monitor population health over time and to provide additional, early-predator detection warning (e.g. absence of first four to five age classes indicates one or more predators present). Instigate monitoring at any new Barred Galaxias sites. Monitoring will be used to identify appropriate populations which may be used to provide individuals for translocation or captive breeding activities.	DELWP
Undertake research to identify key biological functions	Undertake research into key biological processes which will aid recovery actions, such as desiccation tolerance (adults, larvae and eggs), age, specific habitat requirements, diet, climbing ability, instream movements of adults and juveniles, and techniques for long-term captive breeding and on-growing.	DELWP

Undertake threat monitoring	Continue threat monitoring at all Barred Galaxias sites during annual monitoring. Threats to be monitored include presence of predators (trout), new potential sources of sediment input, water quality, risks from any new disturbance to the catchment (e.g. timber harvesting, improved access via new/improved roading, etc.). During drought periods, more frequent monitoring of stream baseflow levels is required at high-risk sites to ensure the population is not extirpated due to stream drying, and immediately following wildfire at all impacted sites to monitor for significant ash and/or sediment input. During wetter periods, greater monitoring of predator incursions is required, as incursions may be facilitated by increased stream flows, and by more favourable temperature regimes which will aid survival of predators.	DELWP

Personal Communications

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