Department of Sustainability and Environment

Guidelines for the translocation of Barred Galaxias (*Galaxias fuscus*) for conservation purposes

Black Saturday Victoria 2009 – Natural values fire recovery program

Renae Ayres, Michael Nicol, Tarmo Raadik

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Guidelines for the translocation of Barred Galaxias (*Galaxias fuscus*) for conservation purposes

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Front cover photo: Adult Barred Galaxias, *Galaxias fuscus* (T. A. Raadik).

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Summary

Barred Galaxias (*Galaxias fuscus*) is a small native freshwater fish endemic to upper headwater streams of the Goulburn River catchment in central Victoria, Australia. The species has suffered extensive declines in range and abundance. Several populations are extinct and only twelve small, isolated and fragmented populations are known to remain. Barred Galaxias is listed nationally as endangered under the Australian *Environment Protection and Biodiversity Conservation Act 1999* and is also listed under the Victorian *Flora and Fauna Guarantee Act 1988*. Increasing the number of Barred Galaxias populations and individuals is a recovery objective of the National Recovery Plan for Barred Galaxias. Its associated recovery actions include investigating captive breeding techniques for Barred Galaxias, as well as planning and conducting translocations and maintaining these new populations.

The Black Saturday bushfires of 7 February 2009 brought into sharp focus the need for securing populations of Barred Galaxias. These fires burnt the surrounding vegetation of 45% of known populations. Prior to this, in 2006, 45% was also burnt. Only 10% of populations remain with unburnt vegetation.

This document describes a protocol for the translocation of Barred Galaxias from a wild source population to a release location in public waters for conservation purposes. It is intended to guide future development of translocation plans for specific Barred Galaxias translocation events. General principles regarding preparation and pre-planning for translocation, implementing the translocation and post-release monitoring are discussed.

Definitions

Founder population: Individuals that are introduced to establish a new population.

Genetic supplementation: Addition of individuals to an existing population in an effort to increase genetic heterozygosity and improve its long-term genetic viability.

Inbreeding depression: The loss of reproductive fitness, vigour and long term viability of populations as a consequence of breeding between closely related individuals.

Introduced: A non-indigenous species.

Ne : Effective population size. The number of individuals which are effectively participating in breeding and the successful production of offspring; invariably this number is lower than the estimated number of animals in the population (*N*).

Re-introduction: The deliberate or accidental translocation of a species into the wild areas where it was indigenous in historic times but is no longer present.

Release site: The geographical location at which translocated individuals are released.

Resident population: Existing population.

Source population: The population from which translocated individuals will be sourced.

Translocation: The movement of a living organism, by people, from one area to another.

Viable: A population capable of persisting and reproducing in the long term (i.e. many generations).

Wild population: Population not previously translocated and existing in a natural state.

1 Introduction

Barred Galaxias is a small native freshwater fish, endemic to upper headwaters (above 400 m altitude) of the Goulburn River catchment in central Victoria. The range and abundance of the species has declined significantly (over 95% of its likely historical distributions and abundance) due to predation by, and competition with, introduced Rainbow Trout (*Oncorhynchus mykiss*) and Brown Trout (*Salmo trutta*), sedimentation, drought and bushfire impacts, altered water regimes and genetic isolation (Raadik *et al.* 2010). Only 12 highly fragmented, small and reproductively isolated population centres are known to remain (Raadik *et al.* 2010). Barred Galaxias is listed nationally as endangered under the Australian *Environment Protection and Biodiversity Conservation Act 1999* and is also listed under the Victorian *Flora and Fauna Guarantee Act 1988*.

Management actions for conserving Barred Galaxias have focused on stabilising populations by eliminating the impact of trout predation and competition (Saddlier and Raadik 1995; Lintermans and Raadik 2003). More recently, effort has been directed towards salvaging individuals from populations impacted by ongoing drought conditions and the 2006/07 and 2009 bushfires. Rescued individuals were temporarily maintained in captivity until habitat conditions improved, following which they were returned to their natal streams (Raadik *et al.* 2009).

However, relying on captive maintenance has inherent limitations (see Synder 1996):

- Maintaining captive populations is expensive and requires adequate space, equipment, and staffing (O'Brien and Dunn 2005).
- It can be difficult to maintain survivorship and develop self-sustaining populations under captive conditions without suitable environmental, physiological and psychological requirements.
- Disease outbreaks can be more frequent in captive animals because of increased exposure to carrier individuals and exotic pathogens.
- Animals may become progressively domesticated the longer they are held in captive conditions.
- Often the re-introduction success of captive animals is poor because of various reasons including the threat in the natural environment has not been mitigated or eliminated, and animals lack behavioural skills that are necessary for survival, such as foraging, predator avoidance and mate choice.

Translocating Barred Galaxias to establish viable populations within its natural range (in-situ management) is preferable to captive maintenance (ex-situ management), decreases the extinction risk of Barred Galaxias and enhances the natural recovery rate of existing managed populations. Additionally, translocation better ensures that behavioural and genetic attributes of individuals and populations are maintained. The National Recovery Plan for Barred Galaxias (Raadik *et al.* 2010) recommends translocations as a recovery action to increase the number of individuals and populations. Until now, a translocation protocol has not been developed for this species.

This document, endorsed by the Barred Galaxias Working Group, describes a protocol for the translocation of Barred Galaxias from a wild source population to a release location in public waters for conservation purposes. It is intended to guide future development of translocation plans for specific Barred Galaxias translocation events. Two key scenarios for translocating the species are considered:

1. to rescue a wild population under immediate threat; and
2. to establish a viable wild population from an established wild source population.

A third scenario, translocating individuals between populations to maintain or improve genetic diversity, may also become important when population genetics information becomes available.

This document consists of five sections discussing the general principles of a Barred Galaxias translocation project, including project conception, project commencement, translocation, post-release monitoring and lessons learned. Publications by Minckley (1995), DPI (2005), O'Brien and Dunn (2005) and George *et al*. (2009) were particularly helpful in guiding development of this document.

2 Project conception

2.1 Project justification

The purpose of the Barred Galaxias translocation should be well defined and clearly documented. This will aid planning and comparison of project objectives against outcomes to measure the success of the translocation. Short- and long-term success indicators should be identified. Additionally, having a project brief prepared will be beneficial when applying for permits, approvals and funding.

2.2 Funding and resources

It is essential that sufficient financial resources, dependable logistics and reliable personnel are sourced and secured prior to the project commencing. Funding may be available through various grants, government agencies, catchment management authorities and other organisations. Funding and resources should be committed to planning the project, undertaking the translocation, post-release monitoring, and project reporting.

3 Project commencement

3.1 Plan and coordinate the project

Barred Galaxias translocations can be complex, time-consuming and labour intensive. The success of the project relies on having the translocation event and post-release monitoring planned in detail well before the actual operation commences. Particular aspects of the project, such as permit approval, staffing and resources, and identifying suitable source populations and release sites, are vital steps in such translocations. Thoroughly planning the translocation and post-release monitoring helps to pre-empt potential problems and identify solutions: it provides a rationale for prioritising tasks; it helps to coordinate activities and people; and, it provides opportunities to identify and engage relevant stakeholders.

An advisory committee should be established to provide advice throughout the project. Specific details of the project should be set and endorsed by the advisory committee.

3.2 Engage relevant stakeholders

There are a number of stakeholders that need to be engaged to facilitate translocation and post-release monitoring of Barred Galaxias. Fisheries Victoria and Department of Sustainability and Environment (DSE) need to be consulted early to acquire resources and relevant permits and approvals. If a translocation is planned to occur within a national park, Parks Victoria should be engaged before the project commences. Anglers and community groups play an important role in the conservation of Barred Galaxias and they too should be engaged through appropriate representative organisations, such as Landcare or the Victorian Recreational Fishers organisation (VRFish). A stakeholder engagement and communication plan should be developed to identify all stakeholders, their involvement, the timing of their engagement, and messages to be communicated.

3.3 Permits and approvals

Permits and approvals must be gained from relevant government agencies and regulatory authorities prior to translocating Barred Galaxias, including:

- *Fisheries Act 1995* – Permit application and approval.
- *Flora and Fauna Guarantee Act 1988* – Permit application and approval.
- *National Parks Act 1975* – Permit application and approval, if working in National Parks or reserves.
- Complete and submit an 'Application for the translocation of live aquatic organisms in Victoria – Initial screening application' for evaluation and approval by DPI with advice from the Translocation Evaluation Panel (TEP) (DPI 2009). Translocation proposals must comply with all relevant Victorian and Commonwealth legislation, policies and protocols, such as, 'Guidelines for assessing the translocation of aquatic organisms in Victoria' (DPI 2009) and 'Protocols for the translocation of fish in Victorian inland public waters' (DPI 2005).
- Animal ethics application and approval.

3.4 Establish a project team

Implementing the translocation and post-release monitoring events requires adequate staffing. A multidisciplinary approach is needed involving a team whose skills should include: fish handling; electrofishing; four-wheel driving; fish transportation/knowledge of biological requirements; species expertise; genetics; veterinary; and, stakeholder engagement. Staff or technical advice may be sourced from government or non-government agencies, funding bodies, veterinary institutions, universities etc. Additional expertise may be sourced as needed on an ad hoc basis. The team leader should be responsible for coordination between various groups, and directed by the advisory committee.

3.5 Identify a source population

These guidelines consider two key scenarios for undertaking translocations:

1. to rescue a wild population under immediate threat; and
2. to establish a new, viable wild population from an established wild source population.

In scenario 1, the source population should be readily identifiable because it is at risk from imminent threat, for example, post-fire impacts, and the translocation is needed to conserve the population. Since the threat may result in the death of individuals and extinction of the population, effort should be directed at translocating as many individuals as possible. Additionally, this will aid the population's long-term survival and preserve its genetic integrity.

In scenario 2, identifying a suitable wild source population is more complex due to risks of detrimentally affecting the source population. The removal of individuals from the wild source population must not endanger the wild source population. The wild source population must be of a reasonable size, be reproductively stable (*Ne* stable or increasing annually; contain a broad range of size cohorts; stable sex ratio) and should have no obvious adverse health conditions (e.g. parasites, disease). In this scenario, data from annual monitoring of Barred Galaxias populations should be referred to when identifying a suitable wild source population.

3.6 Identify a suitable release site

Potential release sites must be surveyed, assessed and selected prior to the translocation event. Sites can be identified through mapping exercises overlayed with historical fish distributions and advice from regional DSE staff. Sites should be surveyed and assessed for suitability based upon obvious habitat threats (e.g. fire and logging impacts, hydrology), the presence of fish, the occurrence of a physical barrier to predatory fish, and catchment size.

General criteria to be satisfied:

- Confined to public waters, in accordance with the DPI (2005) and translocation permit approval.
- The waters are within the known former range of the species (for Barred Galaxias: > 400 m altitude, in the upper Goulburn River catchment, Victoria, Australia).
- Fish will not be translocated into waters where they will be exposed to previous causes of decline (at the time of translocation).
- No fish present, including resident populations of Barred Galaxias. This will eliminate predation, competition, disease spread, hybridisation and reductions in genetic integrity and diversity.
- An effective physical barrier must be present downstream to prevent upstream movement of other fish species. Effective barriers:
  - Consist of a solid, long-lasting material such as rock;
  - Are vertical or near vertical with a height of 2.0 m or greater;
  - Are within a V-shaped valley so that higher flows remain directed to the centre of the channel (to minimise likelihood of fish moving upstream across recently inundated land along the stream bank); and,
  - Do not have a pool immediately below that is of significant depth or size which could aid fish in jumping over the barrier.
- Suitable habitat that meets the requirements of the species, for example, clear, cool, flowing water, invertebrates for food resources, boulders for spawning, must be available and likely sustained. The waters should have sufficient capacity to sustain survival and growth of the translocated population and support a viable population in the long term. The catchment should have high water security and minimal or no population-threatening disturbance from, for example, bushfire or timber harvesting operations.
- Fish will not be translocated into waters for conservation purposes where there is reasonable evidence they may constitute an unacceptable risk to another threatened species or community (e.g. listed under FFG Act or EPBC Act).
- The release site should in part be selected based on remoteness, or human inaccessibility, to reduce the likelihood of adverse anthropogenic effects, e.g. human introduction of predator species.

4 Translocation

All procedures applied during the translocation process must comply with the 'Protocol for the translocation of fish in Victorian inland public waters' (DPI 2005) and adhere to conditions dictated by the translocation permit. Furthermore, the procedures applied during translocation and post-release monitoring must minimise stress and avoid injury or illness to the fish.

If the purpose of translocation is for fish rescue, then the timing of translocation in relation to spawning season and weather conditions is not important as fish need to be translocated as soon as possible. However, if the purpose is to establish a new population, these factors should be considered.

Translocating individuals from the wild source population prior to spawning may encourage translocated fish to spawn at the release site, leading to early successful recruitment and aid in establishment. Alternatively, potential stress associated with the translocation event or unfavourable habitat conditions at the release site may discourage translocated individuals from reproducing if they are shifted at an advanced stage of reproductive development. It is therefore recommended that translocations occur outside of the breeding season, from November to April, with consideration of weather conditions.

Increased water temperatures or high flow conditions associated with summer and winter periods respectively may create unfavourable habitat conditions for translocation and cause unnecessary stress on translocated individuals. It is therefore recommended that the optimum translocation period be further refined, where feasible, to late Spring (November) or mid Autumn (April). Adhering to these time periods will also allow the translocated adults to settle into their new environment well before the onset of the next breeding season, potentially improving the chance of the translocated population spawning during their first year.

Other important considerations during stages of the translocation process are detailed below.

4.1 Fish Collection

- Record general site and sampling information, such as, GPS coordinates, date and time, and digital images.
- Measure and record water quality at the source site, i.e. electrical conductivity, temperature, dissolved oxygen (mg/l and % saturation), pH and turbidity.
- Barred Galaxias are most efficiently collected by backpack electrofishing. This method involves an operator electrofishing all accessible habitats in an upstream direction and followed by an assistant to collect stunned fish.
- If the purpose of translocation is for fish rescue, the full length of the stream occupied by the species should be surveyed, beginning at the downstream extent of the known population. Multiple electrofishing runs should be conducted to maximise the number of fish removed and all fish collected should be translocated unless they have visible signs of infection (e.g. fungal infections). These fish could be left at the source site, or treated before translocation at a later stage.
- If the purpose of translocation is to establish a new population, Barred Galaxias should be collected from multiple, discontinuous, reaches throughout the range of the wild source populations to maximise and conserve genetic diversity, and to minimise depletion at localised sites.
- If the purpose of translocation is to establish a new population, individuals should be selected from across all size classes collected and should include individuals of both sexes (if sex is known), aiming for an equal sex ratio. This will maximise the translocated population's likelihood of reproducing within the first year, whilst also not overly depleting the wild source populations' reproductive potential.
- Record the distance sampled and average stream width to enable an estimate of fish density at the site(s) (= number of fish collected by the area [distance by stream width] fished) for stocking densities at translocation sites later.
- If the purpose of translocation is to establish a new population, visually inspect fish for disease, parasites and injury. Seek advice and a health certificate from a qualified veterinarian to concur with conditions of the approved translocation permit. Only translocate healthy fish that appear in good condition.
- Measure weight (g), total length (mm) and sex (if possible) of all fish collected. For genetic analysis, take a caudal fin-clip (approximately 5 mm^2) from all individuals that will be translocated, preserved in a labelled vial containing 100% ethanol.

4.1.1 Genetic considerations

- The population genetics of Barred Galaxias is currently being determined. Populations may be significantly genetically different due to the geographically fragmented and reproductively isolated nature of all populations. Information on the genetics of populations will be used to identify evolutionary significant units for conservation management, and to guide future translocation events.
- This information may also be used to guide translocation activities to improve genetic diversity within some populations if required, by translocating smaller numbers of individuals between particular populations.
- If the purpose of translocation is to establish a new population, individuals selected for translocation should be from the same management unit as the release site to avoid mixing of distinct genetic lineages. This can be achieved by translocating individuals from populations that originate from the same or connected waters to the release site.
- Considering conservation genetics, it is difficult to quantify numbers for founder populations and minimum viable population sizes (Frankham *et al*. 2002; Avise 2004; Moore *et al*. 2010). If the purpose of translocation is for rescue, as many fish as possible should be recovered to conserve the genetic diversity of the population. If translocating individuals from a wild source to establish a new population, the number for the founder population may be limited by the wild source population size and Ne. Not all individuals forming the founder population will reproduce, therefore a population's Ne may be smaller than the actual number of individuals translocated. To achieve long-term genetic viability and reduce the risk of inbreeding depression, the founder population should be large if the addition of individuals (genetic supplementation) in the future is unintended or may be small if genetic supplementation is planned (Frankham *et al*. 2002; Avise 2004; Moore *et al*. 2010).

4.2 Transportation

- Transport fish in containers that are free from disease, parasites, chemicals and other species (i.e. sterilised), and maintaining required biological conditions.
- Fish should not be fed during transportation. If transporting from secure aquarium facilities, do not feed fish for 48 hours prior to transportation.
- Place fish in containers with source water. Add NaCl at 2.5g/L to calm fish and treat any infections and transport injuries. Aerate water and maintain in-situ temperature by periodically adding ice stored in sealed plastic bags.
- Keep time of transportation to a minimum.
- If walking with fish into a remote release site is required, transfer fish into appropriately sized plastic fish transport bags (double bagged) containing source water and cool using a small portion of ice stored in separate sealed plastic bags (avoiding introduction of non-source water). Fill remainder of bag with 100% oxygen and seal. Each bag should contain an appropriate number of fish for the volume of the water. The volume of water will depend upon what the individual person can carry into the release site.
- Any fish injured beyond recovery during transportation should be euthanased according to ethics approval. Euthanized fish should be preserved in labelled containers containing 100% ethanol for genetic analysis.

4.3 Acclimatisation

- Check the water quality of the transportation medium and release site water.
- Acclimatise fish by gradually mixing release site water into the transport medium ensuring disposal of the decanted water away from the release waterway. The greater the difference in water quality, the more time should be taken during acclimatisation.
- During acclimatisation, fish behaviour and health should be monitored.

4.4 Release

- If possible, release fish at least 100 m upstream of any effective physical instream barriers to avoid fish being displaced downstream over the barrier.
- Release fish at densities reflecting that of the wild source population, and within the best available habitat.
- Document each release event on to an appropriate database (e.g. VBA).

5 Post-release monitoring

Post-release monitoring of translocated and source populations should be conducted until the survival and reproduction of individuals can be established. This may be for a single year for the source populations, but should extend over multiple years for the translocated populations. Post-release monitoring allows the success of the translocation to be measured against the original objectives, and facilitates quick intervention if undesirable outcomes are detected (e.g. poor survivorship, inbreeding depression and habitat changes).

The post-release monitoring design should be tailored to suit each translocation event to allow evaluation of the proposed objectives, whilst adhering to budget and resource provisions. Designs may vary in, for example, the timing and frequency of monitoring, sampling technique, and distanced surveyed. Fish length, weight and general condition information (i.e. maturation, lesions, visible parasites etc.) should be recorded during surveys to assess how individuals are growing and breeding, which may be measures of a successful translocation.

Genetic monitoring of the translocated and wild source populations is strongly advised to determine the genetic impact (increase, maintenance or loss of genetic diversity), if any, of removal of founder individuals on the wild source population and to ascertain changes in the genetic composition of translocated and wild source populations over time. This information will also inform whether genetic supplementation is needed. The collection of fin-clips over a time period, for example, 2 years, 5 years, 10 years, will be needed for genetic analysis.

It is recommended that ongoing monitoring occurs of translocated populations to evaluate the long-term success of the project. Ongoing monitoring of these populations may eventually be incorporated into an annual monitoring program of all known Barred Galaxias populations.

6 Lessons learned

Although Barred Galaxias have been translocated in the past when rescuing populations exposed to drought and post-fire affects (Raadik *et al*. 2009), all have been returned to their natal stream. Translocating fish to establish new populations is a new venture. It is important to learn from past translocations to prevent errors in the future and to continue developing and refining best practice. Also, translocation procedures may require updating with new research findings on the species and as technology advances.

Therefore, translocation and post-release monitoring events should be thoroughly documented and made accessible to allow review and revision of procedures and document lessons learnt.

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