Giant Freshwater Lobster

Astacopsis gouldi

Recovery Plan 2006 - 2010

Australian Government

Tasmania

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The listing status of the threatened species referred to in this recovery plan was correct at the time of publication.

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The Tasmanian and Australian Governments facilitate the publication of recovery plans that set out the actions necessary to stop the decline of, and support the recovery of, threatened species. 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.

ABBREVIATIONS

ANZECC: Australian and New Zealand Environment and Conservation Council
CAR: Comprehensive, Adequate and Representative (Reserve System)
CFEV: Conservation of Freshwater Ecosystem Values project
DPIW: Department of Primary Industries and Water, Tasmania (previously DPIWE)
DPIWE: Department of Primary Industries, Water and Environment, Tasmania (now DPIW)
DEH: Department of Environment and Heritage (now Australian Government Department of the Environment and Heritage AGDEH)
ESP: Endangered Species Program
FPC: Forest Practices Code
FPA: Forest Practices Authority (previously Forest Practices Board FPB)
FPP: Forest Practices Plan
IFS: Inland Fisheries Service

IUCN: International Union for the Conservation of Nature
LAWA: Land and Water Australia
PWS: Parks and Wildlife Service
RFA: Regional Forest Agreement
TCFA: Tasmanian Community Forest Agreement

CONTENTS

SUMMARY

Species Description

The Tasmanian giant freshwater lobster, *Astacopsis gouldi* Clark, is a slow-growing and long-lived freshwater crustacean. It can grow to over 4 kg in weight. The species is endemic to Tasmania and naturally occurs in streams and lakes in northern and north-western Tasmania. Although a crayfish, it is locally known as the giant freshwater lobster, or by the indigenous name 'Tayatea'.

Conservation Status

Astacopsis gouldi is listed as 'Vulnerable' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, 'vulnerable' under Tasmania's *Threatened Species Protection Act 1995* and as a 'protected fish' under the *Inland Fisheries Act 1995*. The species is listed as a 'priority species requiring consideration' under the *Tasmanian Regional Forest Agreement 1997* and is therefore to be protected through the CAR (Comprehensive, Adequate and Representative) reserve system and/or by relevant management prescriptions. The species is not listed under any international agreements including CITES (Convention on International Trade in Endangered Species).

Habitat Requirements

To maintain healthy populations, *Astacopsis gouldi* requires waterbodies with good water quality, a stable thermal regime of relatively low water temperature, snags, pools, undercut banks, and ample canopy cover. Riparian vegetation needs to be predominantly intact and extensive to provide the shading, nutrient, energy and structural inputs required for the species' in-stream habitat.

Threats

The two major threats to the species area:

- the cumulative effects of past and current (illegal) fishing pressure
- the large-scale habitat disturbance for agricultural, urban and forestry land use

These threats have reduced the species' abundance and the viability of some populations.

Recovery Objectives, Performance Criteria and Actions

The overall objective of this recovery program is the down-listing of *A. gouldi* from its current Vulnerable classification under the Tasmanian *Threatened Species Protection Act 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* within 14 years (one generation) from adoption of this plan.

The recovery plan endorses and encourages community efforts to undertake activities which are compatible with this strategy, especially habitat protection, rehabilitation and awareness activities.

The recommended specific recovery objectives to be met within the 5-year life of the recovery plan, and the associated performance criteria and actions are:

Recovery Plan Objectives	**Performance Criteria**	**Actions**
1. Reduce and eliminate fishing pressure.	Fishing pressure on *A. gouldi* has been eliminated or reduced to a low level that is no longer considered a threat to population density or structure across its former range. A community education and awareness program has continued. A high level of community awareness of *A. gouldi* management issues and support for conservation has been demonstrated.	• Continue a community education and awareness program on *A. gouldi* conservation. • Enforce the fishing ban. • Monitor awareness and compliance with the ban. Assess level of awareness and conservation support through angler questionnaires and other surveys.
2. Prevent and ameliorate habitat degradation.	Areas of private land are being protected for *A. gouldi* conservation under cooperative mechanisms. Effective habitat protection and rehabilitation measures have been developed and implemented for agricultural, forestry and other potentially damaging activities. Protection of key areas (see Objective 3) has been progressed through available mechanisms such as private land covenants, public land reserves, Regional NRM strategies. A community education and awareness program has continued. A high level of community awareness of *A. gouldi* management issues and support for conservation has been demonstrated.	• Develop and implement new and existing cooperative mechanisms and strategies for protecting habitat on private land. • Improve agricultural and urban management practices through development of effective habitat protection measures, communication with landowners, establishment of demonstration sites for habitat rehabilitation, and liaison with land and water management agencies. • Implement effective habitat management in areas of forestry operations by refining and implementing management prescriptions to protect *A. gouldi* habitat, and evaluating their effectiveness.
3. Monitor and assess *A. gouldi* populations and habitats.	A survey of population abundance, recruitment, size structure, sex ratio and habitat characteristics has been conducted at a stratified set of sites using standardised methods. The surveys are incorporated into monitoring programs so that they are repeated every 5 years. Monitored populations do not further decline and show recovery, measured in the short term by maintenance or increase in the populations' size range and numbers, and successful recruitment. A comprehensive database has been established and is maintained on *A. gouldi* population abundance, recruitment, structure, habitat condition and distribution, to enable detection of trends. Key areas requiring protection have been identified and documented.	• Conduct a population and habitat survey to obtain baseline data for detecting trends. • Establish and maintain a database for population, habitat and distributional data. • Identify and document key areas for protection using population survey data and an analysis of reservation status, needs and gaps.
4. Increase understanding of *A. gouldi* biology and conservation requirements to improve management.	Knowledge gaps have been addressed in the areas of adult and juvenile movement, environmental flow requirements, efficacy of Forest Practices Code provisions for *A. gouldi* population protection, and genetic relationships between populations. The information is applied in species management e.g. through Forest Practices Code provisions, management prescriptions, Water Management Plans and advice to landowners.	• Facilitate and coordinate selected research projects to support conservation management of *A. gouldi.* • Apply the results to improve species management, through Forest Practices Code provisions, management prescriptions, Water Management Plans and advice to landowners, etc.
5. Coordinate implementation of the recovery program.	The recovery program is effectively and efficiently implemented through coordination of actions and reporting.	• Coordinate recovery plan actions, reporting and funding to achieve the Recovery Plan Objectives.

Long term criteria (>15 years):

1. *Astacopsis gouldi* will no longer be considered Vulnerable when it no longer meets any of the criteria for listing as Vulnerable under the Tasmanian *Threatened Species Protection Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

2. Habitat protection measures are in place on all land tenures where potentially threatening processes have been demonstrated to have adverse impact on local or downstream lobster population structure or viability.

3. Protected areas of high suitability habitat contain sufficient populations of *A. gouldi* to ensure the species' viability.

4. Long-term population recovery will be demonstrated when impacted populations show comparable structure, recruitment and densities to undisturbed populations (within the range of natural variability for the species).

Estimated Cost of Recovery

Estimated cost of each recovery action. All costs shown in the plan are in thousands of dollars at 2005 prices.

Action	1	2	3	4	5	TOTAL
Year 1	129.9	160.7	99.9	4.5	19.1	414.1
Year 2	105.1	156.9	92.3	3.8	16.5	374.6
Year 3	85.7	139.6	40.4	3.8	17.3	286.8
Year 4	75.7	152.9	17.4	6.1	17.3	269.4
Year 5	76.3	149.2	17.4	6.1	21.1	270.1
TOTAL	**472.7**	**759.3**	**267.4**	**24.3**	**91.3**	**1615**

Benefits to other Species and Ecological Communities

By managing northern Tasmanian freshwater ecosystems for the benefit of *A. gouldi*, many other threatened native aquatic fauna and other riparian values will also benefit. These values include over 40 species of threatened aquatic invertebrates especially hydrobiid snails and caddisflies, four species of threatened burrowing crayfish, two threatened frog species and the nationally threatened Australian Grayling. Other native species that will also benefit from the implementation of these recovery actions are platypus, native frogs, many freshwater fish especially galaxiids and a host of freshwater invertebrates including two closely related Astacopsis species where an overlap in range occurs.

PART A: BACKGROUND INFORMATION

This recovery plan is a revised and updated version of the 1997 plan prepared for the Tasmanian Comprehensive Regional Assessment (CRA) Endangered Species Project Number ES01, as part of the Regional Forest Agreement process. The plan identifies actions needed for the recovery of the Vulnerable giant freshwater lobster *Astacopsis gouldi* and estimates the costs of implementing the actions. This plan has been prepared by the Department of Primary Industries and Water. It builds on the advice and, at times divergent views of the Giant Freshwater Lobster Recovery Team, and has considered the views of other specialist consultants and the Threatened Species Community Review Committee.

Most stakeholders with an interest in the species were represented on the Giant Freshwater Lobster Recovery Team. The recovery team was chaired by the Inland Fisheries Service and comprised members from the Biodiversity Conservation Branch of DPIW, Threatened Species Network, Forest Practices Authority (previously the Forest Practices Board), Forestry Tasmania, University of Tasmania, Dorset Waterwatch, Central North Field Naturalists, Tayatea Enterprises and Freshwater Systems consultancy. The Water Resources Assessment and Planning Branch of DPIW and the Tasmanian Farmers and Graziers Association have an advisory capacity rather than active membership. The Aboriginal Land Council Tasmania receives progress updates and information has been sought from a number of specialists. Hydro Tasmania also receives progress updates and information.

Description of the Species

The Tasmanian giant freshwater lobster, *Astacopsis gouldi*, is the largest freshwater crayfish in the world, and is endemic to rivers in the north of Tasmania. Although a crayfish, it is locally known as a lobster and therefore the common name, giant freshwater lobster, is used in this plan. An alternative name is the indigenous name 'Tayatea'. It can be distinguished from *A. franklinii* and *A. tricornis* by the presence in *A. gouldi* of a prominent raised ridge on the rostrum (forehead) between the eyes (Clark 1936, Swain *et al.* 1982, Hamr 1992). The genus is endemic to Tasmania. Giant freshwater lobsters are spiny, have large claws, range in colour from blue to brown and have been reported to grow up to 6 kg, although these days animals weighing 2 to 3 kg are considered large. The species is slow-growing, slow colonising, large-sized, easily caught, and has relatively low fecundity.

Conservation Status

Astacopsis gouldi is listed as 'Vulnerable' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The species is also listed as 'vulnerable' under Tasmania's *Threatened Species Protection Act 1995*. *Astacopsis gouldi* meets the IUCN criteria for a 'vulnerable' classification (IUCN 2001), based on extent of occurrence, estimates of population decline (number of subpopulations and number of mature individuals), reductions in the extent of occurrence and the area and quality of habitat. The species was identified as a Category 3 fauna species (for which conservation needs can be managed by management prescriptions) under the Tasmanian comprehensive regional assessment process (PLUC 1997). It was subsequently listed as a 'priority species requiring consideration' under the *Tasmanian Regional Forest Agreement 1997* and is therefore to be protected through the CAR (Comprehensive, Adequate and Representative) Reserve System and/or by applying relevant management prescriptions (RFA Clause 68). The species is not listed under any international agreements including CITES (Convention on International Trade in Endangered Species).

Management

Management of *A. gouldi* is primarily the responsibility of the Inland Fisheries Service under the provisions of the *Inland Fisheries Act 1995*, and DPIW under the *Threatened Species Protection Act 1995*. Since January 1998 *A. gouldi* has been a 'protected fish' under the *Inland Fisheries Act 1995*, prohibiting fishing for the species. However, some illegal fishing continues as evidenced by the presence of recent baitlines, anecdotal reports and prosecutions. Previous fisheries regulations allowed a recreational fishery for the lobster during the angling season, with original regulations allowing a bag limit of 12 lobsters a day, a minimum size of 130 mm carapace length, and no taking of females in berry (Hamr 1990b). From the 1993-94 season, the taking of all females was prohibited and a bag limit of three males per day applied. Six catchments, including the Hellyer, Inglis, Duck, Emu, Mersey and Great Forester were closed to the taking of freshwater lobster (Inland Fisheries Commission 1993a, b). A study of baitline distribution (Lynch and Blühdorn 1997) indicates that some fishers ignored these closures. In addition, taking of any freshwater crayfish (i.e. including the two other species of *Astacopsis*) was prohibited under Inland Fisheries regulations in 2000.

Management of the species in relation to forest practices is subject to the provisions of the Forest Practices Code (FPB 2000). A Forest Practices Plan (FPP) must be prepared for any forest clearing on non-vulnerable land that is in excess of 1 hectare or 100 tonnes of timber per year upon any one property, even if no commercial wood is produced (FPB 2002). On vulnerable land, a FPP is required for any clearing, unless that clearing is undertaken to protect public safety or maintain existing infrastructure and does not exceed 1 hectare or 5 tonnes of timber per property per year. Forest Practices Plans are subject to specific management prescriptions for threatened species, which are delivered via the *Threatened Fauna Adviser* decision support system (FPB 2001). The intent of these recommendations is to enhance the standard provisions of the Forest Practices Code according to the needs of threatened species. Areas reserved for threatened species purposes become vulnerable land upon expiry of the FPP. No further clearing or harvesting is permitted on such vulnerable land retained for threatened species conservation, such as *A. gouldi* (*Forest Practices Act 1985*).

Guidelines are available with recommended management practices for works in waterways (Gallagher 2003) and to protect and rehabilitate riparian zones on agricultural land (e.g. Munks 1996, Hamlet 2002).

Under the Tasmanian *Threatened Species Protection Act 1995* it is an offence to knowingly take, trade in, keep or process any listed species without a permit. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* applies similar protection to species on Commonwealth lands or impacted by Commonwealth activities or decisions, and populations of listed species regardless of land tenure. The RFA requires that priority species be protected through the CAR (Comprehensive, Adequate, Representative) Reserve System and/or by applying relevant management prescriptions (Clause 68), which are adequate for species protection and have a sound scientific basis (Clause 96). The process for development, implementation and review of *A. gouldi* management prescriptions for forestry operations is given in Appendix 1 of this plan. Management prescriptions and actions identified in jointly prepared and agreed recovery plans are to be implemented as a matter of priority (Clause 70).

The recovery process for *A. gouldi* needs to be integrated with a number of State strategies, which include principles relating to habitat protection. These strategies include the *Threatened Species Strategy for Tasmania* (DPIWE 2000), *Tasmania's Nature Conservation Strategy* (DPIWE 2002), catchment management plans, water management plans (under the *Water Management Act 1999*) the *State Policy on Water Quality Management* (1997) and *A Wetlands Strategy for Tasmania* (DPIWE 2004).

Role and Interests of Indigenous People

In 2003 the Aboriginal Land Council Tasmania was invited to have representation on the *Astacopsis* recovery team and a formal consultation process is under way for Tasmanian Recovery Plans to ensure that assistance and input from the indigenous community is sought. The Tasmanian Aboriginal Land and Sea Council (TALSC) and Aboriginal Heritage Office (Department of Tourism, Arts and the Environment - DTAE) will assist in the identification of potential indigenous management responsibilities for land occupied by threatened species, or groups with a cultural connection to land that is important for the species' conservation. Continued liaison between DPIW and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions. Approval to conduct activities on indigenous land will always be sought and all recovery activities will be conducted in a manner that is consistent with the requests of TALSC and the Aboriginal Heritage Office (DTAE).

Benefits to other Species and Ecological Communities

By managing northern Tasmanian freshwater ecosystems for the benefit of *A. gouldi*, many other native aquatic fauna will also benefit. The Forest Practices Authority's Threatened Fauna Manual (FPB 2001) and the Threatened Fauna Handbook (Bryant and Jackson 1999) list a number of other threatened species that occur in *A. gouldi* habitats, including hydrobiid snails and four species of burrowing crayfish. Because of the linkages between riparian and in-stream ecosystems, the protection of riparian zones will benefit riparian and in-stream fauna. Functional, intact riparian zones are directly related to high in-stream biodiversity (Boulton and Brock 1999) and contribute to the floristic diversity of off-reserve areas.

These benefits can be effectively achieved by measures to raise awareness of freshwater environments and their conservation management requirements, and by encouraging implementation of management through private and community projects, private land conservation agreements, and forest and agricultural industry management prescriptions and codes of practice.

Affected Interests, Social and Economic Impacts

A number of parties affected by any measures implemented for the recovery of *A. gouldi* are represented on the recovery team or acted as advisers during the development of this plan. They include the major land-use industries, forestry and agriculture. Any measures to assist recovery of this species that involve restrictions on the use of riparian land may result in economic impacts on such industries. All interested stakeholders, however, have indicated support for evidence-based actions that are required for the recovery of this species. Adoption by agriculture and wood producers of practices which conform to certification standards help to maintain their licenses-to-operate. Improvements in water quality expected to result from increased protection of *A. gouldi* habitat may be economically and socially advantageous. Increased public awareness of the lobster and its undisturbed forest habitat may bring social and economic advantages through tourism. State government support for protection of lobster habitat on private land may also be available.

Part B: DISTRIBUTION, RESERVATION STATUS AND HABITAT

Distribution

The range of *A. gouldi* extends from the Arthur River, in Tasmania's north-west, across the north of the state to the Ringarooma River, including the Arthur River catchment and all river catchments flowing into Bass Strait, with the exception of the Tamar catchment (Horwitz 1994). In addition, the species has been introduced to two catchments: the North Esk catchment (St Patricks River) and the Derwent catchment (Clyde River) (IFS unpublished data) (Figure 1).

Within these catchments *A. gouldi* occurs at altitudes below about 400 m, with most specimens caught below 200 m (Horwitz 1991, 1994). There is little overlap in the distribution of the three *Astacopsis* species, although species occasionally occur together in some permanent headwater streams (Horwitz 1994, Growns 1995, Davies and Cook 1999).

The extent of occurrence of *A. gouldi* within its range is apparently disjunct. Based on condition of habitat, historical records and anecdotal reports, localised extinctions or large declines in numbers are thought to have occurred in the Welcome, Montagu, Rubicon, Don, Brid, Boobyalla, Pipers, Ringarooma, Duck, Little and Great Forester Rivers and Claytons Rivulet (Horwitz 1990, 1991, 1994).

Reservation Status

The estimated range of *A. gouldi*, based on catchments where the species is currently known to occur and from historical reports of species presence, is approximately 1,070,000 ha (Table 1).

Approximately 54% of the species' range occurs on unreserved private land, 24% on State Forest (couped and uncouped) and 2% on other public land (eg unallocated Crown land, local council, etc) (Table 1). Approximately 19% of the species' range comprises either formal or informal reserves.

Habitat Critical to Survival

A. gouldi are found in flowing and still waters and are believed to occur in all sizes of stream, with adults living in still, deep pools, sheltered beneath submerged and decaying logs and undercut banks, and also moving through shallow riffle zones (Lynch 1967, Hamr 1990a). Using radio-tracking, Webb (2001) found that adult lobsters selected habitat in patches of instream logs near the river margin in pools, and had a high degree of site-fidelity: they would return to the same site after movements away. Smaller juveniles also inhabit shallow fast-flowing stream habitats (Hamr 1990a) and favour habitats with large rocks or logs that are big enough to be stable, not embedded in finer substrates, overlying coarser substrates and/or with a distinct cavity underneath (Davies and Cook 2004). Streams where *A. gouldi* are found are usually well shaded (Lynch 1967; Hamr 1990a, b; Growns 1995). In captivity, adult *A. gouldi* were not tolerant of water temperatures exceeding 18°C for several weeks (Forteath 1987) and in the wild temperatures of study streams occupied ranged between 8-21^{o}C (Webb 2001), 5.2-18^{o}C (Hamr 1990a), and 8.5-17.9^{o}C (Lynch and Blühdorn 1997). *Astacopsis gouldi* may also be found in hydro impoundments eg Lake Barrington.

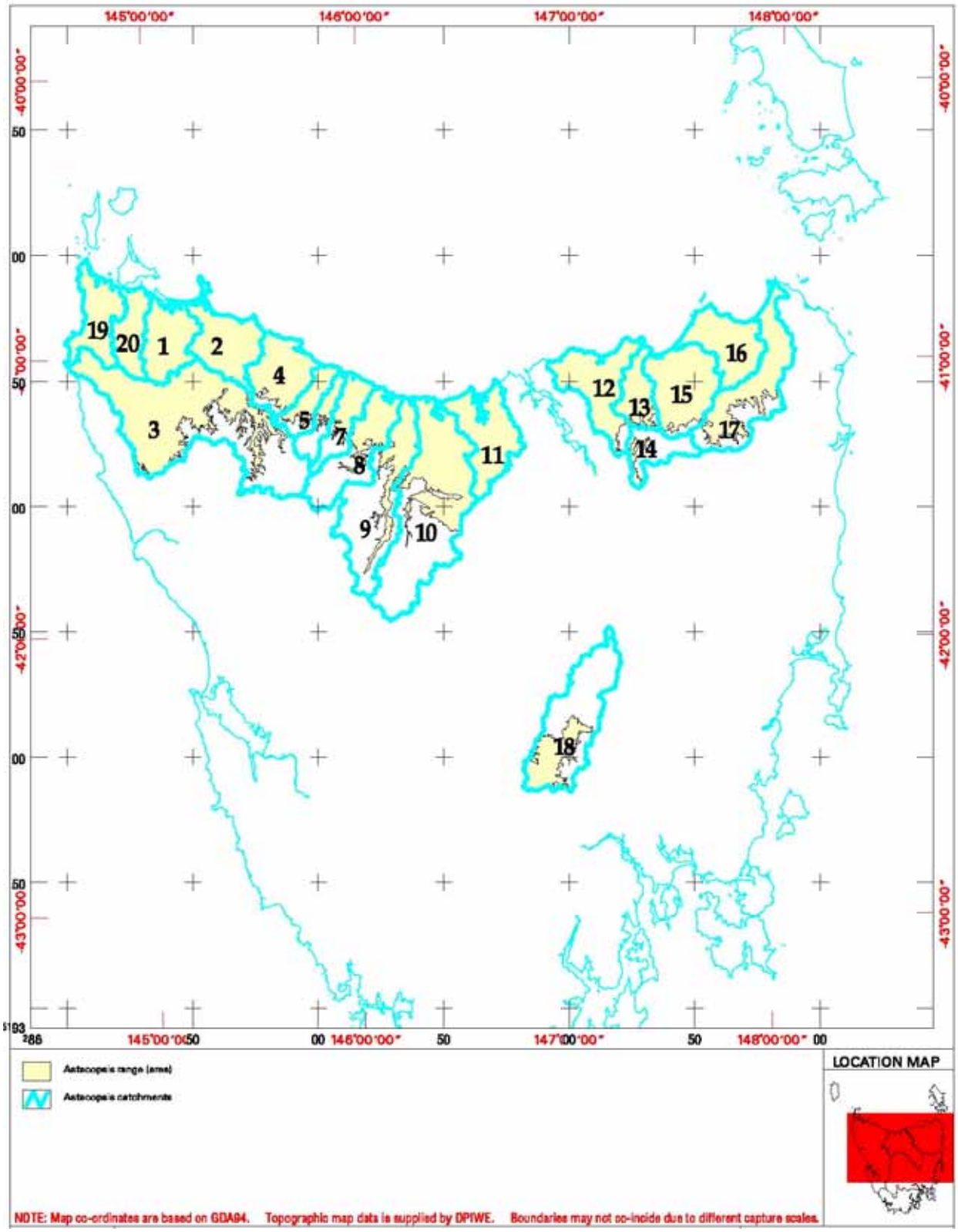

Figure 1. Catchments where *Astacopsis gouldi* occurs in Tasmania. Numbers indicate major river catchments as follows: 1. Duck; 2. Black-Detention; 3. Arthur; 4. Inglis-Flowerdale; 5. Cam; 6. Emu; 7. Blythe; 8. Leven; 9. Forth-Wilmot; 10. Mersey; 11. Rubicon; 12. Pipers; 13. Little Forester; 14. St. Patricks; 15. Great Forester-Brid; 16. Boobyalla-Tomahawk; 17. Ringarooma; 18. Clyde (introduced); 19. Welcome; 20. Montagu.

Table 1. Land tenures and land-use categories within the range of *A. gouldi*.

Tenure / Land-use	Range ha (%)
Formal Reserves	132,624 (12.4%)
Informal Reserves and Private CAR Reserves	50,228 (4.7%)
TCFA Formal Reserves	7,696 (0.7%)
TCFA Informal Reserves	16,768 (1.6%)
Other Private Land	579,008 (54.2%)
Other Public Land	19,384 (1.8%)
State Forest (couped)	179,308 (16.8%)
State Forest (uncouped)	83,464 (7.8%)
Total	1,068,480 (100%)

Range = Major river catchments with known localities up to 400m altitude (including introduced populations). Data supplied by Forestry Tasmania (23 Dec 2005).

On a regional scale, habitat for *A. gouldi* may be described as an intact system of densely canopied streams, of several stream sizes including small headwaters, flowing through a relatively undisturbed, forested catchment. On a local scale, excellent lobster habitat is comprised of streams containing snags, pools and undercut, but not eroding banks, with water of relatively low temperature, high dissolved oxygen, little sediment and bordered by intact riparian zones of native vegetation (Lynch and Blühdorn 1997). The species has also been recorded in stream reaches with non-native riparian vegetation (e.g. pine plantations), without riparian vegetation and in farm dams. Horwitz (1994) did not find lobsters in established agricultural areas where the riparian vegetation had been totally removed.

Mapping of Habitat Critical to Survival

Since *Astacopsis gouldi* occupies a large geographical range and only broad habitat parameters are available, it has been difficult in the past to map areas of suitable habitat type in detail.

Davies and Cook (2004), however, provides sufficient information to allow the development of a set of mapping rules that could be applied to Tasmanian stream drainage in order to discriminate stream sections' suitability for juvenile *A. gouldi*. This information coupled with information from further surveys of headwater streams (Davies *et al.* 2005), previous studies (Lynch 1967, Hamr 1990a,b, Horwitz 1991, Horwitz 1994, Growns 1995, Lynch and Blühdorn 1997, Webb 2001, Walsh and Nash 2002, Davies and Cook 2004) and expert opinion has been used to develop an initial set of interim rules discriminating high, medium and low classes of habitat suitability for juvenile *A. gouldi* (Davies *et al.* 2005). These interim rules are provided in Appendix 3. Work is progressing on refining

these mapping rules and ground-truthing habitat suitability for the development of a draft 'habitat suitability' map that would be used to assist conservation planning for *A. gouldi* (Davies pers. comm.).

The area of habitat important for the conservation of lobsters can be described as all areas currently occupied by the species throughout its geographical range, plus their upstream catchments (which are important for the maintenance of the areas where they do occur, as included in EPBC regulation 7.09). The major river catchments are shown in Figure 1.

There are many land managers within this area of lobster habitat, with tenures including private land, State Forest and other public lands.

Important Locations

Several catchments and part catchments have previously been identified as important locations for the lobster (Lynch and Blühdorn 1997, Walsh 2003). It is recommended that these locations be considered in the development of any 'habitat suitability' map from the work of Davies and Cook (2004) and Davies *et al.* (2005). Consideration at the catchment scale is important for aquatic animals, as isolated spot locations can be affected by the upstream catchment. The following catchments were "recommended for reservation" by Lynch and Blühdorn (1997): Hellyer River and tributaries; Flowerdale River from below the Lapoinya Forest Reserve to the top of the catchment; Inglis River and tributaries; Black River and tributaries; Dip River and tributaries; Detention River and tributaries; Minnow River and tributaries; Aitken Creek from downstream of the Nook Road crossing to the Sheffield Road crossing on the Don River; Emu River and tributaries; Great Forester River and tributaries; Little Forester River and tributaries.

Walsh (2003) recommends that the importance of these areas to the lobster be reviewed as their habitat quality may have changed since 1997, and gives additional important areas. Walsh recommends the Hebe River (Inglis catchment), Frankland, Rapid, Keith and Lyons rivers (all Arthur catchment), Duck River catchment above Trowutta Road, Black River catchment, and the Dip Range streams for higher protection due to good quality habitat with good lobster populations. The Cam River catchment is suggested as potentially important with surveys required to assess habitat and populations. The north-eastern rivers are identified by Walsh (2003) as requiring more surveys to determine which areas are important.

Results from a genetic study (Sinclair *et al.* unpublished data) indicate that specimens from a site in the Pipers River catchment (Little Creek) are significantly genetically distinct. Therefore this catchment should also be considered an important location.

Part C: THREATS

Species Biology Relevant to Threatening Processes

Female lobsters are generally not sexually mature until they reach approximately 119 mm carapace length (CPL) and 500 g in weight (Hamr 1996), although Walsh (2003) reports berried lobsters of less than 90 CPL from the Keith River. Growth to 120 mm CPL takes about 14 years (Hamr 1996). Males reach sexual maturity earlier than females at approximately 76 mm CPL and 300 g in weight, which is thought to take 9 years of growth (Hamr 1996). Females apparently spawn biennially (Hamr 1990a, 1992). Mating and spawning occur in autumn after a summer moult and gestation takes about 9 months, with females carrying the eggs through the winter. After hatching in mid summer, the young remain attached to the female until autumn (Hamr 1996). The number of eggs is proportional to female size and egg counts range from 224 to 1300 (Hamr 1996).

Several studies have measured population structure. Most *A. gouldi* recorded by Hamr (1996) from the Inglis River in 1985-88 were in the 60-90 mm CPL range and few very small juveniles and breeding-sized adults were recorded, although juveniles were not actively sought and visual searching for juveniles has a low efficiency (Davies and Cook 2004). The under-representation of the adult size classes was attributed to the results of heavy fishing pressure. From ten sites in the Mersey catchment, Growns (1995) recorded most lobsters in the range of 20-80 mm CPL, with few small juveniles and breeding-sized adults. All these sites had been subjected to fishing and/or forestry impacts (Growns 1995). In a study of two areas in the north and north-west of Tasmania, Lynch and Blühdorn (1997) reported sizes ranging from 39 to 136 mm CPL. Lobsters in both populations were mostly of 50-70 mm length. No lobsters of the previously legal size (130 mm CPL) were caught, with the largest male measuring 109 mm carapace length. The absence of large individuals, especially males, was attributed to the effects of fishing.

The main food item of *A. gouldi* is decaying wood and its associated microbes, although their diet varies with age and they also eat leaves and animal flesh including small fish when available (Lynch 1967, Forteath 1987, Hamr 1996).

The dispersal patterns and migratory activities of the species are largely unknown, although individuals were found to move up to 500 m by Forteath (1987) and Growns (1995), and Webb (2001) tracked one animal that moved 1650 metres. Interestingly, Webb (2001) found that lobsters returned to their 'home site' after small and large-scale movements away. The species can also walk over land (Horwitz 1991). The genetic differences between populations are also largely unknown.

Identification of Threats

The principal threatening processes affecting *A. gouldi* are past legal and now currently illegal fishing pressure, and habitat disturbance (Lynch 1967, Hamr 1990b, Horwitz 1994, Growns 1995, Lynch and Blühdorn 1997). Many of the streams inhabited by *A. gouldi* have been subject to disturbance from agricultural, forestry and urban activities and much of the floodplain riparian area within its range has been heavily modified. With expansion of roading, primarily a result of forestry activities, more of the species' upland refuges can be more easily accessed for fishing.

While *A. gouldi* is widely distributed across the north of Tasmania, these threatening processes are likely to occur in every catchment. Reports of localised extinctions and large declines in numbers due to fishing and/or habitat degradation are relatively common (e.g. Hamr 1990a, Horwitz 1991, 1994, Maxwell *et al.* 1997), although much of the evidence consists of anecdotal accounts. The

structure of populations studied in recent years indicates an absence of large individuals, particularly males, with very few lobsters of a size indicating sexual maturity being found (Growns 1995, Hamr 1996, Lynch and Blühdorn 1997).

The recolonisation of impacted streams appears to be very slow (e.g. Maxwell *et al.* 1997), indicating that dispersal is naturally slow, is being made more difficult and/or that the animals available for such migrations are no longer plentiful. The life-history stage or environmental cues, which precipitate migratory or dispersal activity, are not known. The species' slow growth and relatively low fecundity compound the problems facing recruitment into impacted areas.

Factors identified as limiting implementation of recovery measures, across all land tenures and land use activities, are the compliance with the fishing ban, limited integration of natural resource management at the catchment scale, and the lack of a comprehensive agricultural code of practice (or equivalent). The latter could be complementary to the Forest Practices Code to guide land management practices under agriculture.

Fishing

Fishing for the lobster legally ceased as of January 1st 1998 (*Inland Fisheries Act 1995*), however, the impacts of ongoing illegal fishing continue to threaten *A. gouldi*. The full implications of fishing on the population dynamics of the species are not well understood, although population surveys indicate that past fishing pressure has had a significant impact on *A. gouldi* populations. The population study carried out for the recovery plan, prior to the fishing ban, failed to capture a single legal-sized individual (130 mm CPL) (Lynch and Blühdorn 1997). Despite the study being limited in scope and extent, such a finding suggests a major impact has occurred if the catchments studied were representative of the lobster's broader distribution.

Davies (1991) assessed past fishing pressure through a questionnaire survey of licensed recreational anglers (who were only a proportion of lobster fishers), and minimum annual catches of the order of 10,000 – 12,000 individuals were estimated. Fishing pressure targets mainly adult and large sub-adult members of the population. Although the fisheries regulations since 1993 prohibited the taking of females, in practice few fishers would have known how to determine the sex of a lobster. It is likely that the absence of the larger size classes diminishes the population's recruitment potential by removing many of the reproductively active members and leaving only relatively small, newly mature individuals available for mating and spawning. However, removal of adults may also increase recruitment by a reduction in intra-population pressures.

A degree of fishing activity is known to be continuing despite now being totally illegal. This is evidenced by the presence of recent baitlines, anecdotal reports and prosecutions. A study of baitlines by Lynch and Blühdorn (1997) indicated that the regulations applicable at the time (prohibiting lobster fishing in certain catchments and capture of females) had no discernible effect on implied fishing pressure.

Habitat Disturbance

Habitat disturbance includes the removal or destruction of riparian vegetation, bank erosion, desnagging, channelisation, siltation, nutrification, toxic chemical inputs, instream barriers to lobster movement such as culverts and farm dams, and alterations to stream flow and thermal regime. The possible impacts on lobsters have been documented elsewhere (Horwitz 1994) and impacts may also affect a substantial number of aquatic and riparian species. While these impacts have historically been associated with agricultural and urban land use on floodplain areas, expansion of forestry

activity has extended disturbances to upland catchments.

Climate change is a significant overarching threat that may result in altered stream flows, stream temperatures and changes to catchment vegetation. Such habitat disturbance may affect the entire local lobster population, not just large individuals.

In agricultural areas, lobster populations may be affected by general stream degradation caused by clearing of riparian vegetation, desnagging, extensive modification of stream channels, access by stock, water abstraction and inflows of agricultural chemicals and nutrients. The overall result of these practices has been probable local extinctions of *A. gouldi* from some river reaches and the apparent disappearance of *A. gouldi* from some of its original distribution, especially in floodplain and estuarine areas (Horwitz 1994).

Forestry operations (e.g. logging, roading, plantation establishment, etc) have the potential to create adverse impacts on *A. gouldi* through the loss of riparian canopy cover, increased runoff, sedimentation, changes in hydrology and chemical spraying. These are addressed in the Forest Practices Code (Forest Practices Board 2000) and associated planning tools that deliver management actions to ameliorate such impacts. Forestry roads may also improve access to previously inaccessible *A. gouldi* populations. This can result in an increase in fishing pressure on previously undisturbed populations (Hamr 1996). This impact may be addressed by raising awareness and enforcing the prohibition on fishing for the species, revegetation and constructing barriers across redundant roads (ie. those that are not planned to be used again or for a long time), and restricting access to previously inaccessible areas.

Areas under Threat

The threats identified in this plan are all operating across the lobster's range to varying degrees. Areas under threat can only be described in general terms, as detailed information is available for only small parts of the range (e.g. Lynch and Blühdorn 1997). Implied fishing intensity (as measured by baitline occurrence) appears related to accessibility, with most baitlines associated with access roads (Lynch and Blühdorn 1997, Hamr 1990a, 1996). The proportion of mature individuals in accessible populations can drop to as low as 5%, compared to up to 40% in less accessible sites (Hamr 1990a). Remote areas are likely to be less heavily fished (Hamr 1990a). Fishing pressure is highest in areas of high quality lobster habitat, with most baitlines found at sites where there was good riparian vegetation and pools with snags and undercut banks (Lynch and Blühdorn 1997). Actual fishing pressure is likely to be higher than baitlines indicate, as many fishers leave no trace of their activities. It should be noted that this data pre-dates the ban on fishing and so may not be indicative of current activity.

Habitat disturbance also varies in intensity across the lobster's range, with most disturbances in areas subject to agricultural, urban and forestry activities. Horwitz (1994) suggests that the lobster has declined most in the north-west extremity of its range and in lower to middle reaches of rivers.

Populations under Threat

Consistent information on population status is not available across the lobster's range. However, available information indicates that populations in the following catchments have had major declines due to the main threatening processes: Welcome River, Montagu River, Duck River, Rubicon River, Pipers River, lower reaches of the Little Forester, Great Forester and Brid rivers, Don, Boobyalla and Ringarooma rivers, Caroline Creek, upper Arthur River, and upper Minnow River tributaries (Horwitz and Hamr 1988, Horwitz 1994, Growns 1995, Lynch and Blühdorn 1997, Walsh 2003).

Part D: RECOVERY OBJECTIVES, CRITERIA AND ACTIONS

Strategies for Recovery

Recovery must occur within the original distribution of *A. gouldi* because of the species endemicity and must counteract or remove the threatening processes currently identified. Recommended recovery objectives and criteria are specified below. Recovery actions focus on two areas, namely reduction in fishing through community education and enforcement, and habitat protection and rehabilitation. Intact, largely undisturbed populations should be identified and steps taken to provide for their protection and adequate conservation of their habitat. Disturbed populations should be provided with habitat conditions that will encourage their recovery.

The plan does not promote or endorse research into aquaculture, captive breeding, restocking, translocation within Tasmania or movement interstate of *A. gouldi.* These are not considered necessary for recovery of the species at this stage and are not recovery actions. All research and management work should focus on conservation of the species in the wild in Tasmania. However, the species has been introduced to previously uninhabited catchments in Tasmania and is reported to be translocated to dams and streams. The development of policies on controlling translocation, restocking, reintroduction and captive breeding is required in relation to conservation of the species. IUCN technical guidelines on *ex-situ* populations (IUCN 2002) and a draft national policy on translocation of threatened species by ANZECC may guide development of such policies for *A. gouldi*. An important related issue is that of disease and pest risks associated with moving freshwater crayfish species (reviewed in AQIS 1999).

Strategies for the recovery of *A. gouldi* are based on five primary objectives:

- reduction in fishing pressure;
- prevention and amelioration of the effects of habitat disturbance;
- monitoring of population recovery, and identification and protection of core populations;
- increasing knowledge of the species' biology and habitat requirements; and
- overall coordination of the recovery process.

Increased public awareness and community support are integral to meeting these objectives. While the recovery plan specifies community involvement on some key actions it encourages community support more widely on activities which are compatible with this strategy, especially habitat protection, rehabilitation and improving awareness.

Overall Recovery Objective

The overall objective of this recovery program is the down-listing of *A. gouldi* from its current Vulnerable classification under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Tasmania's *Threatened Species Protection Act 1995* within 14 years (one generation) from adoption of this plan.

Long Term Criteria (>15 years):

1. *Astacopsis gouldi* will no longer be considered Vulnerable when it no longer meets any of the criteria for listing as Vulnerable under the Tasmanian *Threatened Species Protection Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

2. Habitat protection measures are in place on all land tenures where potentially threatening processes have been demonstrated to have adverse impact on local or downstream lobster population structure or viability.

3. Protected areas of high suitability habitat contain sufficient populations of *A. gouldi* to ensure the species' viability.

4. Long-term population recovery will be demonstrated when impacted populations show comparable structure, recruitment and densities to undisturbed populations (within the range of natural variability for the species).

Specific (short term) Objectives, Criteria and Actions

Specific recovery objectives to be met within the 5 year life of the recovery plan are in Table 2.

Table 2. Specific recovery objectives to be met within the 5 year life of the recovery plan

Recovery Plan Objectives	Performance Criteria	Actions
1. Reduce and eliminate fishing pressure.	Fishing pressure on *A. gouldi* has been eliminated or reduced to a low level that is no longer considered a threat to population density or structure across its former range. A community education and awareness program is continuing. A high level of community awareness of *A. gouldi* management issues and support for conservation has been demonstrated.	• Continue a community education and awareness program on *A. gouldi* conservation. • Enforce the fishing ban. • Monitor awareness and compliance with the ban. Assess level of awareness and conservation support through angler questionnaires and other surveys.
2. Prevent and ameliorate habitat degradation.	Areas of private land are being protected for *A. gouldi* conservation under cooperative mechanisms. Effective habitat protection and rehabilitation measures have been developed and implemented for agricultural, forestry and other potentially damaging activities. Protection of key areas (see Objective 3) has been progressed through available mechanisms such as private land covenants, public land reserves, Regional NRM strategies. A community education and awareness program is continuing. A high level of community awareness of *A. gouldi* management issues and support for conservation has been demonstrated.	• Develop and implement new and existing cooperative mechanisms and strategies for protecting habitat on private land. • Improve agricultural and urban management practices through development of effective habitat protection measures, communication with landowners, establishment of demonstration sites for habitat rehabilitation, and liaison with land and water management agencies. • Implement effective habitat management in areas of forestry operations by refining and implementing management prescriptions to protect *A. gouldi* habitat, and evaluating their effectiveness.
3. Monitor and assess *A. gouldi* populations and habitats.	A survey of population abundance, recruitment, size structure, sex ratio and habitat characteristics has been conducted at a stratified set of sites using standardised methods. The surveys are incorporated into monitoring programs so that they are repeated every 5 years. Monitored populations do not further decline and show recovery, measured in the short term by maintenance or increase in the populations' size range and numbers, and	• Conduct a population and habitat survey to obtain baseline data for detecting trends. • Establish and maintain a database for population, habitat and distributional data. • Identify and document key areas for protection using population survey data and an analysis of reservation status, needs and gaps.

	successful recruitment. A comprehensive database has been established and is maintained on *A. gouldi* population abundance, recruitment, structure, habitat condition and distribution, to enable detection of trends. Key areas requiring protection have been identified and documented.	
4. Increase understanding of *A. gouldi* biology and conservation requirements to improve management.	Knowledge gaps have been addressed in the areas of adult and juvenile movement, environmental flow requirements, efficacy of Forest Practices Code provisions for *A. gouldi* population protection, and genetic relationships between populations. The information is applied in species management e.g. through Forest Practices Code provisions, management prescriptions, Water Management Plans and advice to landowners.	• Facilitate and coordinate selected research projects to support conservation management of *A. gouldi.* • Apply the results to improve species management, through Forest Practices Code provisions, management prescriptions, Water Management Plans and advice to landowners, etc.
5. Coordinate implementation of the recovery program.	The recovery program is effectively and efficiently implemented through coordination of actions and reporting.	• Coordinate recovery plan actions, reporting and funding to achieve the Recovery Plan objectives.

Budget Summary

The total cost of the recovery program is $1,615,100 over five years. The majority of expenditure is on monitoring population recovery and enforcement, especially in the first year.

000's	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*TOTAL*
Total	414.1	374.6	286.8	269.4	270.1	1615

Recovery Actions

This section details the actions required to achieve the objectives of this recovery plan. The plan should be reviewed and amended toward the end of this period to meet the conditions prevailing at that time.

1 Reduce and Eliminate Fishing Pressure

Available data on population demographics from the mid-1990s indicates that over-fishing has had a dramatic impact on lobster populations. The 1997 draft recovery plan (Blühdorn 1997) recommended regulatory changes to introduce a prohibition on fishing, for at least one *A. gouldi* generation of 14 years. This was achieved in January 1998 with *A. gouldi* being declared a 'protected fish' under the *Inland Fisheries Act 1995*. Despite this ban there is evidence that poaching continues (from baitlines, anecdotal reports and prosecutions) while few resources are made available for policing the ban on fishing.

The tasks recommended to significantly reduce and ultimately eliminate the fishing pressure on *A. gouldi* comprise: a community awareness and education program, enforcement of the fishing ban and policing the illegal trade, and monitoring of awareness and illegal fishing to assess compliance with the ban on fishing.

1.1 Community Awareness and Education Program

The recovery of *A. gouldi* is not possible without the continuing support and involvement of the community, especially in complying with the fishing regulations. While previous fishing restrictions appear not to have been completely successful, it is hoped that involving local communities in the recovery of the species can change this situation. An awareness and education plan is needed, aimed at producing a change of ethos from one of exploitation to one of protection.

A community awareness and education program will be developed for schools, local government, community action groups, forest-industry workers and private landholders. Persistent poachers are also an important target group. This program will aim to increase awareness of the fishing regulations prohibiting fishing for *A. gouldi* and why the taking of *A. gouldi* is no longer acceptable, as well as environmental needs of *A. gouldi* and riparian management and stream ecology. Some work in this area has already been conducted as part of a Natural Heritage Trust-funded project (no. 00013163). Angling clubs within the Northern Tasmanian Fisheries Association and North Western Fisheries Association will be encouraged to participate in community education.

It is recommended that the program be administered by the IFS (project staff) in partnership with community groups and other interested stakeholders. It should commence as soon as possible and continue until the monitoring programs show widespread compliance with the regulations and community adoption of a more protective attitude toward the lobster.

- Opportunities for development of minimal-impact nature-based tourism ventures focused on the lobster in the wild will be investigated.

- A fact sheet produced by the DPIW, colour brochure, posters and stickers produced by IFS are already available but funding is required for reprinting, development of more printed material (information sheets and displays) and material for slide presentations, etc.

- Extensive advertisement of the regulations in newspapers, the IFS newsletter, angling magazines, landcare newsletters will be undertaken.

- Lobster information will be added to the IFS website and linked to other relevant sites.

- Signs will be developed and placed prominently on bridges etc advising of the ban on fishing. Tags or tape will be produced to label baitline stumps (after baitline removal) with information on the fishing ban.

- The program will provide information material to agricultural industries through organisations like the Tasmanian Farmers and Graziers Association, etc.

- An awareness program for the forest industry will include articles in industry newsletters, presentations and field days at Forest Practices Officers courses, field days with contractors and presentations to FT districts and forestry companies. It will emphasise the benefits to the forest industry of a successful implementation of the fishing ban. It will be linked with monitoring of *A. gouldi* populations in forestry areas.

- Lobsters will be promoted as a flagship species for good catchment management. Landowners will be encouraged to maintain healthy lobster populations on their land and to not allow access to potential poachers.

	Yr1	Yr2	Yr3	Yr4	Yr5	Total
Cost ($000s)	50.3	30.2	31.5	33.8	34.4	180.2

1.2 Enforcement

During the prohibition of fishing the species should be wholly protected with effective deterrents in place to discourage illegal disturbance or harvesting. Fishing is a fineable offence (up to $10,000) under the *Inland Fisheries Act 1995* and the *Threatened Species Protection Act 1995*. However, to be an effective deterrent, such fines must be backed by focused and high profile enforcement activities. DPIW, PWS and IFS enforcement officers, and Tasmania Police, need to be aware of how to obtain the evidence necessary for successful prosecution and an information brochure has been produced for this.

A routine, high-profile enforcement effort led by the IFS including surveillance, apprehension and charging of offenders and prevention of illegal trade in specimens is required. The emphasis should be on publicising the enforcement effort and the reasons for it. It is recommended that this action commence immediately and continue for the first 3 years of the recovery plan with routine enforcement continuing indefinitely. As a minimum the equivalent of at least one of the existing IFS enforcement staff will focus on *Astacopsis* issues at half time for 6 months of the year (ie 0.25 FTE) when the lobsters are most active and easily fished (Nov-April). IFS enforcement staff will be encouraged to actively communicate to recreational fishers on the north and north west coasts about the regulations, and to keep records of such encounters. Parks and Wildlife officers and Tasmania Police are also responsible for enforcement.

An existing brochure will be reprinted and distributed for IFS and PWS enforcement staff and Tasmania Police showing how to recognise *A. gouldi* and how to obtain the evidence required for prosecution under the *Inland Fisheries Act 1995* and/or *Threatened Species Protection Act 1995*. Training in identification will be provided by IFS.

The education and awareness program will encourage everyone to assist with surveillance by reporting fishing to IFS inspectors or via the Bushwatch phone number.

To halt the illegal trade in *A. gouldi* trophy specimens, a process for registering and permitting of existing mounted specimens collected legally before the ban of fishing will be developed and put in place.

	Yr1	Yr2	Yr3	Yr4	Yr5	Total
Cost ($000s)	59.0	55.0	35.0	30.0	30.0	209.0

1.3 Monitoring of Awareness and Compliance

To assess the effectiveness of the above actions, programs to monitor (a) awareness of the ban on fishing and (b) compliance with the ban (i.e. how much illegal fishing is continuing and in what circumstances) are required. Results can feed back to the public awareness and enforcement programs which can be adapted accordingly.

Monitoring of awareness will be carried out by inclusion of appropriate questions on the annual postal angler survey conducted by the IFS. It is recognised that this will target the section of the community who are likely to be best informed about fishing regulations, and other survey methods will be used when available to reach non-anglers, including standardised verbal survey at Agfest and

IFS Open Day and DPIWs Living Treasures Week activities, etc.

Monitoring of compliance requires assessment of continuing illegal fishing levels. This is difficult as those likely to continue to fish (professional poachers), may leave no trace of where they have been.

Baitline surveys have been conducted in the past as a measure of implied fishing pressure (Horwitz and Hamr 1988, Horwitz 1991, Growns 1995, Lynch and Blühdorn 1997) and although they have biases, they are the only objective method available to indicate a trend in fishing levels.

Baitline surveys will be conducted at selected previously surveyed sites (from studies above), with baitlines being counted and removed annually over a three year period. Lines placed since the last visit can then be counted. Counts will be compared with pre-ban data. Project staff will conduct this in cooperation with local community groups, who may take on surveys at particular sites. Other indications of fishing level may be available such as reports of fishing to authorities.

Baitlines will be counted, cut and stumps labelled with information at all the population monitoring sites on each visit. These will not be the same sites as used for monitoring of fishing effort as above, as informing fishers will bias monitoring of illegal fishing levels.

Resources required are for the angler questionnaire, staff time, field gear, vehicle, running costs, accommodation, allowances and field equipment for annual baitline surveys and result compilation.

	Yr1	**Yr2**	**Yr3**	**Yr4**	**Yr5**	**Total**
Cost ($000s)	20.6	19.9	19.3	11.9	11.9	83.5

2 Prevention and Amelioration of Habitat Degradation

Disturbance to *A. gouldi* habitat is caused mainly by inappropriate agricultural practices, forestry operations and a variety of other disturbances on private land. Actions required to prevent or ameliorate these impacts are described below. Development and implementation of integrated Natural Resource Management at regional and catchment scales is required to assist in this area.

2.1 Habitat Protection on Private Land

Various mechanisms are available for protecting and managing threatened species habitat on private land, such as management agreements, conservation covenants, the Land for Wildlife program, etc.

- Mechanisms for protecting lobster habitat on private land will be further developed and promoted, in cooperation with DPIW. Advice will be given to landowners on management options available. Application of existing policies such as the State Water Quality Management Policy to protect habitat will be investigated.

- Input will be made to relevant strategies, policies and programs which are planned or under development by Federal, State and local government and other organisations: for example, Regional NRM strategies, DPIW Conservation of Freshwater Ecosystem Values project (CFEV 2005), Water Management Plans, Tasmanian Farmers and Graziers Association environmental policy etc.

	Yr1	Yr2	Yr3	Yr4	Yr5	Total
Cost ($000s)	19.3	18.0	18.0	20.3	20.3	95.9

2.2 Improving Agricultural and Urban Practices

Disturbances to urban streams and their environs can be severe in their effects on *A. gouldi* populations. Local government authorities have regulatory powers to control many adverse actions and to promote rehabilitation of riparian and aquatic habitats. The requirements of *A. gouldi* should be added to those of a number of species and habitats to encourage changes in the perception and treatment of urban stream environments.

At present there are few mechanisms by which agricultural activities on private land are regulated. The EPBC *Act 1999* requires that any activities deemed to have a significant impact on the species be referred to the Australian Government Department of the Environment and Heritage (AGDEH) for assessment and approval. Agricultural land management practices that impact *A. gouldi* can be improved through community education and voluntary changes to land-use practices. The RFA background report part G (1997) recommends the development of an agricultural code of practice that focuses on stream protection. *Tasmania's Nature Conservation Strategy* (DPIWE 2002) also recommends the development of codes of practice for agricultural sectors. The Resource Management and Planning System has potential for, but currently limited application in, controlling agricultural land use. The situation varies between local councils. Water abstraction, dam construction and environmental flows are controlled through licences and Water Management Plans under the Tasmanian *Water Management Act 1999*.

With the increasing influence of community-based conservation organisations, there is growing community awareness of environmental issues and principal among these is riparian rehabilitation. The destruction of riparian zones and consequent impacts on in-stream life affects a wide array of plant and animal species. The recovery needs of *A. gouldi* should be combined with those of other identified threatened species or habitats in order to work towards a change in community attitudes, and to encourage effective riparian and aquatic rehabilitation activities.

The following actions can be taken to prevent or reduce disturbance to *A. gouldi* habitat on private land subject to agricultural activities:

- The key action is communication with land managers to improve awareness of *A. gouldi* habitat requirements, the need to avoid habitat disturbance through good land and water management, how riparian lands and watercourses can be rehabilitated and the benefits of this. *A. gouldi* will be promoted with community environmental groups and in the regional Natural Resource Management process. Resource material on rehabilitation is available from State and Australian government agencies including LAWA and DPIW (e.g. Raine and Gardiner 1995, LWRRDC 1996, Munks 1996, Hamlet 2002) and will be promoted with landowners and managers.

- Demonstration sites for *A. gouldi* habitat rehabilitation in agricultural areas will be established in cooperation with community groups, preferably in areas which are moderately rather than severely impacted. Habitat restoration work is already underway by community groups in some areas and this will be promoted in education programs.

- Liaison with water managers will be undertaken to ensure that requirements of *A. gouldi* are included in water management planning and environmental flow assessments.

- Promote the development of agricultural codes of practice that will protect and improve *A.*

gouldi habitat.

- In-stream developments proposed within the range of *A. gouldi* should be referred to the Australian Government Department of the Environment and Heritage for assessment and approval if and as required under the EPBC Act.

	Yr1	Yr2	Yr3	Yr4	Yr5	Total
Cost ($000s)	27.7	26.4	22.1	29.9	29.9	136.0

2.3 Improving Forestry Practices on Public and Private Land

The impacts associated with forestry operations relate to habitat disturbance and direct fishing pressure as described in Part C Threats. Any activity that may impact on the integrity of the canopy or stream water quality in areas of *high suitability habitat* (see Appendix 3) should be restricted. If high-intensity burning, chemical spraying, or stream crossings and roading are necessary they should be carried out in such a way as to prevent damage to the integrity of the stream system. This may require a wider buffer zone, the retention of large trees within the buffer zone, interception of runoff, or modified forms of stream crossings. Culverts need to be designed and sited so that they do not pose a barrier to movement for *A. gouldi*. Effective buffer zones between logging (or land clearing for any purpose) and waterways can protect riparian and aquatic habitat. The implementation of buffer zones that effectively protect high suitability *A. gouldi* habitat is considered essential. In a review of buffer strips for the protection of streams and biota, Dignan *et al.* (1996) concluded that buffer strips as wide as one mean potential dominant tree height are probably required for maintenance of large woody debris input, and buffers at least 30 m wide are generally adequate to protect aquatic biota. The only available Tasmanian research shows that minimum buffers of 30 m minimise impacts from logging on Class 2 streams (Davies and Nelson 1994). There is no scientific evidence regarding buffer widths specifically for smaller streams, although Dignan *et al.* (1996) consider that protection of aquatic biota in ephemeral streams is likely to require similar buffers to those used for permanent streams.

Some of these measures are already included by the Forest Practices Authority and DPIW as prescriptions in the 'Threatened Fauna Adviser' decision support system (Forest Practices Board, 2001) currently in use by forest planners. The current management prescriptions, first developed in 1995 (revised in 1998 and 2000) and delivered in accordance with procedures agreed between the Forest Practices Authority and DPIW (Appendix 1) took into account all existing published information and expert opinion. Prescriptions vary depending on the occurrence of the species or its habitat, size of the watercourse, and type of operation. For example, where native forest is being converted to pasture, 30 m buffers are prescribed for small headwater streams (classified as class 4 streams in the Tasmanian Forest Practices Code, Appendix 2), at known (recorded) *Astacopsis* sites or in areas immediately adjoining them (ie. within 2 km upstream of the recorded sites). For potential habitat within the range of the species (i.e. where it has not been recorded), class 4 streams are provided with 10m buffers (compared to the basic Forest Practices Code 10m machinery exclusion zones required in other areas). For Class 2 and 3 streams, a streamside reserve buffer of 30m is provided. For Class 1 rivers, the standard streamside reserve of 40m is provided, as per the Forest Practices Code. Both the industry and general public have raised concerns, however, over the effectiveness and the impact on land management of these current prescriptions, particularly those relating to the protection of headwater streams within the range of *A. gouldi.*

As a first step in addressing these concerns, and to inform revision of the prescriptions, a study was initiated by researchers from the Forest Practices Authority and University of Tasmania in 1999 (Davies and Cook 2004) to assess the occurrence of juvenile *A. gouldi* in Class 4 streams and to

identify the characteristics of habitat where they occurred. This study found that Class 4 streams are used by juvenile *A. gouldi*, but at significantly lower densities than Class 2 streams; juvenile numbers were highly spatially variable; and juvenile *A. gouldi* were considerably more abundant in Class 2 streams of moderate catchment size and wider channels (Davies and Cook 2004). The study identified macro and meso habitat features favoured by juvenile *A. gouldi*. Macro features include: wide streams with catchment areas typically 2-30 km^2; <2 % substrate as silt; high proportions of moss cover; moderate proportions of substrate as boulders; channel slopes <15 %; or, small streams of 0.4 - 2 km^2 catchment area and with spring fed flows leading to higher year-round baseflows (Davies and Cook 2004). Meso-habitat features include large rocks or logs that are big enough not to be easily dislodged, not embedded in finer substrates, that overlay coarser substrates and/or with a distinct cavity underneath. The results of this project support the need to manage Class 4 streams with potential habitat and can be used in the identification of areas of *high suitability habitat* that require extra protection measures (see 'Mapping of Habitat Critical to Survival section'). Research and monitoring is continuing to assess the downstream impact of forestry operations in headwater streams on juvenile *A. gouldi* and monitoring the effectiveness of the current prescribed actions.

In the absence of information on the effectiveness of the current management prescriptions, undisturbed buffer strips of at least 30 m are recommended on either side of all class 2 to 4 streams classed as *high suitability habitat* for *A. gouldi* (as defined in Davies *et al.* 2005 and current predictive modelling, see Appendix 3). In addition, as an interim measure the maintenance of at least 10m streamside reserves on class 4 streams (30m for Class 2 and Class 3, and 40m for Class 1) is recommended in areas of *moderate suitability habitat* (as defined in Davies *et al.* 2005 and current predictive modelling, see Appendix 3). Significant research is currently occurring on the refinement of this modelling (FPA) and it is recommended that the outcomes of this research should be used to update prescriptions in the TFA.

Streamside reserves in plantation areas containing streams with the potential to support *high suitability habitat* should be managed to enhance habitat suitability. These streamside reserves should remain intact and be protected from fire and other disturbance during and after forestry operations. For special operations such as aerial pyrethroid spraying, 'no spray' buffer strips of at least 50 m are required on all stream classes to minimise mortality of stream invertebrates (Barton and Davies 1993). It is recommended that current prescribed actions delivered via the *Threatened Fauna Adviser* (Forest Practices Board 2001) be reviewed to meet the above requirement. Further review will be required as further information becomes available, and additional landscape management approaches (e.g. priority protected areas, either for the species or via the CFEV process) need to be developed and implemented.

The efficacy of the Forest Practices Code provisions to ensure that forestry operations in catchments immediately upstream of streams classed as *high suitability habitat* do not impact on *A. gouldi* should be the subject of further research.

2.3.1 Implementing management prescriptions and review of forest practices

Reviewing the Forest Practices Code and associated provisions is the responsibility of the Forest Practices Authority, in consultation with other stakeholders. Under the Forest Practices Code there are two mechanisms for prescribing practices to protect *A. gouldi* habitat: provisions governing stream protection for soil and water values; and provisions for protection of individual threatened species by management prescriptions (see Appendix 1). The requirements of this recovery plan can be implemented via both mechanisms. The FPA has a system in place for notification when threatened species or their habitat is likely to be present in an area subject to a Forest Practices Plan (FPP), so that appropriate management prescriptions can be incorporated into a FPP.

Recommended actions to be taken during the life of this plan in order to facilitate the continual improvement and implementation of conservation measures for *A. gouldi* are:

- The current management prescriptions for *A. gouldi* delivered via the *Threatened Fauna Adviser* (Forest Practices Board 2001) will be reviewed during the *Threatened Fauna Adviser* review process to ensure they meet the requirements of this plan. Other planning tools used in the FPP planning process ie. Threatened Fauna Manual (Forest Practices Board 2001) and Fauna Technical Notes will also be updated. Training courses for forestry personnel involved in planning, identification of habitat and implementation of prescriptions will be conducted.

- A strategic plan for the management and/or reservation of *A. gouldi* habitat, based on a catchment-by-catchment approach informed by habitat suitability mapping and the CFEV Project, should be developed and incorporated in forestry planning processes. Such a plan should take into account habitat important for the species and the protection of this habitat through informal reservation or streamside protection prescriptions.

- Independent experts, the Scientific Advisory Committee and the Community Review Committee (appointed under Tasmania's *Threatened Species Protection Act 1995)*, review new information and management prescriptions delivered by the FPA and DPIW to protect *A. gouldi* habitat during and after forestry operations, and any strategic management plans. Recommendations for protection of *A. gouldi* habitat will be made to management authorities accordingly.

- Monitoring of implementation of management prescriptions for protection of *A. gouldi* habitat is required. The results of implementation monitoring should be used to evaluate the degree of compliance and to develop ways to improve implementation of any new recommendations. The results of an implementation monitoring study conducted by the FPA for the 97/98 and 2001/02 years are being analysed.

- The effectiveness of the prescriptions and Code provisions will be evaluated under Actions 2.3.2 and 3.1, with the aim of minimising direct impact on lobster populations from forestry operations. Indirect impacts, such as illegal fishing will be addressed through enforcement of the fishing ban and management of access to extant roads .

	Yr1	**Yr2**	**Yr3**	**Yr4**	**Yr5**	**Total**
Cost ($000s)	43.7	42.5	29.5	32.7	29.0	177.4

2.3.2 Forest-industry supported research programs

Forest-industry supported collaborative research aimed at ensuring sustainable and long-term protection of *A. gouldi* and its habitat is being undertaken by researchers from the Forest Practices Authority, University of Tasmania, Freshwater Systems and Forestry Tasmania. This work includes:

- A series of current research projects on the extent to which small streams and their biota are sensitive to forestry impacts.

- A program of work assessing the likely downstream impacts of disturbance from forestry operations on habitat quality and populations of *A. gouldi* and other stream biota.

Further research needs include effects of eucalypt and pine plantations, culverts, roading, sedimentation and erosion, chemical inputs etc on downstream habitats and how these impacts can be ameliorated. It is recommended that the following new studies, particularly the first one, be undertaken as a matter of priority:

- Study of the downstream impacts of forestry operations on *A. gouldi* and its habitat and the effectiveness of the Forest Practices Code and *Threatened Fauna Adviser* provisions in ameliorating any impacts. This would include a retrospective survey and a pre and post-logging study of *A. gouldi* populations in Class 4, 3 and 2 streams, logged and managed according to the Forest Practices Code (2000). Recruitment of woody debris and other relevant stream processes should also be considered.

- Evaluation of habitat suitability predictions from the work of Davies (and Cook 2004, *et al.* 2005).

- Determine appropriate land management practices for streamside reserves for all stream sizes.

- The impacts of culverts on *A. gouldi* movement.

- The impacts of forest harvesting, regrowth and plantation development on water yields in catchments above *high suitability* habitat.

The results of these studies will be used to inform improvement of the management prescriptions applied for the protection of *A. gouldi*. The results of all of this research will be made publicly available to reinforce the community awareness and education programs (Action 1.1). Costs will depend on actual project designs so have been estimated only.

	Yr1	**Yr2**	**Yr3**	**Yr4**	**Yr5**	**Total**
Cost ($000s)	70	70	70	70	70	350

3 Monitoring and Assessment of Populations and Habitats

Monitoring of a representative set of populations is required to:

- assess trends in population density and structure across the species' historical range; and

- determine the effectiveness of recovery actions in reducing impact from threatening processes.

These populations should span the geographical and habitat range of the species and include both impacted sites and comparatively undisturbed sites. An outcome of these studies will be data for use in identification of key areas for habitat protection (see Action 3.2).

3.1 Monitoring Population Recovery

In order to determine the effectiveness of the above recovery actions in reducing impacts from threatening processes, it is recommended that the status of *A. gouldi* populations be assessed on a regular basis to monitor trends in abundance, age structure and recruitment. The monitoring outlined below will also enable protective measures to be reviewed on a regular basis:

- Monitoring surveys be carried out at selected comparable sites across the range of *A. gouldi* which have been affected by these impacts, as well as relatively undisturbed benchmark sites. Sites will be selected across the species' geographical and habitat range (stream size and altitude). The study will include several previously studied sites (Hamr 1990a, Growns 1995, Horwitz 1994, Lynch and Blühdorn 1997, Walsh and Nash 2002) and undisturbed sites as part of the overall design. Monitoring will include trapping, measuring and marking of adults and sub-adults as well as standardised visual searching of habitat for estimates of juvenile abundance. A database will be established for recording of population structure, densities and habitat characteristics for analysis of changes over time and between sites.

- Surveys will include recording of riparian and instream habitat characteristics and condition at each site.

It is recommended that the survey be completed over a two-year period within the first five years of the recovery plan, and repeated at five-yearly intervals to assess population trends. The slow growth, low fecundity and age at maturity for the species mean that a long time is required to observe trends in population recovery from recent impacts. Databasing, analysis and population spot-checks will be required throughout the life of the plan.

	Yr1	**Yr2**	**Yr3**	**Yr4**	**Yr5**	**Total**
Cost ($000s)	81.7	75.4	28.7	10.1	10.1	206.0

3.2 Identification of Key Areas for Protection

To determine which areas of *A. gouldi* habitat are the highest priority for protection (by reservation or other appropriate means), a GIS analysis of the current reservation status of available habitat will be conducted and compared to the data available through the CFEV Project, habitat suitability mapping and any other relevant source. This information and data from population surveys (as above) will be used to identify habitat protection needs, gaps and priorities. Options for mechanisms of habitat protection will be explored and protection initiated.

	Yr1	**Yr2**	**Yr3**	**Yr4**	**Yr5**	**Total**
Cost ($000s)	18.2	16.9	11.7	7.3	7.3	61.4

4 Increasing Understanding of *A. gouldi* Biology and Conservation Requirements

Concurrent with other recovery actions, studies aimed at improving knowledge of the species' biology to support management and conservation of the species are recommended. Key studies required are of *A. gouldi* habitat use, movement recruitment and genetics; impacts of agricultural and forestry practices; and effectiveness of habitat protection measures.

While these studies may not be immediately related to the recovery of the species, they will provide important information for the review of management strategies and practices for ongoing conservation of the species and its habitat.

Ecological studies could investigate:

- The effects of habitat fragmentation on recruitment and population dynamics;

- Barriers to movement, dispersal and colonisation;

- Viable population size and characteristics;
- Water quality, pesticides and nutrient level tolerances (by correlative studies, not experimental);
- Riparian ecology in relation to *A. gouldi*;
- Genetic diversity of the species.

Forestry-related studies (Action 2.3.2) recommended are:

- Assessing the downstream impacts of forestry activities on *A. gouldi* habitat;
- Assessing the effectiveness of streamside reserve prescriptions including Class 4 requirements;
- Assessing the effects of culverts, road crossings or stream barriers on *A. gouldi* movements;
- Assessing the impacts of forestry operations on upper catchment stream flows.

Studies related to agricultural issues should include:

- The effects of culverts, road crossings or stream barriers on *A. gouldi* movements;
- The impacts of agricultural practices;
- Environmental flow requirements; and
- The development of management prescriptions for riparian and instream habitat management and retention, e.g. for willow removal, flood mitigation, snag removal, etc.

Research costs are described in previous sections. The following cost is to facilitate the liaison between researchers and the development and coordination of funding requests.

	Yr1	**Yr2**	**Yr3**	**Yr4**	**Yr5**	**Total**
Cost ($000s)	4.5	3.8	3.8	6.1	6.1	24.3

5 Co-ordination of the Recovery Program

A project officer is required to direct and co-ordinate the range of actions for recovery of *Astacopsis gouldi*. Tasks will include implementation and supervision of actions described in the recovery plan, liaison with stakeholders including government agencies and non-government organisations, seeking funding, reporting to funding bodies and providing a contact point for all matters relating to the recovery plan. The coordinator will oversee and participate in fieldwork and report on results.

Other staff required are a technical officer for years 1-5 to carry out fieldwork and provide technical and general assistance in conducting all the recovery actions, and an additional technical officer in years 1 and 2 for assisting this officer with population surveys and monitoring. Costs below are for the proportion of staff time spent on coordinating and reporting activities; time spent on other actions is costed to those activities within this plan.

	Yr1	**Yr2**	**Yr3**	**Yr4**	**Yr5**	**Total**
Cost ($ 000s)	19.1	16.5	17.3	17.3	21.1	91.3

Part E: MANAGEMENT PRACTICES

The following management practices are recommended to avoid a significant adverse impact on *Astacopsis gouldi*:

- Continue to prohibit any fishing for the species. Enforce and educate to make the ban effective.

- Restriction of access to previously inaccessible areas of *high suitability* habitat, including natural or active revegetation and/or constructing barriers across forestry roads that are no longer required.

- Roads crossing streams with *A. gouldi* habitat should allow for free passage of lobsters under the road. Use existing guidelines for fish-friendly culverts (FPB 2000, Gallagher 2003, NSW Fisheries 2003).

- Maintain quality and width of riparian vegetation, at levels consistent with this plan, to maintain suitable habitat including stream temperature and light regimes, substrate, inputs of leaf and wood material, and filter surface runoff under heavy rainfall conditions.

- Manage water quality where *A. gouldi* occurs to maintain waters free of significant levels of nutrient, sediment, pesticide and other pollutants, consistent with the ANZECC guidelines for water quality (ANZECC 2000) and to maintain high dissolved oxygen and a natural temperature regime with 20^{o}C maximum.

- Continue to prohibit the import, translocation and possession of all exotic freshwater crayfish species, and introduction of *A. gouldi* from outside Tasmania. Enforce and educate to make the ban effective.

- Maintain adequate flow regime as required by *A. gouldi* at all life stages.

Part F: DURATION OF PLAN AND ESTIMATED COSTS

Duration and costs

This plan covers the 5-year period 2006-2010. Towards the end of this time the plan will be reviewed. However, this plan will remain effective until superseded by a subsequent plan.

Table 1. Implementation and cost schedule. Costs are estimated in $ 000s.

Task	Task Description	Priority	Feasibility	Yr 1	Yr 2	Yr3	Yr 4	Yr 5	Total
1	**Fishing Reduction**								
1.1	Awareness	2	100%	50.3	30.2	31.5	33.8	34.4	180.2
1.2	Enforcement	1	100%	59.0	55.0	35.0	30.0	30.0	209.0
1.3	Monitoring Awareness	2	80%	20.6	19.9	19.2	11.9	11.9	83.5
2	**Habitat Protection**								
2.1	Private Land	1	50%	19.3	18.0	18.0	20.3	20.3	95.9
2.2	Agriculture Practices	1	50%	27.7	26.4	22.1	29.9	29.9	136.0
2.3.1	Forest Practices	1	80%	43.7	42.5	29.5	32.7	29	177.4
2.3.2	FI research projects	1	100%	70	70	70	70	70	350
3	**Population Monitoring**								
3.1	Population Recovery	1	100%	81.7	75.4	28.7	10.1	10.1	206.0
3.2	Key Sites	1	100%	18.2	16.9	11.7	7.3	7.3	61.4
4	**Research Liaison**	**3**	100%	4.5	3.8	3.8	6.1	6.1	24.3
5	**Coordination**	**1**	100%	19.1	16.5	17.3	17.3	21.1	91.3
Total				**414.1**	**374.6**	**286.8**	**269.4**	**270.1**	**1615**

Resource Allocation

To ensure efficient and effective use of resources for conservation of *A. gouldi*, this recovery plan will be forwarded to the Northern and Cradle Coast Natural Resource Management committees for consideration in their funding programs. The plan is consistent with the *Threatened Species Strategy for Tasmania* (DPIWE 2000) and the *Tasmanian Nature Conservation Strategy 2004-2006* (DPIWE 2002). Existing staff will be used for actions where possible. Studies and surveys will build on existing data and use previously studied sites where possible. The processes for determining habitat management for forestry operations are already in place and can be used to implement any required changes to management. As there is some geographical overlap with the Burrowing Crayfish (Engaeus) Group Recovery Plan 2001-2005 (Doran 1999), staff and other resources will be shared where possible (e.g. for liaison with landowners). Liaison between the various agencies responsible for *A. gouldi* management will continue to coordinate management and avoid duplication.

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APPENDIX 1

Procedures for the management of threatened species in wood production forests under the forest practices system

Threatened species as listed in the schedules to the *Threatened Species Protection Act* 1995 will be managed in wood production forests under the forest practices system as follows.

1. *Provisions of the Forest Practices Code.* The Code prescribes the approach that must be taken with respect to the conservation of flora and fauna, including threatened species. The Code (2000) provides that threatened species must be managed in accordance with procedures agreed between the Forest Practices Board (FPB) and the Secretary of DPIWE.

2. *Forest Practices Officers* -Forest Practices Officers are responsible for planning and supervising forest operations and are therefore key personnel for the transmission of good management prescriptions to landowners and forest workers. Specialists within the FPB and DPIWE will actively support and facilitate the continuing training of Forest Practices Officers.

3. Endorsed management prescriptions

3.1 Fauna

3.1.1 The *Threatened Fauna Manual for Production Forests in Tasmania* and the *Threatened Fauna Adviser* Expert System program will be the basis for providing management prescriptions at the operational (coupe) scale.

3.1.2 The *Threatened Fauna Manual for Production Forests in Tasmania* and the *Threatened Fauna Adviser* program will be updated on a regular basis, as new information becomes available. In addition, the manual and program should be reviewed at least every 5 years, to coincide with the 5 yearly reviews under the RFA. The development and review of the manual and program and any updates will be subject to consultation among specialists within FPB and DPIWE, landowners and Forest Practices Officers. The manual and program and any changes will be subject to formal endorsement by the following bodies - the Secretary of DPIWE, the Scientific Advisory Committee established under the *Threatened Species Protection Act* and the Forest Practices Advisory Council established under the *Forest Practices Act*. Any proposed changes will be taken as endorsed by a body where that body has not responded within 3 months to a request for endorsement of a change. New site data that become available to the FPB will be added to the Threatened Fauna Manual (web version) as soon as practical after the site is received (within 2 weeks) to ensure that the most up-to-date information is available to the forest industry. Such alterations to the Threatened Fauna Manual do not require endorsement by the parties listed above. Specialists from DPIWE will supply relevant data on forest-associated threatened fauna, as the data become available.

3.1.3 Forest Practices Officers will consult the *Threatened Fauna Manual for Production Forests in Tasmania* (or an up to date version in GIS format) to determine whether an operational area contains or is likely to contain threatened species.

3.1.4 The Forest Practices Officer will consult the *Threatened Fauna Adviser* to determine the appropriate endorsed management prescription and will seek further specialist advice from the Senior Ecologist of the FPB where required by the provisions of the *Threatened Fauna Adviser*.

3.1.5 Where an operational area contains or is likely to contain threatened species, the Forest Practices Officer will notify the Senior Ecologist of the FPB.

3.1.6 Where a Forest Practices Officer seeks further advice for a specific operational area in accordance with the *Threatened Fauna Adviser*, or where endorsed prescriptions are not appropriate for an operation, the Senior Ecologist of the FPB will consult with the DPIWE to determine an appropriate management prescription. This should involve consultation and negotiation among the specialists, the Forest Practices Officer and the landowner and may involve field inspections or surveys. Advice will be provided within 6 weeks, otherwise the Forest Practices Officer may proceed on the basis of the best available information.

4 *Forest Practices Plans* - Once the Forest Practices Officer has obtained an endorsed management prescription, the officer will apply the prescription by incorporating appropriate provisions into the Forest Practices Plan for the area. The provisions of a certified Forest Practices Plan are legally binding on all parties who operate within the area covered by the plan for the duration of the plan. A permit for the purpose of s.51 of the *Threatened Species Protection Act* is not required where a Forest Practices Plan has been certified in accordance with these procedures.

5 *Monitoring of compliance* - Compliance with the provisions of the Forest Practices Plan, including provisions that relate to threatened species, will be assessed by a Forest Practices Officer and a report on compliance will be lodged with the FPB within 30 days of the expiry of the plan, as required under s.25A of the *Forest Practices Act*. The Board will publish information on compliance in its Annual Report.

6 *Independent audit and enforcement* - The Board will audit the standard of planning and the degree of compliance with the implementation of the provisions of the Code and Forest Practices Plan, including those that relate to threatened species, as part of its annual audit. Results will be published in the Board's Annual Report, as required under s.4 of the *Forest Practices Act*. Appropriate action will be taken with respect to instances of poor planning, or failure to comply with the provisions of a plan, in accordance with the provisions of the *Forest Practices Act*. Potential breaches of the *Threatened Species Protection Act* will be reported to DPIWE as soon as practicable.

7 *Monitoring of efficacy of prescriptions* - The Board in association with the DPIWE will monitor the efficacy of management prescriptions through a coordinated approach to research.

8 *Research* - The FPB and the DPIWE will consult with landowners and other stakeholders to determine the priorities for research into the ecology and management requirements of threatened species. Both bodies will coordinate an approach to secure appropriate levels of funding from all available sources. The forest industry recognises its role in contributing to research into the effects of forest management practices on threatened species. The forest industry will consider the research needs for threatened species as part of its overall contribution to forest practices research under the terms of the forest practices research fund.

APPENDIX 2

Stream size classes as defined in the Tasmanian Forest Practices Code (FPB 2000)

Stream type	Definition
Class 1	Rivers, lakes, artificial storages (other than farm dams) and tidal waters-: generally those named on 1: 100 000 topographical series maps.
Class 2	Creeks, streams and other watercourses from the point where their catchment exceeds 100 ha.
Class 3	Watercourses carrying running water most of the year between the points where their catchment is from 50 to 100 hectares.
Class 4	All other watercourses carrying water for part or all of the year for most years. A Class 4 watercourse is differentiated from a drainage depression by having at least one of the following features: a gravelly, pebbly, rocky or sandy bed, indicative of flowing water; an obvious gully; a short steep section of streambank adjacent to the watercourse bed. A Class 4 watercourse will often have a change in understorey vegetation from the streambank to the surrounding forest e.g. riparian/ moist vegetation on streambanks -ferns, mosses, sedges.

APPENDIX 3

Interim mapping rules for discriminating stream habitat suitability for juvenile *Astacopsis gouldi* from Davies *et al.* 2005 (Table 2). Work is progressing on refining these mapping rules and the development of a draft 'habitat suitability' map to assist conservation planning for *A. gouldi* (Davies pers.comm.). When finalised, the outcomes of this work will be used to update prescriptions for management of the species. This mapping is currently being undertaken by Forestry Tasmania in conjunction with Freshwater Systems and the Forest Practices Authority. Stream classes (1 – 4) are as defined in the Forest Practices Code (FPB 2000) and repeated in Appendix 2.

Interim rules (as of March 2005) to be used in numerical sequence (1 to 4) as follows:

1. UNSUITABLE HABITAT

- all stream reaches > 400m elevation within catchments known or likely to contain *A. gouldi* as in current range boundary GIS layer (based on current known records and expert opinion).

2. HIGH SUITABILITY (ie, relatively undisturbed lowland perennial streams with coarse substrates)

- stream classes 1 & 2 and 3, and stream class 4 in geomorphic contact zones (e.g. between overlying basalt deposits and sedimentary geology resulting in perennial streams from groundwater discharge);

with:

a. < 250m elevation; and

b. drainage section average slope < 10%; and

c. geomorphic mosaics that represent optimal meso-habitat (ie, boulders & coarse substrates - exact classes to be provided) and snags; and

d. riparian forest in relatively good condition (ie drainage section CFEV ripveg index > 0.8)

3. MEDIUM SUITABILITY

- stream classes 1, 2 & 3, and class 4 streams in geomorphic contact zones, (ie, perennial streams):

  o with 250-400m elevation; and

  o that meet all the slope, mosaic and riparian forest rule conditions for High Suitability (b-d above);

or

- stream reaches < 250 m elevation that:

  o only meet one of the slope or mosaic conditions for High Suitability (b-c above) and

have riparian vegetation in good condition (ie of CFEV ripveg index > 0.8); or

- o they meet both mosaic and slope conditions for High Suitability (b-c above)and riparian vegetation is not in good condition (ie CFEV ripveg index < 0.8).

4. LOW SUITABILITY

- stream classes 1, 2 & 3, and class 4 streams in geomorphic contact zones, that have poor condition riparian forest (ie CFEV ripveg index < 0.2); or
- all remaining class 4 streams (ie not in geomorphic contact zones); or
- all remaining streams of 250 – 400 m elevation (ie those that fail one or more of the High Suitability rule conditions for mosaics, slope or riparian vegetation)