

Appendix to

**National Recovery Plan for the
Gouldian Finch (*Erythrura gouldiae*)**

Background information

Acknowledgments

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Gouldian Finch recovery program progress reviewed

The national Gouldian Finch recovery program has been in progress since 1993 guided by information from Gouldian-focussed research and adaptive management projects, actions identified in the previous versions of the national recovery plan (Baker-Gabb *et al.* 1994; Dostine 1998), and by decisions made within the national recovery team.

Over this period, Gouldian Finch populations appear to have remained stable over much of their current range, with seasonal fluctuations in some local populations.

Significant outcomes from the recovery program to date have included improved understanding of Gouldian Finch distribution and ecology, data on wild population dynamics and threats to populations, and development of habitat-enhancing fire management programs. The bulk of the earlier ecological research and population monitoring programs has been coordinated by the NT Parks and Wildlife Service (formerly Parks and Wildlife Commission) and focussed at two sites in the Northern Territory – Yinberrie Hills and Newry Station. In Queensland, there have been repeated attempts to find remnant populations. More recently this has been augmented by targeted research, population monitoring and management activities at Mornington Wildlife Sanctuary owned by Australian Wildlife Conservancy in the Kimberley, and by management activities at a number of Parks in the NT and at an Australian Defence property - Bradshaw Field Training Area in the Top End. There have also been three attempts to reintroduce Gouldian Finches near Mareeba in Queensland.

Key projects undertaken over the last decade as part of the Gouldian Finch recovery program have included:

- annual systematic waterhole counts since 1996 at sites within the Yinberrie Hills;
- compilation and maintenance of a comprehensive national database of historical and current Gouldian Finch records;
- implementation of an annual mosaic-burning program at the Yinberrie Hills, and more recently at Bradshaw Field Training Area;
- dietary studies looking at seasonality of resource use;
- research into habitat utilisation;
- radio telemetry studies to record seasonal movements;
- research into the impact of fire regimes on seed yield of key wet season grasses;
- physiological studies aimed at determining the key stress period for food availability; and
- three experimental attempts to reintroduce finches into Mareeba Wetlands.

Since the endorsement of the first recovery plan in 1994, there has been sound progress on recovery actions relating to the ecology and habitat requirements of the Gouldian Finch, and on educating the broader community about the recovery effort (see Table 1). However, there is still considerable scope for actions relating to adaptive management to improve Gouldian Finch habitat, and in engaging landholders in fire and grazing management activities to benefit Gouldian Finch populations. This version of the recovery plan seeks to address these issues.

Table 1 Audit of progress towards achieving objectives identified in the previous recovery plan (Dostine 1998)

Specific objective [and progress made]	Actions*	Progress toward achieving actions
1. Improve knowledge of species habitat requirements and identify key threats Overall, there is now significantly improved understanding of habitat requirements, and the range of threats facing the species. However, definitive information on direct links between unfavourable fire and grazing regimes and physiological impacts and/or population declines is lacking. There is also still a lack of specific data on ideal fire or grazing regimes for a range of habitat types in the NT and Kimberley. Current research and adaptive management effort at AWC's Mornington Wildlife Sanctuary, and in the NT at the Yinberrie Hills is aimed at redressing this.	1.1 Collate and maintain database of all known records of the Gouldian Finch	Completed. All historical and current records collated and maintained in national database managed by NT Parks and Wildlife with input from TSN. Sightings data actively solicited from the public on regular basis by RT members. Sightings can be forwarded to rangelands@wwf.org.au
	1.2 Review patterns of distribution, habitats, potential threats and conservation status of savanna granivorous birds	To date this action was specifically aimed at producing review papers (Franklin 1999; Franklin <i>et al.</i> 2005).
	2.1 Conduct GIS-based analysis of coarse-scale habitat attributes of Gouldian Finch localities	Partially completed. Analysis of key attributes at the Yinberrie Hills location was partly completed, but has not been extended beyond this site in the life of the recovery plan. The intent was to use these data to predict other potential Gouldian locations. More recently, detailed habitat data have been collected in the Kimberley at Mornington Wildlife Sanctuary.
	2.2 Analysis of habitat at a regional scale	No progress.
	2.3 Analysis of nesting habitat	Completed for Yinberrie Hills (Tidemann <i>et al.</i> 1999). Further data being collected at Mareeba Wetlands Reserve.
2. Prepare guidelines for survey methodology and habitat management Overall progress satisfactory. Waterhole count methodology was disseminated in 2005, and fire management prescriptions in place for Nitmiluk NP, Nathan River and Mornington Wildlife Sanctuary. A requirement is to scale up to management guidelines for off-reserve land managers.	3.1 Liaison with stakeholders	Intent was to distribute information to solicit distribution data (used in 1.1) and as such is completed. Poster-style information and survey questionnaires were widely distributed, and more recently a DVD has been produced for schools, and a sightings information kit distributed broadly.
	3.2 Strategic surveys of suitable habitat	Ongoing. Recent targeted Gouldian survey effort to find new populations includes Nathan River, NT and Mornington Wildlife Sanctuary in WA. Targeted surveys were also undertaken over four dry seasons at Bradshaw Field training Area.
3. Assess population size, population trends and habitat characteristics at sites across the range of Gouldian Finches Eight years of population trend data available at single site (Yinberrie Hills); two year's data available at two sites (Newry, Nathan R.). Detailed habitat characteristics described for a small number of sites mainly in the NT. Cost of methodology for assessing population size and trends at local and regional scales thwarts progress.	4.1 Indices of population sizes at key sites	Partially completed. Annual waterhole counts in Yinberrie Hills since 1996 and these data were analysed in 1999 and again in 2005 to give an indication of long term population trends (Price <i>et al.</i> , <i>in prep.</i>). Less comprehensive datasets exist for Newry Station and Nathan River, and more recently for Mornington Wildlife Sanctuary.
	4.2 Persistence at sites throughout current range	Ongoing – known to have been present at three sites in the NT since 1987 and at Mornington Wildlife Sanctuary since 2000. Known not to have been present at Cumberland Dam, Georgetown since 1996. Other sites not visited with sufficient frequency to determine persistence.

Table 1 (continued)

Specific objective [and progress made]	Actions*	Progress toward achieving actions
4. Implement experimental management and analyse the effects of fire and grazing on Gouldian Finch populations at key sites Overall progress toward management outcomes on these two threatening processes has been unsatisfactory, and more targeted adaptive management approaches are needed to progress this. Work currently underway at Mornington Wildlife Sanctuary will hopefully improve our understanding of grazing and fire impacts on key seed resources.	5. Diet and foraging ecology	Partially completed. This research activity was intended to be undertaken at 3 geographically dispersed sites and is completed for Yinberrie Hills and to some extent Newry Station (Dostine and Franklin 2002; Dostine <i>et al.</i> 2001) and Rookwood Station, Queensland (Smith 1986). Current research underway at Mornington Wildlife Sanctuary will augment this.
	6. Effects of fire, grazing and rainfall on resources	Partially completed. The effects of fire and rainfall on wet season food resources has been documented for the Yinberrie Hills site (Dostine <i>et al.</i> 2001), and data on specific fire regime effects on two key wet season grasses at this same site have recently been analysed (Price <i>et al. in prep</i>). Grazing impact studies are currently under way at Mornington Wildlife Sanctuary (S. Legge <i>pers. comm.</i>)
5. Increase public awareness...and facilitate involvement of community groups...in monitoring and management Overall progress is good, and community involvement in monitoring and research activities at Mornington and reintroduction at Mareeba continues to be high.	8.1 Regional operations groups	North Queensland Gouldian Regional Operations Group held 6 meetings, organised surveys in Georgetown area and collaborated on reintroductions at Mareeba. Regional Operations Groups were not instituted elsewhere.
	8.3 Promote recovery program	Completed. Web-based, poster, CD, and leaflet based information distributed widely. More recently a sightings information kit (WWF 2005) and educational DVD and school's activity kit (PWS NT 2005) were distributed. Media coverage, including Australian Geographic article (McGhee 2005).
	9.1 Operation of the recovery team	Completed.
6. Implement management of significant Gouldian Finch habitats throughout its range Overall progress on this objective has been unsatisfactory, probably largely due to a lack of continuity of coordination and management of the Gouldian recovery program in the NT. Adaptive management actions figure strongly in this new version of the Gouldian Finch Recovery Plan.	7. Management of significant sites	In progress. Intent was to produce a GIS-based management tool for key sites using data collected in 4.1, 5 and 6. Fire history data have been collated for a 10-year period in the Yinberrie Hills site, and development of a GIS-based management tool is proposed for funding through NHT in 2006.
	8.2 Management guidelines for landholders	No progress.
	9.2 Recovery program evaluation and review	Not completed. Intent was an annual external review of the program's progress.

* Nb: the numbering of actions does not relate directly back to specific objectives, but rather to a set of progress criteria identified in the 1998 plan.

Species information

Conservation status

The Gouldian Finch *Erythrura gouldiae* (Gould 1844) is a small, brightly coloured granivorous bird endemic to the savanna woodlands of northern Australia. Its former range extended from Cape York Peninsula, through the Top End of the Northern Territory, to the Kimberley region in Western Australia (Garnett and Crowley 2000; Franklin 1999).

Once believed to be amongst the most common finches of the northern savannas (Smedley 1904, Berney 1903, Heumann 1926), the Gouldian Finch has suffered significant population declines throughout its range, and now mainly exists in relatively small, fragmented populations in parts of the Northern Territory and the Kimberley. Population declines have been greatest in the eastern parts of its range (Franklin 1999). In Queensland, Gouldian Finches have been recorded sporadically in the wild in the last 25 years, rarely at the same place twice (S. Garnett *pers. comm.*; GF Database 2005).

The Gouldian Finch is listed as endangered under the *Environment Protection and Biodiversity Conservation Act* 1999, and was deemed to meet the endangered criteria under IUCN Red List categories C2a(i) or C2a(ii) - fewer than 2500 mature birds with no more than 250 mature individuals in a single population or >95% in a single subpopulation, which is continuing to decline; IUCN SSC 1994; Garnett and Crowley 2000). The uncertainty over the category arose from deficiencies in data on Gouldian distribution, estimated abundance, and population trends across most of its known range, and a lack of knowledge of potential dispersal distances of known populations. A review of recent distribution data (particularly in the Kimberley - see Table 1 in the Recovery Plan), re-evaluation of population trend data from the Yinberrie Hills (see Figure 2) and the increase in recent sightings suggests this assessment may be unduly conservative for the following reasons:

- a) **Population total may exceed 2,500 mature individuals.** Based on dry season waterhole or transect count data the number of adults at only two sites is known to exceed 150 individuals (Yinberrie Hills and Mornington Wildlife Sanctuary) and is estimated at between 50 and 100 birds at four sites (Mt Thymann, Newry Station, Nathan River and Durack River – see Table 1). Reliable estimates are not possible at most other sites where the species has been recorded opportunistically, however database records and anecdotal evidence suggest that the Kimberley populations combined may be in excess of 1,000 adult birds. Flocks of 200-400 birds, including juveniles, were recorded in 2005 at three sites (Butterfly Gorge, Mary River, Kakadu: Ron Stanton *pers. obs.*). It may well be that more systematic monitoring of populations across the species' range will show that the total populations exceeds 2,500 birds;
- b) **Population may not be continuing to decline.** The majority of populations known from across the species' range 10 years ago still persist. Continuous population monitoring data has not been collected over a long enough period at any site apart from the Yinberrie Hills to demonstrate population trends. Although the counts at this site fluctuated, no trend could be detected (see Figure 2). Substantial flocks were detected in 2005 at Butterfly Gorge, Mary River and the Marrakai Track in the Northern Territory, and at a smaller numbers at sites on Cape York Peninsula. All these sites have been visited frequently by birdwatchers in recent years without seeing any Gouldian Finches. An understanding of the persistence of current threatening process across the species' range justifies projecting a decline in the future;
- c) **Gouldian Finches may not exist as a single population and the Kimberley subpopulation may be more than 250 adult birds.** Radio tracking of birds suggests population movements are relatively small and there are major disjunctions in range between Nathan River, Yinberrie Hills and sites in the Kimberley and western Northern Territory. However lost radio-tracked birds may have moved beyond point of detection, and a sighting of wild birds at Ethabuka just north of the Simpson Desert in 2004, well away from any historical or current breeding site, suggests substantial movement. This is consistent with reports of migration to breeding areas (Berney 1903, Smedley 1904) and the lack of detectable geographical patterns in genetic variability (Heselwood *et al.* 1998). Thus disjunctions may simply be recent artefacts of land use

intensification making intervening breeding areas unsuitable. Furthermore, even if Kimberley Gouldian Finches are considered to be a subpopulation, current database records suggest that there may be more than 250 adult birds present.

If data collected provides confirmation over the course of the current recovery plan, the Gouldian Finch may need to have its conservation status reviewed.

Genetic variability

Comparative DNA analysis of specimens from Queensland, the Northern Territory and Western Australia showed that no substantial genetic differences existed between Gouldian Finch populations across northern Australia (Heselerwood *et al.* 1998), however more sophisticated DNA analysis methods are currently being used to re-examine the genetic relationships between geographically distinct populations (R. Esparza-Salas *pers. comm.*). Results of this analysis are not yet available. Resolving the extent of genetic variability across remaining wild populations may also help determine the appropriate categorisation for the species.

Distribution, abundance and population trends

Gouldian Finches formerly ranged from the Cape York Peninsula in Queensland, through the Top End of the Northern Territory, to the Kimberley region in Western Australia (Figure 1; Garnett and Crowley 2000; Franklin 1999; Tidemann 1996), and were once believed to be amongst the most common finches of the northern savannas - with flocks numbering in the thousands occasionally being observed (R. Birch in Evans and Bougher 1987; Heumann 1926).

Within the last one hundred years Gouldian Finch populations have undergone significant population declines and a contraction of their known range (Franklin 1999; Franklin 1998; Tidemann 1996; Evans and Fidler 1986), so that currently Gouldian Finches are only reliably recorded at a small number of sites in six bioregions (Ord Victoria Plains, Victoria Bonaparte, Pine Creek, Central Kimberley, Northern Kimberley, and Dampierland) within the Northern Territory and Western Australia (GF database 2005; Figure 1). Until 2004 they were only seen occasionally at a few sites in Queensland (all Einasleigh Uplands). In 2004 and 2005 additional records were obtained from Darwin Coastal, Daly River and Central Arnhem bioregions in the NT and Channel Country, Cape York and Gulf Fall and Uplands in Queensland.

The declines in Gouldian Finch populations inferred from the historical record (Franklin 1999; Franklin 1998) did not occur at the same time throughout the entire range. In Queensland there are anecdotal reports of declines in the Herberton area in the 1940s, Chillagoe areas in the 1950s and from near Mareeba and the Gulf Plains in the 1960s. Declines in the Burdekin floodplain and Dalrymple Shire probably occurred earlier (L. Stewart, G. Hayles, M. Little, W. Entsch *pers. comm.* to S. Garnett). Declines in the Katherine region were greatest in the early 1970s, and sharp declines in Kimberley populations occurred in the mid to late 1970s (Evans and Fidler 1986; D. Franklin *pers. comm.*), prompting the prohibition of trapping of Gouldian Finches for the aviary trade (Franklin *et al.* 1999).

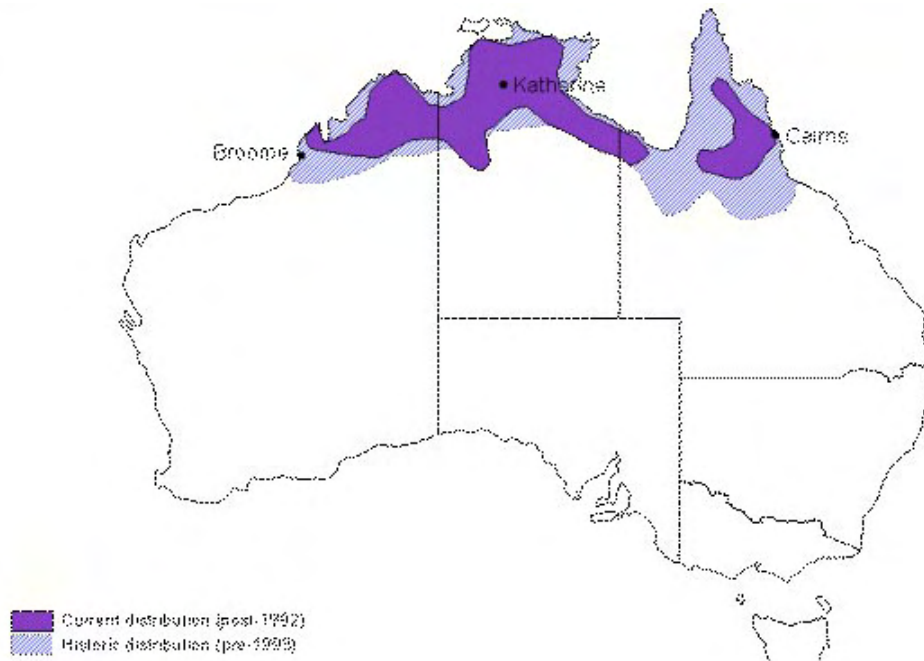


Figure 1 Current and historic distribution of Gouldian Finches in northern Australia

(Nb. Within shaded areas Gouldian distribution may be patchy and fragmented)

The pattern of historical decline in Gouldian Finch populations is similar to that observed for a suite of granivorous birds inhabiting the northern savannas, including seven endemic species (Franklin 1999), and four other threatened taxa: Star Finch (*Neochmia ruficauda ruficauda* and *N.r.clarescens*) populations in Queensland (Todd *et al.* 2003); Partridge Pigeon eastern subspecies: *Geophaps smithii ssp. smithii* (Fraser 2000); Black-throated Finch *Poephila cincta cincta* (Franklin 1999) and the Golden-shouldered Parrot *Psephotus chrysopterygius* (Crowley and Garnett 2003). These patterns of decline are believed to reflect reduced availability of important grass seed resources resulting from the expansion of pastoralism and resultant changes in fire regimes in the savannas (Franklin *et al.* 2005; Crowley and Garnett 2001).

Apart from the Yinberrie Hills near Katherine in the Northern Territory, Mornington Wildlife Sanctuary in the central Kimberley (S. Evans *pers. comm.*) is the only known site within current Gouldian Finch range where breeding populations of more than 150 adult birds are known to persist. Estimates of populations in the vicinity of 50-100 adult birds (based on waterhole counts or habitat searches) have been made at Mt Thymanan within Bradshaw Field Training Area, Newry Station near Timber Creek and for Nathan River within the Gulf region (M. Lewis *pers. comm.*), and can be inferred from count data for waterholes associated with the Durack River in the central Kimberley (Birchenough *et al.* 2002). Reports of congregations of one to three hundred birds at waterholes in the vicinity of Kununurra (eastern Kimberley) associated with tributaries of the Ord and Keep Rivers within the last ten years (GF database 2005) consisted of large numbers of juveniles, so that adult populations alone are likely to be less than 100 birds. Recent counts at Butterfly Gorge (200 birds) and Mary River (400 birds) also included substantial numbers of juveniles.

The absence of population data across the majority of Gouldian Finch range, combined with disparities in observer effort temporally and geographically, means that it is very difficult to estimate numbers of Gouldian Finches remaining in northern Australia. A conservative estimate of a total population of fewer than 2500 mature birds has been made (Garnett and Crowley 2000) for the purposes of IUCN categorisation of the species, however this figure may not reflect the full extent of populations that remain.

At this stage, the only method of monitoring population trend at the local scale that produces statistically analysable results involves annual dry season waterhole counts. Methodology for these counts is included in the *Additional Resources* section of this document, and requires the involvement of a number of people with good bird identification skills over many seasons to give meaningful trend data.

Long-term waterhole count data only exist for one site – the Yinberrie Hills. Recent analysis of an eight-year dataset from this site showed that the number of Gouldian Finches recorded fluctuated markedly between years (Figure 2; Price *et al. in prep.*), possibly reflecting availability of either surface water for drinking or of seed resources (Dostine *et al.* 2001; Tidemann *et al.* 1999). Despite these seasonal fluctuations, there is no clear trend in estimated Gouldian abundance at this site over an eight-year period (Price *et al. in prep.*).

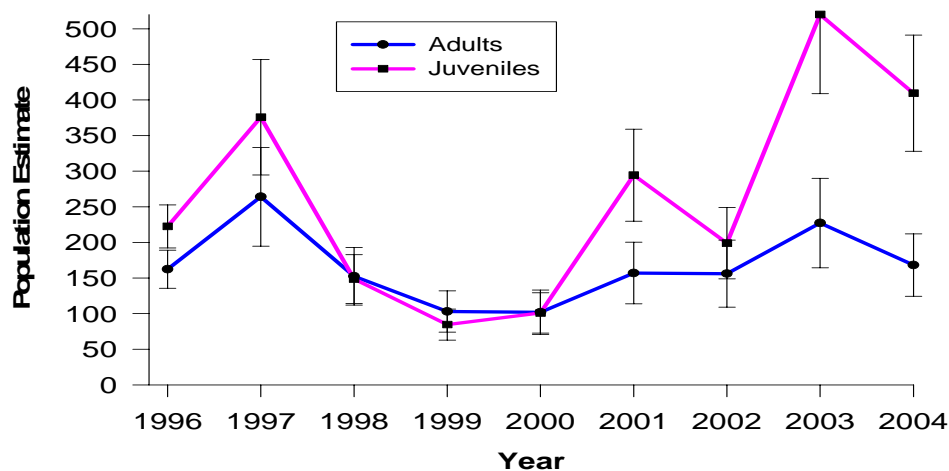


Figure 2 Population estimates (with 95% confidence intervals) for 12 waterholes in the Yinberrie Hills (Graph from Price *et al. in prep.*)

Food resources

Gouldian Finches appear to have a more restricted diet than co-occurring finch species such as Masked or Long-tailed Finches (Dostine and Franklin 2002), Crimson or Star Finches (Todd *et al.* 2003), or than other generalist savanna granivores such as Partridge Pigeons (Fraser 2000), Peaceful Doves (Garnett and Crowley 1994), Hooded Parrots (Garnett and Crowley 1995), or Golden-shouldered Parrots (Garnett and Crowley 1999). Whereas the Long-tailed Finch (*Poephila acuticauda*) and Masked Finch (*P. personata*) supplement their diet with protein obtained from insects (Dostine and Franklin 2002) or from seeds of forb species, Gouldian Finches feed exclusively on seed from a restricted range of grass species (Dostine and Franklin 2002; Dostine *et al.* 2001; Tidemann 1996).

In the Yinberrie Hills and at Mornington Wildlife Sanctuary in the Kimberley Gouldian Finches feed predominantly on seed of annual spear grasses (*Sorghum*¹ *intrans*, *S. stipoideum* and *S. timorensis*) and perennial sorghum (*S. plumosum*) throughout the dry season (Dostine and Franklin 2002; Dostine *et al.* 2001; Tidemann 1996; Tidemann 1993; S. Legge and S. Murphy unpublished data; M. Lewis unpublished data), and on seed from a suite of mainly perennial grass species during the wet season. Favoured wet season grasses in the Top End and Kimberley

¹ *Sorghum* genus has been reassigned to *Sarga* in some parts of Australia including WA, but these changes have yet to be adopted in the NT (R. Kerrigan *pers. comm.*)

regions include cockatoo grass (*Alloteropsis semialata*), spinifex grasses (*Triodia* species including *T. acutispicula*, *T. bitextura*, *T. bynoei*, *T. pungens* and *T. schinzii*) and golden beard grass (*Chrysopogon fallax*) (Dostine and Franklin 2002; Dostine *et al.* 2001; S. Legge and S. Murphy unpublished data). The seeds of other wet season grasses such as kangaroo grass (*Themeda triandra*), giant spear grass (*Heteropogon triticeus*), white grass (*Sehima nervosum*), red grass (*Mnesithea formosa*); ricegrass (*Xerochloa laniflora*), northern wanderrie (*Eriachne obtusa*), mauve sandgrass (*Whiteochloa biciliata*) and *Aristida dominii* are also eaten when preferred species are not available (Dostine *et al.* 2001; Tidemann 1996; S. Legge and S. Murphy unpublished data; M. Lewis unpublished data; D. Donato *pers. comm.*; W. Goulding *pers. obs.*). At Rookwood Station in Queensland, where *Sarga* and *Triodia* are absent, Gouldian Finches were recorded feeding on *Schizachyrium* spp. and *Mnesithea formosa* at the start of the wet season (Smith 1996). There is some evidence to suggest that Gouldian Finches can utilise seed resources from introduced grasses such as buffel grass (*Cenchrus ciliaris*: S. Legge and S. Murphy unpublished data), barnyard grass (*Echinochloa colona*: Tidemann 1996) or *Panicum maximum* (S. Garnett *pers. comm.*).

In the wet season Gouldian Finches mainly feed from seed held on standing grass tillers (Dostine *et al.* 2001; Garnett and Crowley 1994), whereas later in the dry season and during the early part of the following wet season they feed from the ground on fallen spear grass seed (Dostine *et al.* 2001; S. Tidemann 1996; M. Fidler *pers. comm.*), and are often observed in patches of recently burnt habitat where they feed on exposed seeds (Dostine *et al.* 2001; M. Lewis *pers. comm.*; M. Fidler *pers. comm.*). Gouldian Finches will resort to feeding on germinating spear grass seed early in the wet season when other grass seed is scarce (S. Legge and S. Murphy unpublished data; Tidemann 1996).

In general, preferred wet season grasses are very patchily distributed throughout the landscape compared to the extensive tracts of sorghum or spear grass dominated grasslands that are available in the dry season (Crowley and Garnett 2001; M. Lewis unpublished data; S. Legge and S. Murphy unpublished data). There is also substantial variation in the temporal distribution of wet season seed resources between years influenced by rainfall patterns (timing and length of wet season, plus total rainfall) (P. Dostine *pers. comm.*). The restricted diet of Gouldian Finches makes them particularly vulnerable to any seed shortages that might occur during a particular wet season if seed production is limited (Dostine and Franklin 2002; Crowley and Garnett 2001; Dostine *et al.* 2001).

Reduced availability of fertile seeds of palatable wet season grasses may also be linked to grazing pressure (eg. cockatoo grass: Crowley and Garnett 2001) and/or unfavourable fire regimes over single or successive seasons (eg. cockatoo grass and curly spinifex: Price *et al. in prep.*). There is some evidence from recent research in the Kimberley that spinifex grass seed may be an important component of the early wet season diet of Gouldian Finches at that site. Availability of this seed resource may require the persistence of patches of unburnt habitat over successive seasons, which is the case at Mornington Wildlife Reserve, largely as a result of topography that impedes the progress of wildfires (S. Legge and S. Murphy unpublished data). By comparison, spinifex habitat in the Yinberrie Hills burns relatively frequently as a result of late dry season fires (M. Lewis unpublished data), which may explain the reliance of Gouldian Finches there on very patchily distributed cockatoo grass or golden beard grass seed resources (S. Legge and S. Murphy unpublished data). It may also explain the early loss of the species from much of Queensland where, in the absence of *Triodia*, the birds probably relied on seed from grasses more palatable to cattle (S. Garnett and G. Crowley *pers. comm.*).

Breeding ecology

Most known Gouldian Finch breeding areas occur in hilly terrain with open woodland vegetation, and nests are built in hollows in either snappy gum (*Eucalyptus brevifolia* in both the NT and WA) (Tidemann *et al.* 1999), or in salmon gum (*Eucalyptus tintinnans*) in the Northern Territory (Tidemann 1993; McNee and Collins 1992). Other potential nest trees include bloodwood (*E. dichromophloia*: Tidemann *et al.* 1992) and woollybutt (*Eucalyptus miniata*: McNee and Collins 1992). In Queensland reintroduced Gouldian Finch have been observed nesting in poplar gum (*Eucalyptus platyphylla*), a close relative of salmon gum (W. Goulding *pers.obs.*), and ghost gum (*Corymbia dallachiana*) is also believed to have provided nesting habitat for Gouldian Finch in the past (S. Garnett *pers. comm.*).

A shallow cup-shaped nest of grass is generally built inside a termite-formed tree hollow (Tidemann 1996), however there are also a few records from both the Northern Territory and Western Australia of Gouldian Finch nests built in hollows within termite mounds (e.g. N. Kolichis in WA Museum records). A clutch of 3-8 eggs is laid between January and August, with the peak breeding season in April (Tidemann *et al.* 1999; Tidemann and Woinarski 1994). Up to three clutches can be produced in a season, giving an estimated annual productivity of roughly 2.5 fledglings per adult bird per year (Tidemann *et al.* 1999).

The timing of breeding in Gouldian Finches coincides with the period of peak resource availability within their habitat (Dostine *et al.* 2001). Plentiful supplies of sorghum seed provide nestlings and fledglings with a reliable food resource, however juvenile survival through the potential resource bottleneck period early in the wet season is less certain. Woinarski and Tidemann's (1992) population study based in the Yinberrie Hills and Newry Station in the late 1980s showed a higher proportion of juveniles in the population in the period immediately after breeding compared to that recorded for either masked or long-tailed finch populations at the same sites. However, there are no sound data on juvenile population dynamics, and it is not known whether low recapture rates of Gouldian Finches in banding studies were due to high mortality rates, or high dispersal rates (Woinarski and Tidemann 1992).

The moult period in adult Gouldian Finches generally begins after breeding and in most years is completed prior to the onset of water and seed resource scarcity in the late dry/early wet period (Tidemann and Woinarski 1994). The timing (after completion of breeding) and length (more rapid in Gouldian Finches) of the moult period in Gouldian Finches differs markedly from that of co-occurring masked and long-tailed finches, and may be reflective of the more mobile and dispersive nature of Gouldian Finches (Tidemann and Woinarski 1994).

The timing of the juvenile moult period mirrors that for adults and occurs for all birds at the same time of year, regardless of the age of individual birds (Franklin *et al.* 1998). Given that the moult period finishes close to the time of year when seed resources are at their lowest, there is a potential for high levels of physiological stress in Gouldian Finches (particularly young birds) due the combined stresses of moulting and scarcity of food resources in bad years (see Franklin *et al.* 1998).

Data from captive-reared populations of Gouldian Finches suggest that this species has what is essentially an annual lifecycle, with well-fed captive birds surviving up to three breeding seasons only. Evidence of low numbers of adult birds in the wild in the following wet season after high juvenile to adult ratios of Gouldian Finches were recorded in the breeding season may be further evidence of an annual lifecycle in wild populations of Gouldian Finches. An annual lifecycle would mean that Gouldian Finches are likely to be much more sensitive to inter-year variations in the length of a resource shortage period, compared to more perennial species.

Habitat characteristics and habitat utilisation patterns

It is clear that Gouldian Finches currently utilise only a small percentage of the habitats formerly occupied (particularly in Queensland), and it is possible that habitats currently used are not optimal. Remaining populations appear to be utilising the “topographical refuge” areas that Franklin *et al.* (2005) have proposed as being those areas to which some declining granivore birds have retreated to in order to avoid the environmental changes associated with pastoral industry expansion in more productive parts of the savannas.

The following descriptions of habitat are based on a small number of well-studied sites currently supporting significant Gouldian populations. At the landscape level it appears that a combination of rocky hills in proximity to flatter country supporting patches of key wet season grasses is important to remnant Gouldian Finch populations. The majority of known occupied Gouldian habitat is characterised by the predominance of annual spear grasses or perennial sorghum in the understorey during the dry season.

In at least six known Gouldian Finch breeding sites (Mornington Wildlife Sanctuary, Yinberrie Hills, Bradshaw Field Training Area, Newry Station, Nathan River, Kununurra area) rocky hills provide essential breeding habitat during the dry season, and in these areas the presence of hollow-bearing smooth-barked gums (eg. salmon gums or snappy gums) in the tree layer is critical for providing nesting sites. Given the propensity for wildfire damage to hollows in these trees and the avoidance of fire-charred hollows by Gouldian Finches (Tidemann 1996), key habitat criteria would need to include the presence of significant numbers of unburnt potential nesting hollows in these areas.

The presence of reliable sources of dry season surface water in close proximity to nesting habitat appears to be critical for Gouldian Finches (Tidemann 1996), given their need to drink every day. Gouldian Finches appear to favour shallow waterholes or soaks that are not densely vegetated nor too exposed to aerial predators, but in some cases Gouldian Finches will also drink from the edges of billabongs or dams.

Radio tracking studies in the Yinberrie Hills have shown that Gouldian Finches move on average less than two kilometres per day between feeding sites and water sources in the dry season, whereas later in the wet season birds were recorded travelling up to 11 km in a day in search of seed resources (Palmer 2005). In contrast to the Yinberrie Hills, in the Kimberley Gouldian Finches do not appear to travel significantly further in the wet season compared to the dry season. Radio tracking studies of populations in Mornington Wildlife Sanctuary showed that birds travelled 6-14 km per day in the dry season and 3-17 km per day in the wet season (S. Legge and S. Murphy unpublished data).

The extent of daily wet season movement by Gouldian Finches is likely to be determined by availability of seed resources. Where unfavourable seasonal conditions or fire or grazing pressure have impacted on local seed resources such that seeding in favoured grasses is restricted to small patches that are fragmented throughout the landscape, birds are likely to have to travel further each day to access these resources. The differences observed between wet season Gouldian Finch movements in the Yinberrie Hills and Mornington Station may be attributable to the abundance of spinifex grass seed resources at the latter site (S. Legge and S. Murphy unpublished data).

Threats to Gouldian Finch populations

Historical threats

A number of different likely causes of historical declines in Gouldian Finch populations have been put forward, including the impact of wild harvest of birds for the aviary trade (Franklin *et al.* 1999; Tidemann 1996; Evans and Fidler 1986), loss of habitat and nesting trees due to wildfire (Tidemann 1996), infection of populations with the air-sac mite endoparasite (Bell 1996; Tidemann *et al.* 1992), and environmental changes associated with the spread of agricultural and pastoral enterprises within the northern savannas (Franklin *et al.* 2005; Garnett and Crowley 2001; Franklin 1999).

In trying to attribute cause of historical population declines, the deficiencies in comprehensive population and ecological data for the species across its former range make it difficult to draw definitive conclusions. What is clear from existing data is that historical declines in Gouldian Finch populations did not occur evenly throughout the species' range (Franklin 1999), with populations in Queensland succumbing earliest (1950s and 1960s), those in the Katherine region declining next (mid 1970s: Lane and Goodfellow 1989; Tidemann 1987), and those in the Kimberley region experiencing more recent population declines (mid-late 1970s: Evans and Fidler 1986; D. Franklin *pers. comm.*). This pattern of population decline has been observed to be similar to that shown by a number of other seed-eating birds of the northern savannas (Franklin *et al.* 2005; Franklin 1999), and to mimic the timing of pastoral settlement of this region (Franklin *et al.* 2005; Garnett and Crowley 2001; Franklin 1999).

In some cases, however, the speed of population declines is not easily explained by incremental environmental change occurring as a result of pastoral settlement. It has been suggested that a disease agent may have been responsible for inferred population crashes of Gouldian Finches, and evidence of high contemporary rates of infection of wild populations with the endoparasitic air sac mite *Sternostoma tracheacolum* (Tidemann *et al.* 1992) has provided some support for this theory. Both wild and aviary-reared Gouldian Finches infected with air sac mite can develop serious respiratory problems that can lead to death (Bell 1996). It is not clear whether the disease was introduced into the wild population from aviary birds or whether it is endogenous within wild Gouldian Finch populations (Bell 1996). Air sac mite disease could potentially still be playing a role in ongoing population declines, and it has been speculated that physiological stress brought about by food shortages at the onset of the wet season may trigger higher rates of expression of the disease (e.g. Lane and Goodfellow, 1989; M. Fidler *pers. comm.*). Selection for individuals with tolerance of or resistance to air sac mite may also be behind the recent spate of sightings at new sites in tropical Australia.

The cessation of legal trapping of birds for the aviary trade in 1981 may have removed considerable pressure on wild populations (Franklin *et al.* 1999; Evans and Fidler 1986), but there has been no evidence of any population recovery (Birchenough *et al.* 2002; Tidemann 1996; Evans and Bougher 1986) in areas like the Kimberley region where over 20,000 birds were recorded being trapped commercially in the 1968-1981 period (Franklin *et al.* 1999). Illegal harvest from the wild is not expected to be a significant threat currently, given the extent of aviary breeding and the low price of aviary-reared Gouldian Finches (Franklin *et al.* 1999).

The loss of critical habitat due to infrastructure development, such as in the case of the creation of Lake Argyle in the Kimberley region, may have played a role in regional Gouldian Finch population declines (see Franklin *et al.* 1999), and it is possible that some local populations may currently be being affected by mining activity or infrastructure development.

Current threats

Current threats to Gouldian populations include evidence that Gouldian Finches, in common with other threatened granivorous savanna birds (Garnett and Crowley 2003; Todd *et al.* 2003; Fraser 2000), experience a resource decline early in the wet season when previously abundant annual spear grass seed begins to germinate and wet season preferred grasses have yet to come into seed production (Dostine *et al.* 2002; Dostine and Franklin 2002; Crowley and Garnett 2001).

It has been suggested that Gouldian Finches are likely to be more vulnerable to potential early wet season seed shortages than other co-occurring granivorous birds because of their comparatively restricted diet (Dostine and Franklin 2002; Fraser 2000; Crowley and Garnett 1994), and because their moult period finishes so close to the period when seed shortage can occur (Franklin *et al.* 1998).

Although there is evidence to show that seed resource availability changes between seasons and between years, there is as yet no clear link between resource scarcity and Gouldian Finch

population declines. Legge and Murphy (unpublished data) were unable to detect any significant differences in a range of measures of physiological health of Gouldian populations compared to Long-tailed Finches at Mornington Wildlife Sanctuary between dry season and wet season sampling in the 2004-2005 season. This result may have been confounded by the location of the population sampling within a highly productive, rarely burnt section of the reserve, and so the authors are currently extending this study to areas with different fire and grazing regimes that are likely to impact on wet season grass seed availability.

The main threats potentially affecting seed resource availability for Gouldian Finches are grazing pressure exerted by stock and feral herbivores, and unfavourable fire regimes. Grazing intensity has been shown to be the factor most strongly correlated with historical granivorous bird species decline across the northern savannas, and data suggest that the negative impacts of grazing may be worse where pastoral settlement and grazing intensification occurred earlier, as in Queensland (Franklin *et al.* 2005).

Key Gouldian Finch wet season grasses, cockatoo grass and golden beard grass, were observed to be less abundant in cattle-grazed sites compared to ungrazed sites in the Top End of the Northern Territory, and seeds of these perennial grasses were also shown to be more likely to occur on ungrazed than grazed sites (Fraser 2000). In experiments designed to mimic cattle grazing pressure in Queensland savannas, seed production in cockatoo grass was reduced for at least two years following moderate levels of defoliation in the early wet season (Crowley and Garnett 2001).

The selective rooting up and killing of cockatoo grass tussocks by feral pigs potentially has an even greater impact than cattle grazing on seed production in cockatoo grass (Garnett and Crowley 2003), and in the Yinberrie Hills both pigs and horses have been recorded feeding preferentially on this grass during the early wet season before the grass had produced seed (M. Lewis unpublished data).

Across northern Australia there has been a significant shift in wildfire patterns since Aboriginal people ceased patch-burning practices over large areas of the landscape with the advent of European pastoralism. This change has resulted in a higher incidence of late dry season fires, which tend to be much hotter and burn through large tracts of country (Dyer *et al.* 2001). Under this regime, a substantial proportion of the Kimberley and Top End regions burn every year in hot late dry season fires, and this is believed to be having a significant impact on fire-sensitive plant and animal communities in the region (McKenzie and Burbidge 2002; Russell-Smith *et al.* 2001).

Fire also appears to play a significant role in shaping the availability of Gouldian Finch seed resources. In Queensland, seed production in cockatoo grass has also been shown to be highest in the first wet season following burning, regardless of the timing of the burn, and this is believed to be due to greater availability of nutrients in the soil following burning (Garnett and Crowley 2003).

A fire impact study carried out in the Yinberrie Hills showed that fertile seed set in both cockatoo grass and curly spinifex was negatively affected by fire in the previous season (Price *et al. in press*). The effect was most marked in curly spinifex, where any late dry season fire resulted in no fertile seeds being produced at all in the following year. In contrast, golden beard grass seed production was shown to be positively associated with fire. Increases in fertile seed production were recorded in plots where a regime of three successive years of late dry season fires was applied. The study also showed the potential benefit of an early wet season burning regime on seed production in all three grasses - a finding that has important management implications for remaining Gouldian Finch habitats.

In addition to grazing and fire impacts, Gouldian Finch populations may also be currently threatened at the local scale by loss of nesting hollows to wildfires (Tidemann 1996 ; G. Lodge *pers. comm.*), feeding habitat loss due to infrastructure development such as transport corridors or mining activities (M. Lewis unpublished data), disturbance to dry season water sources caused by cattle or buffalo (see Franklin *et al.* 1999; M. Lewis *pers. comm.*), and potential predation pressure from

raptors, goannas, snakes and quolls when Gouldian Finch population levels are very low (see Koertz 2003; Tidemann 1996).

Significant populations and existing conservation measures

The last comprehensive surveys of Gouldian Finch nesting habitats in the Northern Territory and Western Australia occurred in the early 1990s (Tidemann 1993; McNee and Collins 1992; McNee and Collins 1991), and at that time Tidemann identified seven sites in the Northern Territory that supported important breeding populations of Gouldian Finches: Yinberrie Hills, Newry Station, Timber Creek, Eva Valley (in Kakadu NP), Mt Thymanan (in Bradshaw Field Training Area), Kidman Springs, and Manbulloo. More recently breeding populations have also been documented at Australian Wildlife Conservancy's Mornington Wildlife Sanctuary in the central Kimberley (M. Fidler *pers. comm.*; S. Legge *pers. comm.*), and at Nathan River in Limmen Gate National Park (Griffiths *et al.* 1997; M. Lewis unpublished data). The absence of regional survey data for the bulk of the Kimberley means that few breeding sites have been documented (NSR, 1992). Several recent reports of congregations of large numbers of juvenile and adult birds at particular waterholes (Birchenough *et al.* 2002; GF database 2006) in the east Kimberley region suggests that the region continues to support significant breeding populations.

Using the current (1993-2005) distribution database (GF database 2006) as a surrogate for survey data, besides the Yinberrie Hills, Bradshaw Field Training Area, parts of Kakadu National Park, Nathan River and Mornington Wildlife Sanctuary, observations of 30 or more birds are now reliably recorded only in the east Kimberley region. Important locations in the Kimberley include waterholes near Kununurra associated with tributaries of the Ord, Dunham and Keep Rivers (particularly the Golden Gate Creek/Thompson Falls area where groups of 100-300 birds have been recently recorded: R. Birch *pers. comm.*), and Pumpkin Springs where prior to 1997 flocks of 100 birds were occasionally seen), in the vicinity of Wyndham (where groups of up to 100 birds have been seen: R. Birch *pers. comm.*), around waterholes associated with the Durack River and its tributaries (Ellenbrae, Campbell and Dawn Creeks: up to 70 birds recorded in a single observation and counts of over 250 birds in a single monitoring period: Birchenough *et al.* 2002), and waterholes associated with the Drysdale and Gibb Rivers in the central Kimberley (S. Evans *pers. comm.*). The reliability of sites at Marrakai Track, Butterfly Gorge, Mary River and Kakadu, where flocks were seen in 2005, is not yet known.

These significant populations, along with the reintroduction site at Mareeba Tropical Savanna and Wetland Reserve in Queensland, are listed in Table 1 of the recovery plan, as is information relating to potential or known threats and any conservation management activities currently occurring at these sites.

Other locations where Gouldian Finches are still reliably recorded in low numbers (fewer than 30 birds in a single observation), or for which there are recent one-off records of flocks of greater than 30 birds, include Timber Creek, Pine Creek and Katherine surrounds, Bulman surrounds, Argyle Diamond Mine tourist village, Yampi Sound, Dampier Peninsula and Cape Leveque, and waterholes north of Kalumburu associated with rivers or creeks that drain into the Napier Broome Bay (where counts of close to 300 birds were recorded in a single monitoring period: Birchenough *et al.* 2002). There is also a record of four Gouldian Finches in late February 2004 outside the normal range of the species at Ethabuka Station, north-west of Bedourie (M. Mathieson *pers. comm.*). In 2005 small groups of <20 birds were seen at Violetvale and Koolburra on Cape York Peninsula and north Boojamulla National Park in Queensland. Other sightings of <20 birds at Lake Mitchell and other sites on the Atherton Tablelands may be attributed to release attempts at Mareeba Wetlands (S. Garnett *pers. comm.*). Given the deficiencies in distribution data for remote parts of the Northern Territory and Western Australia and the relatively low observer effort compared to more accessible areas, it is very likely that other significant populations of Gouldian Finches remain in the wild.

Gouldian Finches are known to occur in several National Parks within the Northern Territory and Western Australia including Kakadu, Nitmiluk, Keep River, Gregory, Hidden Valley (near

Kununurra), Mitchell River (north Kimberley) and Limmen Gate (Nathan River) National Park in the Gulf of Carpentaria. Populations also exist in other conservation reserves including Mornington Wildlife Sanctuary (central Kimberley), Parry Lagoons Nature Reserve (near Wyndham), and King Leopold Ranges Conservation Park (central Kimberley). The species is also known to be present on Commonwealth managed lands including Kakadu National Park and Department of Defence land at Bradshaw Field Training Area in the Northern Territory and at Yampi Sound, north-east of Derby.

Gouldian-focussed fire or grazing management programs are currently in place in the Yinberrie Hills and Nitmiluk National Park, at Mornington Wildlife Sanctuary, and Bradshaw Field Training Area. Fire management plans are in development for a number of other national parks or reserves in the Northern Territory where Gouldian Finch populations exist, and an important action in the current recovery plan relates to the inclusion within these plans of mosaic burning regimes for Gouldian feeding and breeding habitat.

Affected interests and potential economic or social impacts of proposed recovery actions

Current known Gouldian Finch populations occur on lands of several different tenures: Aboriginal freehold lands, joint Aboriginal-Commonwealth owned land managed by Parks Australia and Traditional Owners (Kakadu National Park), Commonwealth land managed by Australian Department of Defence (Bradshaw Field Training Area and Yampi Sound Military Reserve), land managed for conservation purposes by Australian Wildlife Conservancy (Mornington Wildlife Sanctuary), Aboriginal freehold land jointly managed by Jawoyn Aboriginal Corporation and NT Parks and Wildlife Commission (Nitmiluk NP), Northern Territory Conservation Land Corporation (Limmen Gate NP, Gregory NP, Keep River NP), Western Australia Department of Conservation and Land Management land (Hidden Valley NP, Mitchell River NP, King Leopold Ranges Conservation Park and Parry Lagoons Nature Reserve), pastoral leases (including a number of Aboriginal-owned leases and Indigenous Land Corporation held pastoral lands), mining leasehold lands (eg. Argyle Diamond Mine lease) and local government-owned or freehold land in the vicinity of Timber Creek, Pine Creek, Wyndham, Kalumburu and Kununurra.

Gouldian Finch distribution extends over lands of many different Traditional Owner groups in Queensland, the Northern Territory and Western Australia represented by various Land Trusts and Aboriginal corporations. The Carpentarian Land Council, Balkanu Aboriginal Corporation, Northern Land Council and Kimberley Land Council are the major organisations representing the rights and interests of Aboriginal traditional landowners in northern Australia, while the North Australian Indigenous Land and Sea Managers Alliance (NAILSMA) is a recently-formed alliance aimed at increasing Aboriginal people's involvement in land and sea management research and implementation.

To date the recovery program has only effectively engaged with Jawoyn Aboriginal Corporation in the recovery effort. Jawoyn Aboriginal Corporation has been represented on previous recovery teams and actively involved in collaborative fire management and feral pig control projects with Parks and Wildlife in the Yinberrie Hills. The recovery team has identified the need to broaden the interest and involvement of Aboriginal land managers and Traditional Owners in the next phase of the recovery program.

Pastoral interests within the region are represented by Ag Force (Queensland), the Northern Territory Cattleman's Association; Kimberley Aboriginal Pastoralist Alliance, and the Pastoralists and Graziers Association (Kimberley region). A number of pastoral landcare groups also exist in the Northern Territory including the Victoria River District Conservation Association, Katherine Landcare Group and Roper River Landcare Group. Potentially a number of the proposed recovery actions aimed at improving fire and grazing regimes at particular sites could impact on pastoral productivity.

Beneficial fire regimes for wet season grass seed production critical to Gouldian Finch survival may also benefit pastoral productivity, by promoting biomass production in those grasses also favoured by cattle. Conversely, measures aimed at enhancing grass seed yield by fencing off critical wet

season grass patches may have some negative impact on pastoral productivity, and such measures will have to be carefully negotiated with pastoralists. The recovery plan includes several actions relating to enhancing the participation of pastoral land managers in adaptive fire and grazing management programs at key Gouldian Finch sites in the Kimberley and Top End regions.

Across the known Gouldian Finch range there are five regional bodies (Northern and Southern Gulf Natural Resource Management Group and a yet-to-be-formed Cape York group in Queensland, Northern Territory NRM Board, and the WA Rangelands NRM Coordinating Group – sub-regionally represented by the Kimberley NRM group) responsible for decisions relating to allocation and administration of federal natural resource management funding through the Australian Government National Action Plan for Salinity and Water Quality and the Natural Heritage Trust program. The recovery team needs to ensure that investment strategies for these regions include targets aimed at conserving threatened species populations – in particular declining granivorous bird populations.

The majority of Gouldian Finch research and recovery activity over the past decade has been managed and undertaken by the Northern Territory Parks and Wildlife Service (formerly NT Parks and Wildlife Commission), and Nitmiluk National Park staff have been actively involved in fire management work in the Yinberrie Hills. More recently, the Australian Wildlife Conservancy (AWC) has become a principal player in Gouldian Finch research and adaptive management. Two scientists have been employed by AWC to plan and implement a Gouldian Finch recovery program at their Mornington Wildlife Sanctuary in the Kimberley, and their representation on the national recovery team ensures that the program augments key recovery actions detailed in the recovery plan.

In Queensland staff from the Queensland Parks and Wildlife Service have facilitated actions by the regional Gouldian Regional Operations Group, including surveys for wild populations and recent reintroduction trials, in association with the Mareeba Wetlands Foundation and staff and students from James Cook University. The Mareeba Wetlands Foundation relies on volunteer effort for much of the habitat enhancement, weed and fire control, and population monitoring work that is ongoing as part of reintroduction trials at this site.

The Australian Government Department of Defence has already committed resources to detecting and conserving Gouldian Finch populations in the Mt Thymanan area of Bradshaw Field Training Area near Timber Creek. In establishing a conservation zone around core Gouldian habitat the Department of Defence have effectively removed that area from land available for training activities on the remainder of their property. The Department of Defence is also committed to implementing a fire management program at the Mt Thymanan site to optimise preferred wet season grass recruitment and seeding, and to continuing feral pig and horse control work over the conservation zone.

The Argyle Diamond Mine (owned by Rio Tinto) is located in the eastern Kimberley region, and its associated tourist village and surrounding land supports existing Gouldian Finch populations. To date the recovery team has not involved the mine in planning or implementing recovery activities. There are opportunities to build these links and to encourage environmental staff associated with the mine to maintain a sightings database and to develop a population monitoring program.

Other interests likely to be affected by, or needing to be consulted about, proposed recovery actions include the Town/Shire Councils of Katherine, Timber Creek, Pine Creek, Kununurra, Kalumburu and Wyndham. These towns can be expected to benefit from increased eco-tourism potentially generated through greater publicity about Gouldian Finch populations that exist in surrounding areas.

Volunteers sourced nationally and internationally through the NT Parks and Wildlife, Australian Wildlife Conservancy, Threatened Species Network and Birds Australia have played a crucial role in population monitoring and ecological research in the Yinberrie Hills, Mornington Wildlife Sanctuary and at Newry Station. It is anticipated that volunteer involvement will continue to be an important component of the recovery effort.

Community organizations with an interest in the conservation of northern savanna environments or Gouldian Finch populations include the World Wide Fund for Nature (WWF), Birds Australia, Threatened Species Network (TSN), Wildlife Preservation Society of Queensland, Cairns and Far North Environment Council, the Queensland Conservation Council, the Environment Centre Northern Territory, the Save Endangered East Kimberley Species group, and Environs Kimberley. WWF/TSN is currently represented on the recovery team, and Birds Australia was represented on previous versions of the recovery team.

Additional Resources

Gouldian Finch volunteer opportunities

Threatened Bird Network email: TBN@birdsaustralia.com.au ph. (03) 9882 2622

Save Endangered East Kimberley Species email: seeks@westnet.com.au

Gouldian Finch sightings information kit

Information to help with the field identification of Gouldian Finches and to encourage sightings from the public. Produced by WWF-Australia and available as a PDF from the WWF website www.wwf.org.au/ourwork/species/publications/ or in hard copy by emailing rangelands@wwf.org.au

Gouldian Finch educational DVD – *A story about the gorgeous Gouldian Finch*

An educational DVD aimed at school children about Gouldian Finch and the recovery program produced by NT Parks and Wildlife Service in collaboration with the national recovery team. Teachers resource notes also available.

Abbreviations used

ADD	Australian Government Department of Defence
AWC	Australian Wildlife Conservancy
WA DEC	WA Department of Conservation and Land Management
GF	Gouldian Finch
IUCN	The World Conservation Union
NAILSMA	Northern Australia Indigenous Land and Sea Managers Alliance
NRETA	Northern Territory Department of Natural Resources, Environment, and The Arts
NRM	Natural Resource Management
NT PWS	Parks and Wildlife Service Northern Territory (formerly Parks and Wildlife Commission)
Qld EPA	Queensland Environmental Protection Agency
TSN	Threatened Species Network
WWF	Worldwide Fund for Nature Australia

References and selected bibliography

- Andrew, M. H. and Mott, J. J. (1983). Annuals with transient seed banks: the population biology of indigenous *Sorghum* species of tropical north-west Australia. *Australian Journal of Ecology* **8**, 265-276.
- McGhee, K. (2005). Winged Jewels *Australian Geographic* September issue: pp 38-45
- Baker-Gabbe, D., Burbidge, A., Dostine, P., Garnett, S., Hindmarsh, J., Male, B., Morris, T, Nias, R. and Woinarski, J. (1994) Recovery Plan for the Gouldian Finch *Erythrura gouldiae* Parks and Wildlife Commission, NT.
- Bell, P. J. (1996). Survey of the nasal mite fauna (Rhinonyssidae and Kytoditidae) of the Gouldian finch, *Erythrura gouldiae*, and some co-occurring birds in the Northern Territory. *Wildlife Research* **23**:675–685.
- Berney, F.L. (1903) North Queensland notes on some migratory birds. *Emu* **2**: 210-213.
- Birchenough, A. C., Douglas, G. W. and Evans, S. E (2002). The status of Estrilid finches in North-western Australia. *Australian Bird Watcher* **19**: 147-160
- Collins, B. G., and McNee, S. A. (1992). *Impact of the proposed Mount Todd Gold Mine and other environmental factors on the Gouldian Finch in northern Australia*. Report, Zapopan NL and NSR Environmental Consultants, Curtin University of Technology, Bentley, W. A.
- Crowley, G.M. and Garnett, S.T. (2001). Growth, seed production and effect of defoliation in an early flowering perennial grass, *Alloterospis semialata* (Poaceae), on Cape York Peninsula. *Australian Journal of Botany* **49**, 735-43.
- Dostine, P. (1998) Gouldian Finch Recovery Plan *Erythrura gouldiae* Parks and Wildlife Commission NT and Environment Australia, Darwin.
- Dostine, P. L. and Franklin, D. C. (2002). A comparison of the diet of three finch species in the Yinberrie Hills area, Northern Territory. *Emu* **102**, 159-164.
- Dostine, P. L., Johnson, G. C., Franklin, D. C., Zhang, Y. and Hempel, C. (2001). Seasonal use of savanna landscapes by the Gouldian finch, *Erythrura gouldiae*, in the Yinberrie Hills area, Northern Territory. *Wildlife Research* **28**: 445-458.
- Dyer, R., Jacklyn, P., Russell-Smith, J. and Williams, D. (2001). *Introduction in: Savanna burning: Understanding and using fire in northern Australia*. Dyer, R., Jacklyn, P., Partridge, I., Russell-Smith, J. and Williams, D. (eds). Tropical Savannas CRC, Darwin.
- Evans, S.M. and Bougher, A.R. (1987). The abundance of estrildid finches at waterholes in the Kimberley (WA). *Emu* **87**:124-127.
- Evans, S.M. and Fidler, M.E. (1986). *The Gouldian Finch*. Blandford Press, Poole.
- Franklin, D. C. (1999). Evidence of disarray amongst granivorous bird assemblages in the savannas of northern Australia, a region of sparse human settlement. *Biological Conservation* **90**: 53-68.
- Franklin, D. C. (1998). *Patterns in the decline of granivorous birds in the northern Australia savannas*. M.Sc. thesis, Northern Territory University: Darwin.
- Franklin D.C., Whitehead P.J., Pardon G., Matthews J., McMahon, P. and McIntyre, D. (2005) Geographic patterns and correlates of the decline of granivorous birds in northern Australia. *Wildlife Research* **32**: 399–408
- Franklin, D. C, Burbidge, A. H., and Dostine, P. L. (1999). The harvest of wild birds for aviculture: an historical perspective on finch trapping in the Kimberley with special emphasis on the Gouldian finch. *Australian Zoologist* **31**: 92–109.
- Franklin, D. C., Dostine, P. L. and Tidemann, S. C. (1998). Post-juvenile moult strategies of co-existing Gouldian, Long-tailed and Masked Finches. *Corella* **22**, 73-79.

- Fraser, F. J. (2000). *The impact of fire and grazing on the Partridge Pigeon: the ecological requirements of a declining tropical granivore*. Ph.D. thesis, Australian National University, Canberra.
- Garnett, S.T. and Crowley, G.M. (2003). *Recovery Plan for the golden-shouldered parrot Psephotus chrysopterygius 2003-2007*. Queensland Environment Protection Agency, Brisbane.
- Garnett, S.T. and Crowley, G.M. (2000). *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra.
- Garnett, S.T. and Crowley, G.M. (1995). Feeding ecology of hooded parrots *Psephotus dissimilis* during the early wet season. *Emu* **95**: 54-61.
- Garnett, S.T. and Crowley, G.M. (1994). Wet season feeding by four species of granivorous birds in the Northern Territory. *Australian Bird Watcher* **5**, 306-9.
- Griffiths, A.D; Materne, C.M; Sherwell, D.J (1997) *Biological Survey of the Proposed Limmen Gate National Park*, Parks and Wildlife Commission of the Northern Territory, Darwin.
- Heslewood, M. M., Elphinstone, M. S., Tidemann, S. C. and Baverstock, P. R. (1998). Myoglobin intron variation in the Gouldian Finch *Erythrura gouldiae* assessed by temperature gradient gel electrophoresis. *Electrophoresis* **19**:142-151.
- Heuman, G. A. (1926). Birds in the Northern Territory and the new finch. *Emu* **25**:134-136
- IUCN SSC (2001). *IUCN Red List Categories Version 3.1*. IUCN Species Survival Commission, Gland, Switzerland.
- Koertz, A. H. (2003). *The factors influencing reintroduction success of the endangered Gouldian finch Erythrura gouldiae* Honours Thesis, School of Tropical Biology, James Cook University.
- McKenzie, N.L. and Burbidge, A.A. (2002). *Australian Mammal Audit. Report to the National Land and Water Resources Audit*. Department of Conservation and Land Management.
- McNee, S. A and Collins, B. G.. (1992). *A Survey of Gouldian Finch breeding sites in the East and West Kimberley during 1992*. Consultancy report to Zapopan NL and NSR Environmental Consultants, Curtin University of Technology, Bentley, WA.
- Mott, J. J. and Andrew, M. H. (1985). The effect of fire on the population dynamics of native grasses in tropical savannas of north-west Australia. *Proceedings of the Ecological Society of Australia* **13**: 231-239.
- Palmer, C. (2005). *Review of radio tracking data from the Gouldian finch Erythrura gouldiae Project – Yinberrie Hills study site December 1999 to August 2000*. A report to the Gouldian Finch Recovery Team & Biodiversity Conservation Unit, Department of Infrastructure, Planning and Environment (DIPE).
- Price, O., Palmer, C., Hooper, D. and Lewis, M. (in preparation). A Population monitoring program for the endangered Gouldian Finch in the Yinberrie Hills, northern Australia.
- Price, O., Lewis, M., Hooper, D and Woinarski, J. (in preparation). Native grass seed production in response to recent fire history in a tropical savanna woodland in Australia.
- Russell-Smith, J., Ryan, P.G., Cheal, D.C. (2001). Fire regimes and the conservation of sandstone heath in monsoonal northern Australia. *Journal of Applied Ecology* **35**:829-846.
- Smedley, J.H. (1904) Finches in Northern Queensland. *Emu* **4**: 68-69.
- Tidemann, S. C. (1996). Causes of the decline of the Gouldian Finch *Erythrura gouldiae*. *Bird Conservation International* **6**: 49-61.
- Tidemann, S.C. (1993) Management of a Threatened Species - The Gouldian Finch Example. Pp 123-131 In C.P. Catterall, P.V. Driscoll, K. Hulsman, D. Muir & A. Taplin (eds). *Birds and their Habitats: Status and Conservation in Queensland*. Queensland Ornithological Society, Brisbane.
- Tidemann, S. C. (1993). Where are Gouldian finches after the breeding season? *Victorian Naturalist* **110**: 238–243.

- Tidemann, S.C. (1989). Relationships between finches and pastoral practices in northern Australia. In *Granivorous birds in the agricultural landscape*. Proceedings of general meetings on granivorous birds, INTECOL, Ottawa, Canada. J. Pinowski and J.D. Summers-Smith (eds.). PWN-Polish Scientific Publishers, Warsaw.
- Tidemann, S.C. (1987). Gouldians in the wild. *Bird Keeping in Australia* **30**:145-153.
- Tidemann, S. C. and Woinarski, J. C. Z. (1994). Molt characteristics and breeding seasons of Gouldian *Erythrura gouldiae*, Masked *Poephila personata* and Long-tailed Finches *P. acuticauda* in savannah woodland in the Northern Territory. *Emu* **94**: 46-52.
- Tidemann, S.C., S. McOrist, J.C.Z Woinarski, and W.J. Freeland (1992). Parasitism of wild Gouldian Finches *Erythrura gouldiae* by the air-sac mite *Sternostoma tracheacolum*. *Journal of Wildlife Diseases* **28**(1): 80-84.
- Tidemann, S.C., J. Boyden, R. Elvish, J. Elvish & B. O'Gorman (1992) Comparison of the breeding sites and habitat of two hole-nesting estridid finches, one endangered, in northern Australia. *Journal of Tropical Ecology* **8**:373-388.
- Tidemann, S.C, Lawson, C., Elvish, R., Boyden, J. and Elvish, J. (1999) Breeding biology of the Gouldian Finch *Erythrura gouldiae*, an endangered finch of northern Australia. *Emu* **99**: 191-199.
- Todd, M.K., Felton, A. & Garnett, S.T. (2003) Morphological and dietary differences between common and uncommon subspecies of Crimson Finch, *Neochmia phaeton*, and Star Finch, *Neochmia ruficauda*, in northern Australia, *Emu* **103**(2): 141-148.
- Woinarski, J.C.Z. (1990). The effects of fire on the bird communities of tropical woodlands and open forests in northern Australia. *Aust.J.Ecol.* **15**:1-22.
- Woinarski, J.C.Z. and Recher, H.F. 1997. Impact and response: a review of the effects of fire on the Australian avifauna. *Pacific Conservation Biology* **3**: 183-205.
- Woinarski, J.C.Z. and Tidemann, S.C. 1992. Survivorship and some population parameters for the endangered Gouldian Finch *Erythrura gouldiae* and two other finch species at two sites in tropical northern Australia. *Emu* **92**: 33-38.
- Woinarski, J. C. Z. and Tidemann, S. C. (1991). The bird fauna of a deciduous woodland in the wet-dry tropics of northern Australia. *Wildlife Research* **18**, 479-500.
- Woinarski, J. C. Z. (1990). Effects of fire on the bird communities of tropical woodlands and open forests in northern Australia. *Australian Journal of Ecology* **15**: 1-22.