

Ord-East Kimberley Expansion Project - Weaber Plain Development Area

Gouldian Finch Non Breeding Counts (2017)

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Ord-East Kimberley Expansion Project
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Summary

As part of the requirement for State approval under the *Environment Protection and Biodiversity Conservation Act 1999*, an assessment and regular monitoring of the endangered Gouldian finch (*Erythrura gouldiae*) is required during the operation of the Ord River Irrigation Area Weaber Plain Development Project in Kimberley, Western Australia. This report details the findings from surveys of non-breeding Gouldian finches.

In accordance with the EPBC Act (6AIV) and GFMP (3-4) conditions, this work specifically provides:

- 1) *Gouldian finch counts of the non-breeding population.*

Key results included:

- 1) A total of 52 Gouldian finches were located (38 in the breeding areas and 14 in the Buffer areas)
- 2) This is the highest number of Gouldian finches to be recorded since development started in the area (2012), and suggests that Gouldian finch populations are present and continuing to increase since land clearing commenced.
- 3) The increased densities of non-breeding birds in 2017 may be attributed to higher than average rainfall in the region during the previous (2016-2017) wet season.
- 4) Birds were sighted feeding predominantly on native *Sarga and Triodia* species.

This work provides the required annual data for (1) long-term monitoring of breeding Gouldian finches within the Weaber Plain Development Project, and (2) the conditions detailed in the EPBC Act and GFMP, as well as important on-going and baseline data to ensure appropriate management of the endangered Gouldian finch.

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1 Introduction

As a requirement for State approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Gouldian finch (*Erythrura gouldiae*) populations and their associated habitats (breeding and feeding areas) need to be regularly surveyed during the construction and operation of the Ord River Irrigation Area (ORIA) Weaber Plain Development Project (the Project) in the eastern Kimberley, Western Australia. This is to ensure appropriate management of the endangered Gouldian finch and its habitat before, during and after completion of the development. The Gouldian finch is currently listed as *Endangered and Migratory* under the *Environment Protection and Biodiversity Conservation Act 1999* and listed as “rare or likely to become extinct” under the *Wildlife Conservation Act 1950*.

Because of the status of the Gouldian finch, the current survey sets out to build the baseline groundwork and guidelines for the maintenance of sustainable populations of Gouldian finches in the Project area.

1.1 Gouldian Finch Distribution

The Gouldian finch is an obligate granivorous bird that lives only in the northern savanna region of Australia. Formerly ranging from Cape York Peninsula in Queensland, through the northern half of the Northern Territory, to the Kimberley region in Western Australia, Gouldian finches were once believed to be amongst the most common finches of the region (O'Malley 2006). However, within the last century (and 50 years in particular), Gouldian finch populations have undergone population declines and a contraction of their range. The species is now recorded reliably at only a few sites within the Northern Territory, Western Australia and Queensland. A large known and important Gouldian finch population is located in the Wyndham area, about 100 km west of the Weaber Plain Development Project area. Current national Gouldian finch estimates suggest a population of less than 2500 individuals with no more than 250 birds (and frequently much less) where sub-populations occur (O'Malley 2006).

1.2 General Habitat

Gouldian finches currently utilise only a small percentage of the range they formerly occupied (O'Malley 2006), and it is likely that most habitats currently used are not optimal (Brazill-Boast and Pryke 2011). Also, due to special dietary needs (detailed in 1.3.1) and temporal and geographical variability of feeding grasses, preferred Gouldian finch habitat varies between the dry (breeding) season (ca. January - June), and non-breeding seasons (ca. July - January).

1.2.1 Breeding Habitat

Known breeding habitat for Gouldian finches includes rocky hills with hollow-bearing *Eucalyptus* (e.g. *Eucalyptus brevifolia*, *E. tintinnans*) and *Corymbia* species (e.g. *Corymbia dichromophloia*). Gouldian finches have very specific nesting requirements and require robust and deep hollows with small diameters (Tidemann et al. 1992a; Brazill-Boast et al. 2010). Birds often rely on feeding habitat located within or immediately adjacent to breeding habitats (Brazill-Boast and Pryke 2011), however they will move up to 5 km (or potentially further) to find suitable feeding grounds. Key species of grass utilised during the breeding season, are annual spear grass or native Sorghum (e.g. *Sorghum stipoides*, *S. intrans*, *S. plumosum*) and Spinifex (e.g. *Triodia bitextura*; *T. acutispicula*; *T. bynoei*; *T. schinzii*) (Dostine et al. 2001).

1.2.2 Non-breeding Habitat

Because of limited seed availability following a breeding season (July-January), Gouldian finches usually move away from their breeding habitats and form mixed species flocks, moving over lowland granite soil areas feeding on a range of annual and perennial grasses species. Key species of grass during this period includes kangaroo grass (*Themeda triandra*), cockatoo grass (*Alloteropsis semialata*), giant spear grass (*Heteropogon triticeus*), golden beard grass (*Chrysopogon fallax*), white grass (*Sehima nervosum*), ricegrass (*Xerochloa laniflora*), and Spinifex species (*Triodia spp.*).

1.3 Key Threats

Several processes have been attributed to Gouldian finch declines (Tidemann 1996), including excessive trapping for aviculture (Franklin et al. 1999), infestation with airsac mite (Tidemann et al. 1992b), low survivorship (Woinarski and Tidemann 1992), inappropriate fire patterns (Dostine et al. 2001), mining activities (Garnett and Crowley 2000) and pastoral intensification (Franklin 1999; Franklin et al. 2005). However, the National Species Recovery Plan for the Gouldian finch specifically highlights that “habitat change through landscape destruction and inappropriate fire regimes are the factors most likely contributing to on-going declines or absence of recovery”. Habitat destruction through landscape clearing and inappropriate fire management alters seed diversity, directly affecting foraging ecology and survival (Dostine et al. 2001), and also affects the availability and production of tree cavities, directly affecting breeding ecology and local recruitment (Brazill-Boast et al. 2010; Brazill-Boast et al. 2011).

The Ord Phase Two Expansion Project requires large areas of land clearing for irrigated agricultural land and the addition of infrastructure for secondary roads, irrigation, flood protection and drainage. Approximately 9260 ha vegetation for farms and infrastructure has been cleared, including approximately 8205 ha for farmland. As required by the State Approval of the Project, on the ranges and rocky slopes surrounding and within the proposed Development Area, a designated Buffer Area of approximately 11, 470 ha of native vegetation has been set aside to protect watercourses and surrounding conservation reserves, and help offset disturbance in the Development Area.

1.3.1 Food Availability

Both *Alloteropsis* and *Triodia* species, which are critical Gouldian finch wet season grass species, are highly vulnerable to anthropogenic habitat changes such as land clearing, grazing, and inappropriate fire regimes (O’Malley 2006). *Triodia* is highly flammable and particularly sensitive to repeated, late season wildfires, while *Alloteropsis* is susceptible to pastoralism and suffers reduced seed production for years after even moderate grazing pressure (Crowley and Garnett 2001).

Over the course of the tropical dry season, the availability of the Gouldian finch preferred grass seeds on the soil surface are steadily reduced by wind, rainfall run-off, fire, germination, and consumption and the birds typically move from their breeding habitats to low-lying areas to feed on wet-season seeding grasses (feeding on a variety of annual

and perennial grasses that produce seed at the appropriate times, in order to bridge this bottleneck in food supply (Dostine et al. 2001)). Therefore, the low-lying feeding areas and proposed Buffer Areas are critical for sustaining wet season grass productivity, and hence populations of non-breeding birds.

1.4 Weaber Plain Development Area and Gouldian Finches

Areas of breeding and non-breeding Gouldian finch habitat exist within the Weaber Plain Development Area, the Pincombe Range Conservation Area and Point Springs Nature Reserve, as well as within the Buffer Area to be established for the Weaber Plain Development Project.

The Gouldian finch has earlier been recorded within the Ord-East Expansion Area. A preliminary survey during the non-breeding season of 2010 identified the presence of suitable breeding habitat (Pryke 2010). Additional in-depth surveys during the breeding season of 2011 (March-June) located 5 distinct breeding populations all of which were located within these habitats. During breeding surveys, Gouldian finches have also been sighted feeding on *Sarga* species within the breeding habitats.

Gouldian finches have also been located within the Weaber Plain Development Area during the non-breeding season. In August 2010, birds were observed during general bird surveys (by Animal Plants Minerals). Furthermore, during in-depth surveys in 2011, birds were located in both the Buffer Area and the Development Area (Save The Gouldian Fund, 2011b). In contrast, in 2012, during the initial land-clearing phase, no Gouldian finches were sighted in either the Buffer or Development Areas (Save The Gouldian Fund 2013). However, since land clearing has been completed, 14 Gouldian finches were sighted in the Buffer Areas during the late dry season surveys in 2013 (Save The Gouldian Fund 2014), 29 in 2014 (Save The Gouldian Fund 2014) and a record high of 38 in 2015 (Save The Gouldian Fund 2015), and 33 in 2016 (Save The Gouldian Fund 2016).

In response to the presence of Gouldian finches in the area, the Gouldian Finch Management Plan (GFMP) has been developed (Strategen 2011). The purpose of the GFMP is to ensure the protection of the endangered Gouldian finch by preserving and maintaining habitat and ensuring the retention of vegetation corridors linking feeding areas across the Project.

1.5 Purpose of the Current Survey

To ensure protection and aid in the sustainable management of Gouldian finch populations within the Weaber Plain Development Area, the presence, distribution and relative numbers of Gouldian finches, as well as the quality and availability of their habitat and feeding grounds needs to be regularly monitored and assessed.

There are a number of potential impacts arising from the proposed project that need to be assessed during on-going monitoring. In the Development Area, the primary impacts will be clearing of potential feeding habitat and the removal of feeding grasses (replaced with uninhabitable agricultural land). In the Buffer Area, the primary impacts are wildfire control and cattle grazing (both remove favourable feeding grasses required by Gouldian finches).

In response to the requirements for State approval under the EPBC Act and the GFMP this work aims to specifically address:

(A) GFMP Monitoring Regime (Table 3, Item 6):

Undertake Gouldian Finch counts within the Buffer Area and immediate surrounding reserves.

2 Methods

2.1 Study Site

The Weaber Plain Development Area and Buffer Area of the Ord-East Expansion Project is situated within the East Kimberley region of Western Australia. The area is located 30 km north-east of Kununurra on the Weaber Plains Road and approximately 100 km east of Wyndham. Gouldian finch associated habitat surveys were conducted in areas that have previously been identified as potential feeding (non-breeding) habitats, and in feeding areas within and adjacent to the breeding areas (Pryke 2010b; Save The Gouldian Fund 2011b), as well as in the Buffer Area (within the designated development area).

2.2 Gouldian Finch Survey Method

The Gouldian finch surveys were carried out during September - October 2017. Counting birds at isolated and restricted waterholes during the late dry season is the commonly used method to monitor Gouldian finch populations. However, because of the widespread and continuous availability of ground water in the Weaber Plain Development Area (through the extensive canals), and the record high levels of rainfall during 2017 (Bureau of Meteorology 2017), birds are highly dispersed in the landscape. Therefore, standardised transect-plots (Roberts and Schnell 2006) were used to estimate the number and distribution of birds.

Transects were undertaken between 5:30 and 9:30am to coincide with the period of peak feeding activity. Following guidelines by the IUCN, and recommendations for surveying rare or cryptic species (Joseph and Possingham 2008), the 20 minute 2-ha count method was used (Roberts and Schnell 2006). This method provides resolution at a relatively fine scale and still enables a large number of grids to be appropriately surveyed in the time frame. For each chosen 2-ha plot, the perimeter of the area was walked, and then parallel lines 20m apart are walked inside the area, recording all birds observed during this time.

2.3 Gouldian Finch Counts in Breeding Areas

Breeding habitat has been identified from previous monitoring of breeding Gouldian finches (Pryke 2011). These areas consists of areas situated on gently sloping and rocky hills, and are dominated by open woodland (Brazill-Boast et al. 2010; Brazill-Boast and Pryke 2011). For each of the 5 breeding habitats, a number of 2-ha sample grids were placed over the breeding habitats (at least 100 m apart), such that at least 50% of the breeding habitat was sampled. In total, 31 2-ha plots were surveyed within the 5 breeding habitats and adjoining feeding habitats.

2.4 Gouldian Finch Counts in Non-breeding Areas

A total of 45 2-ha plots were sampled in the potential feeding areas and the general Buffer area. Because the current vegetation mapping of the area is incomplete, the location of feeding grasses potentially utilised by Gouldian finches is unknown. Although some feeding areas have previously been located (e.g. Folly Rock), most of the regional habitat types identified for the area host at least one potential feeding grass (e.g. habitat types: C21, D10, D26, H3; from the ORIA – Weaber Plain Development Project Environmental Impact Statement (EIS) (Strategen 2011). Therefore, Gouldian finches may potentially be located throughout the Weaber Plain Development Area. As a result, 2-ha sample grids were chosen across the landscape, ensuring that each habitat type was included, and thus no specific habitat was favoured for assessment that may lead to a bias in population numbers.

2.5 Feeding Activity and Critical Feeding Grasses

During each survey, the activity of the bird is recorded. In particular, when birds are sighted feeding, the species of grass is recorded to identify the critical grass species used in the area. In addition, grass phenology is assessed and seed samples are collected to infer availability, condition and viability of feeding grasses in breeding and feeding areas, as well as in the general Buffer area.

3 Results

3.1 Non-breeding Gouldian Finches

A total of established 31 2-ha plots were surveyed in the previously established Gouldian finch breeding areas and adjoining feeding areas. An additional established 41 2-ha plots were surveyed in other potential Gouldian finch feeding areas throughout the designated Buffer area.

In total, 52 Gouldian finches were located/observed during the total 72 2-ha plot surveys. All located birds were found within the breeding areas. Table 1 shows a comparison of the number and distribution of Gouldian finches over the last four years.

3.2 Non-breeding Activity and Feeding Grasses

Of the 52 Gouldian finches sighted, 31 were observed feeding. Nineteen birds were sighted feeding on fresh seeds of *Triodia* species, while 33 birds were sighted feeding on seeds on the ground. Although the grass species of these ground-feeding birds could not be reliably identified, most birds were seen feeding in amongst *Sarga* and *Triosia* species.

Table 1. Comparison of the number of observed non-breeding Gouldian finches between 2011-2017.

Area	Number of surveys							Number of Gouldian finches						
	2011	2012	2013	2014	2015	2016	2017	2011	2012	2013	2014	2015	2016	2017
Breeding habitat	45	45	31	31	31	31	31	4	0	14	21	28	26	38
Buffer Area	44	52	45	45	41	41	41	61	0	0	8	10	7	14
Development Area	40	n/a	n/a	n/a	n/a	n/a	n/a	8	n/a	n/a	n/a	n/a	n/a	
Total	129	97	76	76	72	72	72	73	0	14	29	38	33	52

* Note that no surveys were conducted in the Development Area after 2011 because land clearing had commenced in these areas and there was no suitable habitat.

4 Discussion and Implications

As part of the Gouldian Finch Management Plan (Strategen 2012) and as a requirement for State approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), regular assessments of Gouldian finch populations and their associated habitats (breeding and feeding areas) are to be carried out during the construction and operation of the Ord River Irrigation Area Weaber Plain Development Project in the Eastern Kimberly. This report covers the results of the 2017 survey of the presence and distribution of non-breeding Gouldian finches.

4.1 Population Size of Non-breeding Gouldian finches

A total of 72 2-ha plots were surveyed during September – October 2017. During the transect surveys, a record high of 52 Gouldian finches were observed. Thirty-eight birds were sighted in the breeding areas, and 14 in the general Buffer Areas.

Although Gouldian finches were readily sighted in breeding habitats in the early wet season of 2017, these habitats are rarely able to provide suitable feeding grasses for Gouldian finches year-round, and thus it is not uncommon for birds to be absent from breeding areas during the wet season (see section 1.3.1 above). After the depletion of critical dry season grass seeds, such as Sorghum, the birds typically move from their breeding habitats to low-lying areas (e.g. previously established feeding areas and the Buffer Area within the designated Development Area) to feed on wet season seeding grasses. Therefore, the low-lying feeding areas and proposed Buffer Areas are critical for sustaining wet season grass productivity, and thus populations of nonbreeding birds. The presence of Gouldian finches, and in record high numbers, in these low-lying areas in late 2017 suggests that the birds are utilizing these valuable Buffer Areas.

During the 2012 non-breeding surveys (Save The Gouldian Fund 2012), no Gouldian finches were observed during any transect surveys, nor opportunistically, in any of the areas, using the exact same monitoring methods. Although Gouldian finch populations do naturally fluctuate between years and areas, it is likely that the combination of increased activity (due to construction and land clearing), together with high grazing pressures and wildfire damages, contributed to the absence of Gouldian finches in 2012.

During the 2013 and 2014 non-breeding surveys, disturbance was substantially reduced. The Main Compound 2 was dismantled (positioned opposite Gouldian finch breeding area 2 and 3, and associated feeding areas), and the area has subsequently experienced reduced disturbances, noise and dust. Furthermore, cattle pressures and wildfire have substantially been reduced and controlled, which has promoted many more seeding grasses, and thus the likely the return of Gouldian finches to the areas. The number of Gouldian finches recorded during these standardised surveys has steadily increased since 2011 (post-development), with a huge 63% increase between 2016 and 2017. This is likely to due to a combination on reduced development, and a higher than average rainfall in the region during the previous 2016-2017 wet season. Indeed, the Ord Area received more than double the normal long-term average of rain (around 900 mm compared to 420 mm; Bureau of Meteorology, BOM 2017). This is likely to have directly promoted the higher densities of flowering and seeding grasses in the area, and may explain the higher number of both breeding (Save The Gouldian Fund 2017) and non-breeding Gouldian finches this season. Indeed, the number and density of seeding grasses recorded for the wet season was much higher than in previous years (2012-2015). For example, in February 2017 89% of the critical feeding grasses were flowering, whereas in January 2016 only 67% were (Save The Gouldian Fund 2017). This is likely a result of the well above average rainfall received during the 2016-2017 wet season compared to previous years.

4.3 Survival of Gouldian Finch Populations

From mark-recapture data collected over the last five years in the eastern Kimberley, the Gouldian finch is considered to be a largely annual species, with only a small proportion (< 8%) of breeding adults surviving to breed the following season. It is thought that a combination of food shortages during the early wet season (O'Malley 2006), deleterious genetic incompatibilities (Pryke and Griffith 2009) and high stress associated with reproduction (such as finding compatible mates, competing for nest hollows and food shortages; Pryke et al. 2007; Brazill-Boast et al. 2010; Brazill-Boast et al. 2011; Pryke et al. 2012) are the main reasons for their short lifespan.

In the current survey, 52 Gouldian finches were recorded all within the breeding and Buffer Areas. Although this is still lower than the number recorded prior to development (73 in 2011), this is a large increase since previous years (38 in 2015, 33 in 2016). This continual increase in population numbers of Gouldian finches in the area is likely due to

the reduced grazing pressure and wildfire occurrence, and subsequent healthy grass phenology.

5 References

- Brazill-Boast J, Pryke SR (2011) Breeding habitat selection in the endangered Gouldian Finch (*Erythrura gouldiae*) at two spatial scales. *Emu* In press
- Brazill-Boast J, Pryke SR, Griffith SC (2010) Nest-site utilisation and niche overlap in two sympatric, cavity-nesting finches. *Emu* 110:170-177
- Brazill-Boast J, van Rooij E, Pryke SR, Griffith SC (2011) Interference from long-tailed finches constrains reproduction in the endangered Gouldian finch. *J Anim Ecol* 80:39-48
- Dostine P, Johnson G, Franklin D, Zhang Y, Hempel C (2001) Seasonal use of savanna landscapes by the Gouldian finch, *Erythrura gouldiae*, in the Yinberrie Hills area, Northern Territory. *Wild Res* 28:445-458
- Franklin DC, Burbidge AH, Dostine PL (1999) The harvest of wild birds for aviculture: an historical perspective on finch trapping in the Kimberley with special emphasis on the Gouldian Finch. *Am Zool* 31:92-109
- Franklin DC, Whitehead PJ, Pardon G, Matthews J, McMahon P, McIntyre D (2005) Geographic patterns and correlates of the decline of granivorous birds in northern Australia. *Wild Res* 32:399-408
- Garnett ST, Crowley GM (2000) The action plan for Australian birds. Environment Australia, Canberra
- Joseph LN, Possingham HP (2008) Grid-based monitoring methods for detecting population declines: Sensitivity to spatial scale and consequences of scale correction. *Biological Conservation* 141:1868-1875
- O'Malley C (2006) National recovery plan for the Gouldian finch (*Erythrura gouldiae*). Parks and Wildlife NT, Palmerston
- Pryke SR (2010) Sex chromosome linkage of mate preferences and color signal maintains assortative mating between interbreeding finch morphs. *Evolution* 65:1301-1310
- Pryke SR, Astheimer LB, Buttemer WA, Griffith S (2007) Frequency-dependent tradeoffs between competing colour morphs. *Biol Letters* 3:494-497

- Pryke SR, Astheimer LB, Griffith SC, Buttemer WA (2012) Covariation in life-history traits: Differential effects of diet on condition, behavior and reproduction in genetic finch morphs. *Am Nat* 179: 375-390
- Pryke SR, Griffith SC (2009) Genetic incompatibility drives sex allocation and maternal investment in a polymorphic finch. *Science* 323:1605-1607
- Roberts JP, Schnell G (2006) Comparison of survey methods for wintering grassland birds. *J Field Biol* 77:46-60
- Save The Gouldian Fund (2011a) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Breeding Assessment. July 2011.
- Save The Gouldian Fund (2011b) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Non-breeding Population Assessment. December 2011.
- Save The Gouldian Fund (2012) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Non-breeding Population Assessment. November 2012.
- Save The Gouldian Fund (2013) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Breeding Assessment. May 2013.
- Save The Gouldian Fund (2013) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Non-breeding Population Assessment. March 2014.
- Save The Gouldian Fund (2014) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Non-breeding Population Assessment. April 2015.
- Save The Gouldian Fund (2015) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Non-breeding Population Assessment. November 2015.
- Save The Gouldian Fund (2016) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Non-breeding Population Assessment. November 2016.
- Save The Gouldian Fund (2017) Ord-East Kimberley Expansion Project - Weaber Plain Development Area, Gouldian Finch Breeding Assessment. May 2017.
- Tidemann SC (1996) Causes of the decline of the Gouldian Finch *Erythrura gouldiae*. *Bird Cons Int* 6:49-61
- Tidemann SC, Boyden J, Elvish R, O'Gorman B (1992a) Comparison of the breeding sites and habitat of two hole-nesting estrildid finches, one endangered, in northern Australia. *J Trop Ecol* 8:373-388

Tidemann SC, McChrist S, Woinarski JCZ (1992b) Parasitism of wild Gouldian finches (*Erythrura gouldiae*) by the air-sac mite *Sternostoma tracheacolum*. J Wild Disas 28:80-84

Woinarski JCZ, Tidemann SC (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 JCZ, Armstrong M, Brennan K, Fisher A, Griffiths AD, Hill B, Milne DJ, Palmer C, Ward S, Watson M, Winderlich S, Young S (2010) Monitoring indicates rapid and severe decline of native small mammals in Kakady National Park, northern Australia. Wildlife Research 37:116-126.