Ord-East Kimberley Expansion Project - Weaber Plain Development Area

Gouldian Finch Breeding Surveys (2015)

Prepared for
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Summary

As part of the requirement for State approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Gouldian Finch Management Plan (GFMP), a baseline assessment and on-going monitoring of the endangered Gouldian finch (*Erythrura gouldiae*) is required during the construction and operation of the Ord River Irrigation Area Weaber Plain Development Project in the eastern Kimberley, Western Australia. This report details the findings from surveys of Gouldian finches during their annual breeding season (2015).

In accordance with the EPBC Act (6AII) and the GFMP ((2-5, 3-3, 3-7), this work specifically addresses:

1) *Gouldian finch counts of the breeding population within the Buffer Area and immediate surrounding reserves.*
2) *Annual monitoring of breeding populations, including timing and reproductive outputs (i.e. clutch size and fledging success).*
3) *Success of supplying artificial nest-boxes (i.e. salvaged tree hollows) in breeding areas in the Buffer Area and/or adjacent conservation reserves.*

Key results included:

1) Total of 26 Gouldian finch active nests.
2) All 26 active nests were located in the artificial nest-boxes installed in the 5 breeding habitats in 2013.
3) Substantial increase in breeding success this year (2015) compared to last year (9 nests in 2014).
4) One pair banded in 2014 (that also successfully bred together) were found breeding again in 2015 (in a different nest box).
5) 32 Gouldian finches were located feeding during transect surveys, all in the breeding habitats.
6) Birds were sighted feeding predominantly on native *Sarga* species (sorghum).

Overall, 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. This work also provides important on-going and baseline data to ensure appropriate management of the endangered Gouldian finch and its habitat during the construction and operation of the Ord River Irrigation Area – Weaber Plain Development Project.

Contents

List of Tables

1 Introduction

As a requirement for State approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Gouldian finch (*Erythrura gouldiae*) populations 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*.

1.1 Gouldian Finch Distribution

The Gouldian finch (*Erythrura gouldiae*) is a granivorous (seed eating) 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 one of the most common finch species of the region (O'Malley 2006). However, within the last century (and 30-40 years in particular), Gouldian finch populations have undergone severe population declines and a large reduction of their range. The species is now recorded reliably at only a few sites within the Northern Territory and Western Australia (O'Malley 2006). Current key populations of Gouldian finches are 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). The Gouldian finch is also specifically listed as a matter of *National Environment Significance* ((NES); sections 18, 18a), under the EPBC Act. Therefore, the knowledge of distribution patterns, density estimates and migratory patterns are vital to be able to implement a sustainable management plan for Gouldian finch populations.

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). In addition, due to their specialised dietary requirements and the variability (temporal and geographical) of seeding grasses, Gouldian finch habitat geography and structure varies between the breeding (dry) 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 (Brazill-Boast et al., 2010; Tidemann et al., 1992a). Because of localised tree suitability, individuals may breed in small colonies (e.g. nest densities of 1.36 per hectare (Brazill-Boast et al., 2010) and 0.5 per hectare (Tidemann et al., 1992a).

Gouldian finches rely on feeding habitat located within or immediately adjacent to their breeding habitats (Brazill-Boast and Pryke 2011), however, they can move up to 5 km to find suitable feeding grounds. During the breeding season (late wet to dry season: January-June), birds feed predominantly on annual spear grass or native sorghum (e.g. *Sorghum stipoideum*, *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

Following breeding (July – January), Gouldian finches move away from their breeding habitats (because of limited seed availability) and form mixed species flocks, moving over lowland granite soil areas feeding on a range of grass species, including cockatoo grass (*Alloteropsis semialata*), golden beard grass (*Chrysopogon fallax*), giant spear grass (*Heteropogon triticeus*), white grass (*Sehima nervosum*), ricegrass (*Xerochloa laniflora*), kangaroo grass (*Themeda triandra*) and Spinifex species (*Triodia spp)*.

1.3 Key Threats

Several processes have historically been attributed to Gouldian finch population declines (Tidemann 1996), including excessive trapping for aviculture (Franklin et al. 1999), infestation with airsac mite (Tidemann et al. 1992), low survivorship (Woinarski and Tidemann 1992), inappropriate fire patterns (Dostine et al. 2001), mining activities (Garnett and Crowley 2000) and pastoral intensification (Franklin et al. 1999; Franklin et al. 2005). However, the recent National Species Recovery Plan for the Gouldian finch (O'Malley 2006) 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 of the Gouldian finch (Brazill-Boast et al., 2010; Brazill-Boast et al., 2011).

1.3.1 Food Availability

Compared to other finches, Gouldian finches have a very restricted diet, feeding predominantly on a limited range of native grass seeds with no alternative source of protein (e.g. insects) (Dostine and Franklin 2002). Over the course of the tropical dry season, the availability of these seeds on the soil surface is steadily reduced by wind, rainfall run-off, fire, germination, and consumption (e.g. Woinarski et al. 2005). In addition, increasing anthropogenic disturbances, such as land clearing, grazing pressure, and inappropriate fire regimes have reduced the availability of these grass species (O'Malley 2006). Thus, their restricted diet, combined with their annual lifecycle, makes them particularly vulnerable to the seed shortages that can occur at the onset of the wet season.

1.3.2 Nest-site Availability

Gouldian finches are the only obligate cavity-nesting finch in Australia and rely on naturally formed hollows of specific dimensions in the branches of smooth-barked *Eucalyptus* and *Corymbia* tree species for breeding (Brazill-Boast et al., 2010). Increasing evidence indicates that increased land clearing and uncontrolled wild fires have affected the size/age profile of woodland habitat in the northern savannas by

removing many young and very old stems (Lehmann et al., 2008). In addition, most *Eucalyptus* and *Corymbia* trees will not begin producing cavities for approximately 80-100 years (Ambrose, 1982). Furthermore, interspecific (between species) competition for optimal nesting cavities is a factor that may affect Gouldian finch breeding opportunities. For instance, competition from the sympatric (habitat/ecological overlapping) long-tailed finch (*Poephila acuticauda*) over prime nest sites (Brazill-Boast et al., 2010)). Together, this has limited the number of available nesting hollows in some areas (Brazill-Boast et al., 2010). However, to compensate for limited nest-site availability, artificial nest-boxes, which are specifically designed for Gouldian finches, can be a highly effective management tool to increase nest-site availability and local population densities (Brazill-Boast et al., 2013).

1.3.3 Susceptibility of Small Populations

Small and isolated populations are particularly susceptible to localised extinction. This is because in small isolated populations, finding a genetically compatible partner may be time constraining and breeding with an incompatible mate could lead to detrimental population effects (Pryke and Griffith, 2009b). The Gouldian finch has a genetic colour polymorphic, displaying three distinct head-colour morphs (black, red and yellow), which prefer to breed with a mate of the same head-colour morph. Inter-breeding between different genetically incompatible head-colour morphs of the Gouldian finch results in very low offspring survival (20-40%) (Pryke and Griffith, 2009b). In small populations, Gouldian finches are often unable to locate suitable (compatible) breeding partners and are often constrained to breeding with incompatible partners of a different head-colour (20-50% of birds) (Pryke, 2010b; Pryke and Griffith, 2007), which is likely to limit and negatively affect population growth and sustainability.

1.4 Ord River Irrigation Area – Weaber Plain Development Area

The Western Australian Minister for State Development is developing an area of land for irrigated agriculture across the Weaber Plain in the Kimberley region of Western Australia, approximately 30 km north-northeast of Kununurra, adjoining the existing Ord River Irrigation Area.

The Ord Phase Two Expansion Project requires 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 are cleared, including approximately 8205 ha for farmland. 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 (as required by the State Approval of the Project) has been set aside to protect watercourses and surrounding conservation reserves, and help offset disturbances in the Development Area.

The Project is part of the Ord River Irrigation Area (ORIA) and is covered by the Ord Final Agreement (OFA), which includes the protection of vegetation and fauna habitat in six areas across the East Kimberley region over a total area of approximately 188 200 ha (Livistona Range Conservation Area, Pincombe Range Conservation Area, Ningbing Range Conservation Area, Weaber Range Conservation Area, Mt Zimmerman Conservation Area and Packsaddle Swamp Conservation Area).

The Weaber Plain Development Project has been approved by the State subject to a number of conditions (outlined in Statement 830, May 2010). Specifically, the EPBC Act was required as the proposed development was considered to potentially have a significant impact on a number of Matters of *National Environmental Significance* (NES).

1.5 Weaber Plain Development Area and Gouldian Finches

Areas of breeding and non-breeding (foraging) 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 established for the Weaber Plain Development Project.

Gouldian finches have been recorded within the Weaber Plain Development Area. Preliminary surveys during the non-breeding season of 2010 identified suitable breeding habitat for this species (Pryke, 2010a). In-depth surveys during the 2011-breeding season (March-June) located five distinct breeding Gouldian finch populations, all of which were located within the Buffer Area (Appendix 1). In 2011, 43 active Gouldian finch nests were located within these habitats (Save The Gouldian Fund, 2011a), during 2012, 29 active Gouldian finch nests were located in these five breeding habitats (Save The Gouldian Fund, 2012a), and in 2013 and 2014, 13 and 9 active nests were located, respectively (Save The Gouldian Fund, 2013; Save The Gouldian Fund 2014).

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, 63 Gouldian finches were sighted (in 2 days of survey work) within both the proposed Development and Buffer Areas during a preliminary survey of the area in September 2010 (Pryke, 2010a). In 2011, in-depth surveys located a total of 73 Gouldian finches feeding in the area; 61 in the Buffer Area (protected) and 8 in the Development Area (Save The Gouldian Fund, 2011b). In contrast, in 2012, these surveys failed to locate any Gouldian finches in either the Buffer or Development Areas (Save The Gouldian Fund, 2012b). The absence of birds during 2012 was likely due to a combination of extensive grazing damage by cattle and late dry season wildlife removing all critical feeding grasses from the breeding and feeding areas (Save The Gouldian Fund, 2012b). However, in 2013 and 2014, Gouldian finches were again recorded in the Project Area during the non-breeding surveys (Save The Gouldian Fund 2013; Save The Gouldian Fund 2014).

To help protect and promote Gouldian finch populations in the Project Area, 120 artificial custom-designed nest boxes for Gouldian finches were erected in the 5 designated breeding areas in 2015. Nest-boxes were specifically designed and constructed to meet the specialised requirements of the Gouldian finch (Brazill-Boast et al., 2013). They were constructed using hollow branches (collected from the surrounding area during land clearing in 2012) to make entrance tunnels, with a standardised, square detachable nest chamber (7-mm-thick ply; internal volume = 1000 cm^3) attached to one end. The branches used for entrance tunnels varied in size and shape, but depth, width, thickness and fragility morphometrics were within the ranges preferred by Gouldian finches (Brazill-Boast et al., 2010). Each nest-box was numbered, GPS location recorded and placed in a preferred tree species (*C. dichromophloia* or *E. miniata*), by fastening the log entrance to a branch or fork using wire.

1.6 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 availability of critical feeding grasses, the quality of their breeding and feeding grounds as well as the status of the breeding population needs regular assessment.

To ensure protection and aid in the sustainable management of Gouldian finch populations within the Weaber Plain Development Area, the presence, distribution and

population numbers of Gouldian finches, as well as the quality of their habitat and condition/health needs to be regularly assessed. This report details the findings from surveys of breeding populations of Gouldian finches during the 2015 breeding season.

Specifically, this work addressed specific conditions of both the EPBC Act and GFMP:

(A) Undertake Gouldian Finch counts of the breeding population within the Buffer Area and immediate surrounding reserves
GFMP Monitoring Regime (Table 3, Item 3)

(B) Annual monitoring of breeding populations, including timing and reproductive outputs (i.e. clutch size and fledging success)
EPBC Act (Condition 6AII) and GFMP Monitoring Regime (Table 3, Item 7)

(C) Install salvaged tree hollows, as appropriate, in the Buffer Area and/or adjacent conservation reserves and monitor their success
GFMP Management Actions (Table 2, Item 5)

2 Methods

2.1 Study Site

The Weaber Plain Development Area and Buffer Area of the Ord-East Expansion Project is located 30 km north east of Kununurra on the Weaber Plains Road and approximately 100 km east of Wyndham.

Habitat surveys were conducted in areas that have previously been identified as potential breeding habitat (Pryke, 2010a; Save The Gouldian Fund, 2011a). In total, 11 areas of suitable breeding habitats were located within the area. The suitability of the breeding habitat was assessed on a number of variables, and only included areas that were (Brazill-Boast and Pryke, 2011; Brazill-Boast et al., 2010):

- Situated on gently sloping and rocky hills, and dominated by open woodland;
- Supported *Eucalyptus* and/or *Corymbia* tree species (Figure 1);
- Contained suitable feeding grasses in accessible proximity (within a 5 km radius).

Within the breeding habitats identified as suitable for Gouldian finches, 5 breeding populations have been located, all within the Buffer Area. Breeding area 1, 2, and 3 are situated in close proximity to the irrigation channel and a road (and current land clearing and activity in 2013), breeding area 4 is located at the outer perimeter of the Buffer Area and breeding area 5 is also located near a road (and current land clearing and development in 2013).

2.2 Breeding Surveys

Breeding surveys were conducted during the breeding season. Within all known/identified suitable breeding areas, natural nest hollows and breeding Gouldian finches were located by two methods. First, by visiting all suitable tree hollows that had been identified in previous surveys (Save The Gouldian Fund, 2011a) and searching for new hollows within the area (Brazill-Boast et al., 2010). This included initially assessing the potential of new hollows using binoculars. All trees that supported potential nest hollows with entrance diameters between 25 and 100 mm were marked, and assessed closely by climbing a ladder (4.5 m in extension) and using a custom-built extendable and

flexible camera and light source to view the contents. Second, nests were occasionally located by either sighting parents calling and entering their nest or through the vocalisations of chicks begging in the nest (nestling begging calls are very loud and can be heard from a distance of 50–100 m).

In addition to searching natural nest hollows, all 120 nest-boxes (placed in four breeding habitats in May 2013) were regularly checked every three-four weeks. Nest boxes were checked using ladders (and located with GPS) for evidence of nest building, eggs and/or chicks

2.3 Timing and Reproductive Output

In active Gouldian finch nests (active = tree hollows with a nest containing eggs or chicks), the number of eggs and nestlings were recorded, and nestling age was estimated (as a measure to infer start date of breeding attempt). Three active nests in natural hollows were inaccessible due to their narrow entrances and deep nest cavity (> 50 cm) and the contents (i.e. eggs or nestlings) could not be reliably quantified.

2.4 Morphology and health assessment

To measure morphology and health of the Gouldian finch populations, birds were caught at water sources (using mist-nets) or at their nests (using hand-nets) during the breeding season. All birds were banded with a standard ABBBS individually numbered metal bands (Australian Bird and Bat Banding Scheme) and a unique combination of three plastic colour bands (for remote individual identification in the field). Birds were also weighed (to the nearest 0.1 g), measured (e.g. wing, tail lengths and tarsus length mm) and a small blood sample was taken (150 μl). Caught birds were also assessed for ectoparasites (rank scored (1-5) based on number of lice and mites). In addition, fat score was determined using an estimation of the volume of fat stored in each bird's furculum using a scale of 0 - 5. A fat score of 0 indicated no fat was seen in the furculum, 1 indicated 1 – 10% of the furculum full of fat, 2 indicated 10 – 60% full, 3 indicated 60 – 90% full (concave surface of fat in furculum), 4 indicated greater than 90% full (fat bulging over rim of furculum), and 5 indicated fat overflowing from furculum and connecting with other body fat stores.

Blood samples were cold-stored for later centrifugation and analysis in the laboratory. From the blood samples, haematocrit (ratio of red blood cells to the total volume of plasma) and haemoglobin concentrations (HemoCue, g/dl) were measured ((Pryke et al., 2012)). Haematological measures provide useful indicators of physiological status and have long been used as indicators of animal metabolic activity, disease, stress and nutritional status. Red blood cells contain haemoglobin, an oxygen-binding protein that is essential for oxygen transport throughout the body. Generally, low levels are indicative of unhealthy or less active individuals.

2.5 Foraging surveys

The distribution and number of Gouldian finches feeding in recognised breeding habitats were assessed using standardised transect-plots. Transect surveys were undertaken between 5:30 and 9:30am to coincide with the period of peak feeding activity. Following guidelines by the International Union for Conservation of Nature (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 stated time frame. For each chosen 2-ha plot, the perimeter of the area was first walked, and then parallel lines/transects 20m apart are walked inside the area (in a grid line fashion), recording all birds observed (visual and acoustic identification) during this time.

For each of the 5 breeding habitats (described in 2.1), a number of 2-ha sample grids were placed over the breeding habitats (grids placed at least 100 m apart), such that at least 70% of the breeding habitat (including a 500 m buffer around the breeding habitat) was sampled. In total, 45 plots were surveyed within the 5 breeding habitats and a further 45 plots were also sampled in the surrounding Buffer Areas.

Because the current vegetation mapping of the area is incomplete (and erroneous for some areas), the location of feeding grasses potentially utilised by Gouldian finches is unknown. Although some feeding areas have previously been located in the breeding habitats (Save The Gouldian Fund, 2011a, 2012a), 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) (Strategen, 2011). As a result, 2-ha sample grids were chosen across the

Buffer Area, 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.

2.6 Feeding Activity and Critical Feeding Grasses

As the Gouldian finch is an obligate seedeater, the accessibility and availability of appropriate feeding grasses is vital for population persistence. To be able to assess feeding behavior and preferred/available grass species during each survey, the activity of the bird was recorded. In particular, when birds were sighted feeding, the species of grass was recorded to identify the critical grass species used in the area.

3 Results

3.1 Breeding Gouldian Finches

All breeding Gouldian finches were located in the breeding populations identified in the previous surveys (2010-2015). No breeding Gouldian finches were found in any of the other areas where suitable habitat has been located (Pryke, 2010a). All breeding birds were found within the designated Buffer Area.

In addition to the 158 potential nest sites (suitable tree hollows) located during previous surveys (Save The Gouldian Fund, 2011a, 2012a), an additional 120 artificial nest sites were available for birds in 2014 and 2015.

A total of 26 active Gouldian finch nests (i.e. eggs or nestlings present in the nest) were found throughout the breeding season, within 3 different breeding areas (Table 1). Breeding populations varied in size from 1 to 6 active nests (Table 1). All active nests were located in the artificial nest-boxes; no nests were located in natural hollows.

All active Gouldian finch nests were situated within 1.8 km from a suitable water source (mean ± SD: 143.3 ± 302.3m; range 12 – 1708 m). All suitable water sources were situated in the Buffer Area and included running creeks, floodplains, springs and an artificial quarry.

3.2 Timing and Reproductive Output

The first active nests were located during breeding surveys during April. Using the standard incubation period for Gouldian finches (13 days), it is estimated that the first nest was initiated on 28 February 2015 (i.e. began egg-laying). For the last clutch located during the 2015 survey, the start of egg-laying was estimated to 27 April 2015 (with offspring fledging in May).

Of the 26 active Gouldian finch nests, 12 (46.2%) contained eggs and 14 (53.8%) had nestlings when located. Of the 12 nests with eggs, all (100%) successfully produced a brood of nestlings; 1 nest was predated (contents absent when checked). Brood size varied from 3 to 6 nestlings (mean ± SD: 4.8 ± 0.4 nestlings per brood; n = 25 nests).

Table 1. Summary of the number of potential nest hollows and breeding birds (active nest sites) recorded in the 5 breeding areas in 2015 (population numbers correspond to those provided on map; see Appendix 1).

Population	Number of nest sites (natural and artificial)	Number of active Gouldian finch nests
Population 1	61	3
Population 2	29	0
Population 3	27	0
Population 4	69	8
Population 5	92	15
Total	**278**	**26**
Average per site	**56.6**	**5.2**
Average per Ha of breeding habitat	**0.97**	**0.10**

3.3 Health and Condition

Table 2 provides condition and health scores for adults and for nestlings (nestling age ranging from 11-18 days), including haematocrit and haemoglobin concentrations. All Gouldian finches handled were in good to very good condition (e.g. above fat rank score 3) and had low ectoparasite loads. Haematocrit and haemoglobin concentrations were measured from blood samples from a total of 32 adults and 53 nestlings (Table 2).

Table 2. Summary of the health and condition of adults and nestlings during the breeding season 2012. Values are presented as means ± SD.

Measure	Adults	Nestlings
Condition score (rank score; 1-5)	3.9 ± 0.4	4.1 ± 0.6
Ectoparasite load (rank score; 1-5)	1.4 ± 1.2	1.9 ± 1.8
Haematocrit (relative packed cell volume; mm)	62.4 ± 8.1	59.9 ± 3.2
Haemoglobin (g/dl)	16.8 ± 4.1	16.5 ± 3.7

3.4 Feeding Habitats

A total of 32 Gouldian finches were located during the standardised transect surveys of the feeding habitats located in the Buffer area. Birds were observed in breeding areas 1, 4 and 5, but not in breeding areas 2 and 3 or in the general Buffer Area (Table 3). No birds were sighted outside of the identified breeding areas.

Table 3. Summary of the number of Gouldian finches recorded in the 5 breeding habitats in 2015.

Area	Number of surveys	Number of Gouldian finches
Breeding Population 1	8	6
Breeding Population 2	7	0
Breeding Population 3	5	0
Breeding Population 4	8	15
Breeding Population 5	11	11
Buffer Area (adjacent breeding populations)	22	0
Buffer Area (within the Development Area)	11	0
Total	**72**	**32**

3.5 Feeding Grasses

Of the 32 Gouldian finches sighted, 15 were observed feeding. Most feeding birds (13 birds) were found feeding on native sorghum (*Sarga* species) (Table 4).

Table 4. Summary of the number of Gouldian finches recorded feeding on different grass species.

Grass species	Number of Gouldian finches feeding
Sarga	13
Triodia	2
Other grasses	0

3.6 Survival and Resightings

One pair (male and female) that successfully bred together in 2014, bred again together in 2015. They were located in the same breeding area (area 4) but in a different nest box (230 m from original breeding box). No other resightings were recorded.

4 Discussion and Implications

As part of the Gouldian Finch Management Plan (Strategen, 2011) and as a requirement for State approval under the EPBC Act and the GFMP, regular assessments of Gouldian finch populations are to be carried out during the construction and operation of the Ord River Irrigation Area Weaber Plain Development Project in the Eastern Kimberley. In concurrence with these conditions, this report summarises the results of the 2014 breeding season surveys, which specifically monitored the presence, distribution, health and breeding ecology of Gouldian finches, as well as their feeding habits.

4.1 Breeding Gouldian Finches

In the Buffer area and surrounding reserves, a total of 26 active Gouldian finch nests were found during the 2015 breeding surveys. Based on the minimum breeding areas used by birds, this amounts to an average breeding density of 0.1 per hectare, which is higher than breeding densities recorded for Gouldian finches breeding in the same areas for the last two years, since development initiated (2014: 9 active nests and 0.02 per hectare; 2013: 13 active nests and 0.07 per hectare), but still lower than those recorded prior to development (2012: 29 active nests and 0.15 per hectare; 2010: 43 active nests and 0.22 per hectare), and in nearby Wyndham (Western Australia) populations (1.3 – 1.8 per ha).

Reproductive output (e.g. number of fledged offspring) for breeding birds in the Buffer area was similar to that recorded in the last three years (2011-2013) and similar to other known Gouldian finch populations. Broods compromised an average of 5 offspring, which is comparable to findings from previous studies (Brazill-Boast et al., 2010; Pryke and Griffith, 2009a; Pryke et al., 2010). Predation rates on natural nests vary from 20.3-60.4%, depending on aspects of tree cavity morphometry (e.g. length and diameter of hollow), the presence and densities of main predators (e.g. goannas and snakes) and the location of the nest (Brazill-Boast and Pryke, 2011). Predation rates in artificial nest-boxes this year (3%) were similar to those recorded for other nest-box populations (0-2%; Brazil-Boast et al. 2013).

4.2 Health and Condition of Gouldian Finches

Birds assessed had similar body condition and immune function to Gouldian finches measured in other nearby populations during this time of the year (e.g. nearby Wyndham populations). Both haemotocrit and haemoglobin concentrations were comparable to those recorded for Gouldian finches in conservation and protected areas in both Western Australia and Northern Territory (Pryke, pers. obs; Maute 2011). Furthermore, health and body condition indices were higher than those recorded for birds in previous years at these sites (e.g. 2012-2013), suggesting that breeding birds were less stressed and in better condition than birds breeding in previous years. This may be related to the recovery of the area after development and the removal of cattle.

Higher haematological indices for adults compared to juveniles is common, especially as adults are often captured after returning to their nest (i.e. after expending energy flying and searching for food), and because haematological measures are generally higher in active (adults) than inactive individuals (chicks in the nest).

4.3 Feeding Habitat and Grasses

A total of 32 Gouldian finches were found in 39 2-ha survey plots in the Buffer area. All birds were found feeding on native sorghum grasses. This is expected because sorghum is a critical dry season seed for Gouldian finches, and often forms the basis of their breeding diet. Indeed, crop samples from nestlings show that sorghum seeds often comprise 90% of the diet that adults feed their chicks.

Adults breeding in the area were sighted feeding in the local breeding habitats. No birds were located feeding outside of the identified breeding habitats. This suggests that sufficient feeding grasses are present in these areas to support the current breeding Gouldian finch populations. This also highlights the importance of managing both the Buffer areas and Buffer corridors (within the Development Area) to retain and promote these dry-season feeding grasses.

Similar to 2014, because of land clearing in the development areas, none of these were surveyed this year.

4.4 Survival

Two banded birds were resighted during the 2015-breeding season. These birds had successfully bred in 2014 and returned to breed in a nearby nest box (230 m from 2014 nest box). This is the first record of Gouldian finches returning to breed at this site since monitoring started in 2011.

There are a number of potential reasons for the low resighting rate of Gouldian finches. (1) Birds may have dispersed to other areas (outside the designated survey area) in search of new breeding/feeding areas. (2) Birds may not have survived through the wet season. 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, 2009a) and high stress associated with reproduction (such as finding compatible mates, competing for nest hollows and food shortages (Brazill-Boast et al., 2010; Brazill-Boast et al., 2011; Pryke et al., 2007; Pryke et al., 2012)) are the main reasons for their largely annual lifespan.

Unfortunately, because little is known about the dispersal patterns and survival of Gouldian finches in general, the reasons for the low resightings are unclear at this stage. However, it is encouraging that resightings have been observed, for the first time, in this area. This information provides fundamental baseline data for further long-term studies on the survival and recruitment of breeding and non-breeding birds in the area.

4.5 Reduced Effect of Cattle and Fire

Both cattle and wild fire had a severe negative impact on breeding populations in 2012 and 2013. However, the substantial reduction in grazing pressure and absence of wildfires in the breeding areas in 2014 and 2015 are likely to have contributed to the observed increases in Gouldian finches in the current and previous year. Phenology surveys also demonstrated that *Sorghum*, *Triodia* and *Alloteropsis* were all flowing and/or seeding, providing a favourable food base for the Gouldian finch.

4.6 Potential Effect of Land Clearing and Increased Disturbance

Along with increasing land clearing and construction, there has been a continued presence machinery, excavation and road activity (and their associated noise) to the area (especially in the favoured breeding areas 4 and 5). Unfortunately, Gouldian finches have received little study (and none in relation to anthropogenic disturbance), and there is no published data on the movement of this species in response to various anthropogenic disturbances. Although Gouldians will move into built-up areas to locate fresh water during the dry season (when water is scarce), they generally inhabit and feed in remote and undisturbed habitats.

In addition to the current land clearing, some areas potentially important to Gouldian finches have been cleared and/or disturbed. For example, the Raw Material Site is on a Gouldian finch feeding areas that was identified in previous baseline surveys (see Figure 1 in Save The Gouldian Fund 2011b). The Site Office is also positioned in the Buffer Area directly opposite a breeding area (breeding habitat 3), and the constant activity and noise from this main hub may, at least to some extent, have affected the presence of birds in these two area. This may explain why no breeding Gouldian finches have been recorded in these two areas since development started (i.e. post 2012).

However, at this stage, it is not possible to fully assess the relative effect of land clearing, and its associated disturbances, on the movement and habitat-use of Gouldian finches. If such disturbances are affecting Gouldian finches, it is expected that the birds would be absent or scarce in the habitats located adjacent to current development areas (and the associated noise, dust, etc.), but be present in the more protected, undisturbed areas that are remote from current development (e.g. northern areas, such as Gouldian finch breeding habitats 4 and 5). This is evident, at least to some extent, as the relatively undisturbed areas (e.g. 4 & 5) supported more Gouldian finches than the other areas. However, there has also been a substantial increase in breeding numbers (288% increase) from 2014, and is the highest number of birds recorded since development started, suggesting that the Gouldian finches are relatively unaffected by the nearby disturbance and are successfully breeding and returning to the Buffer and breeding areas.

4.7 Artificial nest boxes

Previous suitable nest-site densities within the Buffer area comprised about 0.83 per hectare, which is substantially lower than the 3.2–4.6 per hectare reported for other nearby breeding populations (Brazill-Boast et al., 2010). Gouldian finches have very specialised nest-site requirements, only utilising tree hollows of specific depth, size and sturdiness (Brazill-Boast et al., 2010). Gouldian finches also face intense competition from a more dominant and sympatric competitor, the long-tailed finch. Together, the limited availability of suitable nest sites and strong interspecific competition can severely reduce both the relative proportion of the population that are able to successfully breed (Brazill-Boast et al., 2010) and an individual Gouldian finches' reproductive success (Brazill-Boast et al., 2011).

As a way to enhance breeding opportunities and help reduce nest-site limitation, artificial nest-boxes have been very successfully used in other Gouldian finch populations (Brazill-Boast et al., 2013). To aid in the sustainability of Gouldian finch populations within the Project area, and as stipulated in the GFMP, artificial nest-boxes were erected in the breeding habitats in 2013, subsequently increasing suitable nest-site densities to about 0.97 per hectare.

Although the nest-boxes were only erected at the end of the breeding season in 2013, all breeding Gouldian finches located during 2014 and 2015 were in found breeding in the nest boxes. This is similar to findings from other populations, where the birds prefer to nest in the custom-built nest boxes rather than natural hollows (Brazill-Boast et al., 2013). Furthermore, during these two years there has been a substantial increase in the numbers of Gouldian finches breeding in the area, suggesting that nest boxes are helping provide valuable nest sites and boosting Gouldian finch breeding success and numbers.

4.8 Implications and Future Management

The Gouldian Finch Management Plan (GFMP) (Strategen 2011) details a number of strategies to protect the populations of Gouldian finches and their associated habitats during development of the Ord River Irrigation Area - Weaber Plain Development Project. Vital to the GFMP is to (1) implement a fire management plan (aimed at reducing the incidence and impact of late season wildfires), and (2) remove cattle in the area to prevent/reduce intense grazing pressure.

The 2013-2014 wet season vegetation surveys showed that there was a significant reduction in the distribution and intensity of extreme grazing compared to the earlier surveys in 2012-2013. Subsequently, both breeding and non-breeding populations of Gouldian finches have increased substantially in 2014 and especially 2015. This suggests that potential habitat destruction due to severe grazing pressure have been alleviated in this area. It is important that this is maintained throughout and after project development to ensure the availability of Gouldian finch critical feeding grasses.

The work from this survey highlights the importance of implementing the Gouldian Finch Management Plan, together with the Fire Management Plan and the Buffer Management Plan. Removing cattle, as stated in the Buffer Management Plan (Strategen 2011).

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