

# Habitat Management Guidelines for the Black-throated Finch (*Poephila cincta cincta*) in the Brigalow Belt North Bioregion

A project funded by the Black-throated Finch Trust  
August 2011



# **Habitat Management Guidelines for the Black-throated Finch (*Poephila cincta cincta*) in the Brigalow Belt North Bioregion**

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The southern subspecies of Black-Throated Finch is an endangered bird that is now restricted to Queensland and, even there, is found across only a fraction of its former range. The management of its habitat is crucial to its conservation and recovery. These guidelines on how to manage Black-Throated Finch habitat in the Brigalow Belt North Bioregion are a significant contribution to the conservation of the Black-throated Finch. They are based on the best available information at the time of writing and are intended for practical use by land managers and to guide decision-making at all levels. The Black-throated Finch Recovery Team and the Black-throated Finch Trust welcome feed-back from efforts to implement of these guidelines (Email: [enquiries@blackthroatedfinch.com](mailto:enquiries@blackthroatedfinch.com)).

The guidelines were prepared by Peter Buosi (NRA Environmental Consultants) in a project funded by the Black-throated Finch Trust for which NQ Dry Tropics Inc. is the trustee. A draft of the guidelines was reviewed in a workshop convened by The Black-throated Finch Recovery Team on 14 July 2011. Additional comments were received from Neil Boland (NRA), Kim Maute (University of Wollongong), Marnie McCullough (People Grow Business) and Tony Grice (Black-throated Finch Recovery Team).

The Black-throated Finch Recovery Team encourages efforts to apply these guidelines. This document can be freely circulated and cited with appropriate acknowledgement. Copies are available at: <http://www.blackthroatedfinch.com>.





# Document Control Summary

## NRA Environmental Consultants

<b>Job No:</b>	F:\AAA\306 - NQ Dry Tropics (formerly Burdekin)\306005 - BTF Management Guidelines\Reporting\R02\BTF habitat mgt guideline_R02_final.doc
<b>Status:</b>	Final
<b>Project Manager:</b>	Peter Buosi
<b>Title:</b>	Habitat Management Guidelines for the Black-throated Finch ( <i>Poephila cincta cincta</i> ) in the Brigalow Belt North Bioregion
<b>Author/s:</b>	Peter Buosi
<b>Client:</b>	NQ Dry Tropics on behalf of the Black-throated Finch Trust
<b>Client Contact:</b>	Tony Grice and Judy Warner
<b>Date of Issue:</b>	19 August 2011
<b>No. of Copies:</b>	Client: 1 pdf., 1 bound hardcopy, 1 CD with pdf; NRA: 1 Master, 1 Library
<b>Dispatched Via:</b>	Email and Australia Post
<b>Other Info or Requirements:</b>	Final report supersedes and replaces all previous documentation prepared.

Report Summary	
<b>Key Words</b>	Black-throated Finch, BTF, NQ Dry Tropics, BTF Trust; Habitat Management Guidelines; Brigalow Belt North Bioregion
<b>Abstract</b>	These guidelines contain information to assist landholders and managers wishing to maintain healthy habitats in the Brigalow Belt North Bioregion to the benefit of BTFs. The reader is encouraged to adapt these guidelines to suit site-specific circumstances. It is hoped that successful implementation of this advice will result in improved quality of pastures and healthy populations of BTF and wildlife generally.

Quality Assurance					
Author	Technical Review	Editor	Document Version	Approved for Issue by QA Manager	
				Date	Signature
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2009 Queensland Winner  
Sensis Social Responsibility Award

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# 1. Introduction

## 1.1 Project Context and Scope

Acting on behalf of the Black-throated Finch Trust, NQ Dry Tropics engaged NRA Environmental Consultants (NRA) to develop Habitat Management Guidelines for the Black-throated Finch (*Poephila cincta cincta* – BTF). The agreed scope of this project, as outlined in our proposal dated 17 March 2011, is described below.

- Develop generic management guidelines that advise landholders on how to best manage BTF habitat. The guidelines will apply to the Brigalow Belt North Bioregion as shown in **Figure 1**.
- The guidelines shall:
  - be concise (5 to 10 A4 pages), based on the best available information and be suitable for practical use by individual landholders/managers, government bodies and corporate entities
  - be applicable to land parcels of any size
  - be presented in a manner that allows and encourages people to adapt the advice according to their specific situation
  - include photographs, tables and diagrams to assist with the presentation of information.

The BTF Habitat Management Guidelines shall include the following.

- Very brief description of the BTF and its ecology.
- The conservation status of the BTF, including history of its decline.
- Current distribution of the BTF.
- General description of habitat requirements for the BTF.
- Factors influencing decline of populations or degradation of habitat (*ie* threats).
- Management advice that can be applied to maintenance of existing habitat and restoration of degraded habitat.
- Management advice that considers all habitat components and provides targets or indicators for successful management.
- Management advice that considers grazing (domesticated and non-domesticated), fire, weeds, water sources and predators (native and introduced).

A draft of this report was presented at a workshop co-ordinated by the Black-throated Finch Recovery Team on 14 July 2011. The draft was also provided to a number of interested organisations and persons who were unable to attend the workshop. The report has benefited from comments received at that workshop and in particular from review by Mr Neil Boland (NRA), Ms Kim Maute (University of Wollongong), Ms Marnie McCullough (People Grow Business) and Dr Tony Grice (Black-throated Finch Recovery Team).

## 2. General Introduction to Guidelines

Large flocks of the southern subspecies of BTF were once seen in discontinuous areas from about the Atherton Tablelands (Queensland) in the north, to northern New South Wales in the south and up to 700 km inland from the coast. They began disappearing from southern areas early in the 20<sup>th</sup> century and by the 1940s they had mostly disappeared from the south-east of their former range. Declines in their southern extent continued in the following decades, with major declines around Rockhampton reported in the mid 1970s. The subspecies is now patchily distributed within an area extending 500 km inland from the coast between Mareeba in the north and Rockhampton in the south. The observed decline has warranted the listing of the subspecies as Endangered under State and Commonwealth legislation.

In northern Australia, similar declines that have been observed in a number of other granivorous or ground dwelling birds are largely attributed to the combined effects of pastoralism, altered fire regimes and drought (*eg* Franklin 1999; Franklin *et al.* 2005; Barnard 1925; Woinarski *et al.* 2000). Land clearing and the introduction of feral predators and rabbits have also played a role. While the relative importance of these processes vary from region to region, they are likely to operate in a synergistic fashion.

Most remnant BTF populations occur on pastoral lands. Intriguingly, some aspects of pastoralism negatively impact upon BTFs while others do not, highlighting the fact that BTFs can co-exist with pastoralism provided specific threatening factors are controlled. Further, management for BTF conservation need not disadvantage pastoral interests.

These guidelines contain information to assist landholders and managers wishing to maintain healthy habitats in the Brigalow Belt North Bioregion to the benefit of BTFs. The reader is encouraged to adapt these guidelines to suit site-specific circumstances. It is hoped that successful implementation of this advice will result in improved quality of pastures and healthy populations of BTF and wildlife generally.

### 2.1 Important Information on Report Limitations

The very few ecological studies of wild BTF populations that have been undertaken have largely been limited to work on the northern subspecies near Mareeba (the historical zone of intergrade with the southern) and southern subspecies near Townsville. Most of the work on the northern subspecies is attributable to Richard Zann (*eg* Zann 1976). Studies on the southern subspecies are more recent and attributable to David Mitchell (Mitchell 1996), Nicole Isles (Isles 2007), Sally Whatmough (Whatmough 2010), Kim Maute (PhD thesis in preparation) and Peter Buosi from NRA (NRA 2004a–c; 2005a–e; 2006a, b; 2007a–f; 2008a, b; 2009a–f; 2010; 2011). Both subspecies are also assessed in studies investigating the decline of granivorous and ground-dwelling birds on a broad scale (Franklin 1999, Franklin *et al.* 2005) and a local scale (Woinarski & Catterall 2004).

To some degree, our ability to confidently evaluate threats and management requirements is inhibited by our incomplete understanding of BTF ecology, and compounded by the fact that aspects of BTF ecology may vary in response to site-specific conditions (current and historical). However, there is an immediate imperative for conservation actions to address the decline of the BTF. The following guidelines rely on available information on BTF ecology, knowledge of closely related species and professional opinion. The reader should be mindful of these limitations when using the information contained in these guidelines.

Similar guidelines prepared for other granivorous birds were key references during the preparation of this report. The following guidelines were of particular value and relevance.

- Management Guidelines for the Golden-shouldered Parrot Conservation (Crowley *et al.* 2004).
- Healthy Country Indicator Species for Cape York Peninsula. Best Practice Management for Black-throated Finch (northern subspecies, *Poephila cincta atropygialis*) (Crowley *et al.* 2007).

## 3. BTF Taxonomy, Status, Ecology and Distribution

### 3.1 Taxonomy

Two subspecies of the Black-throated Finch are recognised: the southern subspecies *Poephila cincta cincta* which has a white rump and the northern subspecies *P. c. atropygialis* which has a black rump.

The southern subspecies has experienced significant declines and occurs in the area of interest for these guidelines (Brigalow Belt North Bioregion, **Figure 1**). All references to the BTF hereafter are specific to this subspecies, unless otherwise stated.

In the last 25 years, a decline in density and extent of occurrence has been noted in the northern subspecies, though not as dramatic as that seen for the southern subspecies (Franklin 1999; <http://www.birdlife.org/datazone/speciesfactsheet.php?id=8682>). The northern subspecies does not occur in the Brigalow Belt North Bioregion and is not considered further in this report.

### 3.2 Conservation and Legislative Status

Two independent studies have assessed the reduction in the BTF's extent of occurrence (NRA 2007a; TSSC 2005). Both studies compared pre-1998 data (historical extent of occurrence) with post-1998 data (current extent of occurrence) and found the reduction in extent of occurrence to be between 53% and 83%. This decline is largely the basis for the BTF being listed as Endangered under the following pieces of State and Commonwealth legislation.

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- New South Wales *Threatened Species Conservation Act 1995* (TSC Act).
- Queensland *Nature Conservation Act 1992* (NC Act).

In Queensland, the *Vegetation Management Act 1999* (VM Act) also contains provisions for the protection of Essential Habitat for the BTF. Essential Habitat is defined under the VM Act as vegetation in which a species that is endangered, vulnerable or near threatened (as listed under the NC Act) has been known to occur. However, not all areas of Essential Habitat have been defined and some activities (*eg* some forms of mining) are exempt under the VM Act.

The BTF is identified as a High Priority species under the Department of Environment and Resource Management (DERM) Back on Track species prioritisation framework, which was developed to assist with State conservation, planning and funding decisions.

At the species level (*ie Poephila cincta*), the BTF is listed as Near Threatened under the IUCN Red List of Threatened Species (assessed in 2008).

### 3.3 Distribution

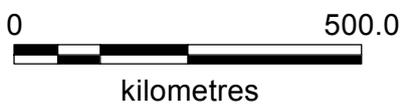
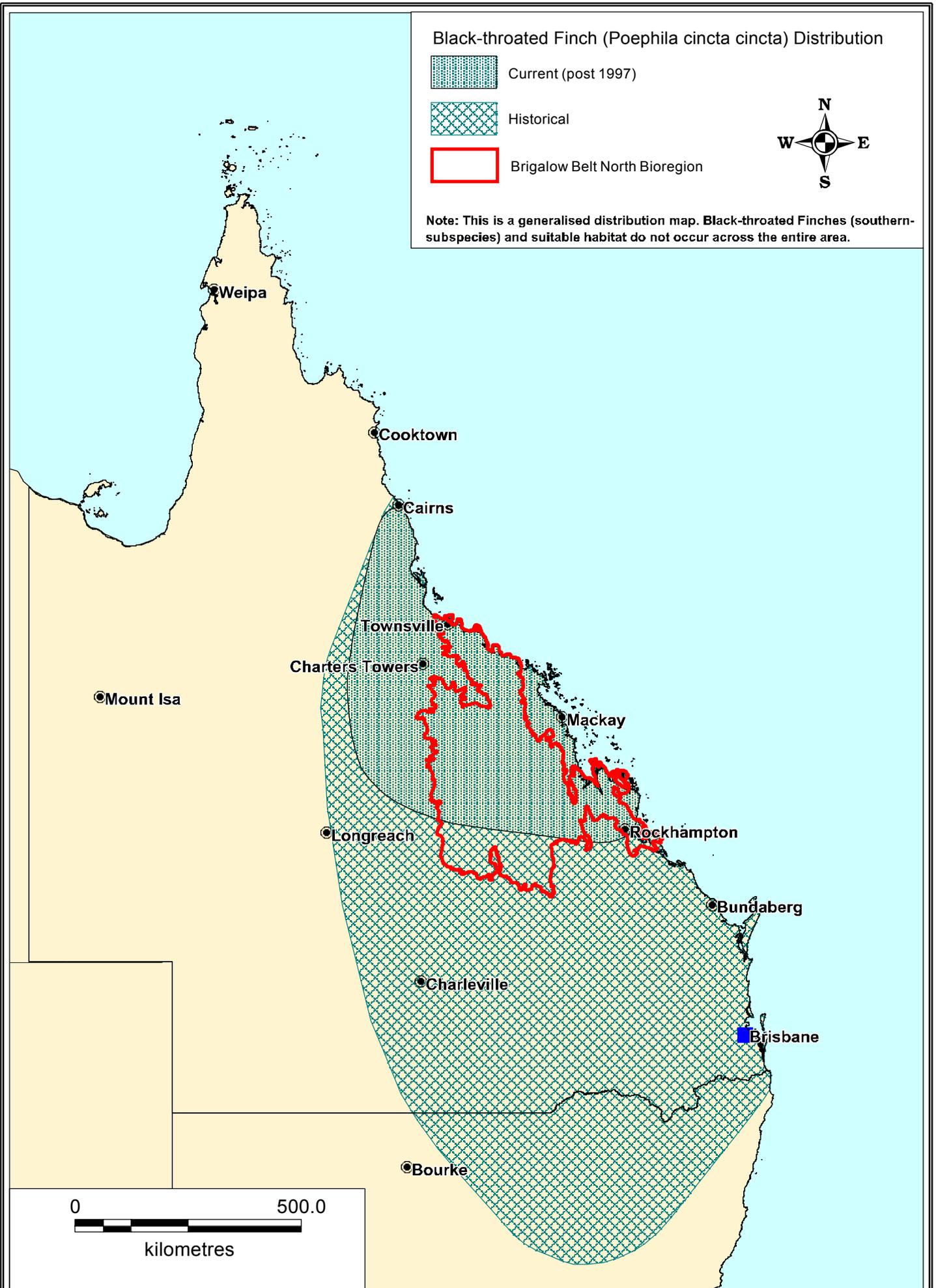
Historical records show *Poephila cincta cincta* occurring from Inverell in north-eastern New South Wales and through eastern Queensland to the Burdekin-Lynd Divide, where it intergrades over a broad zone with the northern subspecies (*P. c atropygialis*). Based on post-1997 records, it appears the southern subspecies now occurs discontinuously in a broad band between Rockhampton and Mareeba and west to Aramac and Hughenden (**Figure 1**). The northern extent is uncertain and may have contracted to south of Mareeba. Small remnant populations may still occur outside this range.

### Black-throated Finch (*Poephila cincta cincta*) Distribution

-  Current (post 1997)
-  Historical
-  Brigalow Belt North Bioregion



**Note:** This is a generalised distribution map. Black-throated Finches (southern-subspecies) and suitable habitat do not occur across the entire area.





### 3.4 Ecology

BTFs are predominantly granivorous birds that prefer to feed on the fallen seeds of native and exotic grasses and herbaceous plants. On occasion they may pull free-standing seed heads to the ground in order to feed. They are also known to feed on flying termites following heavy rains (Smedley 1904).

Their habitat is broadly described as open grassy woodlands or forests, often dominated by eucalypts, melaleucas or acacias, where there is access to seeding grasses and water (Zann 1976; Garnett & Crowley 2000; Higgins *et al.* 2006; Garnett 1993; NRA 2009e).

The BTF is a social species and commonly forms loose flocks. Flock size varies with population size and time of year, though flocks of 5 to 30 individuals are most commonly seen. Larger flocks of 60+ birds are becoming increasingly uncommon and tend to be seen late in the dry season when birds aggregate around remaining water sources. It is thought that when a BTF reaches breeding age, it forms a life-long bond with its chosen mate. They are then rarely apart and share rearing and nest building duties.

BTFs usually nest in loose communal sites, with multiple nests occurring in a small area. In rare circumstances, a single tree may contain several active nests (*eg* two to five nests have been observed in one tree). Nests are used for breeding and roosting, with individuals returning each night to roost. Adult pairs will aggressively defend their nest from conspecifics during the breeding season, though this level of aggression decreases during the non-breeding season. During the non-breeding season, some nests may be used as dormitory nests housing different adult pairs and young. Nests are mostly built high in the outer branches of trees and tall shrubs, in tree-hollows, in mistletoes, and in the base of raptor nests.

The timing and duration of the breeding season appears to be contingent on food resources and is therefore likely to vary annually and geographically according to rainfall patterns, temperature and land condition. NRA (2005a) recorded BTFs breeding in Townsville from January to July; analysis of data contained in Mitchell (1996) recorded breeding in Townsville from March to May; and Bravery (1970) recorded breeding in Atherton from September to January. Although under optimal conditions the species can probably breed continuously throughout the year, the core breeding season around Townsville is believed to begin a few months after the onset of the wet season and continue until ground-stored food resources (fallen grass seed) fall below an undetermined threshold (*c.* February to June). Usually five or six eggs are laid at one time and juveniles remain with their parents for a number of months after fledging.

Little is known about the movement patterns of the BTF. Daily movements appear to be influenced by season, with shorter and more localised movements during the breeding season (*eg* Isles 2006) when foraging resources are relatively high. Daily movements appear to increase during the non-breeding season when foraging resources near the breeding site are presumably lower and juveniles are more mobile (NRA 2005a). Mitchell (1996) observed BTFs utilising patches separated by more than 1.5 km, leading him to conclude that during certain times of the year movements of over 3 km may be a common part of the species' daily routine. Mitchell (1996) also observed birds utilising separate breeding (*c.* February to November) and non-breeding areas (*c.* December to January) throughout the year, and he concluded that the species may undertake seasonal movements, *ie* movement observed between two sites separated by approximately 3 km. At a number of sites around Townsville the species has returned to the same general place to nest and breed over consecutive years. Larger scale movements in response to disturbances such as drought are also thought to have occurred (Ley & Cook 2001) though the regularity and success of such movements are unknown.

## 3.5 Threats

### 3.5.1 Introduction

At the simplest level, BTF habitat comprises water, suitable seeding grasses and woody vegetation in which to build nests. For an area to contain viable habitat, these resources need to be located in reasonable proximity to one another, be available year-round and, with respect to seeding grasses, occur in sufficient abundance to support life. Viable *populations* require sufficient abundance of these resources to support multiple individuals, and connectivity to other populations to allow recruitment and encourage genetic diversity. Catastrophic events, such as fire and drought, have always been a natural part of the environment and the persistence of BTFs in a landscape relies upon the presence of these interconnected populations and landscape-wide areas of suitable habitat in order to survive and recover from such events.

Various permutations of pastoralism, introduced herbivores (mainly rabbits), land clearing and drought are thought to have had the greatest impact on the BTF and are implicated in their decline (NRA 2007a; Garnett 1993; Garnett & Crowley 2000; Franklin 1999). Closer analysis of the processes behind the decline can be used to identify the potential vulnerabilities and conservation requirements of the species. The following analysis is presented with reference to critical life-history stages and the three basic components of BTF habitat – water, foraging habitat and nesting habitat.

Trapping is also a threat to BTFs. Trapping is illegal without approval under the NC Act and the EPBC Act and has the potential to significantly impact on local BTF populations. Illegal trappers should be reported to DERM. This threat is not discussed further in these guidelines.

### 3.5.2 Critical Life History Stages

#### Resource Bottleneck

Grass seed abundance generally peaks around the early dry season (May/June) and gradually declines through until the next wet season. Towards the end of the dry season (September to November) seed abundance is low and little to no replenishment of surface-stored seed occurs. The onset of rains associated with the early wet or storm season (October to December) triggers a significant food shortage as any remaining soil-stored seed germinates or rots. This food shortage, or resource bottleneck, continues until grasses start producing seed again. BTFs are very vulnerable during this period and activities or events that extend this period of food shortage pose a significant threat to their survival. Therefore, those grass species capable of producing seed quickly after the first rains are vitally important for breaking the food shortage. These grass species tend to be early flowering perennial grasses such as Cockatoo Grass (*Alloteropsis semialata*) and Golden Beard Grass (*Chrysopogon fallax*). Recent research has confirmed that BTFs show higher stress levels at the end of the dry season (Kim Maute *unpubl. data*) and mortality levels are likely to be higher at this time of year (October to December) compared with the early dry season (May to July).

#### Breeding

The breeding season is an opportunity for BTF populations to recover from losses sustained at the end of the dry season/early wet season. During this time, parents firstly need to gain sufficient body condition to breed and then once the young have hatched, be healthy enough to fend for themselves and their young. Activities or events that reduce resource availability during this time may reduce reproductive success. If breeding success is unable to off-set mortality over consecutive years then local extinctions may occur.

### 3.5.3 Threats to BTF Habitat (Water, Foraging Habitat and Nesting Habitat)

#### Water

BTFs need to drink water on at least a daily basis and drink more frequently during the drier times of the year. The importance of water to BTFs is highlighted by the fact that they typically nest and breed near water; for example, in Townsville BTFs nested on average 167 m from water (NRA 2009e). The species is thought to undertake local movements in response to rainfall patterns, with some populations utilising seasonally (wet season) available water to access breeding grounds then contracting back to permanent water sources during the dry season (Peter Buosi *pers obs.*). Permanent water sources may therefore act as a dry season refuge.

Activities that reduce the availability (location and duration) of water or detrimentally alter water quality in areas of BTF habitat may impact upon the species. This impact will be greatest in breeding areas and/or dry season refugia. Pressures on the availability of water will be most pronounced during periods of drought. Conversely, the creation of water sources in certain parts of the landscape may create habitat for the BTF; for example, the bird drinks via sucking so they may drink from cattle troughs if there are suitable perches in place to access the water. Feral cats have been observed ambushing birds, including finches, at cattle troughs and may pose a threat in some areas.

#### Foraging Habitat

##### Overview

BTFs require year-round access to seeding grasses and there is general consensus that the reduction in the quantity and continuity of the supply of grass seed has played a large role in the observed declines in granivorous birds (NRA 2007a; Franklin 1999; Franklin *et al.* 2005; Crowley & Garnet 2001). The dominant constituents of their diet may change throughout the year and in unmodified systems the species may eat proportionally more annual grass seed during the dry and more perennial grass seed during the wet. Insects and early flowering perennial grasses may comprise an important part of the diet during the early wet season/storm season. The species appears to preferentially forage in small areas near the nesting site during the breeding season (*eg* NRA 2005a reported 20 to 30 birds were observed foraging in patches within an area of approximately 12 ha, and Isles 2007 recorded three breeding pairs foraging in approximately 2.5 ha). The species will then progressively forage further abroad as conditions become drier.

Although the quantity and continuity of seed supply is likely to be relevant throughout the BTF's entire life cycle, it may be most important when resource demand is high (*eg* during breeding) and when resource availability is naturally low (*eg* resource bottleneck).

The processes that may affect the quantity and continuity of supply across the BTF's potential range are highly complex and will vary according to climate (temperature and rainfall), geomorphology, fire regimes, soil type and land condition. The processes become even more complex in modified systems when different land uses (current and historical) and fire histories are considered.

The quantity and continuity of grass seed supply is largely determined by the relative abundance and composition of grass species in a given area of habitat. Threats comprise those processes that may reduce seed production, continuity of production (across the landscape) and the availability/accessibility of the seed produced. Within the BTF's historical range, activities that contribute to these threats are a complex combination of clearing, drought, increased grazing pressure (domesticated and non-domesticated), altered fire regimes, predation, competition, weeds, exotic pasture grasses and woody vegetation thickening.

### **Quantity of Grass Seed**

The following are examples of factors that affect seed production and therefore the quantity of food available for BTFs.

- **Soil fertility.** Soil fertility refers to the presence and availability of soil nutrients. This is influenced by soil type and soil condition.
- **Soil condition.** Soil condition refers to the ability of a soil to maintain processes that support plant growth. This can be affected by the timing, intensity and duration of grazing, fire, soil compaction (destruction of soil structure) and erosion. Degraded soils are likely to decrease seed production over the long term.
- **Biomass of leaf material.** Substantial loss of leaf material on grasses can reduce seed production. Leaf biomass can be reduced by grazing, fire, competition (particularly with woody vegetation), disease and growing conditions (especially soil condition and moisture).
- **Drought/climate.** Plant growth and seed production are affected by soil moisture. Less grass seed may be produced during extended drought periods.

### **Accessibility or Availability of Grass Seed**

The availability of food resources refers to how much of the grass seed is accessible to the BTF, remembering that the species preferentially forages from the ground. The following are examples of processes that affect the accessibility/availability of grass seed for BTFs.

- **How much seed falls to ground.** The number of seeds that fall from inflorescences to the ground surface may be affected by grazing intensity, fire and disease immediately prior to seed set.
- **How long seed stays on ground.** The duration of availability may be affected by levels of competition (granivorous vertebrates and invertebrates), physical destruction (fire and trampling) and rainfall (germination and decay).
- **How much seed is accessible.** Of the seed that falls to the ground, the following factors may decrease accessibility.
  - *Grass habit/growth forms.* Some grass species (eg Buffel Grass – *Cenchrus ciliaris*; Sabi Grass – *Urochloa mosambicensis*; Guinea Grass *Megathyrsus maximus*) can form very thick monospecific swards (especially when not grazed) which may be physically impenetrable or so thick as to make foraging difficult (eg more difficult to see predators).
  - *Trampling by livestock.* The hard hooves of livestock have the potential to bury seeds beneath the soil surface making them inaccessible to finches. Grazing intensity and soil moisture may affect the quantity of seed buried.
  - *Presence of predators.* Predators may disrupt feeding, thereby reducing accessibility of food.
  - *Distance of the resource from water.* Energy budgets will influence foraging range.

### **Continuity of Grass Seed**

Although the quantity of seed may affect the continuity of seed availability, so may other factors. Because grass species differ in the timing and duration of seed production, the loss of even one food species may break continuity of supply. For example, Crowley and Garnett (2001) found that levels of early wet season defoliation of Cockatoo Grass, though insufficient to affect plant size (equivalent to moderate grazing pressure), can substantially reduce seed production, with suppression continuing for at least two years. They predict this may also be the case for Golden Beard Grass. These species produce seeds early in the wet season and the loss of such species could increase the period of critical food shortage for BTFs.

Persistent overgrazing, feral pigs and annual burning are known to change the composition and reduce the abundance of some grasses and this may reduce the continuity of seed supply. Persistent overgrazing or burning without spelling often leads to the loss of native perennial grasses and eventually the proliferation of annual grasses and broad leaf plants. Feral pigs are known to dig up and feed on the tubers of Cockatoo Grass, thereby destroying the plant.

### **Nesting Habitat**

The location or pattern of grazing impacts on foraging habitat is also relevant to the BTF, especially where they nest and breed. Grazing impacts are generally greatest close to a water point and decrease with distance from the water point (Lange 1969; Landsberg *et al.* 1997). High levels of impact are often visible within 500 m of a water point and signs of impact include broken soil crusts, extensive erosion, dominance of forbs and a reduction in some native perennial grasses (Landsberg *et al.* 1997). The direct effects of grazing are exacerbated by trampling and dust associated with moving animals and are most obvious within 100 m of the water point, often referred to as the "sacrifice zone" (Andrew & Lange 1986; Landsberg *et al.* 1997).

Of concern for the BTF on grazing lands is that during the breeding season the species appears to preferentially forage, nest and breed in areas of suitable habitat close to water, *ie* the area where the impacts of grazing are greatest and during a period when resource demands are high. This grazing effect probably increases foraging effort for BTFs and at worst reduces their reproductive success and fitness/health. These impacts are probably more pronounced during drought years.

Because BTF nests are usually constructed in the outer branches of trees and shrubs, land clearing is also a threat to nesting habitat. A lack of woody vegetation may prevent the BTF from utilising areas of otherwise suitable habitat. In the period 1997 to 2006 the Brigalow Belt Bioregion, a core bioregion for the BTF, experienced one of the highest rates of vegetation clearing in Queensland and by 2006 only approximately 42% remained uncleared (Accad *et al.* 2008). Much of the vegetation that was cleared has been replaced with exotic grasses (mostly Buffel Grass) for pastoralism (Woinarski *et al.* 2000).

The habitat modifications that result from heavy grazing are known to favour certain species, referred to as 'increasers'; for example, Butcher Birds, Crows, Magpies (Reid & Fleming 1992) and Noisy Miners. The tendency for BTFs to construct nests close to each other may increase their vulnerability to predation and harassment by these species. Mitchell (1996) reported a Magpie eating eggs in all of the five BTF nests he could reach and NRA (2005a) reported egg predation by a Pied Butcher Bird.

Mammalian predators (*eg* cats) may occur in higher abundance in areas close to water (*eg* artificial water points – Landsberg *et al.* 1997) and urban areas. The threat of predation by mammals is unknown but probably negligible relative to other threats.

## 4. Management Guidelines

### 4.1 General Goals for Management

If it were possible to design a landscape to support a viable population of BTFs it would contain the following local and landscape scale attributes/characteristics. They are important considerations when developing local and landscape scale management plans to manage existing BTF populations and for those looking to create (or re-create) habitats and/or reinstate BTF populations.

#### Local scale attributes

- Permanent and seasonal water sources that are accessible to BTFs and within approximately 200 m of suitable foraging habitat and suitable nesting trees.
- Large areas of open woodland in which the understorey is dominated by native early flowering perennial grasses (eg Cockatoo Grass) and there is good foraging habitat within approximately 200 m of permanent water sources.
- Large areas of open woodland in which the understorey contains a variety of later flowering perennial grasses that are mostly native and there is good foraging habitat within approximately 200 m of seasonal and permanent water sources.
- Variations in soil type and/or micro-topography to promote varied seeding times in grass species.
- Land management that promotes the quantity and continuity of seed supply.
- Feral pigs and cats are sparse or absent.

#### Landscape level attributes

- Interconnected networks of suitable habitat, ie networks of areas containing the above local scale attributes.
- Fire breaks (natural or constructed) to reduce the likelihood of landscape wide fire damage.
- Variations in soil type and/or topography to promote varied seed production in grasses.
- Connectivity between remnant BTF populations.
- Water sources that persist even during very dry years.
- Feral pigs and cats are sparse or absent.

### 4.2 Property-specific Management Guidelines

The following guidelines are provided to assist land managers to determine what actions can be taken on a property or within a landscape (eg a collection of properties) to conserve habitat suitable for BTFs. In most cases, these guidelines will need to be adapted to suit site-specific circumstances.

Knowing how BTFs use an area is useful for deciding what management actions are required to protect a BTF population. For example, actions required to protect breeding habitat may differ from actions required to protect areas where BTF intermittently forage during the dry season. The ideal outcome for the BTF would be for all property owners within the BTF's range to create conditions that encourage the year-round presence of BTFs on their property and/or for property owners to work collectively to encourage persistence in the broader landscape.

**Figure 2** summarises the important aspects of BTF ecology and may assist in interpreting the management advice.

**Figure 2: General timing of important life history stages and management actions for BTF in the Brigalow Belt North Bioregion**

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Season (six units)		W	W	LW	LW	ED	ED	D	D	LD	LD	EW	EW
<b>Peak in Specific Behaviour</b>													
Breeding	Egg laying & rearing dependent juveniles												
Movements	Movement localised to breeding site												
	Birds progressively range further												
	Some colonies contract to permanent water												
	Some colonies disperse to breeding area												
<b>Critical Life History Stages</b>													
Critical Periods	Resource bottleneck												
	Peak breeding period												
	Dry season stress												
<b>Peak Periods for Seed Production</b>													
Seed Production	Annual grass												
	Perennial grass late (flowering)												
	Perennial grass (early flowering)												
<b>Recommended Management for Healthy BTF Habitat</b>													
Grazing	Wet season spelling to protect grasses												
Fire	Patch burns every 5 yrs or more for asynchronous seeding												

EW = Early Wet Season

ED = Early Dry Season

W = Wet Season

D = Dry Season

LW = Late Wet Season

LD = Late Dry Season



The following references are useful background reading for some of the issues addressed in the management advice.

- Ash, A., Corfield, J. & Ksiksi, T. *The Ecograzed Project: developing guidelines to better manage grazing country*. CSIRO, Queensland Government and Meat and Livestock Australia.
- Dyer, R., Jacklyn, P., Partridge, I., Russell-Smith, J. & Williams, R. *2001 Savanna Burning: understanding and using fire in northern Australia*. Tropical Savannas CRC, Darwin.
- Vanderduys, E., Kutt, A. & Edmonds, J. 2009. *Healthy Grazing Country Indicators: Native Plants and Animals*. NQ Dry Tropics, Townsville.
- Karfs, R., Holloway, C., Pritchard, K. & Resing, J. 2009. *Land Condition Photo Standards for the Burdekin Dry Tropics Rangelands: a guide for practitioners*. Burdekin Solutions Ltd and Queensland Department of Primary Industries and Fisheries, Townsville.
- CSIRO (undated). *Managing recovery: tools for sustainable grazing in the Burdekin catchment*. An information pack on sustainable grazing for graziers to assist in land management. <http://www.csiro.au/resources/Managing-Recovery.html>.

### **Key Objectives**

There are the three key objectives for managing BTF habitat.

- Objective 1 – Maintain open woodlands with a grassy understorey that is dominated by native perennial grasses. Grasses include a high proportion of early flowering perennial grasses such as Cockatoo Grass.
- Objective 2 – Maintain water sources accessible to BTFs near foraging habitat and near woody vegetation.
- Objective 3 – Maintain tall woody vegetation near foraging habitat and water.

The following information is provided to assist land managers in deciding what actions might be necessary to achieve the above objectives.

- A description of the threats to the objective.
- Advice on ways to reduce the impact of each threat.
- Supporting information to assist in the interpretation of management advice.
- Performance indicators to measure the success of management actions.

**Objective 1 – Maintain open woodlands with a grassy understorey that is dominated by native perennial and annual grasses. Grasses include a high proportion of early flowering perennial grasses such as Cockatoo Grass.**

Threatening Processes	Management Advice	Comments
Fire	<p>Note: Fire safety controls and protocols should be checked and relevant approvals obtained prior to all burns.</p> <p><b>Lands Not Grazed by Livestock</b></p> <ul style="list-style-type: none"> <li>• Maintain landscapes that have variety in burning regimes, <i>eg</i> variety in the timing and intensity of fires and the areas burnt each year. This can be achieved by adopting a fire regime that involves burning fire breaks earlier in the season then following up with early dry season (May to July) patch burns (cool burns) in discrete areas (<i>ie</i> don't burn entire landscapes at once). Areas should be left unburnt for 5 or more years apart from fire breaks which may require more frequent treatment.</li> <li>• Protect dry season BTF habitat, especially grasslands near to water, from late dry season fires. This is particularly important during dry years. Also protect grasslands near water sources during the BTF breeding season when there is no alternative water or habitat nearby.</li> <li>• Burn when there is good soil moisture. Spell grasslands after fire to reduce woody vegetation thickening and assist in the recovery of native perennial grasses.</li> </ul> <p><b>Lands Grazed by Livestock</b></p> <ul style="list-style-type: none"> <li>• On grazing lands the focus should be on preventing extensive and uncontrolled fires, <i>eg</i> focus on managing fire breaks.</li> <li>• If fires do occur in BTF habitat then allow grasses to recover (<i>eg</i> spelling or lightly grazing) before reintroducing stock.</li> </ul>	<ul style="list-style-type: none"> <li>• There is no single burning regime that will benefit BTFs. Every regime has benefits and negatives and for this reason a variety of regimes is encouraged.</li> <li>• Management should aim to prevent extensive and uncontrolled fires. This is especially an issue in areas that have high fuel loads, such as lands not grazed by cattle.</li> <li>• On grazing lands, paddocks may need to be rested before fires to allow fuel loads to accumulate and after fires to help grasslands recover.</li> <li>• Cockatoo Grass produces seed approx. 6 weeks after the first heavy rains. Fires during the growing period may reduce and delay seed production, which is deleterious to BTFs. Therefore, wet season fires (January to March) should be avoided.</li> <li>• Fires that occur outside of the growth cycle for Cockatoo Grass may increase seed production in the following wet season.</li> <li>• Maximum seed production for annual grasses and later flowering perennial grasses typically occurs in the early dry season (approx. May and June). Fires prior to seed set may reduce the quantity of seed produced.</li> <li>• Fires reduce ground cover, thereby increasing the risk of soil damage and erosion. Weather cycles, topography and soil type should be considered when planning fires.</li> <li>• See comments below regarding hot fires to manage woody vegetation thickening.</li> </ul>
Woody vegetation thickening	<p>Note: Some forms of woody vegetation clearing are regulated under the VM Act. Check that the necessary approvals are in place prior to destroying woody vegetation.</p> <ul style="list-style-type: none"> <li>• Consider chemical and/or mechanical control for thinning woody vegetation from the shrub layer.</li> <li>• Consider hot fires later in the season to manage vegetation thickening. The use of fire to control vegetation thickening is a complex issue that</li> </ul>	<ul style="list-style-type: none"> <li>• Dense grass layers suppress germination and growth of woody plant seedlings. Woody vegetation thickening is thought to occur when the competitive effect of grasses are regularly removed by cool fires and/or grazing.</li> <li>• Hot fires destroy small woody plant seedlings and in certain situations may reduce or reverse woody vegetation thickening. Repeated fires are sometimes required to increase the effectiveness of control. This</li> </ul>

Threatening Processes	Management Advice	Comments
	requires careful planning and prior research.	<p>technique is not always suitable, and if done incorrectly, may encourage woody vegetation thickening. Careful planning, research and/or consultation with appropriate experts are recommended.</p> <ul style="list-style-type: none"> <li>• La Nina weather cycles may be a good time for hot fires. Avoid hot fires during dry years especially around water sources used by BTFs as dry season refuges.</li> <li>• Fires reduce ground cover, thereby increasing the risk of soil damage and erosion. Weather cycles, topography and soil type should be considered when planning fires.</li> </ul>
Grazing	<ul style="list-style-type: none"> <li>• Identify core habitat for the BTF, <i>eg</i> areas containing early flowering perennial grasses near water and trees and areas where BTF frequently forage and nest. Spell these areas for &gt;12 weeks during the wet season and lightly graze during the dry season (aim for &gt;50% ground cover at the end of the dry season). Ideally, treat areas &gt;200 ha in this manner.</li> <li>• Consider creating BTF habitat in areas that are more convenient from a property management perspective. This could be achieved by installing water sources that are inaccessible to cattle and near suitable grasses and woodlands.</li> <li>• Consider the use of infrastructure to control the impact of livestock in core BTF habitat. Infrastructure can be used to exclude livestock from core habitat (<i>eg</i> fencing or cattle yards) and/or focus grazing pressure in certain areas (<i>eg</i> place lick troughs in densely grassed areas to encourage grazing and create a more open grass layer).</li> </ul>	<ul style="list-style-type: none"> <li>• Seed production by Cockatoo Grass is reduced by defoliation consistent with moderate cattle grazing and the effect may persist for at least two years.</li> <li>• Spelling paddocks during the wet season allows perennial grasses to recover and increases seed production. Ideally spell areas of core BTF habitat at least once in every three years.</li> <li>• Fencing is often the most effective way to manage grazing although fire, lick sheds and water may also be useful.</li> <li>• Wet season spelling promotes maintenance of 3P (palatable, perennial and productive) native grasses, providing benefits for both grazing and BTF habitat.</li> <li>• Pastures managed for BTFs should be near water. Woody vegetation should also occur nearby.</li> <li>• Sections of paddock that contain suitable grasses for BTF, but are remote from water sources can be transformed into suitable habitat by installing water points that are inaccessible (permanently or temporarily) to cattle. Laneways are sometimes suitable areas around which habitat can be created.</li> <li>• Fencing to particular land types (<i>ie</i> similar land types within a single paddock) can encourage even grazing and help manage impacts on BTF habitat. This may also benefit cattle production.</li> </ul>

Threatening Processes	Management Advice	Comments
Weed control	<ul style="list-style-type: none"> <li>Control problem weeds and restrict further spread, <i>eg</i> Lantana (<i>Lantana camara</i>), Chinese Apple (<i>Ziziphus mauritiana</i>), Grader Grass (<i>Themeda quadrivalvis</i>) and Siam Weed (<i>Chromolaena odorata</i>).</li> <li>Prevent exotic pastures from becoming dominant monocultures and dense swards in BTF foraging habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Weed control is a standard practice on most properties, especially pastoral lands.</li> <li>If left uncontrolled, many weeds can become overabundant and degrade BTF foraging habitat.</li> <li>While BTFs may forage on some exotic pasture grasses (<i>eg</i> Sabi Grass), when these grasses are left to form dense swards they degrade BTF habitat by reducing accessibility to seed. Grazing is a tool for managing exotic pasture grasses; however, a diversity of native pasture grasses is preferable to a monoculture of one of two exotic pasture grasses.</li> <li>Avoid burning in landscapes where fire-adapted exotic pasture grasses such as Buffel Grass (<i>Cenchrus ciliaris</i>) or weeds occur. Use grazing or other measures to control these weeds.</li> </ul>
Feral pigs and cats	<ul style="list-style-type: none"> <li>Implement a feral pig and cat control program as per advice from the local and/or State authority.</li> <li>Aim to remove pigs from areas used by BTFs, especially areas containing Cockatoo Grass.</li> <li>Aim to remove cats and potential ambush sites for cats from around water points.</li> </ul>	<ul style="list-style-type: none"> <li>Feral pigs dig up and feed on the bulbs of Cockatoo Grass, thereby destroying the plant.</li> <li>Feral pigs can also destroy smaller waterholes.</li> <li>Cats are known to ambush birds at water troughs.</li> </ul>

### Performance Indicators

- Number of BTFs using property and/or region remains stable or increases over time.
- Early flowering perennial grasses, such as Cockatoo Grass, occur in >25% of 20 randomly-spaced 0.5 m by 0.5 m plots in areas used by BTFs during the early wet season and wet season (November to February). This functional group of grasses is to be dominated by native species.
- At least six different grass species occur in 20 randomly-spaced 0.5 m by 0.5 m plots in areas used by BTFs. At least four should be native.
- In areas not under livestock grazing <20% of the grassy woodlands should receive some cool fire treatment (*ie* patchy burns) in most years. On grazing lands fires are absent or only used to prepare fire breaks and/or treat woody vegetation thickening and/or weeds.
- Extensive and uncontrolled fires do not occur.
- Pig damage evident in <5% of 20 randomly-spaced 0.5 m by 0.5 m plots in areas used by BTFs.

## Objective 2 – Maintain water sources accessible to BTFs near foraging habitat and near woody vegetation

Threatening processes	Management Advice	Comments
Loss of important water source(s)	<ul style="list-style-type: none"> <li>• Manage water extraction to prevent water sources from drying out. Vigilance is especially required during the dry season and during times of drought. Maintain water in rested paddocks.</li> <li>• Manage activities that may increase the volume of sediment entering creeks. This may include excluding or controlling access of stock to creek lines and adjacent areas.</li> </ul>	<ul style="list-style-type: none"> <li>• BTFs require water sources to be within 200 m of and not more than 400 m from foraging and nesting habitat.</li> <li>• Some BTF populations rely heavily on the persistence of one or two permanent water sources.</li> <li>• Water sources can be used to manipulate the distribution of BTFs in a landscape. As per advice in Objective 1 grazing should be excluded and/or reduced around water sources (eg fence-out livestock or place water point above cattle height).</li> </ul>
Decrease in availability/accessibility of an important water source	<ul style="list-style-type: none"> <li>• As above.</li> </ul>	<ul style="list-style-type: none"> <li>• Unlike some birds, BTFs drink by sucking from the water surface.</li> <li>• BTFs will drink from artificial water sources such as dams, cattle troughs and overflow pipes if suitable perches are available for the latter.</li> <li>• Consider BTFs when upgrading, retrofitting or installing new water sources.</li> </ul>
Contamination of an important water source.	<ul style="list-style-type: none"> <li>• Avoid activities that pose a contamination risk to water sources used by BTFs.</li> </ul>	<ul style="list-style-type: none"> <li>• Less likely to be an issue in grazing systems.</li> <li>• More relevant to other land uses such as mining.</li> </ul>

### Performance Indicators

- BTFs using water sources.
- Water sources are located within 200 m of and not more than 400 m from foraging habitat and near woody vegetation.

### Objective 3 – Maintain tall woody vegetation near foraging habitat and water

Threatening processes	Management Advice	Comments
Loss of all or a majority of native woody vegetation due to clearing	<ul style="list-style-type: none"> <li>• Preserve native trees and tall shrubs in areas used by BTFs.</li> <li>• Aim for an open woodland vegetation structure with a sparse shrub stratum.</li> </ul>	<ul style="list-style-type: none"> <li>• Trees and tall shrubs provide nesting sites for BTFs and shelter for cattle.</li> </ul>
Lack of recruitment into tree layer	<ul style="list-style-type: none"> <li>• If recruitment is not occurring naturally, replant and maintain native trees until established.</li> </ul>	<ul style="list-style-type: none"> <li>• Seedlings and saplings of trees and tall shrubs are required to replace older trees once they die.</li> <li>• A lack of younger trees is a sign that supplementary planting may be required and/or that management might be required to reinstate or encourage natural regeneration.</li> </ul>
Woody vegetation thickening	<ul style="list-style-type: none"> <li>• Refer to previous advice regarding woody vegetation thickening (see Objective 1).</li> </ul>	<ul style="list-style-type: none"> <li>• Refer to previous advice regarding woody vegetation thickening (see Objective 1).</li> </ul>

#### **Performance Indicators**

- Number of BTFs nesting on property or in region remains stable or increases.
- Tree canopy remains open (crowns do not overlap) and shrub stratum remains sparse (crowns well separated).

## 5. References

- Accad, A, Neldner, V.J, Wilson, B. A, & Niehus, R.E. 2008. Remnant Vegetation in Queensland. Analysis of remnant vegetation 1997-1999-2000-2001-2003-2005, including regional ecosystem information. Queensland Herbarium, Environmental Protection Agency, Brisbane.
- Ash, A., Corfield, J. & Ksikisi, T. The Ecograzed Project: developing guidelines to better manage grazing country. CSIRO, Queensland Government and Meat and Livestock Australia.
- Andrew, M.H. & Lange, R.T. 1986. Development of a new piosphere in arid chenopod shrubland grazed by sheep. 1. Changes to the soil surface. *Australian Journal of Ecology* **11**: 395-409.
- Barnard, C.A. 1925. A review of the bird life on Coomooboolaroo Station, Duarina district, Queensland, during the past fifty years. *Emu*, **24**: 252-265.
- Bravery, J.A. 1970. Birds of the Atherton Shire, Queensland. *Emu* **70**: 49-63.
- Crowley, G. M. & Garnett, S.T. 2001. Growth, seed production and effect of defoliation in an early flowering perennial grass, *Alloteropsis semialata* (Poaceae), on Cape York Peninsula, Australia. *Aust. J. Bot.* **49**: 735-743.
- Crowley, G.M, Calnan, T., Seabrook, W. & Hokkanen, R. 2007. *Healthy Country Indicator Species for Cape York Peninsula*. Tropical Savannas CRC.
- Crowley, G.M., Garnett, S.T. & Shephard, S. 2004. *Management guidelines for golden-shouldered parrot conservation*. Queensland Parks and Wildlife Service, Brisbane.
- Dyer, R., Jacklyn, P., Partridge, I., Russell-Smith, J. & Williams, R. 2001 *Savanna Burning: understanding and using fire in northern Australia*. Tropical Savannas CRC, Darwin.
- 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. Whitehead, P.J., Pardon, G., Mathews, J., MacMahon, P. & McIntyre, D. 2005. Geographic patterns and correlates of the decline of granivorous birds in northern Australia. *Wildlife Research* **32**, 399-408.
- Garnett, S. (ed) 1993. *Threatened and Extinct Birds of Australia*. RAOU Report Number 82. Royal Australasian Ornithologists Union and Australian National Parks and Wildlife Service.
- Garnett, T. S. & Crowley G. M. 2000. *The Action Plan for Australian Birds 2000*. Commonwealth of Australia.
- Higgins, P.J, Peter, J.M. & Cowling, S.J (eds). 2006. *Handbook of Australian, New Zealand and Antarctic birds. Vol. 7. Boatbill to starlings. Part B: Dunnocks to starlings*. Oxford University Press, South Melbourne.
- Isles, N.L. 2007. Patterns of Foraging Behaviour of the Black-throated Finch during Breeding Season. Honours thesis, James Cook University of North Queensland, Townsville.
- Karfs, R., Holloway, C., Pritchard, K. & Resing, J. 2009. Land Condition Photo Standards for the Burdekin Dry Tropics Rangelands: a guide for practitioners. Burdekin Solutions Ltd and Queensland Department of Primary Industries and Fisheries, Townsville.

- Landsberg J., James, C.D., Morton, S.R. Hobbs T.J., Stol, J., Drew, A. & Tongway, H. 1997. *The Effects of Artificial Sources of Water on Rangeland Biodiversity*. Final report to the Biodiversity Convention and Strategy Section of the Biodiversity Group, Environment Australia. CSIRO Division of Wildlife and Ecology, January 1997.
- Lange, R.T. 1969. The piosphere: sheep track and dung patterns. *J. Range Management*. **22**: 396-400.
- Ley, A.J. & S.M. Cook 2001. The Black-throated Finch *Poephila cincta* in New South Wales. *Australian Bird Watcher*. **19**:115-20.
- Maute, K. *in prep*. The effects of different land management on the health and survival of seed-eating birds. Ph D thesis, University of Wollongong.
- Mitchell, D.F. 1996. Foraging Ecology of the Black-throated Finch *Poephila cincta cincta*. MSc thesis, James Cook University of North Queensland, Townsville.
- NRA. 2005a. Enertrade North Queensland Gas Pipeline –BTF Studies (Post-construction). Report prepared by NRA Environmental Consultants for Enertrade.
- NRA 2004a. North Queensland Gas Pipeline Project: Assessment of Impacts on the Black-throated Finch from the Clearing of Four Areas. Report prepared by NRA Environmental Consultants for Enertrade, 5 May 2004.
- NRA 2004b. Follow-up Black Throated Finch Investigations at Upper Ross River. Letter Report prepared by NRA Environmental Consultants for Enertrade, 16 June 2004.
- NRA 2004c. Black Throated Finch Surveys: Section 1 to Section 4 of Significant Area Plan. Five Letter Reports prepared by NRA Environmental Consultants for Enertrade.
- NRA 2005b. Results of Black-throated Finch Monitoring During the Construction of the Upper Ross River Crossing. Letter Report prepared by NRA Environmental Consultants for Enertrade, 3 February 2005.
- NRA 2005c. Black-Throated Finch Survey and Assessment: Proposed Ross-Townsville South Transmission Line. Report prepared by NRA Environmental Consultants for Powerlink.
- NRA 2005d. Waterway Gardens: Threatened Species Survey and Assessment. Report prepared by NRA Environmental Consultants for Stockland Development Pty Ltd.
- NRA 2005e. Waterway Gardens: Black-throated Finch and Striped-tailed Delma Management Plan. Report prepared by NRA Environmental Consultants for Stockland Development Pty Ltd.
- NRA 2006a. Distribution of Black-throated Finch Habitat in the Townsville-Thuringowa Local Government Areas – A Predictive Model. Report prepared by NRA Environmental Consultants for Enertrade and the Department of Environment and Heritage, October 2006.
- NRA 2006b. Review of the Status of the Black-throated Finch at Waterway Gardens. Report prepared by NRA Environmental Consultants for Stockland Development Pty Ltd.
- NRA 2007a. Review of the Ecology, Threats and Management Requirements of the Black-throated Finch (*Poephila cincta cincta*) to Support Assessment Process Under the *Environment Protection and Biodiversity Conservation Act 1999*. Report prepared by NRA Environmental Consultants for Department of Environment, Water, Heritage and the Arts.
- NRA 2007b. Flora and Fauna Investigation Stoney Creek to Veales Road, Bruce Highway, Townsville. Report prepared by NRA Environmental Consultants for Maunsell Australia Pty Ltd on behalf of Queensland Department of Main Roads.
- NRA 2007c. Flora and Fauna Investigation: Waterway Gardens Intersection Assessment - Section of Bruce Highway Extending One Kilometre West of Bohle River, Townsville.

Report prepared by NRA Environmental Consultants for Maunsell Australia Pty Ltd on behalf of Queensland Department of Main Roads.

NRA 2007d. Flora and fauna assessment of the route of the proposed Brookhill Reservoir supply main and the proposed Toonpan water treatment plant site. Report prepared by NRA Environmental Consultants for Maunsell Australia on behalf of NQ Water.

NRA 2007e. Survey and Assessment of the Black-throated Finch (*Poephila cincta cincta*) at the Chisholm Trail Rural Residential Development, Townsville. Report prepared by NRA Environmental Consultants for Department of Environment and Water Resources.

NRA 2007f. Black-throated Finch (*Poephila cincta cincta*) Survey and Assessment along a section of the proposed Ross to Yabulu South Transmission Line. Report prepared by NRA Environmental Consultants for Powerlink Queensland.

NRA 2008. Black-throated Finch Survey and Assessment. Ross River Dam – Strathmore Substation. Report prepared by NRA Environmental Consultants for Powerlink Queensland.

NRA 2008. MSTA Fauna Update Project (NQ1807 2007/08). Mount Stuart Training Area, Townsville. Report prepared by NRA Environmental Consultants for the Department of Defence.

NRA 2009a. Oak Valley Truck Stop – Black-throated Finch (*Poephila cincta cincta*) Assessment. Report prepared by NRA Environmental Consultants for Queensland Department of Main Roads.

NRA 2009b. Assessment of Potential Impacts on the Black-throated Finch (*Poephila cincta cincta*): Sections of the Proposed North Shore Boulevard and Wastewater Upgrade Projects within the North Shore Multipurpose Development. Report prepared by NRA Environmental Consultants for Maunsell Pty Ltd, 8 January 2009.

NRA 2009c. Black-throated Finch (*Poephila cincta cincta*) Monitoring at North Shore, Townsville - Summary of 2007/08 Monitoring Program. Report prepared by NRA Environmental Consultants for Stockland Pty Ltd, 14 January 2009.

NRA 2009d. Black-throated Finch (*Poephila cincta cincta*) Monitoring at North Shore, Townsville - Summary of 2007/08 Monitoring Program. Report prepared by NRA Environmental Consultants for Stockland Development.

NRA 2009e. Distribution of Potential Nesting Habitat for the Black-throated Finch (*Poephila cincta cincta*) in the Townsville Local Government Area – A Predictive Model. Report prepared by NRA Environmental Consultants for the Black-throated Finch Trust.

NRA 2009f. Flora, Fauna and Soils Assessment to Support Development Application (Reconfiguring a Lot) on Lot 3 EP1372 and Part of Lot 40 EP1309, Pinnacles, Townsville. Report prepared by NRA Environmental Consultants for Wolter Rowlands on behalf of Laudham Park Trading.

NRA 2010. Response to Information Request from the Department of Sustainability, Environment, Water, Population and Communities Regarding Threatened Fauna and the Construction and Operation of a Marine Armour Stone Quarry on Lots 9 and 12 E124175, Townsville. Report prepared by NRA Environmental Consultants for Port of Townsville Limited.

NRA 2011. Impact Assessment of Alternative Haul Route for the Proposed Stone Quarry on Lots 9 and 12 E124175, Townsville. Report prepared by NRA Environmental Consultants for Port of Townsville Limited.

Reid, J. & Fleming, M. The conservation status of birds in arid Australia. *The Rangeland Journal* **14** (2): 65–91.

Smedley, J.H. 1904. Finches in northern Queensland. *Emu*. **4**:68-69.

TSSC (Threatened Species Scientific Committee). 2005. *Commonwealth Listing Advice on Southern Black-throated Finch (Poephila cincta cincta)*.

Woinarski, J., Fensham, R., Whitehead, P. & Fisher, A. 2000. *Rangelands Monitoring: Developing an Analytical Framework for Monitoring Biodiversity in Australia's Rangelands. Background paper 1. A Review of Changes in Status and Threatening Processes*. A report to the National Land & water Resources Audit by Tropical Savannas CRC, October 2000.

Vanderduys, E., Kutt, A. & Emonds, J. 2009. *Healthy Grazing Country Indicators: Native Plants and Animals*. NQ Dry Tropics, Townsville.

Woinarski, J.C.Z. & Catterall, C.O. 2004. Historical changes in the bird fauna at Coomooboolaroo, northeastern Australia, from the early years of pastoral settlement 1873 to 1999. *Biological Conservation* **116**: 379-401.

Zann, R. 1976. Distribution, status and breeding of Black-throated Finches *Poephila cincta* in northern Queensland. *Emu* **76**:201-206.