Southern Gulf NRM

FIRE MANAGEMENT *for the Carpentarian Grasswren*

PHASE ONE PROJECT REPORT

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Southern Gulf NRM

Contents

The tiny Carpentarian Grasswren is found only in Australia's Gulf country. This iconic bird lives in the rocky ranges north and west of Mount Isa. It nests in spinifex clumps and pecks about on the ground feeding on seeds and insects. It is so shy, that only recently did the bird's rarity become apparent.

In recent decades, wildfires have destroyed vast areas of the Carpentarian Grasswren's habitat. The grasswrens only persist in areas of old growth spinifex that have escaped burning. The remaining small population of birds is now restricted to an area between Cloncurry and the Northern Territory border. Wildfire prevention is needed to ensure this bird's future.

Southern Gulf NRM is working with local and regional partners to expand pro-active fire management practices across the grasswren's habitat to reduce the risk of widespread wildfire in the future. Phase one of this project has been funded by the National Landcare Program and Glencore's Community Program North Queensland.

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Continuation of this work in coming years will produce a patchy mosaic of old and new spinifex, retarding the spread of wildfires, and hence protecting valuable grasswren habitat.

Overview

The Southern Gulf region contains the majority of the habitat of the nationally endangered Carpentarian Grasswren. This small bird lives in long-unburnt spinifex, so is vulnerable to habitat loss from the extensive wildfires that sweep through the landscape every few years. When the Carpentarian Grasswren was listed as nationally endangered in early 2016, Southern Gulf NRM moved quickly to establish broadly-based partnerships to address the fire threat to the species and restore habitat to a condition required for its recovery. Phase One of the Carpentarian Grasswren Project, which ran from 2016 to mid-2018, was established with funding from the Australian Government's National Landcare Program. In early 2017, Glencore generously provided additional funding for the project under the Community Program North Queensland, administered through the locally-based Mount Isa Mines Limited.

The overarching objective of the project has been to secure the Carpentarian Grasswren's future by promoting the persistence of old-growth spinifex needed for the species' survival. Phase One has focused on the Buckley River Key Biodiversity Area (KBA), just north of Mount Isa, which is recognised as the species' stronghold. The Kalkadoon People are both the landholders and Traditional Owners of Calton Hills station, which covers the majority of this KBA, and are key to on-ground management for the species. With the assistance of Southern Gulf NRM and fire management professionals, Calton Hills staff have started to reduce wildfire risks to both the grasswren and the property's pastoral assets. In 2017, they participated in fire management training and the development of a property-scale fire management plan. After the first heavy rains in 2018, patchy burns were lit across areas of the heaviest grass growth on the property, as an initial step towards breaking up the extensive single-age fuel load. Continuation of this work in coming years will produce a patchy mosaic of old and new spinifex, retarding the spread of wildfires, and hence protecting valuable grasswren habitat.

Southern Gulf NRM and local landholders are also providing support to BirdLife Northern Queensland to continue annual grasswren surveys that they commenced in 2008. Results from these surveys have been critical for identifying the perilous status of the species, and will help track the grasswren's path to recovery. So far, these surveys have increased the grasswren's known distribution to include the eastern part of Calton Hills station, and demonstrated that the grasswren can still be found across much of the property.

Numerous partners have contributed to the project's developmental phase, creating a sound platform for sustainable fire management to be adopted throughout the region. Southern Gulf NRM is grateful for the enthusiastic support received throughout Phase One, and acknowledges the contribution partners and other stakeholders have made to the project's success.

Calton Hills Station
Australian Department of Environment and Energy
Kalkadoon Prescribed Body Corporate
Glencore
Friendly Fire Ecological Consultants
Mount Isa Mines Limited
BirdLife Northern Queensland
BirdLife Southern Queensland
Firescape Science
Norman Wettenhall Foundation
Adaptive NRM
North Line Copper
Queensland Fire and Emergency Services
Bush Heritage Australia
Queensland Department of Environment and Science
BirdLife Australia
Queensland Parks and Wildlife Service

Acknowledgements

Traditional Owners
Southern Gulf NRM takes this opportunity to acknowledge the Kalkadoon community as Traditional Owners of the project area and to offer our respect to Kalkadoon Elders, past and present. We honour the deep spiritual, cultural and customary connections of the Kalkadoon community to the landscape and look forward to their growing and influential role in natural resource management.

In addition to the organisations identified in this report, Southern Gulf NRM wishes to acknowledge the following people that have assisted with the development and delivery of the project.

Project development
- Gabriel Crowley (Fire Scape Science)
- Katherine Ivansson (Department of Environment and Energy)
- David Weir (Department of Environment and Energy)
- Mary Ann Wipaki (Glencore)
- Jemma Schweikert (Glencore)

Grasswren survey coordination
- Graham Harrington (BirdLife Northern Queensland)
- Kath Shurcliff (BirdLife Northern Queensland)
- Paul Thompson (BirdLife Northern Queensland)
- Ceinwen Edwards (BirdLife Northern Queensland)
- Kayler Plant (Southern Gulf NRM)

Burn program implementation and support
- Peter Edmonds (Calton Hills Station)
- Gavin Fryar (QFES)
- Rob Woodward (QFES)
- Steve Murphy (Adaptive NRM)
- Mick Blackman (Friendly Fire Ecological Consultants)
- Gaven Bunker (Mount Isa Rural Fire Service)
- Ron Croft (Spinifex Fire Warden)
- Kayler Plant (Southern Gulf NRM)

Legacy Planning
- Gabriel Crowley (Fire Scape Science)
- Kayler Plant (Southern Gulf NRM)

Background

The Carpentarian Grasswren - A unique species of northern Australia

The Carpentarian Grasswren (*Amytornis dorotheae*) is a small but striking brown and white bird with a moderately long tail that it flicks erect in a cheeky display [1]. Adults are between 16 and 17.5 cm long and weigh between 21 and 25 grams. A member of the Magnamytis subgroup within the genus *Amytornis*, the Carpentarian Grasswren has only one close relative, the White-throated Grasswren (*Amytornis woodwardi*), which is found in western Arnhem Land [2]. The other four members of this subgroup live in isolated populations across the arid inland. Although they have distinct plumage and habitat preferences, these grasswrens have only recently differentiated into identifiable species [2].

The Carpentarian Grasswren's restricted habitat consists of siltstone ranges and broken plateaux across the Mount Isa Inlier and Gulf Fall and Uplands bioregions [3]. Historically, the species was found between Borroloola in the Northern Territory and Cloncurry in Queensland, an area covering more than 2.8 million hectares (**Figure 1**). However this range has been greatly reduced by large-scale wildfires, hence it is listed as Endangered in Queensland and Northern Territory, as well as at the national level. The species is an important indicator of the health of spinifex habitat across the gulf, as it can only survive where old growth-spinifex persists [4].

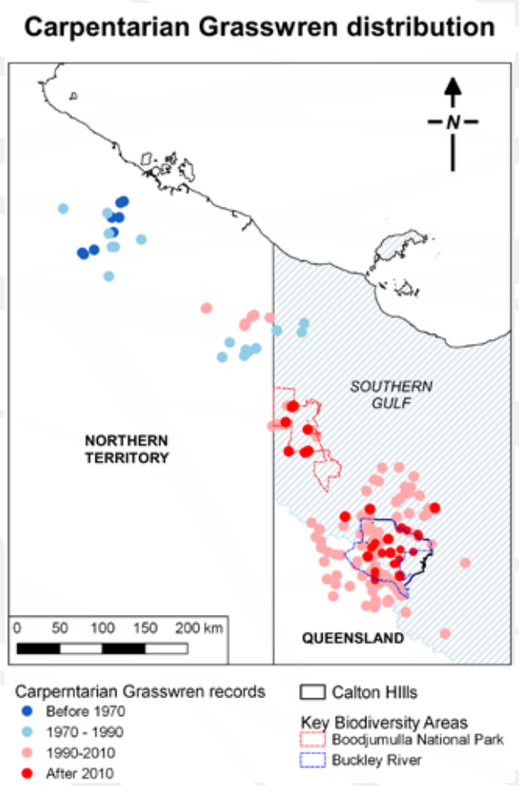


Figure 1. Carpentarian Grasswren records showing contraction of range and importance of Southern Gulf to the species recovery [10, 15, 16, 17]

Bird observers establish threatened species listing

The Carpentarian Grasswren is one of north-west Queensland's most distinctive and high-profile species. The opportunity to sight a Carpentarian Grasswren attracts many birdwatching enthusiasts to Mount Isa every year. It has only been through community concern that the Endangered status of this species was recognised.

As late as 2010, the Carpentarian Grasswren was considered to be no worse than Near Threatened [5], although loss of up to 30% of the species habitat in wildfires was of considerable concern [6, 7]. Assessment of this loss was based on annual surveys by volunteers coordinated by BirdLife Northern Queensland since 2008. Data collected in these citizen-science surveys was subsequently used for re-assessing the species' conservation status [4]. As a result, the Carpentarian Grasswren was nationally listed as Endangered on 5th May 2016, with Queensland following suit in 2017. Listing of this species spurred Southern Gulf NRM to adopt the Carpentarian Grasswren as a focal species for its biodiversity conservation program.

Wildfire threat to critical habitat

The Carpentarian Grasswren undoubtedly evolved under a patchy fire regime [4] produced under Indigenous land management [8]. Fire management by Traditional Owners in the region ensured that small patches of spinifex were burnt regularly, creating a mosaic of clumps of different post-fire ages. If one clump was burnt, the fire could only spread a small distance before it reached a patch where the spinifex was too sparse to carry fire, and so went out.

In and around Calton Hills, spinifex typically takes four to five years of growth before it will carry fire [9]. So, it is possible to establish a healthy mosaic of old-growth and young spinifex clumps by burning small patches that cover up to 20% of the landscape every year.

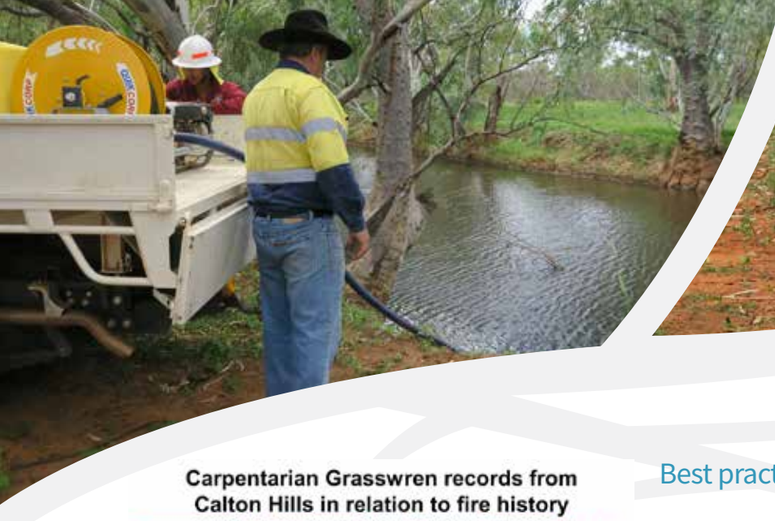
In the absence of traditional fire management, increased fire intensity and frequency have devastated habitat for the species, particularly in the northern part of its range. As a result, the area currently occupied by the grasswren is only two thirds that of its original extent, and is almost entirely restricted to Queensland [4]. Three quarters of all Carpentarian Grasswren sightings recorded since 2010 have been from Calton Hills Station [10], whose importance as the stronghold for the species is recognised in its designation as the Buckley River Key Biodiversity Area [11].

Spinifex-dependent fauna

Many species depend on old-growth spinifex for food and shelter, so fire management benefits a range of biodiversity values. Establishing a fine-scale mosaic of spinifex clumps is particularly important for additional threatened species.

- Gouldian Finch (*Erythrura gouldiae*)[12] – listed as Endangered both nationally and in Queensland
- Carpentarian Antechinus (*Pseudantechinus mimulus*)[13] – listed as Vulnerable nationally
- Purple-necked Rock-wallaby (*Petrogale purpureicollis*)[14] – listed as Vulnerable in Queensland

The Carpentarian Grasswren's persistence in and around Calton Hills can be attributed to the persistence of large areas of unburnt spinifex. Nevertheless, wildfires that destroyed about one-third of the species' habitat throughout its range in 2011 and 2012 [4] also destroyed the ground layer vegetation across 58% of Buckley River IBA and 55% of Calton Hills (Figure 2). Therefore active intervention is required to prevent the grasswren's disappearance from its stronghold.



Carpentarian Grasswren records from Calton Hills in relation to fire history

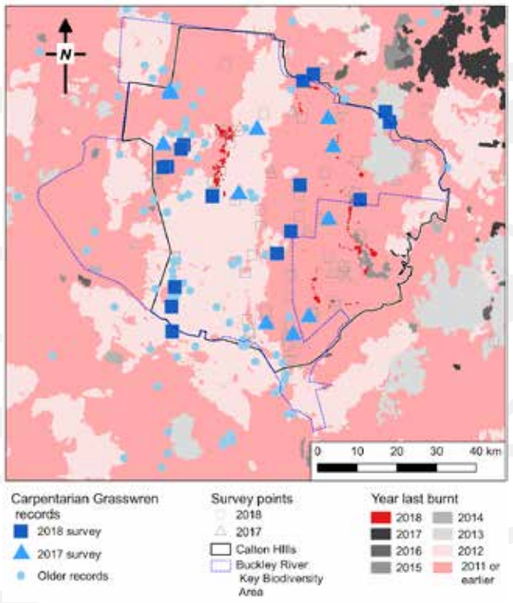


Figure 2. *Carpentarian Grasswren records in relation to fire history across Buckley River Key Biodiversity Area and Calton Hills* [10, 16, 17, 18].

Wildfire extent is largely a function of climatic conditions. As well as the annual cycle of monsoon rains, the region experiences longer cycles of periodic deluges and crippling droughts. These alternating periods of high and low rainfall produce high fuel loads during wet conditions followed by periods of high fire danger dry conditions, in which wildfires can spread over thousands of square kilometres [19]. Climate change is expected to increase both the severity and extent of wildfires in the Southern Gulf region by increasing both the intensity of wet periods, and the length and severity of dry periods [20]. The type of fires that occurred in 2011 and 2012 could therefore become a frequent occurrence. If this were to happen, the species could also be eliminated from its recognised stronghold. Fire management in and around Calton Hills will therefore become increasingly important through time.

Best practice fire management for spinifex

The methods for reducing the severity and extent of wildfires in spinifex within the grasswren's range are well understood and are more-generally recognised as best practice fire management for maintaining biodiversity health [21]. A patchy fire mosaic impedes the spread of wildfires by breaking up the fuel load [22]. Spinifex grows in clumps that are reduced to ground level by fire, and then slowly regrow over a number of years. Unburnt patches allow fire sensitive animals to persist in a burnt landscape by providing refugial habitat from which species can recolonise adjacent burnt areas as these regrow [23]. In a landscape that has been denuded by a widespread wildfire, most of the fuel layer will recover at the same time. It can be difficult to get a fire to carry in the first few years after such a fire, but difficult to stop any fires from spreading in subsequent years once uniform heavy grass cover has re-established. Active fire management is therefore needed to ensure that the whole landscape is not lost again in a single fire, and usually mean burning when the fuel is moist, just after wet season rains [19].

This can be achieved by:

- ensuring the area to be burnt is surrounded by burnt and or dozed fire-breaks and natural barriers (such as active streams or moist vegetation)
- using aerial incendiaries to achieve patchy mild-intensity fires, limiting canopy scorch [24, 25].
- using spot- rather than line-ignitions [26, 27, 28]

A patchy fire mosaic can rarely be established with a single burn or within a single year, but requires persistence over a number of years [29, 30]. Annual follow-up burn programs are required, with each patch being burnt at a three to five year interval, before fuel accumulation in the surrounding patches reaches dangerous levels. However, once established reduced effort is required to maintain the mosaic.

Carpentarian Grasswren Fire Management Project – ***PHASE 1***

Throughout Phase One of the project, Southern Gulf NRM aimed to improve the biodiversity condition of Carpentarian Grasswren habitat by:

- Building the capacity of the Southern Gulf community to manage fire through training and on-ground mentoring
- Supporting fire management implementation throughout 300,000 hectares of Calton Hills Station
- Developing regional fire management to protect conservation and pastoral values
- Supporting the ongoing Grasswren surveys organised by BirdLife Northern Queensland
- Ensure ongoing support for fire management in the region through legacy planning

Achievements in each of these areas are described below.

Building adaptive capacity and resilience

Southern Gulf NRM identified the need to build fire management capacity before on-ground work for Carpentarian Grasswren recovery could begin. While some of the region's landholders are members of local fire brigades and manage fire as an integral part of their property management, others do not have the required skills or confidence. This is particularly the case for land managers who are new to the region, and may have developed their approached to fire management under different conditions. Hence, the core objective of this capacity building is to assist land managers to:

- acquire an awareness and understanding of how fire can be effectively managed
- develop the skills, experience and confidence to burn effectively to achieve specific outcomes and to prevent fires getting out of control
- obtain the necessary safety and fire-fighting equipment and the competence to use them correctly
- fulfil their legal obligations [31]
- collaborate with adjoining land holders
- undertake continual reassessment of objectives, actions and outcomes for property bases fire management

Staff at Calton Hills station saw benefit in participating in such a program, and Southern Gulf NRM identified other land managers with similar needs. Queensland Fire and Emergency Services (QFES) was already holding regular fire management training and regional planning groups, and agency staff were keen to assist in the project. In 2017, they provided foundational fire training through the Mount Isa Rural Fire Brigade. Their nationally accredited course included six modules covering use of communications equipment; occupational health and safety; wildfire response; injury prevention; team work; and maintenance of fire-fighting equipment. Course participants included personnel from Calton Hills and neighbouring mining and pastoral properties, as well as Southern Gulf NRM staff. All 16 participants became volunteers for their local Rural Fire Brigade and either the Mount Isa or Spinifex Regional Fire Management Group. They will also benefit from ongoing training and support, and insurance cover and workers compensation during permitted burn operations.

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The ongoing partnership developed between Southern Gulf NRM and QFES aims to increase participation in fire management training beyond the current focal area. The knowledge and skills the landholders acquire should benefit a range of threatened species across the region, including the Carpentarian Grasswren, as well as the productivity of pastoral operations.

On-ground mentoring was also provided to Calton Hills staff by Friendly Fire Ecological Consultants during fire management operations in early 2018. The experience station staff gained in these exercises should improve their confidence in undertaking future prescribed burn programs.

Preparation for burning

There was much preparation to be done before fire management could be undertaken on Calton Hills station. Fuel loads needed to be assessed to identify where to focus fire management effort; property assets and access routes needed to be identified, and equipment sourced; fire breaks needed to be upgraded; and approval for fire management needed to be obtained from neighbouring landholders. Meanwhile, the location of grasswrens needed to be determined (see *BirdLife Northern Queensland grasswren surveys*). All these considerations went into a fire management plan for Calton Hills that was to be delivered in three stages, and formed the basis of acquiring a permit to burn from QFES. The first stage – a demonstration of aerial control burning – was to be undertaken in the 2016/17 wet season. The main aim of this demonstration burn was to instil confidence in the Calton Hills board of management and other stakeholders that the team had the necessary skills to manage fire according to plan, and not burn out the next year's pasture, or the neighbouring properties. The second and third stages were to be undertaken in the following wet season, and involved first securing the property boundaries from the ground to prevent fires escaping beyond target areas, followed by using aerial burning to start breaking up the spinifex fuel layer.

Best practice fire management for pastoral values

Good fire management for biodiversity protection in spinifex country also makes sense for protection of pastoral values. The last thing a pastoralist wants is to lose large areas of forage in a single fire. Breaking up the fuel load to protect grasswren habitat ensure continuity of feed for grazing animals. This reduces the need to hand-feed or offload cattle after fires. Burning pasture in patches across the property can also enhance its nutritional value and help spread grazing pressure as animals are attracted to the new growth that sprouts after fires.

Initial fuel load assessments for Calton Hills were undertaken by Adaptive NRM and Friendly Fire Ecological Consultants in collaboration with station management in March 2017. These assessments indicated that a lack of prescribed burns since the 2011 and 2012 wildfires had left the property with extensive stands of old-growth spinifex, but that a run of dry seasons since these fires had meant the fuel load was lower than expected [32]. This reduced the urgency of burning in the 2016/17 wet season. This was fortunate, because almost complete failure of wet season rains restricted the window in which burning could be undertaken safely. Much of this window was taken up in negotiations and deliberations about fire operations. In the end, all project partners considered that the risk of the demonstration burn turning into a wildfire posed a greater threat to both biodiversity and pastoral assets than did leaving the fuel to accumulate for another year. So the decision was made not to undertake the demonstration burn, but to focus on on-ground preparation and improving management capacity instead.

During the lead up to the 2017/18 wet season, Calton Hills management undertook an enormous amount of work preparing the property for the coming fire season by grading station roads to improve their effectiveness as fire breaks and access tracks, as well as selectively grazing areas to reduce the risk of fire escaping Calton Hills along the western boundary [33]. These efforts also reduced the risk of any wildfire entering the property and threatening grasswren habitat. In addition, fire-lighting and response equipment was purchased and loaned from QFES. A slip-on unit was purchased using Glencore funding to assist in building the local capacity to mitigate wildfire risk and also implement prescribed burn programs.

The other important preparatory activity was to engage neighbouring landholders to ensure they understood the project's objectives and had confidence in its successful delivery. In turn, these landholders provided the project team with valuable insights into fire behaviour in the local landscape, and particular risks to avoid. Their general advice was that burning should take place only after widespread rain, when there had been minimum falls of 150 mm 33. As a result of this engagement, neighbouring land-holders were supportive of the project, and some were motivated to participate in the fire training activities described in the previous section (see *Building adaptive capacity and resilience*).

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Burning commences

By the end of 2017, the neighbours were on board; all on-ground preparation had been completed; the grasswren's habitat and priority areas for fuel reduction identified; and the necessary permit had been obtained. The decision had been made to focus burning on the high fuel load areas scattered through the station, as these presented the highest high risk for fire spread in the event of a wildfire. Breaking up this fuel load would assist the landholders to suppress any wildfire that did occur in the near future. In the longer term, this burning would provide the foundations for establishing a complex mosaic of spinifex clumps that should prevent wildfire spread with minimal further intervention.

Despite the promise of an early 2017/18 wet season, Calton Hills and surrounding areas received only scattered falls up until early March. When the monsoonal break occurred, it lasted only a week [34]. So, again, the window of opportunity to burn safely was short, but this time the advance preparations paid off, and the fire team was ready to go. Nevertheless – given the weather conditions were still not optimal – the consensus was to take a conservative approach. In all, 2,333 ha of spinifex was burnt across the property, predominately by using incendiaries dropped from a helicopter to produce a series of over 300 separate burn scars. A subsequent fly-over to inspect these burns indicated that their intensity had been mild, leaving tree canopies intact, and that refuge areas of old-growth spinifex clumps had been retained within most fire scars. These clumps will be essential for the persistence of fire-sensitive fauna on Calton Hills. The Carpentarian Grasswrens and other animals sheltering in them should be able to recolonise recovering spinifex habitat as the surrounding burnt patches regrow [33].

BirdLife Northern Queensland grasswren surveys

A key aspect of the project is to understand where the Carpentarian Grasswrens live, and whether the burning program's aim of promoting the species' recovery is being achieved. Working this out for such secretive birds requires a rigorous monitoring program (see *Grasswren survey techniques*). Their long history of undertaking grasswren surveys made BirdLife Northern Queensland an essential partner in this project. Indeed, without their surveys, the precarious plight of the Carpentarian Grasswren would never have been realised. So, at Southern Gulf NRM's request, BirdLife Northern Queensland refocused their survey effort to identify key areas of grasswren habitat on previously unsurveyed areas of Calton Hills in 2017, and to assess the impact of burning in 2018. Data from these surveys is also building a picture of the species' relationship with spinifex at different post-fire stages.

Value of the permit system

In Queensland, a 'Permit to Light Fire' is required for all fires lit for landscape management. The preparation needed before a permit can be issued – and the conditions imposed on how the fire is to be managed – help to ensure that fire is used safely and responsibly, minimising any risks to people, property and environmental values. Lighting a fire without a permit – or not adhering to permit conditions – can attract serious penalties, including on-the-spot fines or prosecution. In the event a fire does cause loss, injury or damage, as long as permit conditions have been followed correctly, those responsible for the fire are protected against prosecution.

2017 survey

Calton Hills had been included in previous surveys, but limited access across its rugged terrain had restricted survey efforts to the western side of the property. Initial aerial assessments conducted as part of the fire management project indicated that suitable Grasswren habitat also occurred in the inaccessible extents in central and eastern parts of the property [32]. As a result, the objective of the 2017 survey was to establish if Carpentarian Grasswrens were present throughout the eastern side of Calton Hills.

Nine birders from north Queensland and interstate visited as much of the property as possible over a 10 day period in June 2017. They found grasswrens at a total of 12 locations (Figure 2). As well are establishing the persistence of the grasswrens at previously surveyed sites, they encountered Carpentarian Grasswrens at six sites in areas that had not previously been surveyed. The species' scattered presence throughout the property should provide insurance against any wildfire, so will aid in the recovery of the population through subsequent breeding events [16].

Grasswren survey techniques

Even the most experienced birders consider themselves lucky to catch a glimpse of the Carpentarian Grasswren. The shy nature of the species makes recognition of its call an essential tool for determining the grasswren's whereabouts. Even so, while sighting the bird or hearing its call confirms the species' presence, lack of calls and sightings does not mean grasswrens are not there. Hence surveys alone cannot be used to assess either distribution or population size [16]. To overcome this problem, Adaptive NRM has been trialling sound recorders that can be left in the field for several months. Even a single call picked up by these recorders can be used to confirm that the grasswrens are present in an area; and more frequent calls can be used to assess habitat quality for this secretive bird.

2018 survey

With the help of 19 volunteers, BirdLife Northern Queensland increased their survey efforts on Calton Hills in 2018. As well as aiming to confirm the Carpentarian Grasswren's persistence across the property, the survey was designed to gather about the grasswren's dependence on old-growth spinifex. The volunteers would therefore be sent to look for grasswrens in spinifex of different post-fire age classes. These classes were identified using mapping software to overlay access tracks on mapped fire histories; and at least 20 survey sites were randomly selected along sections of track that intersected with each age class.

This time, the volunteers confirmed the presence of Carpentarian Grasswrens at 17 locations on – or adjacent to – Calton Hills (Figure 2). As in previous surveys, Carpentarian Grasswrens were found in spinifex patches that were at least four years old [17]. Beyond this, it is too early to establish any relationship between number of birds and age of spinifex clumps, but these should become apparent as data are gathered in subsequent surveys. Grasswrens were not found in the small patches that were burnt earlier in the year – either before or after the fires – but they were found nearby. As these patches regrow, they could therefore provide important refuges for the grasswrens should a future wildfire burn the surrounding areas.

REGIONAL *collaboration*

At the same time as supporting on-ground fire management efforts on Calton Hills, the project team has been working towards improving fire management across the region in collaboration with QFES, the State's lead fire agency, and other regional stakeholders. This includes working in consultation with the Queensland Parks and Wildlife Service (QPWS), which is actively managing Carpentarian Grasswren habitat on Boodjamulla National Park. Their successful establishment of multi-aged spinifex habitat (Figure 3) is a great accomplishment for the National Park and the region. In total, the efforts of the region's land managers, including Traditional Owners, pastoralists, miners and QPWS, is contributing to Southern Gulf NRM's vision of best practice fire management across 2,580,000 ha of Carpentarian Grasswren habitat as outlined in the following section (see *Project Legacy*).

Regional Fire Management Groups

Through its Rural Fire Service, QFES has established a network of regional Fire Management Groups (FMGs) to facilitate a cooperative approach to fire management across property boundaries. Southern Gulf NRM has attended and contributed to FMG meetings held at Mount Isa and Adel's Grove. These events have provided a valuable platform for discussing fire management with regional stakeholders and identify ways in which collaborative wildfire mitigation can safeguard both grasswren habitat and pastoral assets. An SG NRM workshop also provided QFES with the opportunity to discuss forming a Spinifex FMG east of Mount Isa.

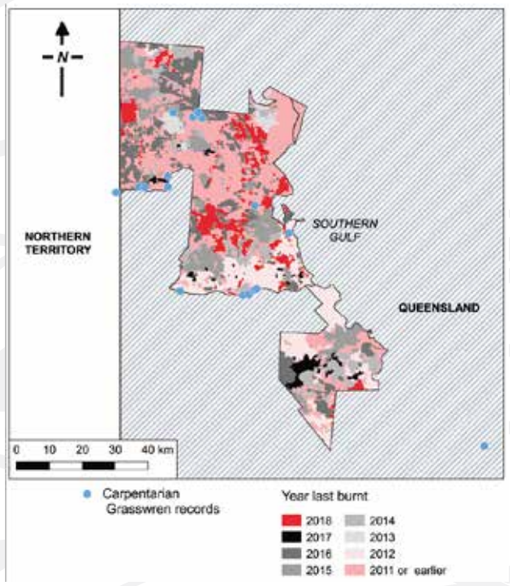

Figure 3 *Age of Spinifex habitat on Boodjamulla National Park in 2018* [18].

Project **LEGACY**

Southern Gulf NRM is committed to securing Carpentarian Grasswren recovery through the species' Queensland entire range. Although Calton Hills is the stronghold of the grasswren population, it lies is at the very south-eastern extent of the species' range. At the north-eastern end lies Boodjamulla National Park, which is also listed as KBA based on its importance to the grasswren. Restoring the Carpentarian Grasswren to its former range will require adoption of best practice fire management across the landscape between Calton Hills and the national park. Southern Gulf NRM's vision is therefore to establish a 2,580,000 ha corridor of best practice fire management for recovery of the Carpentarian Grasswren. Southern Gulf NRM will continue to work with Traditional Owners and other landholders to expand the fire management program from Calton Hills across this corridor.

Securing the Grasswren's future in Queensland is not only ambitious in terms of the area to be managed, but will require sustained support over a period long enough to ensure that fire management becomes an integral part of property management. A Legacy Plan has been produced to explore various options to ensure ongoing project support until this can be achieved [35].

A key feature of the legacy project is to expand collaboration with Traditional Owners through Indigenous ranger groups. Native Title exists over almost the entire corridor, and is held by the Waanyi, Indjalandji-Dhidhanu and Kalkadoon peoples, for whom fire management is a high priority [36]. Future project work throughout the proposed corridor would provide opportunities for Traditional Owner to work on country and land managers to obtain income from diversified sources. Combining their efforts with biodiversity co-benefits not only meets several national priorities identified by the Australian Government, but is likely to garner support of international conservation organisations operating in northern Australia [37].

By supporting fire management from Calton Hills to Boodjamulla National Park, this approach also links in with BirdLife International's KBA program. The legacy project design also ensures alignment with Queensland's biodiversity offset program. Just over half of the corridor is designated as either a strategic biodiversity area or offset investment areas. Conservation efforts in these areas can attract funds raised to offset adverse environmental impacts of land clearing and development [38].

Another feature of the legacy project is expanding the focus from the conservation of a single threatened species to a quartet of threatened species that depend on old-growth spinifex (see Features of legacy project for Carpentarian Grasswren recovery). While each of the Corridor Quartet is currently listed as threatened species at either the state or national level, none is currently a priority for federal funding[39]. However, the high level of interest and involvement in the species' conservation (including through an informal Carpentarian Grasswren recovery network) is helping to raise the profile of the species, and thus attract financial backing. To date, Glencore's support has been critical for key project elements, including the aerial incendiary program and the grasswren surveys. Southern Gulf NRM is keen to build on this support, as well as to attract support from other philanthropic organisations.

In conclusion, Southern Gulf NRM believes that the best way to ensure Carpentarian Grasswren recovery is to work with the widest possible range of stakeholders to support fire management across the whole Carpentarian Corridor and provide the broadest conservation, Indigenous land management and pastoral outcomes. By doing so, Southern Gulf NRM is confident of attracting the commitment of the region's land managers, and the financial support of government agencies and philanthropic organisations.

Features of legacy project for Carpentarian Grasswren recovery

- Build and strengthen partnerships across a 2,580,000 ha corridor that contains most of Queensland's Carpentarian Grasswrens, including with Traditional Owners, pastoral land managers, miners, Government agencies, National Parks, conservation NGOs
- Actively engage Traditional Owners and support Indigenous ranger groups
- Canvas support from potential funding partners
- Expand efforts to secure Carpentarian Grasswren recovery to benefit a 'Corridor Quartet' of threatened species by including Gouldian Finch, Purple-necked Rockwallaby and Carpentarian Antechinus habitat
- Identify a staged approach to building the fire management capacity across this corridor over a 10year period, with the aim of embedding fire management into the management of at least 10 properties across the corridor.
- Monitor, evaluate and report on the impact of the project on
  - Uptake of fire management and integration into the day-to-day property management
  - Wildfire extent and patchiness
  - Extent of old-growth spinifex
  - Distribution, abundance and conservation status of the Corridor Quartet.

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