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Deployment of novel nest-shelters to increase nesting attempts in a small population of Rock Parrots *Neophema petrophila*

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Abstract. The population of Rock Parrots *Neophema petrophila* on Rottnest Island, Western Australia, has declined markedly in recent decades, from flocks of many dozens recorded in the 1930s to just seven birds in 2012. Availability of suitable nesting sites has been identified as a potential limiting factor in the recovery of the local population. In our study, roof tiles were installed as nest-shelters on Duck Rock, the only known breeding site on Rottnest Island and its associated islets, resulting in Rock Parrots successfully fledging 13 nestlings from them between 2015 and 2017. Descriptions of the tile nest-shelter designs are included.

Introduction

Improving breeding success has been recognised as a key component in the conservation of fauna worldwide (Pascal *et al.* 2008; Malpas *et al.* 2013). One technique to achieve this for avian species is the provision of artificial nesting shelters (Larson *et al.* 2015). The addition of man-made structures can potentially improve nesting opportunities in areas where appropriate nest-sites are lacking, where competition for habitat is high or where predation at natural nest-sites occurs (Libois *et al.* 2012; Björklund *et al.* 2013). However, to achieve the desired success with artificial nest-shelters, they must be species specific and suitably tailored through design and/or placement (Sherley *et al.* 2012; Goldingay *et al.* 2015). Artificial nesting shelters have been or are currently being used as a tool for the conservation management of numerous bird species, particularly parrots (e.g. Olah *et al.* 2014; Department of Environment, Land, Water and Planning 2016; Stojanovic *et al.* 2017).

The Rock Parrot *Neophema petrophila* is a small parrot (50–60 g) occurring on the coastal margin, rarely more than 400 m wide, from Shark Bay in Western Australia to the Coorong in South Australia (Lindgren 1973; Higgins 1999). Breeding takes place between August and December, with females laying clutches of 2–5 eggs. Unlike most other species of parrot which nest in tree-hollows, Rock Parrots nest within limestone crevices and overhangs, under vegetation or in abandoned burrows created by other species on offshore islands or islets (Higgins 1999). Although listed as Least Concern in the IUCN Red List of Threatened Species, their population appears to be declining throughout their range (BirdLife International 2016). The population on Rottnest Island, which is located 20 km offshore from the Port of Fremantle, has shown a similar trend in decline (Wykes & Blythman 2013). Where flocks of >20 individuals were once observed on Rottnest Island, this species is now uncommon, with targeted surveys in 2012 locating only four adults and three juveniles (Wykes & Blythman 2013). The decline is thought to be from a combination of factors, including predation by feral Cats *Felis catus*, harvesting of nestlings for sale in the aviculture industry and the destruction by the army of Phillip Rock, which at the time was one of the last remaining breeding sites on Rottnest Island (Storr 1965; Joske *et al*. 1995; Saunders & de Rebiera 2009; Algar *et al.* 2011).

The only known breeding site on Rottnest Island is Duck Rock (31°59′S, 115°32′E), a small, 0.2-ha rocky Islet ~200 m offshore from the north-eastern corner of Rottnest Island. The closest known breeding site to Duck Rock is Lancelin Island, located 112 km to the north (31°00′S, 115°18′E). To the south, the closest known breeding site is 265 km away on Seal Island (34°22′S, 115°09′E) (Gregory 1941; Storr & Johnstone 1988; Storr 1991; Abbott & Wills 2016; and *contra* Wykes & Blythman 2013).

The Rottnest Island Authority expressed concerns that the Island's population of Rock Parrots was facing local extinction. Availability of suitable nesting sites at the only known breeding site on Rottnest Island was identified as one of several potential limiting factors to the recovery of the population. In our study, two designs of clay tiles were used to test if nesting could be increased through the provision of more nest-sites.

Materials and methods

Site

Rottnest Island, a 1900-ha A class nature reserve, is a highly protected class of crown land where acts of parliament and public consultation are required to initiate changes that may impact its native flora and fauna (Rottnest Island Authority 2014). Its landscape is dominated by low shrubland, coastal blowouts and salt lakes, and there are numerous small islets covered in low vegetation occurring within 500 m of the shore.

Approximately 30% of Duck Rock is covered by vegetation, dominated by Nitre Bush *Nitraria billardierei* and Common Ice Plant *Mesembryanthemum crystallinum*. In addition to Rock Parrots, Duck Rock is also a known breeding site for

Silver Gulls *Chroicocephalus novaehollandiae* and Bridled Terns *Onychoprion anaethetus* (Storr 1964). It is also a roost-site for ~25 Pied Cormorants *Phalacrocorax varius,* and an old Eastern Osprey *Pandion cristatus* nest on the western tip is often used by Ospreys as a feeding platform.

Nest-shelters

Nineteen clay ridge-hip-end roof tiles, of two designs, were deployed as nest-shelters on Duck Rock between 2014 and 2015. The first of these was imported from Europe, and has a low, wide entrance (*La Escandella* ridge-hip-end tile, Bristile Roofing, Caversham, Western Australia: Figure 1). The second style is made in Australia, and has a high triangular entrance (locally made clay ridge-hip-end tile, Bristile Roofing, Caversham, Western Australia: Figure 2).

Nest-shelters were deployed in the vegetated area of Duck Rock before the commencement of the breeding season and were positioned a minimum of 1.5 m from any known natural nests. Thirteen were placed under vegetation, with cover varying from ~10% to 70%, and the remaining six were placed in the open. All were installed over sand (Figure 3).

Throughout the breeding season, the nest-shelters were checked approximately fortnightly using a burrow scope (Wireless Video Burrowscope, Faunatech, Mt Taylor, VIC). If a nest-shelter was in use, remote sensing cameras capable of taking still images and movies (LTL-5610A, Little Acorn, Oakleigh South, VIC) were positioned ~1 m from the nest, facing the entrance. Australian Bird and Bat Banding Scheme and colour bands were applied to nestlings' legs to enable monitoring after fledging.

Islets surrounding Rottnest Island (including Parakeet and Dyer Islands, and Phillip and Wallace Rocks), where Rock Parrots had previously been recorded breeding, were searched for natural Rock Parrot nests during breeding periods.

Results

Over the study period (2013–2017), Rock Parrots used at least three natural nests. The first, used in 2013, was made in a sand burrow that was likely an old shearwater *Puffinus* sp. nest. Its entrance was 140 mm high and 200 mm wide, and the burrow had a depth of 450 mm. It contained four eggs, from which three birds fledged (birds seen on mainland Rottnest Island). The burrow was checked in September 2014 but it was no longer usable as it had collapsed and was covered in cormorant faeces.

The second natural nest, used in 2014, was located within 1 m of the 2013 nest and was also presumed to be an old shearwater burrow in sand with a 150-mm-wide entrance, concealed under vegetation. It was 400 mm deep and had three eggs sitting in an unlined bowl-shaped depression.

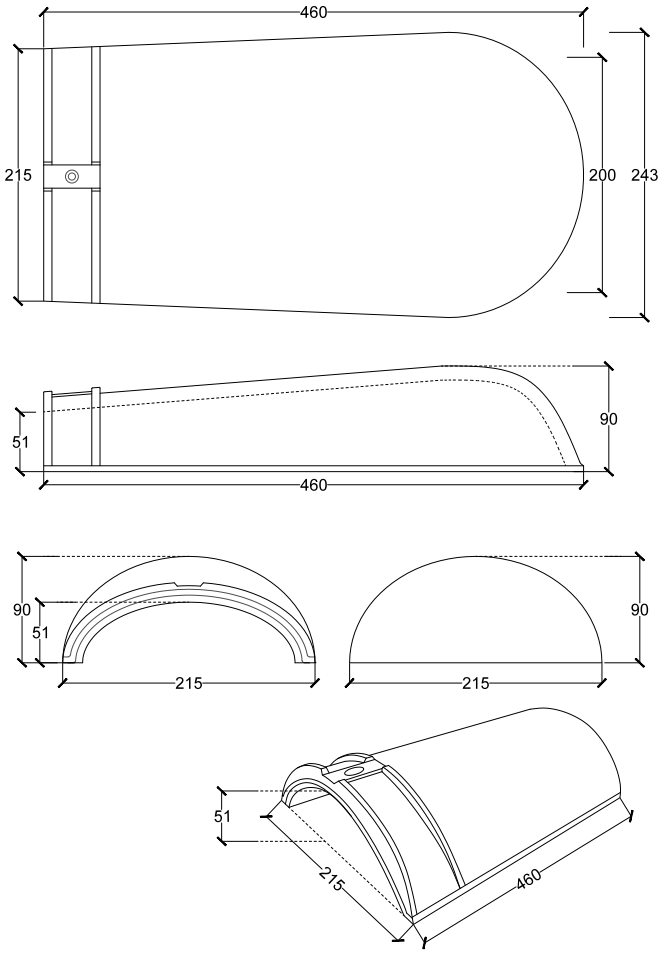

Figure 1. *La Escandella* tile installed as a nest-shelter for Rock Parrots, with dimensions shown in mm.

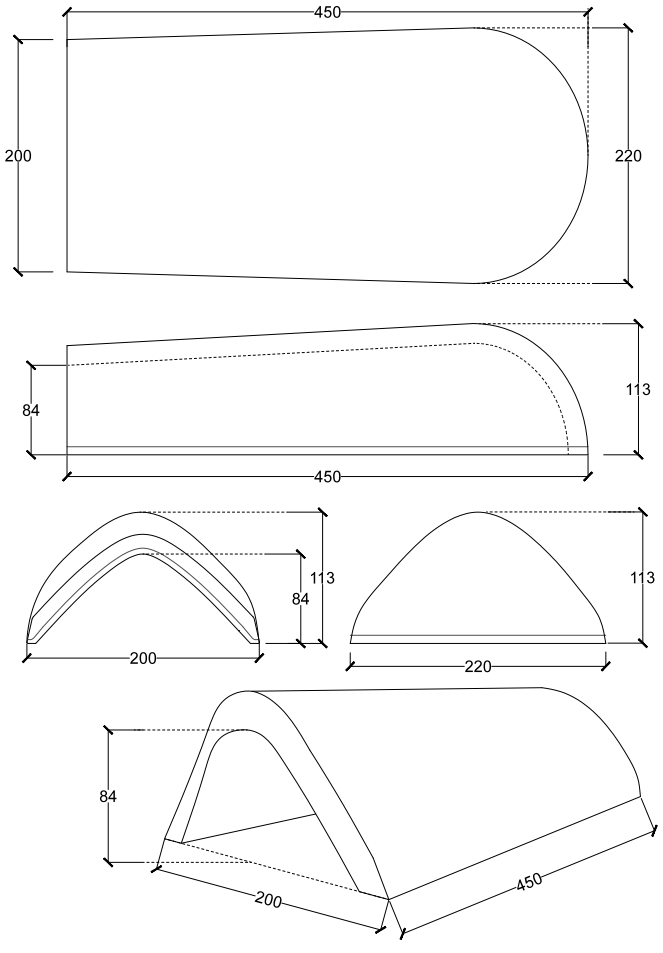

Figure 2. Locally made tile installed as a nest-shelter for Rock Parrots, with dimensions shown in mm.

Figure 3. Local-tile nest-shelter *in situ*. Photo: Mark Blythman

Figure 4. Two Rock Parrot nestlings inside a local-tile nest-shelter. Photo: Mark Blythman

A third natural nest was thought to be located within a limestone cliff on the southern side of the islet. This nest was never found as it was located in an inaccessible part of the islet, but it was presumably used most seasons.

Four of the 19 available tile nest-shelters were used by Rock Parrots between 2014 and 2017, three of which were of the local style and one of a *La Escandella* style (Table 1). Two of the birds that used nest-shelters were fledglings from the 2013 natural nest (Table 1). Three of the nest-shelters were used over multiple breeding seasons. One of the local-style nest-shelters used in 2017 is shown in Figure 3; Figure 4 shows its interior with two nestlings. A total of 13 nestlings fledged from the nest-shelters, with camera images revealing that another nest-shelter was regularly entered during the breeding season although no nest was made in it.

Table 1. Rock Parrot activity at nest-sites on Duck Rock, Rottnest Island, WA, in 2013–2017 breeding seasons: nest-shelters of local and *La Escandella* tiles, and natural nests. D = deployed, E = eggs, F = young fledged (number of fledglings in parentheses).

Nest reference	*Year*				
	2013	*2014*	*2015*	*2016*	*2017*
Local style 1			D		E, F (3)
Local style 2			D	E, F(2)	E
Local style 3			D	E	E, F (2)
La Escandella style 1		D, E	E, F (2)	E, F (3)	E, F (1)
Natural nest 1	E, F (3)				
Natural nest 2		E			

All four nest-shelters that were used had been positioned under vegetation with >50% cover, but none of the nest-shelters placed in the open under slight vegetation (<20% cover) were used.

Accurate numbers of fledglings from natural nests are difficult to quantify. However, as new recruits are easily identified by the orange bill and lack of a distinct frontal band, estimates are possible. Based on our observations, we estimate that over the 5-year period a total of between three to five birds fledged from natural nests.

Duck Rock was not visited during the 2018 breeding season but multiple targeted searches across Rottnest Island were conducted pre- and post-breeding season and only one young Rock Parrot was observed. This, along with the discovery of abandoned eggs in a nest-shelter post-breeding on Duck Rock, indicates that there was very low recruitment from the 2018 breeding season. During the 2018 post-breeding surveys for Rock Parrots on Duck Rock, Bridled Terns were observed sitting on eggs in four separate nest-shelters.

Discussion

Standard roof tiles and concrete pavers have been used as a survey tool to help determine the presence of terrestrial vertebrates such as small mammals and reptiles (Homan 2012; Michael *et al.* 2012). Kalmari (2014) described a purpose-built concrete-and-wire-mesh igloo nest-box utilised by Little Penguins *Eudyptula minor* in south-eastern Tasmania but, to our knowledge, off-the-shelf clay roof tiles similar to those used in the present study have not been used as artificial nest-shelters for ground-nesting birds.

The unique shape of the Rock Parrot nest-shelter provides enough space for nesting while having an entrance that is too small for potential predators such as Silver Gulls and Australian Ravens *Corvus coronoides* to enter. Libois *et al*. (2012) found that the breeding success of the Mediterranean Storm Petrel *Hydrobates pelagicus melitensis* was higher in artificial nest-boxes when compared with natural sites because of protection from predators such as Yellow-legged Gulls *Larus michahellis*. In the present study, Silver Gulls were often observed harassing adult Rock Parrots on Duck Rock but there were

no instances on camera where gulls entered nest-shelters although there was evidence that gulls interfere with Rock Parrot fledglings. In one case, primary wing-feathers and tail rectrices of a fledgling were found scattered near a nest-shelter being used by Rock Parrots consistent with an attack by a Silver Gull, most likely when the fledgling was out of the nest-shelter.

The Rock Parrots in this study exhibited nest-site fidelity similar to other parrot species, as described by Saunders *et al.* (2018). One pair used a natural nest in 2013; after the nest collapsed, they moved <1 m to another nest the following year. Nest-site fidelity was also exhibited by several other individuals that used the same nest-shelter over consecutive years.

This study shows that Rock Parrots preferred to utilise well-placed, artificial tile nest-shelters over natural nest-sites on Duck Rock and therefore these could be deployed onto additional islets around Rottnest Island to help establish new breeding sites. Given how readily Rock Parrots and Bridled Terns occupied the nest-shelters in this study, we envisage that roof tiles could be utilised by a range of other species that nest in sheltered positions or burrows.

The estimated population of Rock Parrots on Rottnest Island increased from seven birds in 2013 (Wykes & Blythman 2013) to 16 in 2017 (JS *et al*. pers. obs.). The most recent population estimate, made in early 2019, was seven adults and one juvenile. Lack of recruitment alone does not account for the drop in numbers, and there are likely other factors involved, such as unexplained deaths or natural dispersal from Rottnest Island. In support of the latter, Storr (1965) described seeing a Rock Parrot flying from Phillip Rock on Rottnest Island to the mainland (Perth).

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