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THE BIRDS OF ONE TREE ISLAND WITH NOTES ON THEIR YEARLY CYCLE AND FEEDING ECOLOGY

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ABSTRACT

Results are presented of censuses and regular observations during 1971 and 1972 of the birds of One Tree Island in the Capricorn Group of the Great Barrier Reef. The yearly cycle of the birds and their impact on the reef environment are discussed and an annotated checklist of the birds recorded from One Tree Island is presented as an appendix.

INTRODUCTION

One Tree Island is located in the Capricorn Group at the southern end of the Great Barrier Reef of Australia ($23^{\circ}27'S$, $151^{\circ}55'E$). It is 80 kilometres from the mainland (Central Queensland) and 19 km from Heron Island. During 1971 and 1972 one of us (SD) was resident biologist on One Tree Island, where The Australian Museum has a field station. We decided to use this opportunity to make regular observations on the seabirds and waders of One Tree and in this way contribute to a better understanding of the seasonal pattern of breeding, migration and population size of the birds of the Capricorns.

Kikkawa (1970) has summarized observations on the birds of Heron Island and Lavery and Grimes (1971) have plotted the location and size of seabird colonies for the Great Barrier Reef. Other than these recent accounts summarizing the available data and a few papers on individual species (*e.g.* Shipway 1969; Recher 1972), the literature on the avifauna of the Capricorns is limited to accounts of relatively brief visits to the islands during the spring and summer months by bird-watchers (*e.g.* Cooper 1948; MacGillivray 1926, 1928, 1931; Roberts 1957). Except for a few comments by MacGillivray (1928)

and Lavery and Grimes (1971) and the work by Recher (1972) on Reef Herons *Egretta sacra* there does not appear to be any published account of the birds of One Tree Island. This is not surprising as the island is difficult to approach and land on. Most visitors to the Capricorns have been content with the more easily visited and larger islands (e.g. Heron, Northwest, Wreck).

The purpose of this paper is to present the observations made during 1971 and 1972 on the seabirds and waders of One Tree Island. The feeding ecology of the birds using the reef environment, the nesting cycle of seabirds and their numbers are discussed. Observations by the second author (HFR) made in 1968 and 1972 of terrestrial birds on One Tree Island are incorporated and discussed as part of the migration pattern of birds in the Capricorns. In preparing an annotated checklist of the birds of One Tree Island we have also had access to the unpublished observations of Harold Heatwole and his colleagues which were made between May, 1968 and March, 1971.

The vernacular and scientific names used in this paper follow CSIRO (1969), An Index of Australian Bird Names, Divn of Wildlife Res. Tech. Paper No. 20.

ONE TREE ISLAND

One Tree Island is a small low island, approximately two hundred and fifty metres by one hundred and fifty metres in size. The average height above high tide is two metres. This island, unlike the others in this area, is composed of coarse coralline rubble with little sand, and is located on the south-eastern (windward) end of the reef. The vegetation consists of low shrubs (mostly *Wedelia biflora*) with scattered clumps of wind pruned *Pisonia grandis*, *Pandanus* sp., *Messerschmidia argenta* and *Scaevola taccada*. Towards the centre of the island there is a small shallow pond of brackish water (Fig. 1). The level of water in this pond varies between spring and neap tides, being higher during spring tides. Surrounding the pond for a distance of about five metres is an open area characterized by the low plant *Sesuvium portulacastrum*. The dry season occurs from October to December and except for the *Pandanus*, most plants on the island shed many of their leaves, or in the case of the shrubs, die back, giving the island a much more open aspect. This period coincides with the nesting times of the terns.

The reef upon which One Tree Island is located is approximately four kilometres long by three kilometres wide, and contains a large lagoon within which patch reefs are abundant. The patch reefs are exposed at low tide and provide a large feeding area for wading birds. For the birds frequenting it, a significant aspect of this reef is that it is higher than other reefs in this area, and is therefore exposed for a greater length of time during low tide, enabling waders to feed for a longer

period. For example, Reef Herons have a minimum of six hours to feed each low tide and up to eighteen hours on the lowest tides of year when high water does not cover the reef (Recher and Recher 1972). In contrast, the herons at Heron Island may have as little as two or three hours foraging time and seldom more than six or seven hours foraging time on a low tide.

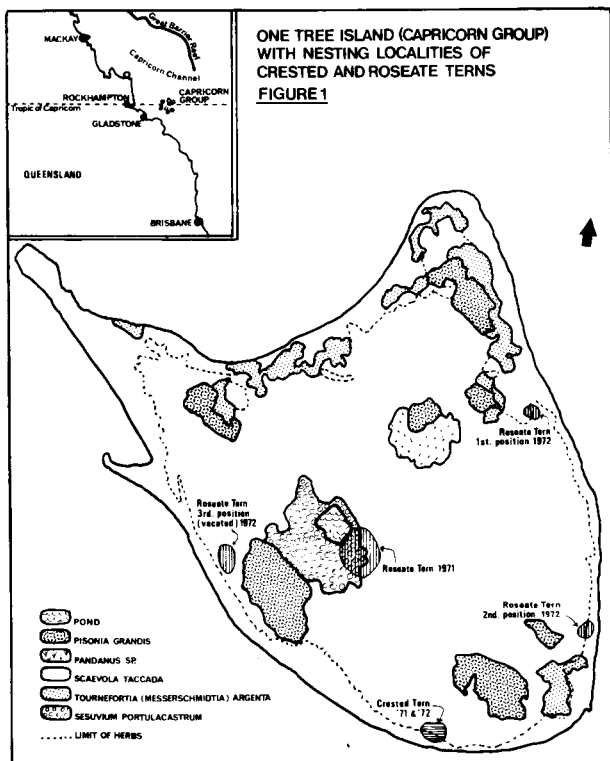


Figure 1. In 1972 the Roseate Tern nested at three different places on the island. This contrasts to the single position used in 1971 and the use by the Crested Tern of the same site in 1971 and 1972.

METHODS

Between September 1971 and December 1972 monthly censuses and general observations were made on all the sea birds and waders seen on the island and surrounding reef. Observations were not made during February and March when the research station was closed. Bird counts were made on the island at high tide, while observations on feeding were made from the reef during low tide. During the winter months (May to August) censusing is more difficult and less accurate than during the remainder of the year. In winter the higher of the two daily high tides occurs during the night with the day tide usually not high enough to drive all the birds from the reef onto the island where they can be counted. The reverse situation prevails in the summer. During numerous trips between islands in the Capricorns, and between One Tree and the mainland, notes were made on the presence and the activities of any birds.

During 1967, 1968, 1970 and 1971, the second author (HFR) studied the foraging ecology of the Reef Heron on Heron Island and on One Tree Island (Recher 1971; Recher and Recher 1968, 1972). One Tree Island was visited in September and October, 1968 and January, 1972 for a total of six weeks. During these visits repeated censuses of herons, waders and some sea birds were made. Notes were taken on the feeding ecology of all waders and seabirds observed during the more intensive study of heron ecology. In January, 1972, samples of the food fed to chicks were obtained from Bridled Tern *Sterna anaetheta* and Crested Tern *S. bergii*. Food samples were obtained by capturing chicks which regurgitated any food in their stomachs. The stomach contents were preserved in formalin and later identified and measured.

OBSERVATIONS

THE YEARLY CYCLE

Significant events on One Tree Island are the nesting of sea birds and the movements of migratory birds. These are tied closely to the seasons of the year. The Capricorns are subtropical with well defined winter and summer periods. For convenience summer can be considered the period between October and April and winter the months of June, July and August. During the summer ocean temperatures rise to 26°C and in the winter fall to 21°C. Air temperatures parallel those of the ocean but water temperature is probably more significant for most sea birds. Rain falls throughout the year and averages 1040 mm per year. The prevailing winds are from the south-east, but between October and February winds often come from the northwest and at this time there can be prolonged periods of calm weather. Cyclonic disturbances occur mostly between December and March. The Capricorns can expect at least one

cyclone every four years.

BREEDING SEA BIRDS

According to Lavery and Grimes (1971) Bridled Tern, Crested Tern, Black-naped Tern *Sterna sumatrana*, Roseate Tern *S. dougalli*, and Silver Gull *Larus novaehollandiae* are the sea birds which nest on One Tree Island. The Bridled Tern and Black-naped Tern colonies are major ones and the Crested Tern colony is the principal colony on the Great Barrier Reef, but only small numbers of Roseate Tern and Silver Gull nest on the Island. Our estimates of the size of the nesting colonies of the different sea birds are presented in Table 1 and changes in abundances are shown schematically in Figure 2. Our estimates of numbers generally agree with those of Lavery and Grimes (1971) but we did not record the Silver Gull nesting and found a small number of nesting Lesser Crested Tern *Sterna bengalensis*. Additionally there is a large colony of the Reef Heron and one or two nesting pairs of the Sooty Oystercatcher *Haematopus fuliginosus*. We also recorded up to 150 pairs of Roseate Tern nesting on One Tree Island.

Lavery and Grimes (1971) indicate that for the terns most nesting and egg laying occurs during early summer on the southern Great Barrier Reef, and give the months October and November. On One Tree Island, Bridled, Lesser Crested, Crested and Roseate Terns begin nesting in October and the first eggs are laid in late October or early November. (Details on the nesting of each species are given in the annotated checklist). In none of these terns on One Tree Island is egg laying highly synchronized. The result is a protracted nesting period. Kikkawa (1970) also found a protracted nesting period for White-capped Noddy *Anous minutus* and Black-naped Tern on Heron Island. The Reef Heron also has a long nesting season (August-February) on these islands (pers. obs.; Kikkawa 1970) and of the two Sooty Oystercatcher nests recorded on One Tree Island, one was found in July and the other in September.

Numbers of Reef Heron and Sooty Oystercatcher remain fairly stable through the year with only a slight increase in heron numbers during late summer (see the annotated checklist). The number of terns, however, changes markedly between the breeding and non-breeding season (Fig. 2). Bridled Tern and Roseate Tern appear to be absent between mid-March and September when numbers rapidly build up as birds arrive and begin nesting. Crested Tern, Lesser Crested Tern, and Black-naped Tern are present in small numbers through the winter.

The Crested, Lesser Crested, Roseate and Black-naped Terns nest in groups or colonies. These terns prefer the more open and peripheral parts of the island, but do not necessarily nest in the same place each year (Fig. 1). Also, a species may aggre-

TABLE I

Numbers of pairs of sea birds and
waders nesting on One Tree Island

Reef Heron	100 - 135	Bridled Tern	150 - 250
Sooty Oystercatcher	1 - 2	Crested Tern	150 - 200
Roseate Tern	100 - 150	Lesser Crested Tern	10
Black-naped Tern	50 - 100		

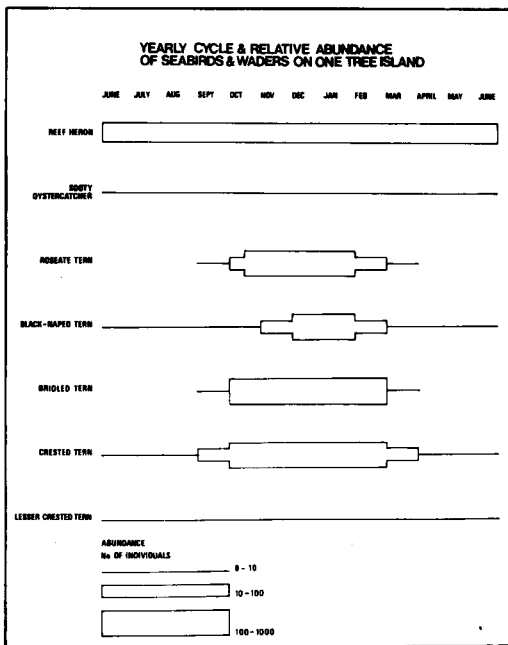


Figure 2. Two waders and five terns are known to nest regularly on One Tree Island. The relative abundances of these species are shown throughout the year. Peak numbers generally coincide with the nesting season.

gate in a single nesting colony or there may be several separate small nesting groups. In 1971, the Roseate Tern, for example, nested in a single colony near the island's tidal pond, but in 1972 formed three well separated nesting groups (Fig. 1). The Bridled Tern, however, spreads evenly throughout the island and nests under low shrubs (*i.e. Wedelia biflora*).

BREEDING LAND BIRDS

A small number of land birds nest on One Tree Island. Most common is the Golden-headed Fantail-warbler *Cisticola exilis* which nests in the low shrubby vegetation dominated by *Wedelia biflora*. In September-October 1968 there were approximately six singing males, but in January 1972 singing was minimal. Breeding is presumably, therefore, restricted to the spring and early summer. Grey-breasted Silvereye *Zosterops lateralis*, Sacred Kingfisher *Halcyon sancta* and Banded Landrail *Rallus philippensis* are resident and may nest on the island. However, we have no nest records and it is possible that these birds are derived from the other islands in the Capricorns. The presence of colour-banded Silvereyes strongly suggests a movement of birds between One Tree Island and Heron Island, where a study of colour-banded Silvereyes is in progress. The only other bird known to have nested on One Tree Island is the White-breasted Sea Eagle *Haliaeetus leucogaster*. There is a massive eagle nest on the island, but there are no recent nesting records. The Sea Eagle does nest on other islands (*e.g.* Erskine Island) in the Capricorns and its failure to nest on One Tree Island in recent years is surprising.

NON-BREEDING BIRDS

A large number of species of birds visit One Tree Island but do not breed there. These fall into four categories; sea birds or aquatic birds which are regular visitors, northern hemisphere waders which winter on the Great Barrier Reef, terrestrial birds which migrate along the offshore islands and vagrants. Many sea birds which do nest on other islands of the southern Great Barrier Reef regularly visit or have small resident populations on One Tree Island. White-capped Noddy and Brown Booby *Sula leucogaster* are examples. Other birds occur infrequently or only after storm conditions and can be considered vagrants (*e.g.* Mangrove Honeyeater *Meliphaga fasciogularis*). Vagrants and irregular visitors are not a significant part of the reef's avifauna. However, the regularly occurring waders and passage migrants are important parts of the reef ecosystem and will be considered in more detail.

Palaeartic Waders

Sixteen species of Palaeartic waders have been recorded from One Tree Island. Another eight species have been reported from other islands in the Capricorns and in addition there are two

resident breeding species and two non-breeding Australian waders. These are listed in Table II. Of the waders recorded from One Tree Island, eight are regular summer residents. To judge by the numbers of waders which spend the northern hemisphere winter in the Capricorns the southern part of the Great Barrier Reef is an important wintering ground for these birds.

TABLE II

Species of waders recorded from One Tree Island

BREEDING OR RESIDENT SPECIES	
Pied Oystercatcher	Sooty Oystercatcher
NON-RESIDENT AUSTRALIAN SPECIES	
Red-capped Dotterel	
PALEARCTIC SPECIES	
Regular Summer Residents	
Mongolian Sand-dotterel	Eastern Curlew
Eastern Golden Plover	Grey-tailed Tattler
Turnstone	Red-necked Stint
Whimbrel	Bar-tailed Godwit
Irregular or Scarce Summer Residents	
Large Sand-dotterel	Great Knot
Common Sandpiper	Sharp-tailed Sandpiper
Wandering Tattler	Sanderling
Knot	Black-tailed Godwit
Not Recorded on One Tree Island but Recorded from the Capricorns	
Double-banded Dotterel	<i>Charadrius bicinotus</i>
Oriental Dotterel	<i>Charadrius veredus</i>
Grey Plover	<i>Pluvialis squatarola</i>
Little Whimbrel	<i>Numenius minutus</i>
Greenshank	<i>Tringa nebularia</i>
Little Greenshank	<i>Tringa stagnatilis</i>
Terek Sandpiper	<i>Xenus cinereus</i>
Curlew Sandpiper	<i>Calidris ferruginea</i>

Some waders are present through the year, but peak numbers occur during the summer months (November-January) and again in late autumn (April). Wader migration is an almost continuous phenomenon. Discussing the wader migration on the California coast (35°N), Recher (1966) considered the migration north to the breeding grounds to continue into May and the migration south to the wintering grounds to begin in July. With some allowance for the more southerly position of the Great Barrier Reef, this is a reasonable time table for wader migration on One Tree Island. Minimum numbers of waders occur from late April through

June and the birds present are probably individuals which will not migrate to the breeding grounds. Wader numbers increase markedly in July and this probably indicates the first influx of southward bound individuals. Numbers seem fairly constant during November, December and January.

Migrating Land Birds

Few land birds visit One Tree Island, but those that do are easy to observe. The small size of the island and the few patches of trees made a daily survey of land birds between September 15 and October 17, 1968 an easy task. During this time five species were recorded which can be considered migrants and are probably regular 'island hoppers' along the Great Barrier Reef; Bronze Cuckoo *Chrysococcyx* sp., Koel *Eudynamis scolopacea*, Dollar-bird *Eurystomus orientalis*, Rufous Whistler *Pachycephala rufiventris* and Black-faced Cuckoo Shrike *Coracina novaehollandiae*. Two others, White-eared Flycatcher *Monarcha leucotis* and Starling *Sturnus vulgaris* were recorded after stormy weather and may only be vagrants. Kikkawa (1970) records some of these species for Heron Island and in addition lists many other land birds. It is interesting that most of the sightings of transient land birds on Heron Island recorded by Kikkawa are for the months of April and May with a few sightings for August. Obviously the pattern of sightings on Heron Island is determined by the time of visits by ornithologists, which occur more often during May and August than in other times of the year. The absence of land bird records during the spring on Heron Island is, therefore, not surprising. The records from One Tree Island and those from Heron Island suggest the regular migration of some species south and north along the Great Barrier Reef.

FEEDING ECOLOGY OF SEA BIRDS AND WADERS

Regular observations were made of the places where the different terns and waders hunted for food on One Tree Reef. Unfortunately, we were not able to quantify our observations and present only our subjective assessment of feeding dispersion. Comments on the food taken by different birds and their manner of hunting is based on observation of prey and on food samples obtained from Reef Herons and some terns.

TERNS

White-capped Noddy and Bridled Tern forage at sea. Both species are often seen flocking over schools of 'gamefish' (e.g. Bonito and Spanish Mackerel) which drive small fish close to the surface. Indeed, it appears that both of these birds are dependent for successful hunting upon the activities of predatory fish. We have few observations of Noddies or Bridled Terns taking prey in any situation other than that described above. The two birds hunt in very similar ways, dipping down and taking fish rather than diving. Both species feed extensively on

anchovies (Engraulidae) (see Table III for data on Bridled Tern) but they usually hunt in different places. At One Tree Island and Heron Island the Noddy hunts along the reef and out to sea, but the Bridled Tern always hunts away from the reef. However, spatial separation of feeding stations is not absolute and mixed flocks can be seen on trips between islands.

TABLE III

The food of the Crested Tern and Bridled Tern

CRESTED TERN

Fish Species	Size (cm)	No. present
Engraulidae		
<i>Engraulis australis</i>	2-10	38
<i>E. australis</i>	2-8*	31
<i>Engraulis</i> spp.	2-10*	20
Exocoetidae		
<i>Parexocoetus brachypterus</i>	8-10*	7
Carangidae		
<i>Caranx sexfasciatus</i>	8	1
<i>Carangoides</i> sp.	8*	1
Pomacentridae		
<i>Pomacentrus</i> sp.	10+	1
Unidentified species	8	1
Labridae		
<i>Stethojulis acillaris</i>	8-10	3
<i>S. strigiventer</i>	8	1
Unidentified species	6-8*	1
Scaridae		
<i>Scarus</i> sp.	10+	1
Unidentified species	10+	1
Eleotridae		
<i>Electricodes strigatus</i>	6*	1
<i>E. longipinnus</i>	10+	1
Scombridae		
<i>Euthynnus affinus</i>	6-10+	23
Balistidae		
<i>Arotrolepis filicauda</i>	6-10	12
<i>Cantherines fronticinatus</i>	6-8	1
Tetradontidae		
<i>Arothron hispidus</i>	10	1
<i>Lagocephalus</i> sp.	6*	1
<i>L. sceratus</i> or <i>luase</i>	6-8	1

TABLE III (Continued)

Fish Species	Size (cm)	No. present
Unidentified fish species	-	2
Invertebrates		
<i>Penaeus caesioides</i> (?)	6-10	1 head/2 bodies
Unidentified squid	-	1 head

BRIDLED TERN

Fish Species	Size (cm)	No. present
Engraulidae		
<i>Engraulis australis</i>	2-8	52
Balistidae		
<i>Arotrolepis filicauda</i>	2-4*	1

* Specimens measured without heads

The other terns hunt predominantly along the margin of the reef, over the reef crest and less often in the reef lagoon. Hunting appears to be difficult in the reef lagoon with schooling fishes staying mostly too deep for the terns. Our observations suggest that those terns which feed from the reef itself hunt more actively during low tide. This may be because of the greater area of shallow water over the reef crest at low tide which enables small fishes to be seen and captured more easily.

All terns other than the Bridled join with Noddies over schools of feeding gamefish along the reef edge. Otherwise foraging by terns appears to be concentrated in turbulent areas at the reef edge and on the reef crest. Possibly small fish are a temporary disadvantage in wave caused turbulence. The sample of prey obtained from Crested Tern chicks illustrates the range of hunting practised by terns on One Tree Island (Table III). Crested Terns hunt by plunge diving and by dipping and individuals may be seen over schools of feeding gamefish in deep water, along the edge of the reef and over the reef crest. Thus the sample of prey contained schooling fishes (e.g. Scombridae and Engraulidae) of the species hunted by gamefish and fishes of the reef crest (e.g. Labridae and Gobiidae). Squid and prawns were also taken, but in small numbers. The places

in which the different species of birds hunt on and around One Tree Reef is summarised in Table IV.

TABLE IV

Sea birds and waders of One Tree Island
Generalised feeding zones at low tide

Open Sea		
White-capped Noddy		Bridled Tern
Sea-ward Reef Margin and Lagoon		
White-capped Noddy		Crested Tern
Brown Booby		Lesser Crested Tern
Silver Gull		Black-naped Tern
Roseate Tern		Little Pied Cormorant
Reef Crest		
Eastern Golden Plover		Sooty Oystercatcher
Turnstone		Pied Oystercatcher
Grey-tailed Tattler		Reef Heron
Knot		
Reef Flat and Lagoon Reefs		
Whimbrel		White-faced Heron
Eastern Curlew		Reef Heron
Bar-tailed Godwit		

An interesting aspect of the reef-birds of One Tree Island concerns their nocturnal activity. Bridled Terns in particular are very active at night, but it is likely that most of the reef-birds feed on calm nights at low tide. This is especially so when the moon is bright. Certain small fishes (*e.g.* Blenniidae) and many invertebrates of the reef are also active at night and furnish easily captured prey for birds foraging at this time.

WADERS

Waders are restricted to feeding on the low tide, but forage during both day and night tides. One Tree Reef offers three main feeding habitats for waders; reef crest including boulder tracts, reef flat, and lagoon patch reef (Table IV). The reef crest is comprised of coral rock with numerous percolation holes and shallow pools. It has extensive areas of low growing seaweeds and in places there is an accumulation of coral rubble. The reef crest is not suited to waders which feed by probing, but is the habitat most used by Mongolian Sand-dotterel *Charadrius mongolus* and Eastern Golden Plover *Pluvialis dominica*. Both visually locate prey on the substrate surface which they simply pick up. Crabs, gastropods and small crustaceans were

seen to be taken. The reef crest is also frequented by Turnstone *Arenaria interpres*, Grey-tailed Tattler *Tringa brevipes* and Red-necked Stint *Calidris ruficollis*, but these waders also hunt in rubble areas and on the reef flat. Tattlers and Stints take prey by probing or by visual location. The Turnstone forages by visually locating prey on the substrate surface and by turning over shells and rubble. Turnstones also probe under the edges of objects too large to turn. Bar-tailed Godwit *Limosa lapponica* Whimbrel *Nunentius phaeopus* and Eastern Curlew *Nunentius madagascariensis* forage on One Tree Reef mostly in areas of rubble and on the reef flat. Normally these waders probe for prey in soft substrates, but on the reef where the substrate is hard, they probe into percolation holes and crevices. Evidently the percolation holes on the reef crest are not suitable for this activity and these waders are seldom seen on the reef crest. Sooty Oystercatcher and Pied Oystercatcher *Haematopus ostralegus* hunt mainly on the reef crest and along the edge of the island.

REEF HERON

Hérons are the other main group of birds which hunt on the reef. The foraging ecology and prey of the Reef Heron on One Tree Reef has been described by Recher (1972) and by Recher and Recher (1972) and will not be repeated. The White-faced Heron *Ardea novaehollandiae* is a winter visitor to the Capricorns and relatively few individuals occur on One Tree Reef. It hunts in similar places to the Reef Heron but uses different hunting behaviours (Recher and Recher, in prep.). On One Tree Reef it may tend to hunt more along the edge of the reef than does the Reef Heron.

THE IMPACT OF BIRDS ON THE REEF ECOSYSTEMS

Birds are important predators of fish and invertebrates on the Reef and surrounding surface waters. They may have the greatest impact on the reef crest and reef flat where waders and herons hunt at low tide and terns hunt when there is a shallow layer of water covering these areas. The abundance of waders and seabirds and the large number of fish taken must figure significantly in marine cycles. Birds are also an important component of the island ecosystem which is an integral part of the overall coral reef. Heatwole (1971) in a study of small cays mentions: "Sea birds, through contributing guano and carrion were chiefly responsible for the energy transfer from the marine to the insular community". The effect on larger vegetated cays would probably be less but nevertheless significant.

On One Tree Island the most obvious effect due to the presence of birds is the addition of nutrients to what must be an impoverished substrate. The high porosity and permeability of coral rubble islands should result in a low retention of nutrients,

as rainwater would tend to wash everything away. Indeed, some if not all of the vegetation found on coral cays must to some extent depend upon the addition of nutrients through the agency of bird guano and carrion. An example of this is the association of the tree *Pisonia grandis* with coral cays where high phosphate levels are provided by the nesting Noddy Terns and Herons. In ranging widely over the coral reef environment to capture their prey, the important effect of birds could be to draw to the central islands those nutrients essential to the establishment and maintenance of the numerous trees and shrubs which are important in consolidating and protecting these islands.

CONSERVATION OF ONE TREE ISLAND

When considering this previously uninhabited island for the site of a research station, considerable thought was given to minimizing any possible deleterious effect on the birds using the island. Areas of major human activity were located in the open and away from possible or known nesting sites. Visitors were asked not to disturb the birds. In view of the large number of Bridled Tern, Crested Tern, Black-naped Tern, Roseate Tern and Reef Heron which nest on One Tree Island, it must be considered an important seabird island and it is worth evaluating the efficiency of the above measures in protecting birds from disturbance. Within two days of the arrival of a team of biologists in September 1968, all Reef Heron nests within 50 to 75 metres of the camp had been deserted. Eggs were abandoned, but it seems that nestlings may simply have shifted away from the focus of human activity. In the summers 1971-72 and 1972-73, Roseate Terns attempted to nest. They laid eggs but were apparently unsuccessful at raising young. Black-naped Tern did not nest in 1971-72, but did nest and hatch young in 1972-73. It is likely that the nesting failures of Roseate Terns are a result of human presence on One Tree Island. We are talking about people just being on the island, not people walking through nesting areas or in any way deliberately molesting the terns. Serventy *et. al.*, (1972) point out that small colonies may be deserted fairly readily during early incubation. Crested Tern, Black-naped Tern and Bridled Tern seem not to be affected seriously by the presence of people. Oystercatchers are also affected by people and the success of the 1968 nest was only because an area of 30 metres around the nest was strictly out-of-bounds.

The increasing numbers of people visiting the islands of the Capricorns makes it extremely important that at least a few islands be totally protected and One Tree Island is an obvious choice. It has important seabird colonies and accessibility is already difficult. We recommend the reservation of One Tree Island as a National Park for the protection of seabirds. After the current research projects terminate, there is no need

for marine biologists or tourists to land on One Tree Island. Certainly landing should be prohibited during the nesting season of terns (September-February).

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APPENDIX

ANNOTATED CHECKLIST OF BIRDS OF ONE TREE ISLAND

WANDERING ALBATROSS *Diomedea exulans*

A dead specimen found by Heatwole *et. al.* in July-August 1969.

WEDGE-TAILED SHEARWATER *Puffinus pacificus*

This is the only Shearwater which nests on the Great Barrier Reef. There is a large breeding colony at Heron Island, but the bird does not breed on One Tree Island. Undoubtedly, this is because the coral rubble substrate is not suitable for burrows. Wedge-tailed Shearwaters are seen foraging in the ocean waters adjacent to One Tree Island.

AUSTRALIAN PELICAN *Pelecanus conspicillatus*

Observed by Heatwole *et. al.* in March-April, 1970.

MASKED BOOBY *Sula dactylatra*

Observed by Heatwole *et. al.* in November-December, 1971.

BROWN BOOBY *Sula leucogaster*

The birds commonly seen are probably from the large nesting colonies in the Bunker Group to the south (Fairfax and Hoskyn Islands). They are usually present, but the numbers seldom exceed six individuals. Brown Boobies are often observed feeding on small fishes by diving, usually in the shallows along the seaward reef margin.

LITTLE BLACK CORMORANT *Phalacrocorax sulcirostris*

MacGillivray (1928) recorded Little Black Cormorants on 7 December 1927. Our only records of this cormorant are for 21 November and 11 December 1971 when two were present, and for 11 December 1971 when twelve were present. Heatwole *et. al.* recorded this cormorant in January-February and November-December 1969 and November-December 1971. Orenstein recorded a single bird among Little Pied Cormorants in October 1972.

PIED CORMORANT *Phalacrocorax varius*

A flock of six Pied Cormorants was on One Tree Reef during January, 1972.

LITTLE PIED CORMORANT *Phalacrocorax melanoleucos*

The number of these birds varies from about 10 to 25, and they are rather shy. During the night they roost in *Pisonia* and *Messerschmidia* trees on the south-eastern side of the island. They are often seen swimming and diving for small fishes in the shallows of the windward reef margin and surf zone. The Little Pied Cormorant is common and almost always present. MacGillivray (1928) also recorded it in 1927 and Cooper (1948) comments that in the Capricorns it occurs more frequently than the other cormorants.

LESSER FRIGATE-BIRD *Fregata ariel*

Individuals appear over the island from time to time, but it is not a regular visitor.

WHITE-FACED HERON *Ardea novaehollandiae*

This heron is not common but from one to ten individuals were seen during the months of April to August, 1972. They often mix with and hunt in the same places as the Reef Herons, although there appears to be a greater tendency for these Herons to forage along the seaward reef margin. Basical-

ly, the White-faced Heron is a winter resident in the Capricorns and only odd individuals occur during the summer months. There are no records of it nesting in the Capricorns.

REEF HERON *Egretta sacra*

The Reef Heron population was censused in October, 1968 and January, 1972. In 1968 the heron population consisted of 175 white morphs and 40 dark morphs. In 1972 a slightly larger population was present with about 200 white morphs and about 60 dark morphs. Robertson (in Kikkawa 1970) censused Reef Herons on One Tree Island and obtained a ratio of 164 white birds to 52 dark birds. During 1971 and 1972 as many as 170 herons were counted aggregated on the Island's perimeter, but the proportion of the two morphs was not determined nor was the entire population censused. The heron population on One Tree Island is therefore a large one (approx. 200-275 birds) and one in which the white form is more numerous. In the short term at least the population seems stable and with a constant proportion of the two colour phases. The slightly higher number of herons in January 1972 when compared with October 1968 may be a result of a large number of young birds present on the island at the end of the breeding season. Reef Herons have a prolonged breeding season. Nesting begins in early August and continues into December. Most birds probably nest early in the season but nesting is not synchronous. Nests are the typical heron platform of sticks and are located in the clumps of *Messerschmidia* and *Pisonia* which fringe the island. These trees reach a maximum height of 5 metres. Nests are placed from 0.5 m to 3.0 m above the ground and are located well inside the outer vegetation. From 2 to 3 eggs are laid (mean of 9 nests: 2.1 eggs). For details of the foraging ecology and territorial behaviour of Reef Herons on One Tree Island, see Recher and Recher (1972) and Recher (1972).

BLACK SWAN *Cygnus atratus*

A Black Swan was recorded in the Lagoon on 17 November 1971.

GREY (WHITE) GOSHAWK *Accipiter novaehollandiae*

A Grey Goshawk (white colour morph) appeared during the last week of April 1972. The bird remained on the island and was collected on 20 May 1972. The specimen has since been lost.

WHITE-BREADED SEA EAGLE *Haliaeetus leucogaster*

Sea Eagles occur regularly but there are no recent nesting records.

PEREGRINE FALCON *Falco Peregrinus*

A Peregrine was recorded on 20 September 1968 when it was seen pursuing (but not catching) a Grey-tailed Tattler

BANDED LANDRAIL *Rallus philippensis*

This rail breeds on the island, but the population is small and may not exceed two pairs.

PIED OYSTERCATCHER *Haematopus ostralegus*

A pair of Pied Oystercatchers was present during September and October 1968. However, they did not nest and are not normally resident on the island. The only other record we have is one bird on 30 April 1972.

SOOTY OYSTERCATCHER *Haematopus fuliginosus*

One pair of Sooty Oystercatchers nests on the island. Others frequent and

may nest on the highest of the rubble banks found on the reef. Two nests have been found on One Tree Island. On our arrival on 15 September 1968 a nest with two eggs was found on the north end of the Island. The eggs hatched on 15 October. The chicks remained near the nest site for a day and then disappeared, but presumably they moved into the vegetation near the edge of the beach. On about 23 July 1972, a nest (a slightly hollowed depression in the rubble) was discovered containing two rather large speckled eggs. This nest was located on the southeast end of the island, well above the high water mark on the margin of the vegetation. On 19 August, one of the eggs hatched. A day later the chick had disappeared, but Orenstein observed one immature bird accompanying a pair in October 1972. The other egg was found to be infertile.

RED-CAPPED DOTTEREL *Charadrius alexandrinus*
Recorded by Heatwole *et. al.*, May-June and July-August 1969.

MONGOLIAN SAND-DOTTEREL *Charadrius mongolus*
Most common during summer when the number varies from 20-150 birds.

LARGE SAND-DOTTEREL *Charadrius leschenaultii*
Orenstein observed one or two birds on the reef flat in October 1972.

EASTERN GOLDEN PLOVER *Pluvialis dominica*
This bird is observed mostly during the summer months when up to 40 individuals may be present.

TURNSTONE *Arenaria interpres*
A common visitor occurring in numbers of from 20 to about 200.

WHIMBREL *Numenius phaeopus*
Flocks of from 10 to 40 birds commonly observed throughout the year, but mostly absent in the summer.

EASTERN CURLEW *Numenius madagascariensis*
During the summer months, flocks ranging in number from two to three individuals up to 20 birds occur on the island.

COMMON SANDPIPER *Tringa hypoleucos*
A single Common Sandpiper was seen during September-October, 1968. Orenstein and Kikkawa also recorded a single bird in October 1972. MacGillivray (1928) recorded "several" individuals on 7 December 1927.

GREY-TAILED TATTLER *Tringa brevipes*
Common throughout the year, but most evident in the summer when numbers average about 150 birds. This and the Mongolian Sand-Dotterel are the most common palaeartic waders in the Capricorns.

WANDERING TATTLER *Tringa inoana*
A single Wandering Tattler was identified among 200 Grey-tailed Tattlers in October 1968. Probably the bird is more common than this, but we did not make the extra effort required to separate it from the more common Grey-tailed Tattler.

KNOT *Calidris canutus*
A rare but regular summer resident on the island. Three were present during September-October 1968 and eight were censused in January 1972, but individuals occurred throughout the summer months of 1971-72.

GREAT KNOT *Calidris tenuirostris*

Three birds were observed by Orenstein in October 1972

SHARP-TAILED SANDPIPER *Calidris acuminata*

Recorded by MacGillivray (1928). Orenstein saw several in breeding plumage in October 1972.

RED-NECKED STINT *Calidris ruficollis*

Small numbers of Red-Necked Stints are present during the summer months and fifteen were counted in January 1972 and five were present during September-October 1968.

SANDERLING *Calidris alba*

Orenstein recorded several in October 1972.

BLACK-TAILED GODWIT *Limosa limosa*

MacGillivray (1928) recorded a single bird on 7 December 1927.

BAR-TAILED GODWIT *Limosa lapponica*

Small numbers of this godwit occur during the summer. Five were present in September-October 1968 and fifteen were censused during January, 1972.

SILVER GULL *Larus novaehollandiae*

The population of these birds varies from about 25-60 and the higher number seems to coincide with the nesting season of the terns. They were continually present during 1971 and 1972. The gulls are often seen near the nesting Crested and Roseate Terns. Silver Gulls were not seen to take eggs or chicks, except when the terns were disturbed by humans (Talbot, pers. comm.). However, in January 1972 Silver Gulls frequented the Great Crested Tern creche where they took fish brought to feed the young terns.

ROSEATE TERN *Sterna dougallii*

These terns appear only during the nesting season, when 300 or more may be present. In 1971 the first Roseate Terns appeared on 4 October and by 23 October there were 200 to 300 birds with 15 to 20 eggs located in the open area near the pond, where they seemed to prefer the areas near the margin of the shrubs. There were one or two eggs in each nest. Earlier, 12 eggs were laid in a grassy area out in the open on the western spit, but these shortly disappeared. No one was on the island for a week and upon returning most of the Roseate Terns had disappeared and the area they had occupied (near the pond) was empty. It was estimated that many of the chicks hatched between 17 and 24 November, but by 26 November there were only ten birds left on eggs, and soon even those disappeared. We are unable to account for the total destruction and disappearance of the eggs and hatchlings. Serventy *et. al.* (1972) mention that for some days newly hatched chicks can be killed by a heavy shower of rain and it is possible that this occurred. A small number of adult birds were seen around the island until January. In 1972 the first Roseate Terns were observed on 5 October and by 25 October there were approximately 100 on the island. By 11 December two colonies of Roseate Terns had established themselves on the upper beach (Fig. 1) and in both colonies there were 30 eggs and about 100 adult birds. No attempt was made by the Roseate Terns to nest near the pond in 1972. Observations were discontinued on 11 December 1972, but a group from the Australian Museum visited the island on 20 January, 1973 and were unable to find any nesting Roseate Terns or their young. (Chilvers, pers. comm.).

BLACK-NAPED TERN *Sterna sumatrana*

These terns are almost always present, the numbers ranging from ten to 250, being more numerous during the summer months. It is at this time that what appears to be mating activity occurs in the form of paired flights with much calling; however, nesting did not take place during the time we were on One Tree in 1971 and 1972. Chilvers (pers. comm.) counted 100 Black-naped Tern eggs in February 1973 on the north side of the island. Young were found in early March and it seems likely that our failure to record the nests of this tern was due to our absence from the island in February and March.

The Black-naped Tern is one of the most characteristic terns of the lagoon, and is commonly seen feeding during low tide by diving into the water for small fishes. It also hunts along the outer edge of the reef and joins other terns over schools of feeding game fish. They have been seen to take anchovies in the reef lagoon and also to hunt over the dense schools of atherinids.

BRIDLED TERN *Sterna anaetheta*

During the nesting season there are from 300 to 500 Bridled Terns on the island. These terns prefer the area of low shrubs for their nests and nest over the entire island. The egg is laid in small natural cavities among the rubble, usually in a place shaded by vegetation. During both 1971 and 1972, the Bridled Terns returned to the island on 6 October. Their appearance is preceded by much calling during the nights which commenced around the middle of September. The first birds appeared on the long spit near the western end of the island, and about two weeks later, Bridled terns could be found over the entire island and soon began laying. No courtship behaviour or mating was observed and the birds seemed to be paired when they arrived. However, it is possible that pairing occurs during the night when these terns are very active and noisy. During 1971 the first eggs were discovered on 31 October and the first chick on 26 November; in 1972 the first eggs were seen on 7 November with the first chick found on 4 December. Only one egg is laid. Upon hatching, the chicks are a mottled dark brown colour, blending well with their background, and within a day or so conceal themselves by crawling into any nearby hole or under thick vegetation. The mortality of eggs and hatchlings appears to be low, but was not measured. Bridled Terns leave One Tree Island in early March. Food is obtained from the open sea and Bridled Terns were frequently observed feeding near One Tree reef. On boat trips to other islands and the mainland, Bridled Terns were noted feeding with Noddies over schools of game fish. In January, 1972 a sample of fish was obtained from Bridled Tern chicks and found to contain mostly anchovies (Table III). This is similar to the prey taken by Noddies on Heron Island (Recher, pers. obs.) and closer study will probably show that Bridled and Noddy Terns hunt in a similar fashion and take similar prey, but that the noddies hunt close to reefs and the Bridled Terns far from reefs.

LITTLE TERN *Sterna albifrons*

Observations on this bird are limited. It does not nest on the island, but is probably present in small numbers throughout the year. Heatwole *et al.* recorded this tern only in November-December 1971. This tern is easily overlooked.

CRESTED TERN *Sterna bergii*

From 10 to 20 individuals are commonly found throughout the year, but during the nesting season the numbers increase to around 300. In 1971 there was only one colony of nesting Crested Terns (with the exception of a few birds near the pond). This was near the southeast corner of the island on the outer margin of vegetation and well above the high tide mark. Eggs were laid in the open amongst the rubble. On 17 November there were approximately 250 terns on this site with 200 eggs, and the first chicks were discovered on 5 December. By 26 December, most of the Crested Terns had left the site and were gathered with their chicks along the seaward margin of the island (south-eastern), and by 9 January, the nesting site was deserted. The first chicks were observed flying on 20 January. During 1972 there were three colonies with the site of the 1971 colony being the largest. The second colony was located about 170 metres around the island to the west, and the third colony about 100 metres around to the east, both along the outer margin of vegetation (Fig. 1). In 1972 the first eggs belonging to the Crested Terns were discovered at the site of the 1971 colony, 21 eggs on 13 November, 100 by 29 November, and by 11 December there were 200 eggs at this site. The first chick was discovered on 4 December. On 17 December 13 eggs were discovered in the second site (west) and 45 eggs at the third site (east) with many more adult birds present on both sites. Observations ceased at this time.

When the young are about three weeks old, the nesting site is deserted and a creche is formed on the water's edge. There is no obvious reason for this behaviour and it does cause certain problems. The creche in January 1972 comprised about 200 young terns, a number of Silver Gulls, and at times, a Reef Heron. The gulls and Reef Heron stole food from returning adults. Difficulties in locating the correct chick and the attempts of the gulls to steal food meant that adult terns often spent up to 30 minutes flying over the creche before landing and feeding their young. Every tern returning to the creche was subjected to attacks by the gulls. Fish were almost always taken from the adult tern and the gulls concentrated their attention on terns carrying large fish. A large proportion of the larger fish brought to the creche were taken by gulls. Terns with large fish were hampered to some extent by the fish they were carrying and could less easily avoid the gulls. A large fish is also easier to take hold of and most gulls waited until the tern had landed before attempting to pirate food. The speed with which the tern chicks swallowed even large fish made it difficult for the gulls to pirate food from the young birds. Reef Herons stole both large and small fish from the terns. While gulls attempted to make the terns drop the fish they were carrying, a heron remained inconspicuous and simply took fish from passing or landing terns with the same striking motions they use to catch fish in the water.

An advantage of the creche may be to spread the risk of gull piracy over a greater number of individuals and increase the individual's chance of successfully feeding its young. However, the concentration of young in the creche also prevents the gulls from attacking chicks and forcing them to regurgitate food. The high level of successful piracy by gulls suggest that the youngest terns in the creche will have a greatly reduced chance

of survival as the attention of the gulls (and herons) is directed to fewer and fewer returning adults.

The mortality rate for the Crested Terns would appear to be about 50%, with only about half of the eggs laid producing birds that reach maturity. While the Crested Terns will feed within the lagoon, especially so when large schools of atherinids are present, they are most commonly observed hunting along the seaward reef margin, and seem to favour the shallows near the surf on the more windward areas of the reef. Here they are often seen standing on boulders or flying low over the water and diving to capture fish. They also join the mixed flocks hunting over schools of game fish. Prey obtained from young terns in January 1972 included a mixture of open water and reef fishes, reflecting the feeding habits of the bird (Table III).

Frequent food item of Crested Terns was a balistid (*Arotrolepis filicauda*) (Table III). This fish has a large dorsal spine which locks into position and would prevent it being swallowed by a tern. However, all the specimens of this species (n = 11) and a single species of *Cantherhines fronticinctus* recovered from young terns had this spine missing. Observation at the creche showed that the spine was absent on all balistids brought in, indicating that the spine was removed before the adult returned to the creche.

LESSER CRESTED TERN *Sterna bengalensis*

This tern has similar habits to the Crested Tern which it resembles, and is usually found along the seaward reef margin. Some of these terns are always present on the island, but their numbers are much smaller than the Crested Tern and range from about 5 to 40, being more numerous during the summer. During 1971 noisy paired flights were observed in the middle of September and could indicate mating behaviour. In early November several Lesser Crested Terns were observed sitting on eggs near the pond, but disappeared within a week or so. During 1972 no Lesser Crested Terns were observed nesting.

WHITE-CAPPED NODDY *Anous minutus*

There appears to be a static population of about 150 birds on the island. These roost in the *Pisonia* and *Messerschmidia* trees during the night, although some birds are present during the day. These birds feed at sea and can often be seen over schools of fish in the deep water along the edge of the reef. They also hunt well out to sea from the reef (15km or more). They usually hunt in places where "game fish" (e.g. bonito) are hunting and may depend upon these fish to drive the small fish to the surface where the noddies can take them. Noddies do not dive like other terns, but skim low over the water taking prey from near the surface. The noddies do not nest on One Tree Island, although large numbers nest on most of the larger islands of the Capricorn and Bunker groups.

HORSFIELD BRONZE CUCKOO *Chrysococcyx basalis*

Orenstein identified a single bird seen on 13 October 1972 as this species.

GOLDEN BRONZE CUCKOO *Chrysococcyx plagosus*

Heatwole *et. al.* recorded this species in September-October 1969 and May-June 1970.

SHINING BRONZE CUCKOO *Chrysococcyx lucidus*

A cuckoo recorded on 3 October 1968 was probably this species, but separation of *plagosus* and *lucidus* is difficult in the field.

KOEL *Eudynamis scolopacea*

A male bird was recorded on 21 September 1968.

SPINE-TAILED SWIFT *Hirundapus caudacutus*

A single bird was recorded by MacGillivray (1928) on 7 December 1927.

SACRED KINGFISHER *Halcyon sancta*

It is a resident but there are no confirmed nesting records. At the most two birds were observed and for long periods only one individual seemed to be present. This species may move between islands.

DOLLAR-BIRD *Eurystomus orientalis*

A single bird was seen on 2 October 1968 and two birds were on the island on 10 October 1968. It was also recorded by Heatwole *et al.* in September-October, 1969, and March-April, 1970.

WELCOME SWALLOW *Hirundo neoxena*

Recorded by Heatwole *et al.* in March-April 1969 and 1970.

BLACK-FACED CUCKOO SHRIKE *Coracina novaehollandiae*

A single bird occurred on 2 October and 8 October 1968 and individuals were heard flying overhead on 29 and 30 September 1968. It was also recorded by Heatwole *et al.* in May 1968, September-October 1969 and May-June 1970.

WHITE-WINGED TRILLER *Lalage sueurii*

It was recorded by Heatwole *et al.* in May 1968, September-October 1969 and November-December 1971.

GOLDEN-HEADED FANTAIL-WARBLER *Cisticola exilis*

It is a common breeding resident on the island, nesting in the low vegetation (dominated by *Wedelia biflora*) which occurs over most of the central portion of the island. Birds were breeding in September-October 1968, but probably not in January 1972.

GREY FANTAIL *Rhipidura fuliginosa*

It was recorded by Heatwole *et al.* in May-June 1971.

LEADEN FLYCATCHER *Myiagra rubecula*

A singing male was sighted by Kikkawa in October 1972.

SATIN FLYCATCHER *Myiagra cyanoleuca*

It was recorded by Heatwole *et al.* in May 1968, January-February 1969 and September-October 1971. A male was noted by Orenstein in October 1972.

BLACK-FACED FLYCATCHER *Monarcha frater*

A single bird was sighted by Orenstein in October 1972.

WHITE-EARED FLYCATCHER *Monarcha leucotis*

A single bird was recorded on 12 October 1968.

RUFIOUS WHISTLER *Pachycephala rufiventris*

A single bird was recorded on 12 October 1968. It was also recorded by Heatwole *et al.* in March-April 1970.

GREY-BREASTED SILVEREYE *Zosterops lateralis*

It is a resident but only small numbers are present (six were counted in October 1968) and some individuals in January 1972 had colour bands suggesting that they came from or visited Heron Island where Kikkawa (1970) has an extensive marking program on *Zosterops*. In October 1972 Kikkawa netted 14 birds of which three had been banded previously on Heron Island. They probably breed on the island.

MANGROVE HONEYEATER *Meliphaga fasciogularis*

A single bird was recorded on 18 September 1968.

HOUSE SPARROW *Passer domesticus*

One female was noted by Kikkawa in October 1972.

STARLING *Sturnus vulgaris*

Single birds were resident on One Tree Island between 15 September and 22 September 1968 and again between 9 October and 12 October 1968. The species was also recorded by Heatwole *et al.* in September-October 1971, and by Orenstein in October 1972

SPANGLED DRONGO *Dicmurus bracteatus*

It was recorded by Heatwole *et al.* in May 1968 and May-June 1969.

MAGPIE LARK *Grallina cyanoleuca*

It was recorded by Heatwole *et al.* between March and October 1970, and by Orenstein in October 1972.

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ADDENDUM

by KEES HULSMAN

The following observations have been made by Ted and June Chilvers, Katerina Lundgren, Jiro Kikkawa and Kees Hulsmán since the work of Domm and Recher. The Red-tailed Tropicbird *Phaethon rubicauda* sighted (TC) over the island on 27 March 1973 is the only addition to the species list. In October 1973 single individuals of the Spangled Drongo, Golden Bronze Cuckoo and Dollar Bird were seen on the island (T & JC), and breeding of Grey-breasted Silvereye was confirmed (JK). The Breeding of Silver Gull was also confirmed in 1973. Several small chicks were seen in February and March and again in August (JC & KH). Two eggs in a clutch of the Sooty Oystercatcher were found on 9 August 1973 (JC). Breeding attempts by a few Lesser Crested Terns on the island were noted in August (KL, JC & KH), but they failed to produce young (JC) on the island. However, on 20 September 120 eggs of this species were found (JC & KL) on a small rubble bank within the One Tree Lagoon about 2 km from the island. About 12 of these had hatched by the end of September (JC & KL) and 85 chicks three to four weeks old were counted in a creche on 25 October 1973 (JK & KH). On 26 October 1973 a flock of 105 Little Terns visited the island (JK & KH). None had breeding plumage.

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A SIGHT RECORD OF BULLERS SHEARWATER IN QUEENSLAND

A. GREENSMITH

On 24 March 1973, Miss H.V. Belsö, R.S. Brown, K. Taylor and myself were watching sea-birds from Point Lookout, North Stradbroke Island. A sea-watch was carried out continuously in the five hours from mid-day, the wind being high from the south south-east with frequent spells of heavy rain. Large numbers of terns passed south including approximately 1,500 Little Terns, *Sterna albifrons* and 40 Common Noddy *Anous stolidus*. Three Arctic Skua *Stercorarius parasiticus* (light phase) passed north and a single Southern Skua *Stercorarius skua* south. Shearwaters passed south in good numbers, the majority being the Wedge-tailed Shearwater *P. pacificus*, but with smaller numbers of Fluttering Shearwaters *P. gavia*. Approximately 800 Wedge-tailed Shearwaters passed south in the five hours and among them were at least seven birds which were considered to be Bullers Shearwater *Puffinus bulleri*.

All passed singly at a medium distance and were easily picked out both through 10 x 40 binoculars and a 40x telescope. In size they appeared as large as *P. pacificus* and were similar in shape, these birds also showing the forward angled wings and elongated wedge-shaped tails. The flight was also similar to that of *P. pacificus* being light and drifting with comparatively slow wing beats compared with other *Puffinus* species, with frequent glides and banking into the wind. This manner of flight differs considerably from all other *Puffinus* species with which I have had experience in Australia, reminding me most of a Northern Hemisphere species, the Cory's Shearwater *Calonectris diomedea*. The under-parts were strikingly white including the under wing coverts which contrasted with the dark under flight feathers and dark cap. The upper-parts were medium grey, a point by which they could be located even when the white under-parts were not visible. The blackish primaries contrasting with the general grey of the upper wings was readily discernable through the telescope, however, due to the frequent banking of the birds in the strong winds and their frequent disappearing into wave troughs, little else was seen of the upper wing pattern.

The only other species of similar size to *P. bulleri* that could possibly be mistaken for it in the field is the white-breasted phase of *P. pacificus*. This is the common phase of many Northern Hemisphere populations and is found in the Pacific Ocean south to about 10°N, after which nearly all the birds are of the dark phase. Until recently this white phase was thought to be

restricted, in Australian waters, to populations that breed on the islands off Shark Bay, Western Australia, where Serventy (1972) estimated the pale phase to constitute 20-30 per cent of the total population. Recently, however, Lane (1972) collected one and saw possibly a second individual on North Solitary Island, New South Wales. In his description he states that the "Upper-parts and tail were a dark brownish black." Serventy *et al.* (1971) state that the two should be separable at sea because Bullers Shearwater is grey backed whereas the white phase *pacificus* is brown backed. This is confirmed by K. Taylor (pers. comm.) who has had previous experience with both *bulleri* and white phase *pacificus* in the field and assures me that white phase *pacificus*, in his experience, always has brown upper-parts, only slightly lighter in some cases than dark phase birds and never showing dark primary contrasts as noticeable as in *bulleri*. Therefore it seems that the grey upper-parts with the noticeable dark primary contrasts are conclusive pointers to *bulleri*.

Bullers Shearwater is an exclusively New Zealand breeding species, nesting on the islands off the North Coast. The eggs are evidently laid about the last week of November or the first week of December (Falla 1934) and the chicks apparently hatch in January and depart late in March. It is suggested by Bourne (1962) that the species takes a circular course up the west side of the Pacific and then down the east side, possibly returning along the Southern Tropical Convergence or further south in the Westerlies. If this is correct, it seems most likely that the Queensland birds originated from post breeding individuals, possibly inexperienced young of the year, that were displaced by the strong south south-east winds while on their migration north and later joining the movement of *pacificus* to the south.

Serventy *et al.* (1971) list four previous records for Australia, all from New South Wales. Two dead birds were washed ashore near Sydney (Hindwood 1955). They were found 31 October and 14 November 1954, respectively, along with numbers of other *Puffinus* species. On 10 October 1960, F.N. Robinson captured a bird on Montague Island off Narooma, New South Wales and on 11 December 1960, another was found in a burrow on Cabbage Tree Island, New South Wales (D'Ombra and Gwynne 1962). This last record is of particular interest as the authors suggest that a few birds may breed on some of the coastal islands off New South Wales. Also of interest is the remark that "One of us (A.F.D.) had seen similar birds off the coast when game fishing some years ago." The only other record I know of is of a single bird seen close inshore off North Head, Sydney by Mr John B. Cox on 15 November 1971. He states (pers. comm.) that he is quite certain of its identification and had good views of the dark cap, grey back, dark 'M' marking on wings and white under-parts. It therefore appears that if our sighting is

accepted it is only the sixth record of *Puffinus bulleri* for Australia and the first for the state of Queensland.

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