Current status and trends of seabirds on the Great Barrier Reef

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Abstract

The Great Barrier Reef (GBR) has more than 25% of the breeding population of Australia's tropical seabird species. The distribution and abundance of these species shows a latitudinal as well as a longitudinal pattern. Most major colonies are in two sections of the GBR Marine Park: Far Northern and Mackay/Capricorn. This is because their preferred island type (coral cays) are concentrated in these two areas.

The pressures that affect the viability of seabird populations are of anthropogenic or non-anthropogenic origin. For example, pressures from increased human activity in the GBR are in addition to those exerted by climatic effects such as reduced food supply caused by El Niño events, cyclones and gales; and biological interactions. The pressures of anthropogenic origin can be managed to a large degree, whereas those of non-anthropogenic origins cannot. Therefore management of seabird populations and their habitats must be affected by controlling the pressures exerted by human activities.

Just how much control is required is not yet clear for most localities because our knowledge of the trends in the population sizes of various species and the reasons for those trends is inadequate. This is in part a result of inadequate knowledge about which population model best fits some species and the lack of essential data such as rates of increase, extent of migration between colonies, and the main causes of mortality of each age group.

The current status of management of seabird populations is that it is under review. The management and research priorities are being determined. One of the focuses of the review is to develop standardised seabird monitoring procedures and data sharing arrangements between Commonwealth and State Agencies.

The lack of vital statistics such as recruitment rates, amount of exchange between colonies, and age-specific mortality make it difficult to determine the most appropriate management plan. In this context it would be wise to adopt a flexible management approach. An Adaptive Management Framework provides that flexibility. One of the key elements of such an approach is monitoring to determine the effects of the management actions taken so that they may be refined or altered to produce the desired outcomes.

Introduction

This paper examines the current status of seabirds on the GBR and trends in their population sizes. For example, are the populations decreasing, remaining constant or increasing? It discusses possible causes for these trends, and management strategies necessary to ensure the continued survival of the seabirds?

Distribution of each type of island on the Great Barrier Reef

There are over 1000 islands and cays on the GBR (King 1993; Ogilvie and King 1993). The GBR has been divided into four biogeographical regions: Torres Strait; Northern; Central; and Southern Regions to assist in the planning for the conservation requirements of seabirds (Ogilvie and King 1993). However, the GBR has also been divided into four management sections by the Great Barrier Reef Marine Park Authority, and these do not coincide with the biogeographical regions. These four management sections (Far Northern, Cairns, Central and Mackay/Capricorn) are used for the purposes of this paper because of its management orientation.

There are eight types of island in the GBR Region. They are high continental, low wooded, mangrove, rock, sand cay, vegetated sand cay, shingle cay, and vegetated shingle cay (see Hopley 1982; King 1993).

High continental is the most common island type in the GBR region (73.2%, Fig. 1), and it is the most common type in each of the four management sections. High continental islands are more numerous toward the southern half of the GBR than in the northern half (Fig. 1). Unvegetated and vegetated sand cays (8.3 and 8.0% respectively) are the next most numerous island types followed by low wooded islands (7.0%). These islands occur mostly in the northern and/or southern extremities of the GBR (Fig. 1, Hopley 1982 [Fig. 11.21]). The remaining types are comparatively rare.

Cays are most numerous on the inner shelf of the Far Northern Section, then the mid shelf of the Mackay/Capricorn Section, and the outer shelf in the Far Northern Section (Hulsman 1996). The bulk of the High continental islands are on the inner shelf in each section except for the Mackay/Capricorn Section where they are more common on the mid-shelf (Table 2; Hulsman 1996).

The relationship between the percentage of islands occurring in each section and major seabird colonies is not very strong (Table 3). However, there is a pronounced relationship between the percentages of cays (vegetated, unvegetated sand and shingle cays) and major seabird colonies (i.e. monotonically increasing, Table 2). This association alludes to a number of questions regarding the distribution of seabird colonies in relation to island type and location on the continental shelf.

Proportion of each type of island (in each section and position on continental shelf) with seabird colonies (major/minor)

Habitat requirements of seabirds include access to suitable areas for breeding and foraging (Hulsman 1980). The habitat requirements for breeding and foraging are intertwined because without an adequate food supply the parents are unable to raise their young to independence.

Habitat requirements for breeding differ in detail between species, but they have basic needs in common. They require: 1) an area free of disturbance by terrestrial predators, humans (directly and indirectly), storms and the tide; 2) conspecifics, including potential mates; and 3) suitable access to foraging grounds.

Table 2. The mean number of species from pelagic, offshore and inshore feeders in relation to island type and its location on the continental shelf. Abbreviations are as per Fig. 1

Island type and location on shelf	Section	Pelagic	Offshore	Inshore	Mean species richness
Continental					
inner	FN	2.0	3.0	3.0	8.0
	C	0.0	1.0	3.3	4.3
	CNL	1.0	1.0	2.0	4.0
	M/C	0.0	1.0	2.0	3.0
	mean	**0.6**	**1.1**	**2.4**	**4.7**
mid-shelf	CNL	0.0	0.3	2.7	3.0
	M/C	0.0	1.0	1.0	2.0
	mean	**0.0**	**0.4**	**2.6**	**3.0**
Low wooded					
inner	FN	0.0	1.5	1.8	3.25
Sand Cay					
mid-	M/C	1.0	1.0	3.3	5.3
outer	FN	0.7	2.2	0.5	3.3
Vegetated Sand Cay					
inner	FN	0.2	0.7	4.6	5.4
mid	FN	0.0	0.0	4.0	4.0
	C	0.0	1.0	5.0	6.0
	M/C	0.9	1.8	2.5	5.2
	mean	**0.7**	**0.8**	**3.1**	**4.5**
outer	FN	3.0	2.8	3.0	8.8
	C	1.0	3.0	5.0	9.0
	M/C	1.0	1.5	1.5	4.0
	mean	**2.4**	**2.7**	**3.0**	**8.4**
Vegetated Shingle Cay					
outer	M/C	0.3	1.7	2.0	4.0

Table 3. Percentage of islands in each of the four sections of the Great Barrier Reef Marine Park and the percentage of major seabird colonies in each of those sections

Section	% Islands	% major colonies	% cays
Mackay/Capricorn	44.5	40.4	26.0
Far Northern	25.8	42.1	60.0
Central	22.2	3.5	0.6
Cairns	3.5	14.0	15.4

Walker (1990) recognised four general breeding distributions for the numerically important species. First, Silver Gulls (*Larus novaehollandiae)*, Crested, Black-naped and Bridled Terns breed in colonies scattered along the entire length of the GBR. Second, Common Noddies, Lesser Crested and Sooty Terns breed almost entirely in the northern half of the GBR. Third, Wedge-tailed Shearwaters and Black Noddies breed almost entirely in the southern end of the GBR. Fourth, Least Frigatebirds, Roseate Terns, Brown and Masked Boobies breed at the northern and southern ends of the GBR.

Seabirds may be divided into inshore, offshore and pelagic feeders on the basis of a suite of characteristics (see Hulsman 1988). The adaptations of the birds enable them to venture away from their young for short periods (inshore feeders), for long periods (offshore feeders) and very long periods (pelagic feeders). These different adaptations affect how far from the colony

parents may forage, the feeding rates and hence the growth rates of their young (Lack 1968; Hulsman 1988). How these adaptations affect the impacts that climatic effects have on the seabirds will be addressed shortly. Their relevance here is that they affect the longitudinal pattern (i.e. cross shelf) of seabird distribution (see Walker 1990; Hulsman 1996).

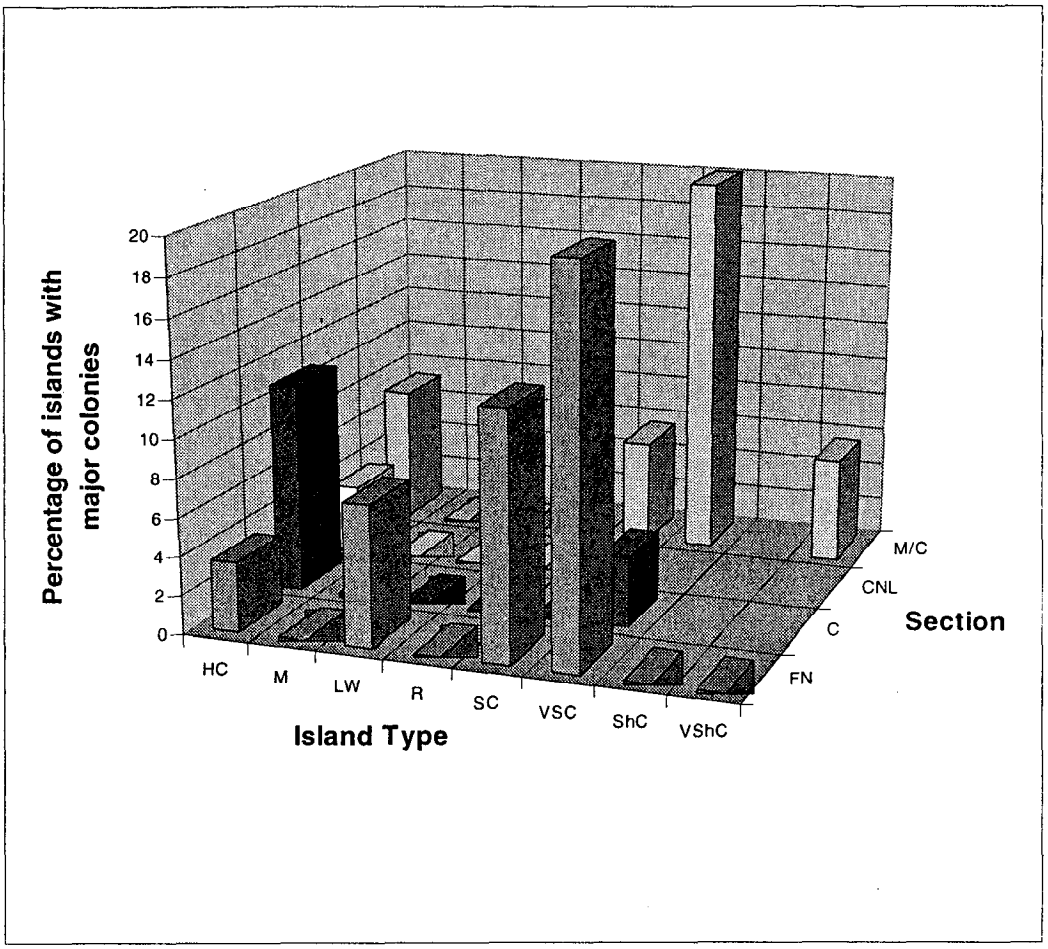

Figure 2. Distribution of major seabird colonies on the Great Barrier Reef in relation to type of island and section of the Great Barrier Reef Marine Park

The basic longitudinal pattern of seabird distribution on the GBR is that close to the mainland (inner shelf) seabird communities are dominated by inshore feeders, but some offshore and pelagic feeders may be present. Further offshore (mid-shelf and outer shelf) more offshore and pelagic feeders occur (Walker 1990, 1994). This pattern, as expected, relates to accessibility of prey habitat types. This is further supported in the Far Northern Section, where the continental shelf is less than 40 km wide. Here large numbers of pelagic species breed on inner shelf islands, e.g. Quoin Island.

Other biogeographic factors may modify where seabird breeding concentrations occur across the continental shelf. For example, the species composition of the Swain Reefs' cays has been likened to that of the Coral Sea cays (Limpus and Lyon 1981), with more pelagic species than other areas in the southern GBR such as the Capricorn and Bunker Groups. Although the Swain Reefs are remote and distant from the mainland, they are spread over a large area with the cays between 50 and 130 km from the edge of the continental shelf. In contrast, the cays in the Capricorn and Bunker Groups are much closer to the mainland but within 40 km of the edge of the continental shelf. This apparent paradox of having more pelagic species nesting in an area

further from the edge of the shelf is at least partly caused by large differences in the total width of the shelf in these two areas. Differences in latitude, variations in reef morphological influences on availability of prey, and proximity to the Coral Sea probably all have some influence on species composition, and help illustrate the range of modifying factors that may influence where seabirds breed.

A greater percentage of islands in the Cairns and Far Northern Sections are occupied by major seabird colonies than in the Central and Mackay/Capricorn Sections. The occupancy rates are not only affected by the need for specific island types for nesting, but also by the numbers of each island type. For example, there are a large number of continental islands and a very small number of vegetated shingle cays. It is also evident that vegetated shingle cays have a higher occupancy rate than sand cays, vegetated sand cays, low wooded and continental islands (Table 2), but because there are so few vegetated shingle cays on the GBR these figures may be misleading.

Occupancy rates of different island types can be useful in providing insights into the effects that island type and location on the continental shelf (proximity to areas suitable for foraging) have on the selection of nesting islands by seabirds. It should also be noted that the 54 major seabird islands are distributed on the various island types in the following proportions: vegetated sand cays (50.0%), sand cays (16.7%), high continental islands (20.4%), low wooded islands (7.4%) and vegetated shingle cays (5.6%).

Continental islands, irrespective of their location on the continental shelf, are not preferred breeding areas. Further, it is not an island's location alone that determines whether seabirds nest on it in large numbers. For example, the vegetated sand cays on the inner shelf in the Far Northern Section had a lower occupancy rate than those on the mid shelf in the Far Northern Section and outer shelf in the Mackay/Capricorn Section (Table 2). There is probably something about the topographical and vegetational features of the cays that affects whether they are suitable for a major colony.

Habitat characteristics such as height above the high water and the presence of suitable vegetation in terms of height, strength and abundance are important for successful breeding. Heatwole et al. (1981) showed that the height of the herb layer affected where terns nested on One Tree Island. The Crested Tern, with its longer tarsi, could nest in sites where the herb layer was too high for Black-naped and Roseate Terns. However, where the herb layer was high enough to nest under it was utilised by Roseate Terns, but not Crested Terns. Bridled Terns nested under the shrubs and small trees. The matching of different habitat requirements of species to the characteristics of habitats and the area that it occupies on a specific island also affects whether a given species will nest there in significant numbers.

It is important to note at this stage that pelagic, offshore and inshore feeders differ in the size of their colonies. Lack (1968) argued that pelagic feeders, because of their ability to venture far from their colonies in search of food and still raise young successfully, are able to select breeding sites far from their foraging grounds. Therefore, they can be more selective about where to nest and for safety and social reasons can nest in very large colonies. In contrast, inshore feeders had a suite of adaptations that do not allow them to venture far from their colonies in search of food. Therefore they nest close to their foraging areas. However, large aggregations of inshore feeders would increase competition for food near the colony, and therefore they tended to nest in small colonies. Offshore feeders fall between these two extremes.

This model accounts for the distribution and abundance of the various seabird species on the GBR. Inshore feeders, such as Black-naped and Roseate Terns, form numerous small colonies