

Vulnerable and threatened: the seabirds of the Coral Sea

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Bridled tern (*Onychoprion fuscatus*), Chesterfield Islands © IRD/E. Vidal

The Coral Sea, a tropical sanctuary for seabirds

The term "seabirds" refers to several families of birds that mostly live at sea or on the shore, and mainly feed on marine animals: fish, crustaceans, squids and other marine invertebrates. Shearwaters and petrels are typical oceanic birds. They are remarkably efficient gliders, good divers, and are capable of transoceanic migrations. The birds of two other families, frigatebirds and tropicbirds, also spend most of their lives offshore, flying over very long distances across the oceans. The foraging range of boobies extends more or less offshore where they usually plunge-dive to catch fish, although they are also able to catch flying fish in midair. Terns and noddies include both

oceanic and coastal species and seagulls feed at the coast or in the lagoon. All these species come back to the shore for breeding because seabirds, like most birds, incubate their eggs and raise their chicks at, or near, the nest for several weeks to several months

The Coral Sea is one of the last tropical regions on the planet where the impact of human activities has been relatively low. Therefore, seabirds, which are sensitive indicators of the state of preservation of marine ecosystems, are still diverse and abundant. Because of their isolation and proximity to feeding areas at sea, coral cays and islets are prime sites for nesting seabirds and are also used for resting outside the breeding season. Although small, these coral

cays are essential habitats for seabirds. During the breeding season, they can host entire populations of birds that usually occupy hundreds of thousands of square kilometers over the ocean.

Most of the seabird colonies of New Caledonia are concentrated on four groups of reefs: the Chesterfield-Bampton Archipelago in the middle of the Coral Sea, the d'Entrecasteaux Reefs to the north of Grande Terre and the islets of the northern and southern lagoons. Uplifted and uninhabited coral reef islands, such as Beautemps-Beaupré and Walpole, are also favorable sites for the reproduction of seabirds. Walpole Island alone is home to at least 11 species of breeding seabirds, including a large colony of brown boobies and one of the few white tern colonies in the Southwest Pacific.

Engineers of coral cays and islets

Different breeding seabird species colonize islets with different vegetation types. For example, the fairy tern lays its eggs in the sand or among coral debris on beaches and sandy cays. Other terns, such as the roseate tern or the sooty tern, nest in dense colonies on cays with almost no vegetation. Others, such as the white tern and the black noddy nest in trees, and therefore only settle on tree-covered cays and islets. Brown noddies can arrange rudimentary nests on the ground or build large and very elaborate nests made of intertwined thin twigs, low down in shrubs. Similarly, the brown booby and the masked booby lay their eggs on the ground, while the red-footed booby and the great frigatebird build large nests made of branches in the trees. Among the petrels, the wedge-tailed shearwater and the Tahiti petrel dig burrows either in sand patches consolidated by herbaceous vegetation or sheltered by the roots of trees. Black-winged petrels also nest in burrows, but they tend to prefer tree-covered islets.

Seabird colonies established on bare cays promote the development of vegetation by fertilizing the islet with their droppings, which contain nitrates and phosphates. An ephemeral ecosystem develops during the breeding season and takes part in the genesis of the soil of the islet, with the contribution of organic matter from unhatched eggs, uneaten regurgitated preys, and dead



Red-footed boobies (*Sula sula*) in velvetleaf soldierbush, Chesterfield Islands. © IRD/P. Borsa



Black noddy (*Anous minutus*) Surprise Island. © IRD/E. Vidal



Masked booby (*Sula dactylatra*) and chick, Loop Islet, Chesterfield. © IRD/R. Proner



Brown bobby (*Sula leucogaster*), Ile Surprise. © IRD/E. Vidal

bird carcasses. The vegetation contributes to the stabilization of the islet, increases its resilience to tropical cyclones, and therefore maintains the habitat available for breeding seabirds. Lastly, the decomposition of terrestrial plants, algae and other floating debris used for nests, as well as the accumulation of seabird droppings contribute to the vertical growth of the islets. Nutriments leaching into the water, or seabird droppings that are released directly into the ocean, possibly also contribute to the growth of corals. In conclusion, not only do seabirds play a key role in the growth and stabilization of coral reefs and islets, but it is possible that they also increase their resilience to extreme weather conditions.

A remarkable biodiversity

Twenty-four seabird species breed in the New Caledonian archipelago (Tabl. 1). The Gould's petrel is the only seabird that nests exclusively in the mountains of Grande Terre. All the other species have been reported to nest on coral cays and islets. The New Caledonian populations of fairy terns, silver gulls and Tahiti petrels are considered to be subspecies endemic to the Coral Sea, although the latter two still have to be confirmed by genetic analyses.

Fairy terns nest in the Chesterfield-Bampton Islands, and on cays of the northern and the southern lagoons. This species used to have a wider distribution in New Caledonia, but the total population is now limited to a few dozen breeding pairs. This makes fairy terns one of the most threatened species in New Caledonia. They are particularly sensitive to disturbance from visitors, which causes reproductive failure.

The most abundant seabird of New Caledonia is the wedge-tailed shearwater. The numerous colonies on islets of the southern and northern lagoons, and in the Chesterfield-Bampton Archipelago, each include several hundred to several tens of thousands of breeding pairs. With a total population exceeding 500,000 breeding pairs, New Caledonia hosts a significant part of the world's population for this species (estimated at about 5 million individuals). Such an abundance can be explained by several factors. Firstly, the availability of nesting sites free from natural predators; secondly, the

availability of prey in sufficient densities within the seabirds' prospecting radius, their adequate size and quality (squid and small pelagic fish), and their accessibility (marine predators such as tuna and cetaceans bring schools of fish closer to the surface and make them more accessible to seabirds). Wedge-tailed shearwaters, like other petrels, are also able to adapt their foraging strategy to the spatial availability of resources according to the phase of their breeding cycle. During the breeding season, the seabirds go out to sea for short trips of one or two days in the proximity of the colony. When they return, they regurgitate their prey to feed their chicks. These short trips alternate with longer trips (of up to 12 days) further offshore, during which they forage for themselves. Once relieved from the constraints of breeding on land, the wedge-tailed shearwaters migrate across the ocean to reach the tropical water resources of the North Pacific, between Micronesia and the Line Islands.

Two other emblematic species breed, or have bred, on New Caledonian coral cays: the Herald petrel and the Polynesian storm-petrel. The Herald petrel was described from three specimens, presumed to have been collected during a visit by the British ship *Herald* to the Chesterfield Islands in the mid-nineteenth century. This was before the intensification of whaling expeditions to the Coral Sea and before guano mining. Since then, there has been no other observation of breeding Herald petrels in New Caledonia. The Polynesian storm-petrel was reported from the Northern Lagoon (Grand Lagon Nord) in the 1990s but has not been observed since and is presumed to have disappeared. According to the IUCN, this species is threatened by extinction, mainly because of introduced predators.

Populations threatened by anthropic activities

On Walpole Island and on many coral cays and islets around Grande Terre and in the Coral Sea, seabirds are exposed to predation by rodents that have been introduced by humans: the Polynesian rat, the black rat and the domestic mouse. Other undesirable invasive species include the electric ant, which harasses the nesting birds, and the cactus *opuntia*, which colonizes breeding sites and obstructs access to burrows. Environmental changes

induced by invasive species have a direct impact on seabird populations and can, in extreme scenarios, lead to local extirpation, which is likely to be the case for the Polynesian storm-petrel. Over the past two decades, rodent eradication campaigns have provided some respite for breeding seabirds at d'Entrecasteaux Reefs, in the Northern Lagoon (Grand Lagon Nord), and in the Southern Lagoon (Grand Lagon Sud).

Past human activities have also been a major cause of the degradation of nesting habitat. The Chesterfield Islands served as a land base for whalers operating in the Coral Sea and crews chopped wood for fire and collected eggs and chicks. Today, humans are still predators of seabirds on remote islets, as fishing vessels that venture to the Chesterfield-Bampton and d'Entrecasteaux reefs still capture booby and frigatebird chicks for food. Guano extraction, which took place at Chesterfield and d'Entrecasteaux, devastated the vegetation and soil of the islets, exposing them to extreme weather events. This may have caused the extinction of the Herald petrel and the red-tailed tropicbird in the Chesterfield Islands, and that of the silver gull on the d'Entrecasteaux Reefs.

The landing of visitors on the islets is another threat that is too often overlooked. A boat approaching an island is sufficient to flush out the breeding seabirds, and therefore expose eggs and chicks to scorching sun and dehydration. This can compromise the whole breeding season of a colony. Furthermore, visitors on foot can trample tern eggs and petrel burrows, and their dogs can catch both chicks and adults. The disturbance is at its highest during the holiday season, with fireworks, loud music and people partying on islets. The development of tourism increases the number of visitors on islets and decreases habitat availability for breeding seabirds. A tourist cruise company has recently decided to stopover at one of the most remote islets of the Southern Lagoon and at the Chesterfield-Bampton Islands. It advertises a "true paradise for nature lovers, which offers long pristine beaches to visitors and is home to thousands of seabirds". The huge size of a cruise ship anchoring near the islets, and the hundreds of tourists that would disembark, would be likely to seriously threaten the breeding season of the seabirds.

To the list of depredations experienced by seabird colonies, we can add the censuses done by amateur naturalists as without proper scientific supervision they represent a risk of disturbance and trampling, or the "health monitoring" program led by the veterinary authorities in the 1990s and which has led to the sacrifice of many seabirds of the Chesterfield Islands and Entrecasteaux.

Paths for future research on New Caledonian seabirds

With the miniaturization of electronics, it is now possible to fit seabirds with Argos transmitters, GPS trackers and other devices such

as diving recorders and heart rate sensors. Recorded data help us to better understand seabird movements and biology, as well as their behavior during their time away from the colony. In the future, it should be possible to automate the collection of data with recorders positioned near the nests. These devices will be able to download data every time a seabird visits its nest without any human action, thus minimizing the risk of disturbance. In addition to the knowledge that is acquired on seabirds themselves, it is now possible to consider using seabirds as "auxiliaries" for research programs. For example, seabirds will be able to inform scientists about sea temperature, or about the nature, depth and density of their prey. All this information will help us to better understand the ecology of the Coral Sea and the impact of global change on oceanic ecosystems.



Black noddy (*Anous minutus*) fishing at the Longue Island Pass, Chesterfield. © IRD/P. Borsa

Species	Scientific name	Nesting sites						
		Chest.	d'Entr.	GTL	N. Lag.	S. Lag.	W	M., H.
Seabirds <i>sensu stricto</i>								
Silver gull	<i>Chroicocephalus novaehollandiae</i>	-	†	-	X	X	-	-
Fairy tern	<i>Sternula nereis</i>	X	-	†	X	X	-	-
Black-naped tern	<i>Sterna sumatrana</i>	X	X	X	X	X	-	-
Roseate tern	<i>Sterna dougallii</i>	X	-	-	X	X	-	-
Crested tern	<i>Thalasseus bergii</i>	X	X	X	X	X	-	-
Bridled tern	<i>Onychoprion anaethetus</i>	-	-	-	X	X	-	-
Sooty tern	<i>Onychoprion fuscatus</i>	X	X	X	X	-	-	X
White tern	<i>Gygis alba</i>	-	-	-	-	X	X	X
Brown noddy	<i>Anous stolidus</i>	X	X	-	X	X	X	X
Black noddy	<i>Anous minutus</i>	X	X	-	-	X	X	X
Grey noddy	<i>Anous ceruleus</i>	-	-	-	-	-	X	X
Red-tailed tropicbird	<i>Phaethon rubricauda</i>	†	X	X	-	-	X	X
White-tailed tropicbird	<i>Phaethon lepturus</i>	-	†	-	-	-	X	-
Brown booby	<i>Sula leucogaster</i>	X	X	X	X	†	X	X
Masked booby	<i>Sula dactylatra</i>	X	X	X	X	†	-	X
Red-footed booby	<i>Sula sula</i>	X	X	-	-	X	X	X
Lesser frigatebird	<i>Fregata ariel</i>	X	X	-	-	-	X	X
Great frigatebird	<i>Fregata minor</i>	X	X	-	-	-	X	X
Wedge-tailed shearwater	<i>Ardenna pacifica</i>	X	X	X	X	X	?	X
Tahiti petrel	<i>Pseudobulweria rostrata</i>	-	-	X	X	X	-	-
Herald petrel	<i>Pterodroma heraldica</i>	† ?	-	-	-	-	-	X
Gould's petrel	<i>Pterodroma leucoptera</i>	-	-	X	-	-	-	-
Black-winged petrel	<i>Pterodroma nigripennis</i>	-	-	?	-	X	-	X
Polynesian storm petrel	<i>Nesofregatta fuliginosa</i>	-	-	-	†	-	-	?
SHOREBIRDS								
Great cormorant	<i>Phalacrocorax carbo</i>	-	-	X	-	-	-	-
Little pied cormorant	<i>Phalacrocorax melanoleucos</i>	-	-	X	-	-	-	-
Osprey	<i>Pandion heliaetus</i>	-	-	X	X	X	-	-
Beach thick-knee	<i>Esacus magnirostris</i>	-	-	-	X	-	-	-

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Table 1: List of breeding seabird and shorebird species recorded over the last two decades at different reef systems in the New Caledonian archipelago

Chest.: Chesterfield-Bampton.

D'Entr.: d'Entrecasteaux.

GTL: Grande Terre-Loyaty.

N. Lag.: Northern Lagoon.

S. Lag.: Southern Lagoon.

W.: Walpole.

M.: Matthew.

H.: Hunter.

†: species presumed locally extinct.

?: species believed to be breeding, but whose reproduction has not been formally recorded to date.

Adapted from SPAGGIARI *et al.*, 2007 and author's original data

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Loading of a mikwaa net on a decked pirogue at Pwadèwia, St. Joseph Bay,
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