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**BIRDS AND PEOPLE ON ONTONG JAVA ATOLL, SOLOMON ISLANDS, 1906-
2008: CONTINUITY AND CHANGE**

BY

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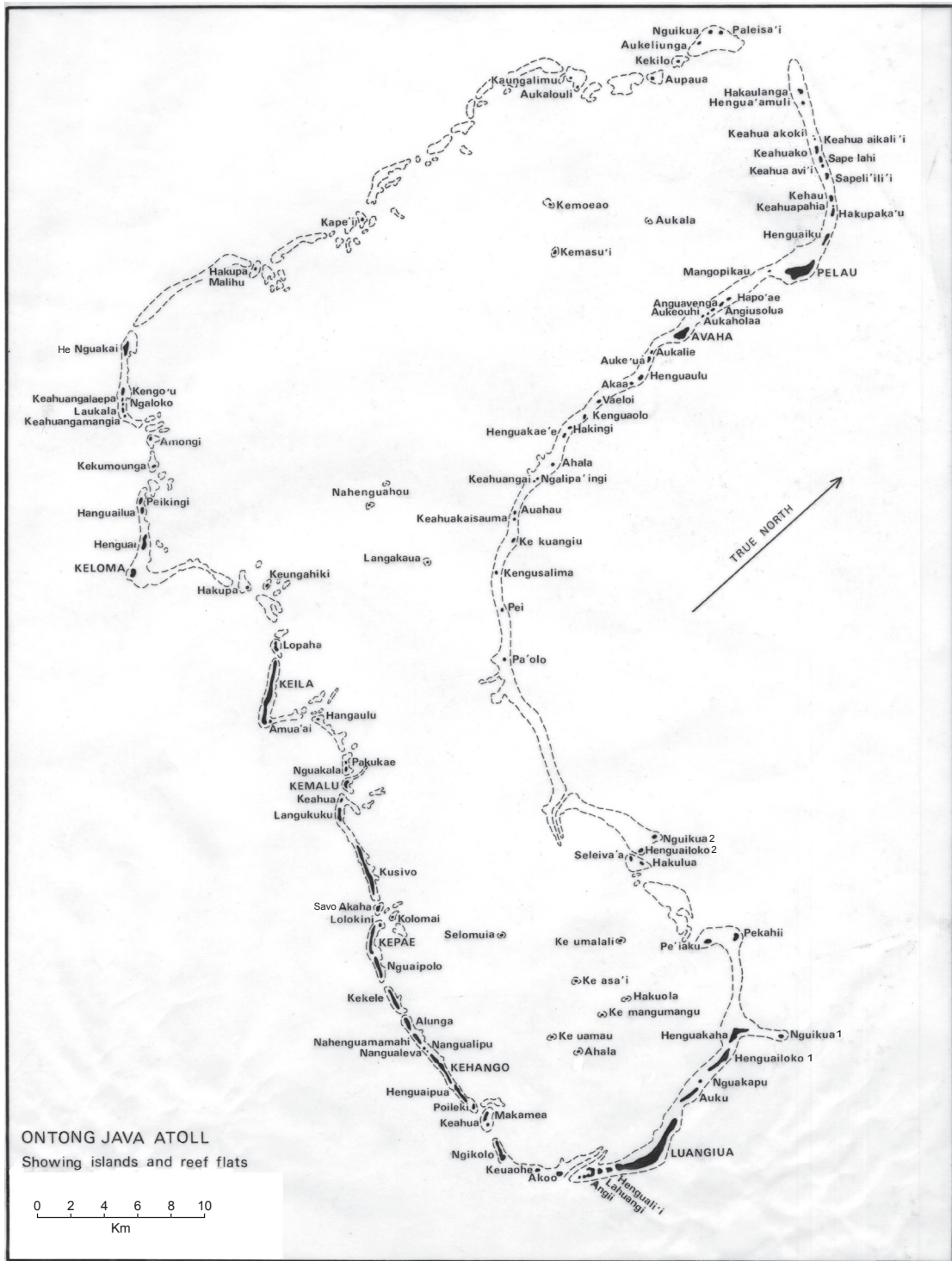


Figure 1. Ontong Java atoll showing the names of islands mentioned in the text.

BIRDS AND PEOPLE ON ONTONG JAVA ATOLL, 1906-2008: CONTINUITY AND CHANGE

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TIM BAYLISS-SMITH¹ AND ANDREAS EGELUND CHRISTENSEN²

ABSTRACT

Changes and continuities in the bird populations of Ontong Java atoll, Solomon Islands, are discussed using historical sources from 1906 onwards and the authors' own observations and surveys in 1970-72 Tim Bayliss-Smith (TBS), 1986 (TBS), and 2006-08 Andreas Egelund Christensen (AEC). Over the whole period of records the birds, particularly seabirds and pigeons, have been subject to some human predation, but the main changes in avifauna result from reductions in habitat for nest sites, particularly for frigatebirds, boobies and noddy terns. With the copra trade, forests dominated by *Pisonia grandis* were replaced by coconut plantations, and since the 1970s, the surviving stands of large trees have been felled for timber and firewood, as settlement has become more dispersed following an intense bêche-de-mer trade. As a result the numbers of nesting Black Noddy (*Anous minutus*) have fallen and Brown Booby (*Sula leucogaster*) and frigatebirds (*Fregata minor*, *F. ariel*) are no longer breeding species. Only on two small islets has effective community conservation been practiced, habitat preserved, and nesting terns and a Red-Footed Booby (*Sula sula*) colony successfully maintained over a period of 40 years.

INTRODUCTION

In this article we review continuities and changes in the bird populations of Ontong Java atoll, Solomon Islands, and the likely effects on birds of exploitation and conservation practices. Because of the unusually detailed information that we have from Ontong Java on the relationship between people and birds over the last 100 years, especially since 1970, we are in a position to contribute to two important debates in the field of environment and development. One is the question of the 'sustainable use' of wildlife, which many now advocate as the best strategy for biodiversity conservation outside protected areas (e.g. Hutton and Leader-Williams, 2003). Is there evidence from Ontong Java for sustainable use of birds in the colonial and post-colonial period, despite the birds being exploited seasonally as a food resource? The second theoretical debate concerns the relationship between poverty reduction and biodiversity conservation (e.g.

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Adams et al., 2004). If poverty limits conservation success, since poor people are forced to over-exploit their resources including those in protected areas, does poverty reduction enhance conservation? Such questions become highly relevant for small islands, where 'limits to growth' are quickly reached and where people live in close proximity to the biological resources of land, reef, lagoon and ocean. The experience of the people of Ontong Java in successfully combating perceived poverty through their engagement first with the copra trade, and, since the 1970s, with bêche-de-mer trading, provides an opportunity to explore these questions in relation to the bird populations of the atoll.

Ontong Java is the largest of the Polynesian Outlier atolls, containing more than 120 islands within and around an extensive lagoon that stretches for 70 km from Luangiua in the southeast to Pelau in the north (Fig. 1). The atoll's human population declined from at least 2,000 people around 1900 to 588 in the census of 1939 (Bayliss-Smith, 1975, 2006). Since malaria eradication in the late 1960s resident populations have increased to 1,850 in 2008, and migrants from the atoll live elsewhere, notably in Honiara. Since 1900 Ontong Java has been included within the Solomon Islands, which initially was a British protectorate but since 1978 has been an independent state.

There have been no systematic surveys of bird populations, but sufficient records exist for the past century to suggest some degree of continuity (Tables 1-4). The birds found on the atoll today are mostly the same as those that were first noted in 1906 and 1910, recorded again in 1930, and were once more seen by ourselves during visits in the past four decades (TBS in 1970-71, 1972 and 1986, and AEC during visits in 2006, 2007 and 2008 – see Appendix 1). Apart from vagrants (see Appendix 4), there was in this period only one bird immigration, the Cardinal Lory *Chalcopsitta cardinalis*, which arrived after a storm in 1972 (Bayliss-Smith, 1973) and was a widespread breeding species in 1986. The Cardinal Lory was still present in 2008 although now restricted to just a few islands. Apart from this immigrant the records seem to show continuity, as the same common species of seabirds, shore birds and land birds have been recorded again and again by visitors.

However, we also show that more subtle changes are underway as population densities decline and certain seabirds can no longer find breeding sites, although they may still visit the atoll on occasion. During the period for which we have bird records land use patterns on Ontong Java have been transformed by development, with the spread of coconut plantations and the reduction in forest resulting in fewer nesting sites for boobies, frigatebirds and noddy terns. As incomes from copra and bêche-de-mer have increased and atoll diets have improved, have any measures been taken to conserve habitat or to refrain from the direct exploitation of birds? We analyse first the effects of natural disturbance and habitat change on the atoll's birds, especially the availability of breeding sites, before examining the changes that have taken place in exploitation patterns and conservation practices.

NATURAL DISTURBANCE

Impact of Cyclone Annie

Habitat change is not just the result of human activities. In November 1967, the southern and western sides of the atoll were devastated by Cyclone Annie (Bayliss-Smith, 1988). There were no human fatalities, but we can infer that many birds were killed and almost all nests were destroyed. Hurricane force winds and storm surge destroyed almost all vegetation in the worst-affected islands, and three years later people said that on these islands the numbers of nesting terns were still diminished by the scarcity of trees. On the other hand the destruction of coconuts also meant that for many years some islands were seldom visited.

On the worst-affected island Nguaipolo (13.54 ha) TBS estimated that 83 per cent of coconut palms were destroyed. As a result, in 1970-72 that island was no longer being visited by its owners, as they awaited the recovery of the coconuts. Despite the lack of human disturbance open and bare areas had not attracted any ground-nesting species (Black-Naped Tern, Sooty Tern, Crested Tern) probably because of rats. However, Brown Noddy were nesting quite near to the ground in bushes of *Pemphis*, *Scaevola*, *Terminalia* and *Allophylus timorensis*, and even occasionally in *Pandanus tectorius*. TBS also noted that “a group of about 12 mature *Pisonia* trees survived the cyclone unscathed at the eastern end, now a huge Black Noddy ternery” (TBS field notes 15.01.70). Perhaps because of the lack of human disturbance Nguaipolo also had a few Pacific Imperial-Pigeons, and many Atoll Starlings had found nesting sites in dead coconut palms.

This particular island has never recovered its pre-cyclone status as a Noddy tern colony. On 4 February 2008 AEC revisited Nguaipolo, which today has an airstrip and a largely cleared interior. The airstrip was built in 1998 and covers almost the length of the island, which no longer has any significant bird populations. Black Noddy does not breed there at all and only a few Brown Noddy and White Tern nests were seen. However, on other islands that were devastated in 1967 *Pisonia* woodland has grown back, at least in places where it is not exploited for fuel and timber. Cyclone Annie was a unique event in the 20th century, but in 19th century oral histories there were two events remembered in 1908 as being comparable, occurring around 1820 and 1850 (Bayliss-Smith, 1988:380). We can infer from this record that three large-scale disturbances to the atoll’s vegetation happened in about 200 years, and this frequency does not constitute a significant threat to bird habitats.

HUMAN IMPACTS ON HABITAT

History of Human Impacts

The data summarised in Tables 1-4 suggest that biodiversity has barely altered over the past 100 years. However, we can show that some species have declined in numbers and that certain seabirds can no longer breed on the atoll. The reasons may be

complex. Seabird and shore bird populations range over vast areas, and events taking place far away from Ontong Java control their numbers as well as processes on the atoll itself. We suggest that those changes in avifauna that stem from processes on the atoll itself result mainly from losses of habitat that can be traced from the copra trade and, since the 1970s, bêche-de-mer processing and human population growth.

Fairly consistent demand for copra on world markets in the century between the 1880s and the 1980s led to an increased planting and management of coconuts on all Pacific islands. On Ontong Java the new coconut plantations were mostly on islands where previously the main vegetation had been strand scrub or dense woodland dominated by *Pisonia grandis*. When German officials declared Ontong Java to be a colony of Germany in 1889 copra traders had already been visiting the atoll for about a decade (Parkinson, 1889:215). A white trader was resident on a temporary basis in the late 1880s (Anonymous, 1890), and by 1895 a permanent trading station had been set up by the E.E. Forsayth Company (Anonymous, 1895). From that date until 1940 German, Swedish, British or Australian copra traders were in continuous residence, and they were replaced in the post-war period by the visits of trading ships from Honiara or Gizo.

However, the process of converting forest to coconuts was necessarily gradual. At the turn of the 20th century Bennigsen (1901:114-5) estimated that half of the area of Nukumanu atoll was not yet planted with coconuts, and it seems likely that the situation on neighbouring Ontong Java was similar. At this time copra production on Ontong Java was about 300 tonnes per year (Bennigsen, 1901), and it did not reach its peak of over 600 tonnes until 1967, the year that Cyclone Annie struck. The 1960s were a time of greatest transformation of the atoll's natural vegetation, and perhaps the greatest impact on bird habitats. After 1967 many islands damaged by the hurricane were virtually abandoned for a decade, and equivalent levels of copra production did not occur again until the years 1981, 1983 and 1985 which were 'off-season' years for bêche-de-mer exports (Bayliss-Smith, 1986:26).

Vegetation Cover in 1970

Using 1962-63 air photography and 1970-71 ground surveys, the atoll's total vegetated area was estimated to be 778 ha spread among some 120 islands (Bayliss-Smith, 1974:26-69; 1986:11). By this time an estimated 651 ha of broadleaf woodland had been converted to coconuts and only 29 ha of the original forest remained. There was in addition about 17 ha of coastal scrub dominated by small trees such as *Scaevola taccada*, *Terminalia samoensis*, *Pemphis acidula* and *Pandanus* spp., but this vegetation was also disturbed and interplanted with coconuts. Some mangrove swamp remained, mainly *Bruguiera gymnorhiza*, but these areas were managed for timber and fuelwood. There were also freshwater swamps totalling 57 ha of which about 39 ha were still cultivated for taro and giant swamp taro (*Cyrtosperma merkusii*). Intensive cultivation of taro (*Colocasia esculenta*) had declined as trade provided the people with alternative sources of carbohydrate in their diet.

The precise effects on bird populations of these changes are not easy to assess, but for those species requiring large trees for habitat and nesting, the spread of coconut

plantations must have had negative effects. A picture of bonito fishing drawn by Oponu of Luangiua in 1910 indicates that a huge flock of terns and frigatebirds was attracted by the shoal of fish (Fig. 2). Was this depiction exaggerated, are such birds just as common today, and if so how many of these seabirds can find nesting sites on the atoll? There are no precise records that allow these questions to be answered, and indeed hardly any records of seabird nesting activity until the 1970s (Table 1), but it is clear from our repeat surveys in 1970-72, 1986 and 2006-08 that removal of large trees and frequent disturbance can have severely negative effects on certain species.

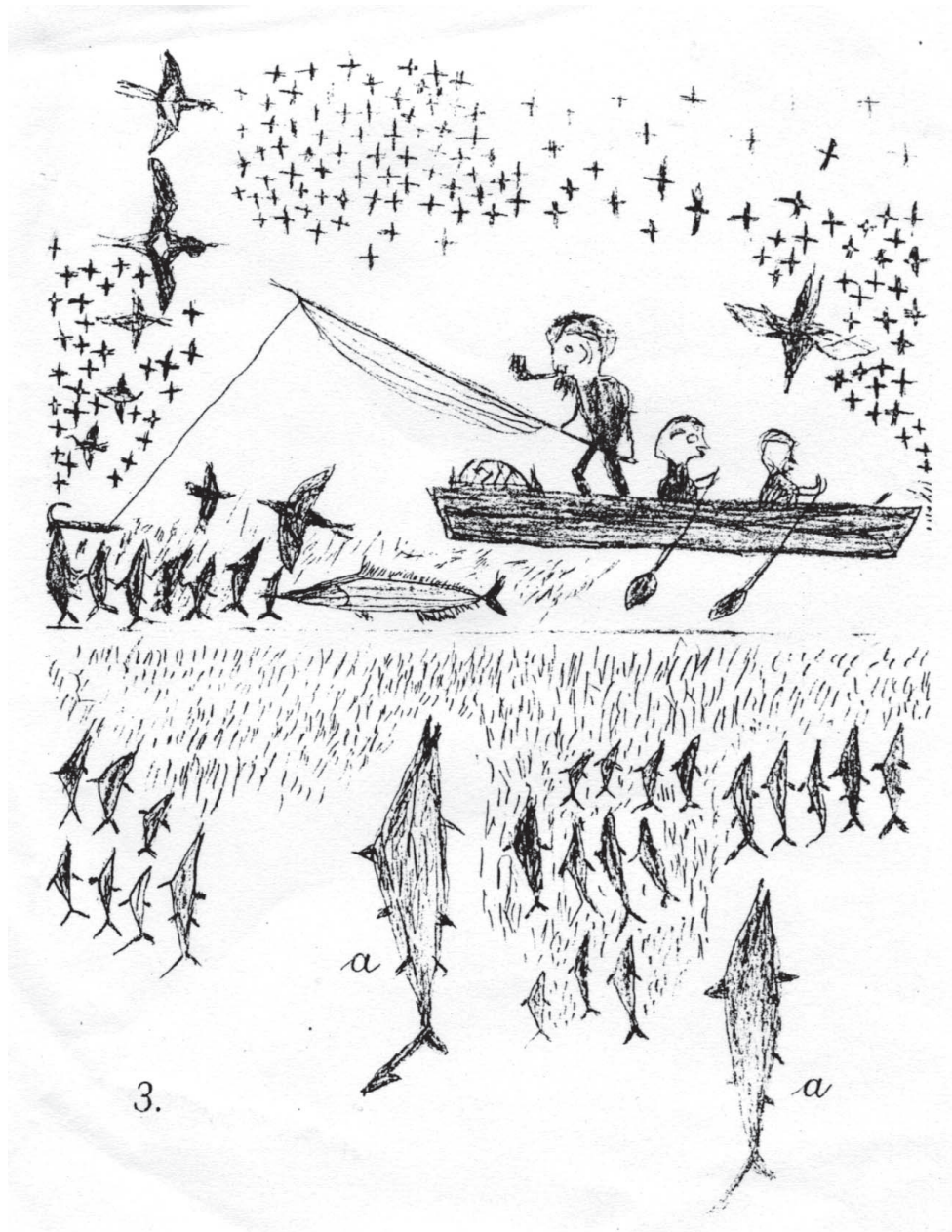


Figure 2. A sketch by Oponu of Luangiua showing the flocks of seabirds (probably frigatebirds and terns) that are attracted by a shoal of bonito (Sarfert & Damm, 1929: Table 24). Translated the caption reads: ‘3. Fishing from a boat. Beneath the shoal of fish some sharks (a) appear.’

Habitat and Nest Sites: Case Studies

In 1970-71 TBS found that the nests of seabirds were noticeably more abundant on islands where big trees remained, and also on small lagoon islands lacking many coconuts and seldom visited. A series of case studies illustrates the dramatic effects of habitat on the number of nest sites, as well as the changes that took place between 1970 and AEC's surveys in 2008.

Henguailoko 1. By 1970 this large (26.53 ha) and accessible island near Luangiua was largely converted to coconut plantation, with only seven mature trees surviving from the former broadleaf woodland. On 3 December 1970 TBS counted the Black Noddy nests in these trees, estimating a total of 178 nests in five *Pisonia* trees and 37 nests in two trees of *Ficus tinctoria*. Contrary to what has been noted elsewhere (e.g. Ogden 1993), there was no field evidence that the sticky fruits of *Pisonia* constituted a hazard to either adults or chicks. TBS estimated that the island as a whole had 430 Black Noddy nests, and their concentration in the few surviving trees was notable. Apart from Black Noddy the island also had many White Terns, and these were better able to find nesting sites in the coconut palms. On 25 January 2008 AEC revisited Henguailoko 1. He found only two mature trees left and no nesting Black Noddy. White Tern was still abundant in the coconut palms, but due to felling of the mature trees and intensified human disturbance the Black Noddy had disappeared as a breeding bird from this island.

Keuamau. In the 1970s some smaller and more remote islands were never visited for copra making and still retained their natural vegetation. These islands attracted many nesting seabirds. In the lagoon, for example, Keuamau island had a vegetated area of only 1.44 ha but in 1970-71 it supported a stunted woodland of *Pisonia*, *Ficus*, *Bruguiera*, *Terminalia* and a few coconuts. On 5 December 1970 TBS estimated that the island contained at least 300 nests of Black Noddy, some on quite low branches. They outnumbered White Terns in a ratio of about 5:1. There were also about ten Great Frigatebirds wheeling above the island, but they left as the canoe arrived and did not appear to be nesting. On 26 January 2008 AEC revisited Keuamau and found no nesting Black Noddy. All mature trees had been cut down and the island was vegetated only with coconut palms and small regrowth trees. The only breeding birds were one pair of Brown Noddy and a few pairs of White Tern. AEC was told that the Black Noddy had disappeared because of hunting and the felling of trees by those families who started to settle on the island during the years of bêche-de-mer diving and trawling. During 2007 as many as five different families lived temporarily on this little island.

Nguikua 2. In the 1970s, before outboard engines and fibreglass canoes were widely used, Nguikua 2 (1.33 ha) was an island even more remote than its neighbour Seleiva'a, and it had largely natural vegetation apart from a few coconuts growing near the beach. TBS recorded:

“The densest noddy tern populations yet encountered. Every tree and bush down to chest height full of nests of Black Noddy, especially the littoral hedge of *Terminalia/Scaevola* and the many [*Pisonia*] trees. Everywhere slimy and smelly. Very hard to estimate numbers – many thousands. Also Brown [Noddy] Tern and White Tern nesting. Black-Naped Tern – many roosting, but too stony for nests. Islet Monarch [seen]. Some recent brushing, but probably [the island] very seldom visited. Coconuts peripheral only”. (TBS field notes, 05.01.71)

Thirty-seven years later AEC revisited Nguikua 2:

“Probably very much the same as when TBS visited the island back in the 1970s, however Matthew [field assistant] explains that there were more trees back then... The island, however, is still protected and considered a conservation area – no birds are allowed to be caught and neither can trees be cut down today. Primarily old and new generation trees with scattered coconuts. Thousands of birds, smelly and noisy – predominantly Black Noddy. No nests seen below about 3 m above the ground – none at chest height as observed by TBS. Matthew confirms many nests were down at chest height earlier. [Improved] access to the island and outboard engines have definitely been an important factor for decreasing number of trees, birds and thus nests at chest height. Only predators must be herons, no [Polynesian] rats on the island.” (AEC field notes, 08.01.08, translated from Danish).

AEC estimated a breeding colony of at least 2,000 Black Noddy, and he also counted about 50 Brown Noddy roosting in the trees but not nesting. Black-Naped Tern were nesting along the upper margin of coral rubble beaches, and 4-6 Sooty Terns were also observed, possibly breeding. The White Tern was present but no nests were seen. About 200 Lesser Frigatebirds were circling above the island, and several Great Frigatebirds were also seen, but neither appeared to be nesting. One pair each of Atoll Starling and Island Monarch were seen, plus a single Reef Egret.

Peiaku. In contrast to Nguikua 2, on the larger nearby island of Peiaku (4.79 ha) TBS noted in 1970 “very few birds probably due to prolonged occupation by copra makers”. Nests of noddy were mainly restricted to large trees of *Hernandia sonora*, a tree species that at that time was preserved for canoe making. The White Tern was also present and nesting, and Melanesian Scrubfowl, Islet Monarch and Atoll Starling were seen. AEC noted from his visit on 8 January 2008 that there were three houses on the island and that only a few birds were breeding in the three mature trees left at the northeast end. Black Noddy and White Tern were present with a few nests.

The above examples suggest that nesting places for seabirds have become scarcer as a result of the spread of coconuts following the copra trade, and because of growing disturbance from humans. Copra making and, more recently, bêche-de-mer diving has meant that families live for long periods far away from the main villages of Luangiua

and Pelau, with consequent pressures on nesting birds. Some of the land birds may also have suffered from habitat change, particularly the pigeons. On the other hand many seabirds like White Tern, White-Tailed Tropicbird and both species of noddy do manage to nest in coconut palms, especially if an island is relatively undisturbed. Moreover the coconut woodland seems in many ways an ideal habitat for sub-canopy species like Atoll Starling, Island Monarch and Collared Kingfisher. The list of birds seen in 2008 has not changed from the lists of previous decades, and some land birds could have become more frequent. However, nesting sites for some species, especially seabirds, have been lost because of the reduced habitat of *Pisonia*-dominated woodland. Over this period do we also see changes in levels of predation?

EFFECTS OF PREDATION

Rats and Cats

The effects on bird populations of the Polynesian Rat (*Rattus exulans*, **i'ole**), an aboriginal introduced species, is unknown. TBS saw Reef Egrets eating rats on a few occasions, but otherwise, apart from cats, rats have almost no natural enemies and they can become very abundant. Rats are found on most of the larger islands around the atoll but in some places they are absent, especially from small lagoon islands (e.g. Kemangumangu, Hakuola, Keumalali) and more remote areas (e.g. Nguikua 2, Henguailoko 2, Hakulua and Seleiva'a). AEC was told that rats do eat eggs but they do not predate the birds themselves, but perhaps the nestlings of smaller species are vulnerable.

In 1970-71 feral cats were present on Luangiua and one or two other islands, and were said to be a predator of the smaller birds and their young. Probably the chicks of ground-nesting species like Scrubfowl (*Megapodius*) are particularly vulnerable. AEC was told in 2008 that feral cats were still present on Luangiua, Savo (Akaha), Keila, Henguakai, Kepae, Makamea and Ahala, but not in large numbers. There were also feral dogs on Kusivo.

Hunting and Gathering Birds in 1910

Has predation on birds by humans increased or diminished over the period that can be documented? Ernst Sarfert, ethnographer with the German Südsee-Expedition of 1910, recorded several birds by their local names under the heading 'Terrestrial animals as sources of food'. However, he suggested that in the overall diet birds were of minor importance (Sarfert and Damm, 1929:130), and in a very detailed account of various ways of preparing and cooking food including root ceps, coconut, fruits, fish, pig and turtle, birds are not even mentioned. Based on Sarfert's descriptions and local names, we can reconstruct the following list of species that were eaten: Black Noddy; Brown Noddy; Crested Tern; an unknown "möve" (German, seagull), possibly Black-Naped Tern but Sarfert provides no local name; Golden Plover; Atoll Starling; an

Imperial-Pigeon, probably *Ducula pacifica*; an unknown “taube” (pigeon or dove) called **ia’i** at Luangiua and **kinakina** on Nukumanu, and from its local name probably White Tern despite being misnamed “taube”; frigatebirds, probably both species as the generic name **akaha** is used, but according to Sarfert they were not often captured; Nicobar Pigeon, described as a “pigeon with a white tail, the size of a hen”, also not often captured; Melanesian Scrubfowl; and an unknown bird called “strandläufer” (snipe) with no local name given, possibly Whimbrel (a prized food in Marshall Islands).

It is interesting that there is no mention of Brown or Red-Footed Booby in this list, suggesting that these birds were already scarce in 1910. Nor were boobies kept as pets, unlike young frigatebirds and Nicobar Pigeons. Sarfert noted that “the latter become domesticated, but the frigatebirds, when they grow older, fly off again” (Sarfert and Damm, 1929:133, translated from German).

In addition to these species that were hunted, we can identify other birds in a sketch by Oponu from Luangiua (Fig. 3). They include a probable Whimbrel and a probable Pacific Reef Egret, described in Sarfert’s caption as ‘Black Heron’ (Sarfert and Damm, 1929: Table 25).

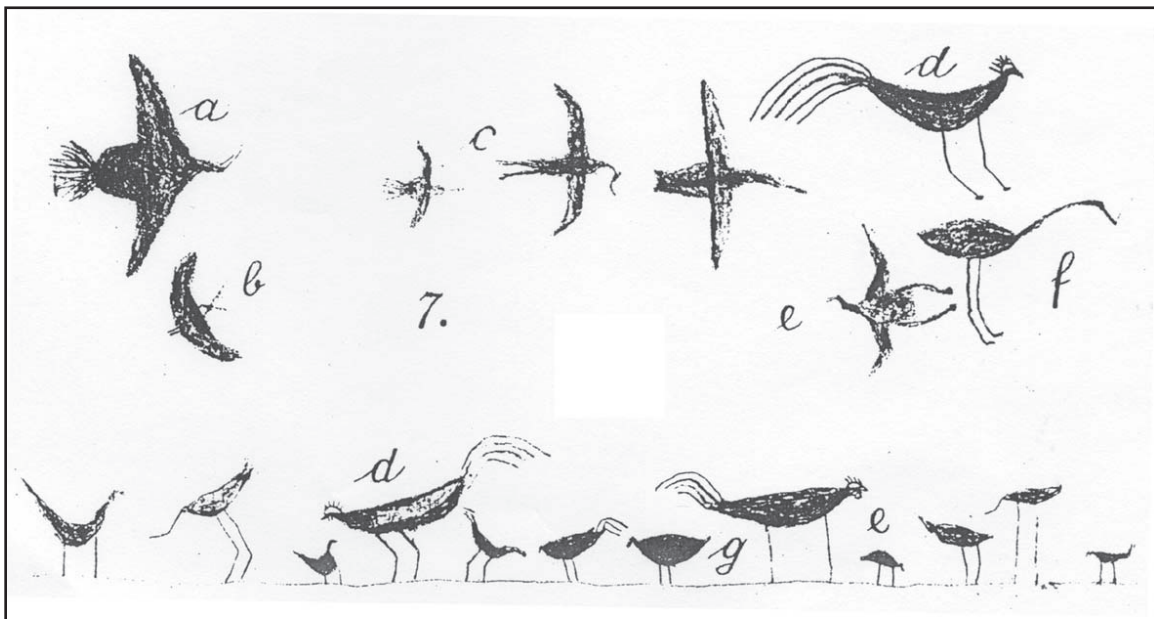


Figure 3. Various birds depicted by Oponu of Luangiua (Sarfert & Damm 1929:Table 25). Translated the caption reads: ‘7. Birds: a. Sea Eagle, b. Seabird, c. Frigatebird, d. Domesticated Fowl, e. Snipe, f. Black Heron, g. Wild Fowl.’ We can identify with some confidence frigatebirds (c), domesticated fowl (d), Pacific Reef Egret (f), and also possibly Melanesian Scrubfowl (g) and Whimbrel (second from left, bottom row). The ‘sea-eagle’ (“Fischadler”) is obscure but might be a reference to Osprey.

Sarfert also provides some details about how birds were captured, listing three main methods: (1) Hand capture of noddy terns, both by day and by night; (2) Net hunting, but he says this was a previously unknown technique that had been learnt in recent times from Sikaiana people; (3) Snare hunting (‘**ausele**’) for capturing “möve”, i.e. terns, at the nest, and also Golden Plover and Atoll Starling (Sarfert and Damm, 1929:131).

The starlings were snared on the beaches when feeding on bait. To snare Golden Plover several loops of coconut fibre were placed on the lagoon beach near the water line, attached to a stick at one end. The whole apparatus was then buried in the sand, and the hunter lay in wait until the bird came along and then pulled on the string. Probably not much food was produced using such methods, whereas the noddy tern hunting sounds like harvesting on a larger scale:

“The natives visit the islands where the birds roost at hatching time. When it gets dark the islanders light torches which they then keep smouldering. They then climb the trees. If they are occupied with capturing lots of sea-gulls the torch is blown to ignite a flame which is then held close to the bird. Blinded by the sudden light the birds fall to the ground. In this way several hundreds of birds can sometimes be caught at one time. Young birds are caught at hatching time and certainly by day”. (Sarfert and Damm, 1929:131, translated from German)

This account suggests that so many thousands of terns nested on the atoll that it was worthwhile to organise their capture, but necessarily it was a seasonal activity. Its overall effect on the bird populations cannot now be reconstructed, but it may not have been substantial. Surveys on Heron Island on the Great Barrier Reef indicate that without predation breeding populations of Black Noddy can grow by about 7% a year (Barnes and Hill, 1989; Ogden, 2006), an annual growth rate that far exceeds the scale of predation that we see in the Ontong Java ethnographic record.

Hunting and Gathering in 1970-71

In 1970-72 the harvesting of seabird eggs and young reached a peak during the breeding season for Black Noddy, which extended from early August to late February. At the end of July 1972 TBS noted that Black Noddy terns were beginning to make nests, and a few already had eggs or young. Brown Noddies had also started to nest, but White-Tailed Tropicbirds were few and were not yet breeding. Starting on 10 September 1970, TBS recorded eggs and young of White-Tailed Tropicbird, Black Noddy, Brown Noddy and White Tern being brought back to Luangiua from the taro swamps, mostly by women. On 21 September a canoe arrived from Henguai island with four Black Noddy and some eggs, one frigatebird (species uncertain), and a live Brown Booby nestling that had been taken from Henguakai. On 13 October there were “eggs of Black Noddy and Brown Noddy coming in quite frequently”, while on 22 November “Sunday – very large numbers of fledgling Black Noddy taken from gardens. Also Brown Noddy and White-Tailed Tropicbird” (TBS field notes, 1970). By January nesting activity was diminishing, and the last eggs were found in late February. At Pelau at the end of March the Black Noddy terns had reared almost all their young, and most nests were deserted.

These species of seabird certainly made a useful contribution to the diet, especially for people living away from the main villages. In 1970-72 residence away from Luangiua or Pelau was undertaken mainly for copra-making, while in 1986 bêche-

de-mer diving was an additional reason for living in more remote parts of the atoll, and this settlement pattern continues today. An example of bird harvesting is provided by Alunga island (18.04 ha) where TBS spent two days in December 1970 along with two families consisting of two men, four women and two infants. The evening meal and breakfast next morning consisted of “38 terns roasted on spits, mainly Black Noddy, some Brown Noddy. [Also] two heaped soup plates of boiled eggs 7:2:1 Black Noddy: White Tern:Brown Noddy” (TBS field notes 07.12.70). As there is no selection in egg collecting, the ratio 5:2:1 is a fair reflection of the relative abundance of Black Noddy, White Tern and Brown Noddy nests.

In 1971 TBS monitored all the foods consumed by 17 persons (six men, six women, five children) living on the island of Keila for copra-making during a 30-day period from 8 February to 9 March. The nesting season was past its peak, but on this large island (71.53 ha) nests were still quite plentiful. Despite the many opportunities for harvesting, birds or eggs were only eaten on eight of the 30 days. In the 30-day survey he recorded the consumption of 115 terns (mostly Black Noddy) and 3 Red-footed Booby as well as 34 eggs (TBS field notes). This harvest generated 12.15 kg of bird meat and 0.58 kg of eggs, contributing in total about 1.1 per cent of the calories in the diet. Birds were not as important as Green Turtle (33.80 kg of meat, 240 eggs) and insignificant compared to the 194 kg of fish that were caught, fish alone contributing an estimated 25.0 per cent of dietary energy over this period (Bayliss-Smith, 1974:399).

In the 1970s other bird species were seldom hunted. In 1970 only one man on the atoll had a shotgun in working order, but he was only seen to use it once when he shot Nicobar Pigeons in Luangiua. By 1986, however, with new wealth from *bêche-de-mer*, there were eight guns on the atoll, five in Pelau and three in Luangiua.

Hunting and Gathering in 2006-08

Today hunting birds and gathering their eggs is still a widespread activity, and makes a significant seasonal contribution to the diet. However guns are no longer available. The Australian-led RAMSI intervention force came to Ontong Java in 2003 following the ethnic tension on Guadalcanal, and the soldiers collected all shotguns and rifles. AEC found in 2008 that no guns were in use.

At Luangiua AEC monitored hunting and collecting of birds using other methods between 19 January-2 February 2008. The total harvest was probably greater than came to his knowledge, especially by people living at the opposite end of the village from where he lived. He recorded small numbers of the following birds and animals being taken, mostly by throwing coral stones with home-made slings: Great Frigatebird, Ruddy Turnstone, Black Noddy, White Tern, Flying Fox. Using other methods Hawksbill Turtle and Coconut Crab were also taken. Most notable, however, was the harvest on four separate occasions of Red-footed Booby, with at least 76 birds killed in total. For example:

“Luangiua, Saturday 19.01.08. A grey, rainy, windy thunderstorm day
– around 2 p.m. a canoe arrives from the ocean side just outside the house of

Mendana [my home]. It is high tide enabling the canoe to travel all the way to the beach easily. Four men (two adults and two boys, Paul, Matthew, Frasier and Barnabas) have been out at sea for fishing and for hunting birds. Matthew explains how they catch the Red-Footed Booby by using hooks, an iron bolt and fishing line – by throwing the iron bolt and hook into the air, aiming at the booby, and by pulling the line the booby is hooked in the wing or another part of the body – thus no use of bait, or capture in the bill. In total 28 Red-Footed booby were caught, adults and immature birds, both white and brown morphs. All caught in the open sea, thus not taken from islands – however the birds were taken off Nguikua 1, where TBS in 1971 counted several nests” (AEC field notes, translated from Danish).

Another hunting method was recorded on Lopaha where six families were living, and is a modern version of the technique first noted by Sarfert in 1910. On 1 February 2008 all the men from Lopaha went at night to the two nearby islands Hanguailua and Peikingi to catch Black Noddy, using a flashlight to blind the birds. After a while the birds fall down from the trees and can be collected directly from the ground. In total 156 Black Noddy were caught.

Collecting eggs was another widespread activity especially for people living away from the main villages. On 7 February 2008 AEC joined Milton Kenohe in collecting eggs from three small and remote islands in the north of the atoll: Hakupa Malihu, Kape’i and a small unnamed sand cay close to Kape’i. In total 58 eggs were taken, all Black-Naped Tern apart from one Great Crested Tern and one Sooty Tern.

The hunting and gathering of birds and their eggs are thus continuing activities and still an aspect of atoll livelihood. How sustainable are these activities? The methods used, especially now that guns have gone, are based on ‘intermediate’ technology. These methods are by no means systematically employed, and we would argue that most species can recover from such predation. We suggest that hunting and gathering is not as severe a threat to bird populations as habitat change, particularly the felling of trees and human settlement on previously uninhabited islands.

CONSERVATION OF BIRDS

Traditional Restrictions

It is difficult to know how far the hunting and gathering of birds and eggs that we have observed is just a continuation of pre-contact practices, or whether they constitute a new relationship to the bird populations of the atoll. Reconstructing traditional beliefs and practices is difficult because Sarfert made so few observations in 1910, and when anthropologist Ian Hogbin began his fieldwork in 1928 copra making had been dominant for about 40 years, the old religion had greatly declined, and the chiefs and priests had lost most of their power.

Hogbin (1931:420) reported that two species of birds had ‘totemistic’ significance in one ‘joint family’ (clan) at Luangiua, but the other six clans had other totems – types of fish, crabs or artefacts. The totems of the Keloma clan were Nicobar Pigeon and

Melanesian Scrubfowl. Eating these birds was completely taboo for all people who were connected to Keloma through their father's line, and they were even avoided by those whose link was through the mother's side. Such taboos would have provided some protection for these species, especially on the particular islands controlled by this clan. In 2008 AEC was told that one family in Keloma clan still respected the cultural taboo on eating these birds, but in general most restrictions of this kind were no longer followed.

At the same time as Hogbin was living on Ontong Java another anthropologist, Raymond Firth, was working on Tikopia. This small volcanic island is also a Polynesian Outlier, and here the influence of colonialism upon indigenous beliefs and practices was much less. Firth wrote:

“The only [mammals] apart from man are rats and bats, which, however, are not regarded as edible, partly from aesthetic and partly from religious reasons. Birds of a number of species exist, but again because of their religious affiliations very few of them are eaten. Even the pigeon, consumed by most Polynesians, is only eaten by members of a few kinship groups, and then rarely. The small swift (*Collocalia frantica*), a noddy, and a petrel are the only birds deliberately and periodically sought by netting. They are not regarded as the property of any individuals or groups, and the catch depends on personal skill and initiative. They are not an important element in the food supply. Of reptiles there are lizards, never eaten, and turtles, usually eaten”. (Firth, 1939:60-61).

It is possible that this account of Tikopia in 1928 provides a better general guide to pre-contact beliefs and practices on Ontong Java than the rather scanty information in Sarfert's and Hogbin's ethnographic accounts.

Conservation Practices Today

Since the mid-20th century, as well as weak cultural restrictions on killing and eating birds, property rights have also fail to provide much protection for birds and their eggs on Ontong Java. The rights to visit an island in order to reside, to make copra or to cut firewood for bêche-de-mer curing are jealously guarded, with access normally restricted to clan members. However, the right to gather a few drinking nuts from an island, for example while on fishing trips, is never denied to members of other clans. In most cases birds and their eggs are treated in the same way, as virtually an open-access resource. In only a few cases would a visitor feel constrained not to take birds and eggs unless granted permission by the senior person of the clan. Hunting and gathering can thus be opportunistic, and such opportunities have increased with greater mobility since outboard engines largely replaced sailing canoes in the 1970s.

There are only two current examples of strict protection of birds and other wildlife, on two uninhabited islands both named Nguikua. The small and relatively remote island Nguikua 2 (1.33 ha) near Seleiva'a has been maintained as a conservation area since at least the 1970s, with only minor tree felling and bird predation. This island was described above.

Nguikua 1 (1.94 ha) east of Henguakaha is a similar case, with its breeding population of Red-Footed Booby protected for the past 40 years. The island is only 2 km from Henguakaha and can be reached by walking along the reef flat at low tide. Henguakaha itself is 11 km from Luangiua but the island is on the same contiguous reef, so although quite a long walk, Nguikua 1 is accessible from the main village on foot. As a result its booby population could easily be over-exploited or even eliminated. In 1970-72 the boobies and frigatebirds survived there because they were protected, following restrictions placed on visiting this island by its customary owners. These rules were discussed and confirmed by Luangiua Council, at a time when that institution was supported by central government and had considerable authority. TBS walked to Nguikua on 3 January 1971 and stayed there alone overnight, sleeping on the beach. He estimated the total adult population of Red-Footed Booby to be in the range 60-100 birds. There were about 35 booby nests on the island, mostly in *Pisonia* forest plus a few in *Bruguiera* mangrove trees (Fig. 4).

Today the island is the exclusive property of a small clan represented by only one family, and the senior man, Peter Keii of Pelau, prohibits hunting and collecting on Nguikua 1 without his permission, and almost no trees have been felled. A bird census by AEC on 25 January 2008 revealed 36 nests of Red-Footed Booby all located in old *Pisonia* trees, compared to the 35 nests in the TBS survey of 1971. AEC also saw at least 20 Great Frigatebirds circling the island and roosting, and a large breeding colony of Black Noddy and White Tern. Land birds recorded were Melanesian Scrubfowl, Collared Kingfisher and Island Monarch, and the shorebirds seen were the usual waders (Pacific Golden Plover, Grey-Tailed Tattler, Wandering Tattler, Whimbrel, Ruddy Turnstone).

These surveys suggest successful conservation of this particular island over 40 years, with demonstrable community benefits. The boobies that breed there are also an open-access resource available for hunting over the ocean by anyone, while the island also functions as a source of Black Noddy to colonise other islands.

ARE BIRD POPULATIONS CHANGING?

Shore Birds

It seems unlikely that in the last 100 years human predation on the atoll has had any impact on the shore birds. Apart from the Pacific Reef Egret these are migratory waders whose scarcity, shyness and (in most cases) small size render them almost immune to hunting, at least until guns arrived on the atoll. Nor has the extent or productivity of their intertidal habitat been affected by land use changes.

Terns. Of the seabirds, those that nest in trees rather than shrubs or on the ground achieve some degree of protection from people, rats and cats, and it may no coincidence that these are also the commonest birds. On other atolls Brown Noddy successfully nests on the ground on uninhabited islands, but it requires trees where predation is a threat. Black Noddy, White Tern and White-Tailed Tropicbird only nest in trees. For all these species it seems unlikely that current levels of egg collecting, harvesting fledglings or

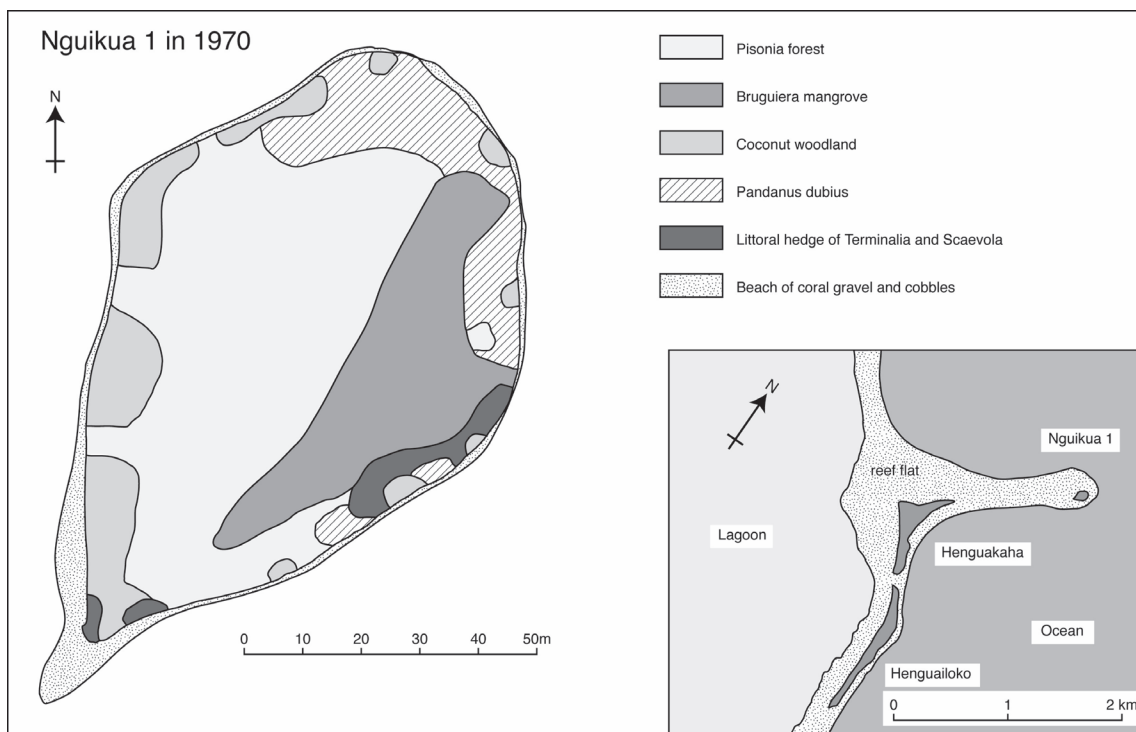


Figure 4. Map of Nguikua, drawn using data from a compass traverse by TBS in January 1971. The nests of birds, including Red-Footed Booby, Brown Noddy, Black Noddy, and possibly Lesser Frigatebird, were mainly restricted to the *Pisonia* forest and the *Bruguiera* mangrove areas.

the hunting of adult birds can seriously affect their numbers. Many trees are difficult to climb, and *Pisonia* trees in particular are known to be very dangerous because even large branches are liable to break suddenly under a man's weight. However, Black Noddy has a strong preference for nesting in mature trees and avoids coconut palms, so that a considerable decline in this species has occurred with habitat change over the past 120 years.

Even more vulnerable are the ground-nesting terns. Sooty Terns and Crested Terns nest in January-March on remote sand cays, sometimes in large numbers, and their eggs are collected when found. Black-Naped Terns are more widespread, using coral rubble beaches as well as sand spits and sand cays as nesting places, and they too are vulnerable to disturbance. For example, TBS noted in January 1986 that 700 eggs of Black-Naped and Crested Terns were collected from a small unnamed sand cay south of Pa'olo (TBS field notes 25.5.86). With the rise of bêche-de-mer diving after 1972 more people were living on small islands especially those within the lagoon, and as a result predation on nesting terns is likely to have increased.

Frigatebirds (*Fregata minor*, *F. ariel*). In the period with records Great and Lesser Frigatebird (**akaha**) have only nested on a few islands, and today the two large islands named after this bird, Akaha and Henguakaha, no longer have breeding populations. In the 1970-71 breeding season frigatebirds were nesting in tree-tops

within or close to the booby colonies, in particular on the small and undisturbed islands of Kekumounga and Henguakai. Because they nested high up and were relatively shy, the adult birds were seldom caught, but the young were sometimes taken as pets (as happened also in 1910). Sixteen years later, in 1986, both of these once-remote islands were occupied by *bêche-de-mer* divers and their families, and the chances of seabirds successfully breeding were much reduced. In 2008 neither species of frigatebird was any longer breeding on Ontong Java.

Brown Booby (Sula leucogaster). Perhaps the most vulnerable of the sea birds are the Brown Booby and the Red-Footed Booby. The birds are relatively tame, their nests are easily found, and they are regarded as good eating. In 1970-71 the Brown Booby was restricted for breeding to Henguakai island, which at that time was uninhabited. An oral history that TBS recorded in Luangiua in 1986 recounts a typical harvesting event on that island, but one with a tragic ending:

“About 16 years ago Walter and his wife were living at Keila. Wife was pregnant and wanted to eat booby chicks, so she asked Walter to climb the *Pisonia* trees at Henguakai and fetch some young birds. He went there before dawn in order to catch the parent birds as well. While climbing the trees Walter fell and broke his skull and back. He died in the canoe before they got back to Keila. Frank Mulvey’s Seagull [outboard motor] helped get them all back to Luangiua, an all-day trip starting soon after dawn, the women wailing all the way”. (TBS field notes, 20.06.86).

Since that time *Pisonia* and other trees on Henguakai have all been felled for timber and firewood, to be replaced by coconut palms. In July 1986 there were 50 people living on this once remote and deserted island, which was now an important station for *bêche-de-mer* collecting, and in 2008 five families had temporary houses there. The only breeding seabirds on Henguakai in 2008 were a few White Tern and Brown Noddy.

Today, therefore, Brown Booby no longer breeds anywhere on the atoll, and although it was observed in 2006-08 it is a less common visitor to the atoll than the other booby species. Elsewhere in the Pacific, for example islands of Bikini atoll that have neither trees nor predators (Garrett and Schreiber 1988), both Brown and Red-Footed Booby are found nesting on the ground, but on Ontong Java its only nesting habitat is mature woodland. Since the onset of the copra and *bêche-de-mer* trade this has been a diminishing habitat subject to increasing levels of disturbance.

Red-Footed Booby (Sula sula). Red-Footed was the commoner of the two booby species recorded by TBS in 1970-71, but its nesting was restricted to three areas: (1) Five rather remote islands northwest of Keloma that retained stands of *Pisonia* trees (Hanguailua, Peikingi, Kekumounga, Henguakai, Kape’i); (2) The western of the two Nahenguahou islets inside the lagoon; and (3) Nguikua 1 east of Henguakaha. In the 1970s none of the islands belonging to Pelau supported any booby populations, and this

reflects the absence of undisturbed woodland on the Pelau side of the atoll.

In 2008 AEC re-visited all of these islands but saw no breeding birds or old nests of Red-Footed Booby except on Nguikua 1, which is now the only breeding site for this species (see above). Nahenguahou was subject to a land dispute until the late 1990s and so remained uninhabited throughout the boom years for bêche-de-mer, and it retained a breeding colony of boobies until 2001. However since then all but one of the large trees have been cut down or have fallen in high winds, to be replaced by coconuts and young regrowth trees. In 2008 AEC revisited Nahenguahou and found that Black Noddy and Red-Footed Booby had both disappeared and the only breeding seabirds were White Tern and about five pairs of Brown Noddy.

Apart from exceptions like Nahenguahou and Nguikua 1, the situation for boobies began to deteriorate with the onset of bêche-de-mer diving in 1972. With human population growth and a booming trade in bêche-de-mer, new temporary settlements were established on many islands that had seldom been visited in copra-making times. For example, Kape'i in 1970-71 was utterly deserted being at least 20 km distant from Kengo'u, the nearest copra island, but by 1986 it had three houses. The people living there told TBS that they suffered from water shortages, and so few coconuts grew on the island that they had hardly any green nuts for drinking, but the bêche-de-mer diving was good. In 2008 AEC revisited Kape'i and found five houses on the island, last inhabited in 2007 during the bêche-de-mer season. There were no boobies, frigatebirds or Black Noddy, but Black-Naped Tern was an abundant breeding bird with approximately 100 pairs.

While bêche-de-mer diving presents no direct threat to seabirds, the presence of people living on once isolated islands causes disturbance and leads to the felling of mature trees for timber and firewood, as well as greatly increasing the potential for predation.

Melanesian Scrubfowl (Megapodius eremita). The Megapode or Melanesian Scrubfowl is another example of a species that, in the past, was subject to conservation measures. In 1937 the ornithologist Dillon Ripley visited a “megapode hatchery” close to the Luangiua village, at the south end of the island:

“Nearly every morning just after sunrise there is great activity here. The surface of the beach is pitted and soft-looking. There are little holes everywhere, out of some of which clouds of sand are coming in short rhythmic bursts. The female megapodes are digging their nest holes” (Ripley, 1947:62).

This resource, just five minutes walk from the village, must have been managed on a sustainable basis for its harvest of eggs, a practice that occurs elsewhere in Solomon Islands (Woodford, 1888). For unknown reasons, possibly predation by feral cats, this particular Luangiua colony died out. In 1970 and 1986, although it was common elsewhere, the Scrubfowl was a bird that no longer nested in close proximity to Luangiua village.

Cardinal Lory (*Calcopsitta cardinalis*). After his return visit to Ontong Java in July 1972 after 12 months of absence TBS reported the arrival of the Cardinal Lory, *Chalcopsitta cardinalis*, a species that had previously not been present. He was told that these birds were first seen after Cyclone Ida in late May-early June 1972, and they had been given the local name of **sivi** (Bayliss-Smith, 1973). Cyclone Ida produced a small hurricane in Choiseul and Santa Isabel as well as gale-force south-westerly winds in Ontong Java, and it seems likely that a flock of Cardinal Lories was blown towards the atoll from the Solomon Islands across the ocean, a distance of about 250 km. Several times in Luangiua village in July and August that year TBS saw a noisy flock of 10-12 birds, and the people reported that they had colonised all the larger islands between Keila and Henguakaha on the southern and eastern sides of the atoll. There were complaints that the birds were damaging the flowers of coconut palms, but no reports of nesting.

Fourteen years later in 1986 the Cardinal Lory appeared to be less abundant, but a pair was seen by TBS flying over Luangiua village on 9 June. Two days later he saw one at Kemalu, 30 km to the west. The people reported that nests were “hard to find”, but several were reported in rotten trees on Henguaipua island about 12 km west of Luangiua (TBS field notes). The species appeared to be permanently established on the atoll, favouring the same habitat, coastal coconut woodland, as in Solomon Islands (Mayr, 1945:230).

In 2006-08 AEC found that Cardinal Lory was less common, and he did not himself observe this species. However independent reports from several reliable informants show that Cardinal Lory remains a breeding species and can be found today on the large islands of Kepae, Savo (Akaha), Kusivo, Keila and Makamea. It is extinct today in Luangiua and all the islands to the northeast, although it was once common there:

“Matthias talks about an old tree on Makamea where the parrots nested inside a hole in the tree. He also tells about a big flock of parrots in Luangiua in 2002 – not seen in the following years – this may be the last reliable observation of parrots in Luangiua island. He adds that there were also big flocks of parrots on the three islands east of Luangiua – Auku, Henguiloko and Henguakaha – but because people have cut down all the big trees on these islands they are gone today. Also people used to shoot the parrots with guns [for sport not eating]” (AEC field notes 02.02.08, translated from Danish).

Domesticated Birds

Sarfert was told that the domesticated fowl or chicken had been present on the atoll throughout its history, and certainly the Ontong Java names (**moa** for hen, **moakangi** for cock) are common elsewhere in Polynesia. Domesticated ducks, however, were a post-European introduction, and they were scarce in 1910 (Sarfert and Damm, 1929:132). TBS saw ducks in Luangiua village in 1970-72, and on Lopaha in 1986 a few were being reared. Perhaps sometimes the fowls become feral, but the ‘wild chicken’ (“Wildhuhn”) that was sketched in 1910 by Oponu of Luangiua has more the appearance of a Scrubfowl than a chicken (Fig. 3). In 2008 chickens were still abundant in Luangiua and Pelau, and one Luangiua family reared ducks as a private farming project.

Pet birds. Sarfert in 1910 listed young frigatebirds and adult Nicobar Pigeons as pets, suggesting that the latter became domesticated. In 1970-72 the pet birds listed by TBS included Brown Booby as well as frigatebirds, but no pigeons. Some different pets were in evidence in 1986: at Luangiua there was a Nicobar Pigeon, an Indian Myna and a Yellow-Bibbed Lory, the last two transported from Honiara; and at Pelau a Crested Tern, a Pacific Reef Egret (this bird was one-legged), and another Yellow-Bibbed Lory brought from Honiara. Of the two imports probably only the Indian Myna would successfully colonise if a pair were to be released into the wild. No immature Brown Booby were seen as pets in 1986, and by then the species was probably extinct as a breeding species.

In 2008 little had changed, AEC listing the following species taken as nestlings and reared as pets: Red-Footed Booby, Great Crested Tern, White Tern, Black Noddy, Nicobar Pigeon, Pacific Imperial Pigeon. There were still some pet Yellow-Bibbed Lory imported from Honiara, but no sign of Indian Mynah either in captivity or in the wild. All these data show a general continuity in pet-keeping practices (along with cats and dogs, the latter temporarily exterminated in 1986 by Area Council edict), with Yellow-Bibbed Lory the only exotic import at the present time.

Vagrant species. Rather like Christiansø (Denmark), Fair Isle (UK) or Happy Island (China), Ontong Java's location – isolated and remote from the mainland and other major islands – makes it a magnet for birds blown out to sea and lost. The atoll is also a good resting place for wintering species, especially waders but also passerines like Long-Tailed Koel. Hence it is perhaps not surprising that the island over time should receive vagrants like Australian Pelican, Frogmouth, Swiftlets, Cardinal Lory, etc., the last even managing to establish a self-reproducing population. Perhaps many more species, especially passerines, may have been overlooked up to now. We suggest in this paper that the following species should be added to the list as probable occasional visitors to Ontong Java: Pelican sp. (*Pelicanus* sp.), Bulwer's Petrel (*Bulweria bulwerii*), Grey Plover (*Pluvialis squatarola*), and Swiftlets (*Collocalia* spp.). More tentatively, we can also add the following as probable occasional species: Red-Tailed Tropicbird (*Phaethon rubricauda*), Osprey (*Pandion haliaetus*), Island Imperial Pigeon (*Ducula pistrinaria*), Shining Bronze-Cuckoo (*Chrysoccyx lucidus*), and Marbled Frogmouth (*Podargus ocellatus*). Another pigeon is present today as a resident species but hitherto has been overlooked (Red-Knobbed Imperial Pigeon, *Ducula rubricera*) (see Appendix 4).

CONCLUSION

Without archaeological surveys it is not possible to estimate the date of the first arrival of humans on Ontong Java, but there is no doubt that centuries if not millennia have elapsed since initial colonisation. There has therefore been a long period of predation by humans leading ultimately, one must suppose, to some sort of balance emerging. Whatever the original situation, by the 19th century it was worthwhile for people to focus their harvesting efforts on birds and their eggs only in the peak breeding season, and even so most nesting birds were not easily accessible. Probably only the

largest birds were really attractive as food sources, and perhaps the boobies and the frigatebirds suffered the most. In 1910 the two booby species were not sufficiently prominent to be mentioned at all as food sources by Ernst Sarfert.

By the 20th century the larger birds and their eggs still provided opportunities for hunting and gathering, but on a minor scale. Their importance in the diet had perhaps diminished with the availability of imported foods after the growth in copra trading. In addition, because of the catastrophic decline in the human population between the 1890s and 1940 (Bayliss-Smith, 1975, 2006), people lived more and more in the main villages rather than on outlying islands. By 1970 only noddy terns were subject to sustained harvesting during the breeding season, and perhaps only the ground-nesting species of tern were still vulnerable to over-exploitation of their eggs. It is possible that because of these changes in the intensity of exploitation, some of the seabirds such as boobies may have recovered in the mid-20th century.

What became a far more important influence, particularly on the numbers of seabirds and pigeons, was the progressive conversion of woodland dominated by *Pisonia grandis* to coconut plantation, in response to the copra trade. European traders arrived in the 1880s and the trade in copra reached its peak a century later by which time only small fragments of natural vegetation remained. In the 1970s the economy diversified with bêche-de-mer trading. While this brought in money and imported foods on a larger scale, the dispersal of the human population to small islands located near suitable areas for diving must have resulted in much disturbance to places that were previously, in the age of copra, so remote or of such little value that they were seldom visited.

Attempts at the conservation of birds seem to have quite a long history on Ontong Java. In the 1930s a Scrubfowl hatchery was maintained close to Luangiua village for egg production. In more recent decades breeding populations of Red-Footed Booby and frigatebirds have been encouraged on Nguikua 1 near Luangiua following an embargo on their exploitation by the island's customary owners. In the 1970s this ban was confirmed by the Luangiua Local Government Council and its successor the Ontong Java Area Council, but in 1996 the failing Solomon Islands state abolished all Area Councils.

Since 1996 local communities in Solomon Islands have experienced a vacuum in political power and a resurgence in the authority of neo-traditional chiefs and elders. As a result the future success of community conservation on Ontong Java now depends on indigenous institutions that, after 100 years of being by-passed by governments, may lack the power or the legitimacy to act effectively (Bayliss-Smith et al., in press). In this paper the encouraging example of two small islands, Nguikua 1 and Nguikua 2, shows that nesting seabirds can be conserved successfully on small islands of suitable habitat over a period of 40 years. However, with growing pressures on both its resources and its social institutions, the future for Ontong Java's birds must remain uncertain.

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APPENDIX 1

NOTES ON THE SOURCES FOR ONTONG JAVA BIRD RECORDS (TABLES 1-4)

1906. The naturalist Charles Woodford first visited Luangiua in 1900 for the declaration of the British Protectorate, and he returned on three other occasions. After his first visit he recorded the frigatebird (**akaha**, species not stated), the wing-bones of which were used for making tattooing needles (Woodford, 1906a:134). In April 1906 he shot specimens at Luangiua of Imperial Pigeon, probably *Ducula pacifica*, and Golden Plover, and he noted the presence of Nicobar Pigeon, Melanesian Scrubfowl and Atoll Starling (Woodford, 1906b; Etheridge, 1906a, 1906b). Parts of one pigeon specimen (two wings, tail and legs) were sent to the Australian Museum in Sydney and were preserved in alcohol, but this bird may not now be identifiable.

1910. Ernst Sarfert visited Nukumanu and Ontong Java during the period 20 August-11 November 1910. From 20 August to 11 September he was on Nukumanu. He spent the rest of his time on Ontong Java based in Luangiua, but with a brief excursion to Pelau 29 September-1 October. As well as domestic chickens and ducks he described 12 different birds, and for most species he recorded their local names in both Luangiua and Nukumanu languages (Sarfert and Damm, 1929:31-32). Apart from an unknown 'snipe', in Sarfert's list there is only one species (**ia'i**, a type of pigeon sometimes hunted) that cannot easily be identified.

1930. The Whitney South Sea Expedition visited in October 1930, collecting specimens of 14 species and later writing zoological and biogeographical papers (Amadon 1943 – *Ducula pacifica*; Bogert 1937 – *Eudynamis taitensis*; Stickney 1943 – *Pluvialis fulva*, *Limosa lapponica*, *Tringa incana*, *Arenaria interpres*; Mayr and Amadon 1941 – *Egretta sacra*; Mayr 1938 – *Megapodius eremita*; Mayr 1945 – *Porphyrio porphyrio?*; Mayr 1949 – *Charadrius mongolus*, *Numenius phaeopus*, *Calidris acuminata*; Mayr 1955 – *Aplonis feadensis*, *Monarcha cinerascens*).

1953. Diana Bradley, ornithologist, made records of seven species that she saw during a three-day visit from 28-30 September 1953, when "opportunities for bird watching were extremely limited" (Bradley, 1957).

1970-72. Tim Bayliss-Smith recorded birds seen during two visits. He was based at Luangiua from 6 June 1970 until 7 May 1971 apart from periods spent at Keila (8 February-10 March) and Pelau (17 March-1 May). During this period he visited 79 of the 120 islands in the atoll, observing birds whenever possible (Bayliss-Smith 1972). He returned to Luangiua and Pelau for two months in June-August 1972 (Bayliss-Smith, 1973). With the exception of one museum specimen of *Todirhampus chloris*, all his records were based on sightings confirmed in most cases by indigenous knowledge of the birds, almost all of which have local names.

1986. Tim Bayliss-Smith made a shorter return visit between 5 May and 24 June 1986, living in Luangiua and Pelau and visiting about half of the islands in the atoll (TBS, unpublished field notes).

2006-08. Andreas Egelund Christensen observed birds during three periods living on the atoll, from 30 November-17 December 2006, 29 January-5 April 2007 and 20 December 2007-21 February 2008 (AEC, unpublished report). During his stays AEC lived in both Luangiua and Pelau and visited altogether 53 islands belonging to Luangiua and several of the Pelau islands.

Ontong Java names: local names are those recorded by Bayliss-Smith (1972, 1974) and Christensen (field notes, 2008), with some spellings corrected according to the orthography of Salmond (1975).

APPENDIX 2

NOTES ON OTHER SOURCES FOR ONTONG JAVA BIRD RECORDS

1928. Ian Hogbin, social anthropologist, carried out fieldwork during two visits to Ontong Java, from November 1927-February 1928 and from May-November 1928. He made no field observations of birds. However, he recorded the use of various bird feathers in rites of passage, namely “tropic-bird” (probably White-Tailed Tropicbird), Pacific Reef Egret and “frigatebird” (Hogbin, 1930:99, 111, 204). He also recorded the names **leia** (Nicobar Pigeon), **malau** (Melanesian Scrubfowl), and **moa** (domesticated fowl) (Hogbin, 1931:420).

1937. S. Dillon Ripley, ornithologist and later Director of the Smithsonian Institution, spent one week at Luangiua (exact date unknown) collecting bird specimens for the Museum of the Academy of Natural Sciences in Philadelphia (Ripley, 1947). The collections have never been published, but some identifications are possible from Ripley’s popular account: “I soon discovered that birds on the island were few and far between. There were quite a number of species of sea birds about, terns of three species including the delicate little all-white ones [*Gygis alba*], sandpipers, plover and curlews [*Numenius phaeopus?*], the latter kinds being on migration. But of native land birds I could find only four species. There was a pretty little blue and brown kingfisher, found throughout the South Seas [*Todirhampus chloris?*]. Then there was a flycatcher about the size of a phoebe, soft grey and reddish brown [*Monarcha cinerascens*] ... Starlings were common in the coconut palms, flying about from tree to tree in chattering flocks. They were blackish with a metallic sheen and had bright yellow eyes [*Aplonis fadensis*]... [T]he megapode [is] a ground-living species about the size of a pheasant with dull brownish-black plumage, short tail, and stout red-brown legs [*Megapodius eremita*]. Far out on the south end of the main islet of Ontong Java there is a megapode hatchery.” (Ripley, 1947:61-62).

1974. A New Zealand naturalist and yachtsman Wade Doak visited Luangiua in December 1974, and recorded the White-Tailed Tropicbird nesting in a coconut palm in the area of taro gardens (Doak, 1976:168).

2004. Don Hadden (2004) published a list of birds from neighbouring Polynesian Outlier atolls Nukumanu, Takuu and Nuguria together with local names, but he did not visit Ontong Java.

APPENDIX 3

PURPLE SWAMPHEN (*Porphyrio porphyrio*): EXTINCTION OR MYTH?

The Purple Swamphen *Porphyrio porphyrio* was recorded by Mayr (1945:280) on Ontong Java, but only in the category of a species that “might be expected from that island but has not actually been recorded”. There appears to be no specimen or sight record. In his 1972 paper TBS stated that “No bird resembling *Porphyrio porphyrio* ... was seen during 1970-71”, and he implied that it should be deleted from the list.

However there still remain some lingering doubts. When TBS showed to Luangiua men the black-and-white illustration of *Porphyrio* in a reprint of Mayr’s (1945) book, some of them thought that they recognised this bird. Was it possible that its disappearance was linked to the introduction of cats to Luangiua? While mapping the Luangiua taro gardens over a period of weeks in 1970, TBS glimpsed a bird that at first he thought might have been the Purple Swamphen, but he decided in retrospect that all sightings were either Melanesian Scrubfowl or Nicobar Pigeon. There were no sightings or local claims in 1986 (TBS field notes) or 2006-08 (AEC field notes). Therefore, from the field evidence we conclude that *P. porphyrio* had either never existed on the atoll, or if it had once been there was extinct by 1970. Therefore this species should not be on the list of Ontong Java avifauna.

If Purple Swamphen had once been present, it may have been a species introduced from Tikopia, where this bird is called **karae** (Kirch and Yen, 1982:283). Tikopia is a Polynesian Outlier that was in intermittent contact with Ontong Java in prehistory, and bones identified as *Porphyrio* have been recovered from all levels in Tikopia archaeological sites. Kirch and Yen (1982:282) suggest that *Porphyrio* was exploited throughout the 3,000 years that people have lived on the island. Yet paradoxically this bird is regarded on Tikopia as having arrived from Ontong Java according to a creation myth recorded by Raymond Firth:

“A canoe came from Luangiua ... [At] Faea [the canoe] held fast, and the canoe rested upon [the sand]. The crew jumped overboard to pull off the vessel. They pulled the vessel to sea, and there is the mark of its haulage, it is called Ruaniua. When the canoe reached the sea again, a bird, the swamp rail [*Porphyrio porphyrio*], was taken from the deck and descended on the land; hence the swamp rail lives in this land” (Firth, 1961:38).

If the origin of Purple Swamphen is associated in myth with Luangiua, is it possible that the transfer was in the opposite direction, from Tikopia to Luangiua? Oral histories from Luangiua suggest that there was two-way contact between these two outliers. One story tells of the voyage of a Luangiua man named Akapu, who brought to the atoll red turmeric from Tikopia and later returned and fought a battle there, which he won. Afterwards he became a chief on the island and lived there until his death. Firth (1961:160), using genealogical evidence from Tikopia and assuming 25 years per

generation, estimated that immigrants arrived from Luangiua around 1725 and founded one of the current lineages on the island. There are also stories of two named chiefs from Tikopia voyaging to Luangiua as passengers in a canoe from Ontong Java, only one of them surviving to return home (Firth, 1961:135-6). With average winds the voyage to Tikopia from Ontong Java would have taken 13 days in the northwest season, not counting Sikaiana and the Reef Islands as possible stopover points on the way (Bayliss-Smith, 1978:51). The transport of this bird to or from Tikopia would therefore have been feasible.

APPENDIX 4

ADDITIONS TO THE ONTONG JAVA SPECIES LIST

The following birds should be added to the list compiled by Bayliss-Smith (1972, 1973), following AEC's observations in 2006-08 and reliable information provided to him by local informants, persons who in many cases have considerable expert knowledge.

Pelican sp., probably Australian Pelican (*Pelicanus conspicillatus*)

In 1978 a pelican was captured by James Asuhelo at Henguai island after a period of strong winds, according to his son Simon Moka. The bird was fed with fish and kept as a pet for about two years before it died. In 2003 numerous men trawling for bêche-de-mer in the lagoon saw a pelican flying around. In October 2007 David Kekaura saw another pelican on a reef near Lopaha. These three separate and detailed reports from trustworthy sources all suggest that *Pelicanus* sp., probably Australian Pelican, should be added to the Ontong Java list as an occasional visitor to the atoll.

Bulwer's Petrel (*Bulweria bulwerii*)

On 25 February 2007 AEC observed two Bulwer's Petrel on a boat trip between Pelau and Nukumanu atoll to the north. The bird is described by locals as black with a curved bill, and is familiar from sightings over the ocean especially when the sea is rough with strong winds. It was also identified from pictures in books by numerous men. Its local name, **kemanu lilikai**, means bird of the surface of the sea. One man said that at some seasons it is also found in the lagoon. The observations of AEC and consistent accounts from numerous reliable informants suggests that Bulwer's Petrel should be added to the Ontong Java list.

Red-Tailed Tropicbird (*Phaethon rubricauda*)

In 2006 a man found and captured a tropicbird with a red tail inside a hole in a tree, height unknown, growing in the interior of Luangiua island. The bird appears to have been roosting or possibly attempting to nest. The man himself was very surprised at the bird's red tail. Although this description is an isolated one it appears to be reliable and unambiguous. We suggest this species be added to the Ontong Java list as a probable vagrant. On neighbouring Takuu atoll people describe Red-Tailed Tropicbird as a rare visitor (Hadden, 2004).

Osprey (*Pandion haliaetus*)

Milton Kenohe of Luangiua spoke about a large bird that he had never seen before flying and calling over the ocean off Kehango island on 2 February 2008 after a period of northwesterly winds. He described it as brown with white underneath, huge

wingspan, big curved bill and prominent feathers at rear of the head. He then identified it with certainty from the book. A similar bird, identified by Sarfert (1929) as “fischadler” (German, sea-eagle), may have been one depicted in 1910 by Oponu of Luangiua (see Figure 3). We suggest this species be added to the Ontong Java list as an occasional visitor to the atoll.

Grey Plover (*Pluvialis squatarola*)

Twice one individual of this over-wintering wader was observed by AEC, in December 2006 at Pelau and in March 2007 at Luangiua. It is a species not hitherto recorded from Ontong Java.

Red-knobbed Imperial-Pigeon (*Ducula rubricera*)

Partial specimens were collected at Luangiua by Woodford (1906b) for the Australian Museum, and were described by him as a *Carpophaga* or Imperial-Pigeon. They were initially identified by R. Etheridge (1906a) as “Rufous-throated Fruit Pigeon, *Globicera rufigularis*”, by which he must have meant *G. rufigula*, a synonym for *D. rubricera* the Red-knobbed Imperial-Pigeon. However, after receiving the opinion of A.J. North, a taxonomist, Etheridge (1906b) changed his mind and wrote to Woodford that the pigeon was “undoubtedly distinct” from *D. rubricera*, requesting another specimen. *D. rubricera* was a species seen by neither TBS nor AEC, but in 2008 all Luangiua informants were positive and unanimous in describing a variety of pigeon with a distinctive red knob, commonly found in the forested interior of Luangiua island. With its red-knobbed feature this pigeon cannot belong to any other Island-Imperial species, and we suggest it be added to the Ontong Java list

Island Imperial-Pigeon (*Ducula pistrinaria*) ?

AEC observed several imperial-pigeons that lacked the distinctive black knob of Pacific Imperial-Pigeon (*Ducula pacifica*) and these were probably Island Imperial-Pigeon (*D. pistrinaria*). For example, several birds lacking the black knob were observed by AEC on Sulumuia island on 4 February 2008. According to Doughty et al. (1999:122) Island Imperial-Pigeon is “found on small islands and in coastal forest throughout Solomon Islands. This is a highly mobile species, with birds frequently observed flying over the sea, sometimes in large flocks, in search of fruiting trees”. It is also a common breeding species in Bougainville and Nissan (Hadden, 2004). However, the knobless birds observed by AEC could have been immature specimens of *D. pacifica* rather than *D. pistrinaria* adults. Local men have no doubt about the existence of both species on the atoll, but at present this addition to the Ontong Java list must be tentative.

Shining Bronze-Cuckoo (*Chrysoccyx lucidus*) ?

Patson Apuli of Luangiua reported in February 2008 that in November 1996 he had found an unknown bird sitting in a tree close to the beach on the ocean side. The bird was exhausted and easily captured, and he tried to feed it but without success, and after three days it died. It was small with shiny feathers, a brownish crown and striped underparts. After looking through Doughty, Day and Plant (1999) he identified it very confidently as *Chrysoccyx lucidus* ssp. *plagosus*, which commonly winters in the main Solomon Islands. This information came from a reliable source, and we suggest this bird be regarded as a probable occasional vagrant to Ontong Java. This bird has also been seen on Nuguria atoll to the west (Hadden 2004) and a specimen was collected from Kapingamarangi atoll (Buden, 1998).

Marbled Frogmouth (*Podocarpus ocellatus*) ?

Another possible record was made from the bird book by Frasier, an adolescent boy, who told AEC in February 2008 that he killed this bird with a slingshot two years ago. It was sitting still in a small tree after a period of strong northerly winds. Another man, Elvis, then said he saw the same bird at Henguai island in about 1999 when he was a boy. The species is found in north Solomons and is sufficiently distinctive for these claims to be probably reliable, but obviously the record must be tentative.

Swiftlet spp. (*Collacalia* spp.)

There is no doubt that swiftlets visit Ontong Java not infrequently, and usually after strong westerly winds. This occurs also on Takuu and Nukumanu atolls (Hadden 2004). TBS saw one flying over Pelau village on 15 April 1971 after two days of such weather. The local name is **ke manumanu kelai**, the little bird coming from the west, and no one knows where they disappear to afterwards. The small black and white bird seen in 1971 was probably Glossy Swiftlet, *Collocalia esculenta*, “an abundant breeding bird throughout the region” (Doughty et al., 1999:132), but other species might also be occasional vagrants.

Table 1. Records of seabird species on Ontong Java atoll. [x] – recorded as probably present; X – recorded as present; XX – recorded as present and presumed breeding; XXX – recorded as present and observed breeding.

Names			1906-1910	1930	1953	1970-1972	1986	2006-2008
Zoological	English	Ontong Java						
<i>Pelicanus</i> sp.	Pelican sp.	--	--	--	--	--	--	X
<i>Bulweria bulwerii</i>	Bulwer's Petrel	manulilikai	--	--	--	--	--	X
<i>Puffinus pacificus</i>	Wedge-Tailed Shearwater	hilikai	--	--	--	X	--	[x]
<i>Phaethon lepturus</i>	White-Tailed Tropicbird	kava'e	--	--	X	XXX	XX	XX
<i>Phaethon rubricauda</i>	Red-Tailed Tropicbird	--	--	--	--	--	--	[x]
<i>Fregata minor</i>	Great Frigatebird	uamea (male), akaha	X	--	--	XXX	--	X
<i>Fregata ariel</i>	Lesser Frigatebird	hohoake (male), akaha	X	--	--	XXX	[x]	X
<i>Sula sula</i>	Red-Footed Booby	anga pa'u	--	--	--	XXX	XX	XXX
<i>Sula leucogaster</i>	Brown Booby	ako'o	--	--	--	XXX	--	X
<i>Sterna fuscata</i>	Sooty Tern	kalahola	--	--	--	XXX	XX	XXX
<i>Sterna sumatrana</i>	Black-Naped Tern	kalapiki	--	--	--	XXX	XX	XXX
<i>Sterna bergii</i>	Great Crested Tern	kala	X	--	--	XXX	XX	XXX
<i>Gygis alba</i>	Common White Tern	popi'i	[x]	--	XXX	XXX	XX	XXX
<i>Anous stolidus</i>	Brown Noddy	ngo'o	X	--	XXX	XXX	XX	XXX
<i>Anous minutus</i>	Black Noddy	leia	X	--	X	XXX	XX	XXX

Table 2. Records of shorebird species on Ontong Java atoll. [x] – recorded as probably present; X – recorded as present; XX – recorded as present and presumed breeding; XXX – recorded as present and observed breeding.

Names			1906-1910	1930	1953	1970-1972	1986	2006-2008
Zoological	English	Ontong Java						
<i>Egretta sacra</i>	Pacific reef Egret	heli	[x]	X	--	XX	XX	XX
<i>Limosa lapponica</i>	Bar-tailed Godwit	kaloakule, ivi, karangoa'a	--	X	--	X	X	X
<i>Numenius phaeopus</i>	Whimbrel	kalanoa	[x]	X	X	X	X	X
<i>Tringa nebularia</i>	Common Greenshank	--	--	--	--	X	--	--
<i>Tringa hypoleucos</i>	Common Sandpiper	kilikavoi	--	--	X	X	--	X
<i>Tringa brevipes</i>	Grey-tailed Tattler	apo	--	X	--	X	X	X
<i>Tringa incana</i>	Wandering Tattler	apo	--	--	--	X	--	X
<i>Arenaria interpres</i>	Ruddy Turnstone	apa'o	--	X	--	X	X	X
<i>Calidris ruficollis</i>	Red-necked Stint	--	--	--	--	X	--	X
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	--	--	X	--	X	[x]	X
<i>Pluvialis fulva</i>	Pacific Golden Plover	'ivi, ma'apo	X	X	--	X	X	X
<i>Pluvialis squatarola</i>	Grey Plover	--	--	--	--	--	--	X
<i>Charadrius mongolus</i>	Mongolian (Lesser Sand) Plover	--	--	X	--	X	--	X
<i>Charadrius leschenaultii</i>	Great Sand Plover	--	--	--	--	X	X	X

Table 3. Records of land bird species on Ontong Java atoll. [x] – recorded as probably present; X – recorded as present; XX – recorded as present and presumed breeding; XXX – recorded as present and observed breeding.

Names			1906-1910	1930	1953	1970-1972	1986	2006-2008
Zoological	English	Ontong Java						
<i>Pandion haliaetus</i>	Osprey	--	[x]	--	--	--	--	[x]
<i>Megapodius eremita</i>	Melanesian Scrubfowl, Megapode	malau	X	X	--	XXX	XX	XX
<i>Caloenas nicobarica</i>	Nicobar Pigeon	leia pura	X	X	--	XXX	XXX	XX
<i>Ducula pacifica</i>	Pacific Imperial-Pigeon	lupe	[x]	X	X	XX	XX	XX
<i>Ducula pistrinaria</i>	Island Imperial-Pigeon	lupe	--	--	--	--	--	[x]
<i>Ducula rubricera</i>	Red-knobbed Pigeon	lupe	--	--	--	--	--	XX
<i>Chalcopsitta cardinalis</i>	Cardinal Lory	sivi	--	--	--	X	XX	XX
<i>Chrysococcyx lucidus</i>	Shining Bronze-Cuckoo	--	--	--	--	--	--	[x]
<i>Eudynamis taitensis</i>	Long-tailed Koel	aleva	X	X	--	X	X	X
<i>Podargus ocellatus</i>	Marbled Frogmouth	--	--	--	--	--	--	[x]
<i>Collocalia sp.</i>	Swiftlet sp.	mamanu kelai	--	--	--	[x]	--	[x]
<i>Todirhampus chloris</i>	Collared Kingfisher	kilihounga	--	--	--	XXX	XX	XX
<i>Monarcha cinerascens</i>	Island Monarch	sisai	X	X	--	XXX	XX	XX
<i>Aplonis feadensis</i>	Atoll Starling	huia	X	X	X	XXX	XX	XX

Table 4. Records of domesticated birds and pet birds on Ontong Java atoll. [x] – recorded as probably present; X – recorded as present; XX – recorded as present and presumed breeding; XXX – recorded as present and observed breeding.

Names			1906-1910	1930	1953	1970-1972	1986	2006-2008
Zoological	English	Ontong Java						
<i>Gallus gallus</i>	Chicken	moa	X	--	--	XXX	X	XXX

FULLY DOMESTICATED								
<i>Anas</i> sp.	Duck	pako	X	--	--	XXX	X	XXX
FLEDGLINGS taken for pets or taken to be reared and eaten								
<i>Fregata minor</i>	Great Frigatebird	akaha, ua mea	X	--	--	X	--	--
<i>Fregata ariel</i>	Lesser Frigatebird	akaha, hohoake	X	--	--	X	--	--
<i>Egretta sacra</i>	Pacific Reef Egret	heli	--	--	--	--	X	--
<i>Sula sula</i>	Red-Footed Booby	anga pa'u	--	--	--	X	--	X
<i>Sula leucogaster</i>	Brown Booby	ako'o	--	--	--	X	--	--
<i>Sterna bergii</i>	Great Crested Tern	kala	X	--	--	--	X	X
<i>Gygis alba</i>	White Tern	popi'i	--	--	--	--	--	X
<i>Anous minutus</i>	Black Noddy	leia pura	--	--	--	--	--	X
<i>Caloenas nicobarica</i>	Nicobar Pigeon	leia	X	X	--	--	X	[x]
<i>Ducula pacifica</i>	Pacific Imperial-Pigeon	lupe	--	--	--	--	--	X
INTRODUCED PET SPECIES (non-breeding)								
<i>Lorius chlorocercus</i>	Yellow-bibbed Lory	?	--	--	--	X	X	X
<i>Acridotheres tristis</i>	Indian Myna	?	--	--	--	--	X	--