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THE STATUS OF THE BIRDS OF WAKE ATOLL

BY

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AND JOHN GILARDI**

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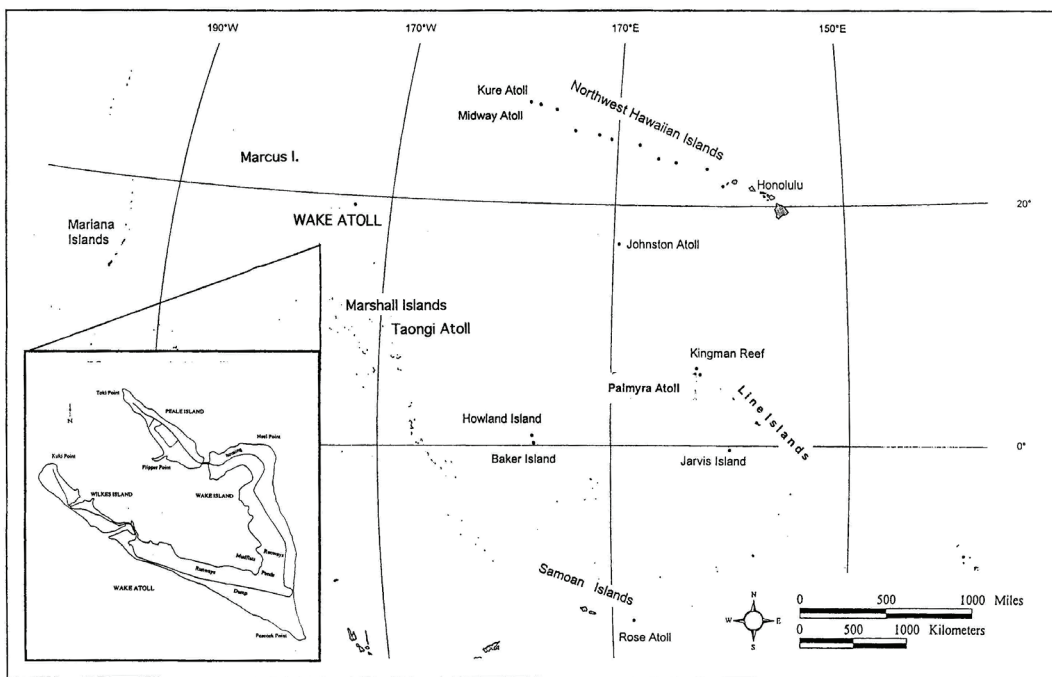


Figure 1. Map of Island Location in Pacific.

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INTRODUCTION

With the exception of the extinct Wake Rail, Wake Atoll birdlife has recovered from the destruction of World War II and the depredations of introduced feral cats. Significant changes in the avifauna of Wake Atoll began with the commencement of cat control in 1996, and accelerated with eradication of feral cats in 2004. (See cat eradication paper in this volume). As a result, Gray-backed Tern and increasing numbers of boobies and shearwaters recolonized areas where they were found nesting before the war. Band recoveries from four species indicate French Frigate Shoals, Hawaii and Johnston Atoll serve as sources for some of the species recolonizing Wake. After cats were eliminated as predators, Pacific rats numbers increased and they depredated tern chicks and eggs. In 2006, Wake was struck by a super-typhoon. Nevertheless, seabird populations continue to increase, and additional species are found as migrants.

Our annotation of 56 bird species add over 20 species to the previous published assessment of 31 species known from Wake Atoll (Jones 1995). We include 15 new records, several unreported museum specimens, document seven species that were previously considered hypothetical and list six needing confirmation. In addition, we include a rare photograph of the Wake Rail from a previously unpublished journal discovered in 2004. We also review some unpublished accounts and report our own observations made during feral cat project spanning 1996 to 2004, as well as observations made during a rat control program from 2006 to 2008, that added additional new species.

We reviewed notes on birdlife published from past Wake Atoll expeditions including those of A. Wetmore (1923) in (Olson 1996); A. F. Bailey (1951); E. H. Bryan Jr. (1959); and F. R. Fosberg (1966). Many bird records were obtained from the Smithsonian Institution's Pacific Ocean Biological Survey Program (POBSP) but there is no published summary of these observations except a study of the Pacific Golden Plover that includes vagrants seen on Wake (Johnston and McFarlane, 1967).

Baker (1951) listed birds known from Wake in his review of the Micronesian avifauna. Although Wake is considered an outlying Marshall Island, the status of Wake birds were not considered by Amerson in his review of ornithology of the Marshall Islands (1969).

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The only nearly complete list of the species known to occur at Wake is a checklist of Micronesia by Pyle and Engbring (1986) who make several references to poorly documented records of specimens housed in the U.S. National Museum. There is another paper entitled Notes on the Birds of Wake Island, Central Pacific, by R. B. Clapp (1986) that was not published. More recently, Wiles (2005) lists a review of Micronesian fauna that includes some of our reports of Wake birds, but did not list species reported without documentation, and VanderWerf (2006) reviews Marshall Island birds from Kwajalein.

Survey Area

Wake Atoll is one of the most isolated islands in the world. Located in Micronesia, it is the northernmost outlier of the Marshall Islands. Wake Atoll (19°18'55" N : 166°38'21" E), lies approximately 1,400 miles from Guam, 1,200 miles from Midway Islands, 2,600 miles from Honolulu 1,600 miles from Johnston Atoll; 900 miles from Marcus Island to the north. The nearest landfall is Taongi Atoll, 375 miles to the south. (Figure 1).

The total land area of Wake Atoll is approximately 739 hectares (1,826 acres; 2.85 square miles; 7.4 km²) with 12 miles of coastline. Its three islands, Wilkes, Wake and Peale, form a “V” shaped atoll, open on the northwest side and surrounded by a barrier reef. (See Figures 2 & 3). The islands are linked by about 9 miles of paved road and about 25 miles of unpaved roads. A 10,000-foot runway, with associated taxiways and aprons covers much of Wake Island at the head of the lagoon. The runway is adjacent to freshwater ponds in a few low-lying, wetland areas. Extensive sand flats at the head of the lagoon also provide shorebird habitat.

The three islets that compose Wake are separated from each other by water. The original channel between Wilkes and Wake Island is now a solid fill causeway but a channel was blasted in Wilkes Islet that is now submerged during high tide. Another channel separating Wake and Peale Islands was spanned with a wooden trestle bridge until it burned down in December 2003. Due to the linkage of Wilkes and Wake and the placement of cement bridge anchors between Wake and Peale, tidal flow has decreased and the lagoon has become shallow with a maximum depth of 25 m. (Banner et al., 1969).

Along the lagoon shore, sandy beaches extend to the tips of the islets (See Figure 3). The island's north side is composed largely of broken coral pieces, interspersed with coral rock shelves. The eastern side and southwest side is very rough, eroded coral rock, with projections of large sheets of flat reef the bordering the island. Captain Wilkes noted in 1839: “Wake's Island is a low coral one, of triangular form, and eight feet above the surface...From appearances, the island must be at times submerged, or the sea makes a complete breach over it.” (Wilkes, 1844). The naturalist for the U. S. Exploring Expedition, Titian Ramsey Peale, described the island similarly: “The only remarkable part in the formation of this island is the enormous blocks of coral which have been thrown up by the violence of the sea.” (Poesch, 1961) ...It has upon it the shrubs which are usually found on the low islands of the Pacific, the most abundant of which was the *Tournefortia*.” (Wilkes Narrative v:284-5-1844 in Bryan 1959)

The vegetation is typical of Pacific islands, composed of six major plant habitat types: *Tournefortia argenticornis* scrub including some *Scaevola taccada*, *Cordia subcordata*

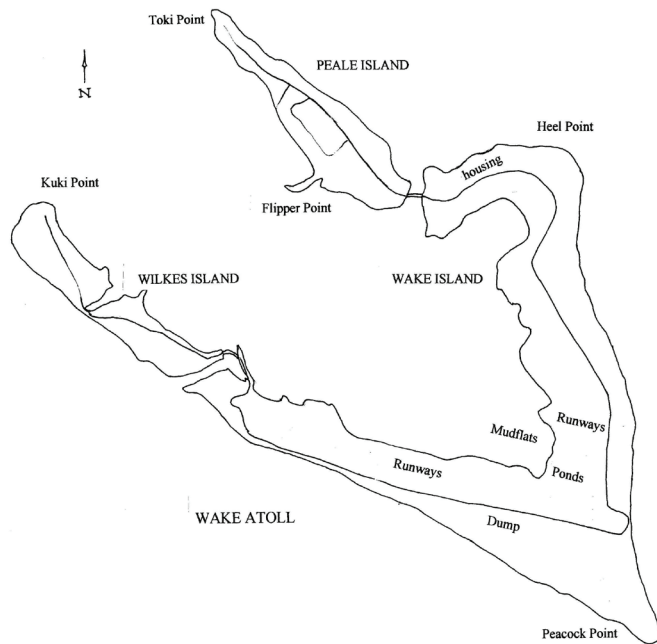


Figure 2. Locations mentioned in text on Wake Atoll.



Figure 3. Satellite Image of Wake Atoll. Peale Island is the turtle-shaped isle in the upper left; Wake Island is the main 'V' shaped island and Wilkes Island is at the lower left.

and *Pisonia grandis*; *Pemphis acidula* scrub; grasslands with *Dactyloctenium aegyptium* and *Tribulus cistoides*; *Sesuvium portulacastrum* wetlands; *Casuarina equifolia* forest; and ruderal areas that include *Leucaena leucocephala* (Fosberg and Sachet, 1969). Birds inhabit relatively small portions of the atoll (See Figure 4). The largest habitat is *Tournefortia* forest (See Fig. 5 & 6). The native vegetation and birdlife was devastated during World War II when thousands of Japanese soldiers were put under siege and bombed by the American forces for four years. After the war, military debris was salvaged, areas of the island were abandoned and native plants recolonized. From the 1950s to the 1960s, the aircraft areas were vegetated in grass and housing areas were landscaped with exotic tropical vegetation. Over 2,000 people lived on Wake in the 1970's, but when the island personnel were reduced, introduced vegetation, especially ironwood trees (*Casuarina equifolia*), becomes a monoculture around the atoll. Ironwood creates habitat for tree-nesting noddies, and other species such as Laysan Albatross, Wedge-tailed Shearwaters, and White-tailed Tropicbirds may benefit from the cover. However, native vegetation is diminishing due to the smothering effect of ironwood needles.



Figure 4: Bird areas on Wake Atoll. Map courtesy of A. Hebshi.



Figure 5. Construction workers with a bo'sn bird and a dark shearwater, maybe Christmas? Peale Island-1936 (photo courtesy of C. Nickerson).



Figure 6. Peale Island:1939-Vegetation Photograph of *Tournifortia* forest. Photo by Torrey Lyons

Avian History

The first bird records from Wake are those regarding albatross made by Titian Peale, the biologist for the U.S. Exploring Expedition in 1838-41 (See albatross species account). The first comprehensive bird survey was by Dr. Alexander Wetmore of the Smithsonian Institution, biologist-in-charge of the Tanager Expedition, who visited Wake

and other islands in the Central Pacific Ocean. These observations made from 27 July to 5 August, 1923, portray the Wake Atoll avifauna after the island had already been raided by Japanese feather hunters in the first decade of the 1900s; but was “more or less in its original condition.” (Wetmore letter, 1939; Olson, 1996).

Wetmore reports that Wake did not have the extensive bird colonies found in the Northwestern Hawaiian Islands (Olson, 1996). E. H. Bryan who accompanied Wetmore on their summer survey of Wake wrote: “In 1923 the sea birds were the usual species: petrels, red-tailed tropic bird, boobies, frigate, and terns...to the Pacific golden plover, bristle-thighed curlew, wandering tattler, turnstone, sanderling, and sandpiper, doubtless could be added other migratory species of the western Pacific.” (Bryan, 1942). Wetmore also found some old albatross bones: “3 weathered humeri, heads of 3 others...These are all *Diomedea immutabilis*.” (Olson, 1996). Wetmore also collected a series of about 45 endemic Wake Rails (*Gallirallus wakensis*) that are housed in the U.S. National Museum.

In 1935, Pan American Airline construction workers reported a similar avifauna:

“There were no goonies at Wake Island and no love birds, [White Terns] but there were large numbers of black terns [Black Noddies] which made their nests in trees. They resented any approach, and would swoop down at us scolding vigorously. The bo’sn bird were also present...Perhaps the bo’sn bird gets his name from his ability to imitate a hard-boiled bo’sn swearing at his crew.” (Grooch, 1936). See Figure 7.

Photo # 80-G-411160 Wake Island, 25 May 1941, looking toward the west



Figure 7. Aerial view of Wake and Peale Islets in 1941- National Archives photo.

An early effort in bird conservation is noted in a letter dated 16 Aug. 1935 from the Commandant of the 14th Naval District to Pan American Airways:

“We appreciate very greatly Rear Admiral Yarnell’s interest in the preservation of the unique birdlife found on Midway and Wake Islands, and the instructions he has been given regarding the introduction of cats, dogs, mice and other bird enemies on these Islands. The introduction of such domestic animals as swine, goats, and sheep on islands in other parts of the world has had equally disastrous effects on bird life by destroying vegetation and cover. May we suggest that these animals be included among those prohibited on the Islands? The Commandant has issued instructions that no domestic animals including swine, goats and sheep be permitted to land on Midway and Wake Islands.”

In 1938, Vaughan (1945) identified Laysan Albatross (“goonies”) and what he called Common and Least Terns in his account of the birdlife.

“Others of which I was uncertain were two or three kinds of terns, a “stormy” petrel, a wader that resembled a Phalarope or a Plover that might be peculiar to this island [Wake Rail?] and a blackish bird that at a distance looked like a crow but probably was not [Brown Noddy?]. My informants were also of the opinion that only the Albatross and perhaps some of the terns were away for part of the year and that the other species were permanent residents.” (Vaughn, 1945).

In 1939-41, Torrey Lyons, a gardener hired by the Pan American Airways, kept a journal of birds observed, collected and photographed for over a year. These observations occurred at a time of minimal disturbance and are especially important for the extensive observations and photographs of the Wake Rail. Lyons’ forgotten journal, and unknown photos of Wake Rails were rediscovered during our research. See Figure 8. These complement the five specimens of Wake Rails, including the only chicks preserved, that Lyons collected and housed at the Museum of Vertebrate Zoology, University of California in Berkeley.



Figure 8. Best photograph of a Wake Rail, Peale I. in the photo collection of Torrey Lyons, 1939.

After the war, natural history investigations did not resume until May 1949 when Alfred M. Bailey visited Wake. He reported the extinction of the Wake Rail and commented on the devastation wrought by the war. He noted few bird species, other than Sooty Terns that were nesting by the thousands on Peale Island:

“A few man-o’war birds (*Fregata magnificens*) [sic] were sitting about on the rusted iron skeletons of the bombed naval buildings. Small groups of noddy terns (*Anous stolidus*) were nesting in the dwarf trees known locally as bukas (*Pisonia grandis*). We saw two white-tailed tropicbirds. It was apparent that the bird population had suffered from the Japanese occupation, for aside from what I have just mentioned, there were no birds. We did not see any boobies (*Sula*), red tailed tropicbirds, or albatrosses. A search for burrow nesting birds as petrels and shearwaters was out of the question...I saw nothing of either.” (Bailey in Bryan 1959).

Fosberg (1966) visited the atoll six times starting from 1951 to 1963 and recorded 15 bird species. A considerable amount of information was obtained by the Smithsonian Institution’s Pacific Ocean Biological Survey Program (hereafter POBSP), during 11 visits from 1963 through 1968. See Table 1. Most reports were by biologist Robert McFarlane, but in 1967, R. Chandler reported 11 bird species from Wake Atoll and importantly; “The main island, Wake proper, was found nearly devoid of birdlife except for occasional golden plovers around the air strips.”(POBSP; Chandler, 1967).

The U.S. Fish and Wildlife Service (USFWS) biologists visited and made observations in 1982, 1983, 1989, and 1994. H. L. Jones (1995) who visited Wake from 24 March – 1 April 1993 published observations of 31 species of birds and summarized some historical data. We build on Jones’ report with observations made during seven extended visits from 1996 to 2004. Our visits were funded by the U.S. Department of Defense Legacy Program and entitled: Conservation of Indigenous Birds at Wake Atoll, during which time we eradicated feral cats, concluding in late 2004. The cat eradication program helped increase bird diversity and populations that are now at the levels first recorded in 1923. A review of past bird populations is in Table 2. We have summarized 56 species that have been identified at Wake, and gathered new information on the extinct Wake rail to be published later (Olson and Rauzon, in prep.). We also report some previous undocumented specimens and confirm several published records (Johnson and McFarlane, 1967) that failed to provide descriptive evidence and therefore were considered as questionable sightings. Pyle and Engbring (1985) list three species requiring further documentation before their identity can be confirmed, and we provide museum specimen numbers for two of these species. In the following Species Accounts, we also provide reviews of four more hypothetically occurring species that need further documentation.

Table 1: Recent Scientific VisitsPOBSP Visits

June 8-16, 1963

July 20-28, 1963

Dec. 21, 1963-Jan. 5, 1964

Apr-11-27, 1964

Aug 22-30, 1964

Dec 19, 1964- Jan 10, 1965

May 8-23, 1965

June 14-21, 1966,

Dec. 27, 1966-Jan. 4, 1967

Mar. 1-15, 1968

Sept 4-7, 1968

CAT Program Visits

Dec. 5-10, 1996

Jul. 17-29, 1998; Oct. 21-23, 1998 (USFWS)

Feb. 17-Mar. 8, 1999

Sep. 21-Oct. 4, 2000

Jun. 28 -Aug. 20, 2003

Nov. 1, 2003 - Jan. 10, 2004

Jul. 25- Aug. 27, 2004

RAT Program Visits

Feb. 17-Mar. 5, 2007- Hebshi et.al

May 23 – Jun. 7, 2007- DoD Legacy Team

Sep. 23 - Oct. 7. 2007- Hebshi et. al

27-29 July 2008- Hebshi et. al

13-14 Jan. 2008- Hebshi et. Al

Table 2. Wake Bird Population Counts
(Population count/number of nests)

BIRDS	1923	1939-40	1949-53	1967	1988-92	1993	Dec-96	Jul-98	Mar-99	Jul-03	Dec-03	Aug-04	2005 IOKE	2006 IOKE	Jun-07	Jan-08	
Laysan Albatross	0	?	0	0	5/1?	p/1	5/1n?	0 (1 n-97)	2/(1n-98)	0	2/n	Feb-00	2/thick p/0		2/failed nest	0/0	
Black-footed Albatross	p/0?	3/0?	0	0	6/?	6/?	3/1n	6-97/?	4/0n	0	3-6/1n?	0	p/0	p/0	1 Dead, p/0	p/0	
Wedge-tailed Shearwater	100/n	100/n	0	6/?	0	0	0	?/50	0	?/70	?/n	176/105			81/90 burrows	24 active nests	
Christmas Shearwater	2/?	+ in 1936	0	0	0	0	0	0	1/?	0	0	1/?			1/n?		
White-tailed Tropicbird		?	2	15/n?						2	4	5/2n?			3/courting		
Red-tailed Tropicbird	30/n	"many"/12	0	20/2		4/n	0	25/?	100/25	p/40	p/?	p/15			p/n		
Masked Booby	3/2n	?/"many"	0	0	?/2n	5/n	10/2n	2/15n	11/5n	25/7	75/18	70/18			60/25	p/31	
Brown Booby	500/n	?/100	0	40/23	212/106n	111/56n	26/13n	400/107n	111/?	400/162	300/31	p/76			313/164	p/60	
Red-footed Booby	5,000	2000+/++	p/n	p/18	p/41	p/35n	1,500/32n	2,200/5n	p/25n?	2,500/20?	2,500/76	3000/5			733/n		
Great Frigatebird	2,000/n	"very many"/25	"a few"/?	30/2n	274/0	225/0	500/0	100/0	400/n	150-300	150-300	150-300	Possible Nesting		Possible Nesting	Nesting/one red-headed juvenile	
Sooty Tern	?/300n	p/500	"1000's"	p/230,000	p/143,000	p/300	10K/n	11K/75	200,000 87,000	p/n	p/0	p/0			Chick mass starvation	50,000 @ Peale	
Gray-backed Tern	100/n	400/?	0	2/1		8/?			4/0n	5/1?	0	60/9			75/n		
White Tern	2,500/n	p/14	p/n	p/n		6/n	p/1n	100/3	60/n	200	300	400/n			all isles nests		
Black Noddy	200/n	p/25	0	0		2/?	200/100n	300/100n	715/2n	1000/n	1500/n	2000/n			common/n		
Brown Noddy	6,000/n	"abundant"/4 nests	p/n	50/0		98/3n	Jun-00	100/50n	20/4n	200/n	500/n	1000/n			Tree&ground nesting		
Pacific Golden Plover	200	"abundant"	24	250		p	200	31	160	20	200	20			23	6	
Bristle-thighed Curlew	3	4		p					4	0	1	1					
Wandering Tattler	2	26	2	10		p			30	5?	15	5				4	
Ruddy Turnstone	2	25	1	20	p	1	4	2	1	5	12	5				3	
Pintail Duck				9	5		4	0	6	0	2	0				9	26 on 10/07

CHART KEY

p/n = number present/number of nests
/? = not known if nesting
"many" are quotes taken from papers
87K = 87,000

TYPHOON IOKE

Wake Island was hit by Typhoon Ioke on 31 August 2006. The storm was a Category 5 level typhoon for five days before it landed at Wake. It built to a ferocious level with a 50' wave surge, and sustained 140 knots gusting to 170 knots. Initial fears that the storm surge would submerge the entire island did not materialize. If this wave had hit as predicted, it would have devastated the island. There were 3 million gallons of JP-5 jet fuel on the weather-side of the island, five tanks filled with asphalt/tar, 4,000 to 5,000-gallon drums of gasoline, three aircraft refueling tanks that were filled to capacity. Fortunately, there were few major damages. The new multi-million dollar runway resurfacing was largely unharmed. The Air Terminal building was intact, however, it suffered roof damage as did many other buildings that were later condemned. The beach houses where Thai workers recreated were largely gone. Several of the beaches were rearranged by large waves from a lagoon surge. The most significant toxic hazard was that asbestos was spread around the island.

Natural resources appeared to have suffered little sustained damage. Most of the birds probably escaped before the storm hit. Typhoon damage impacted the shearwater colony at Peacock Point, Wake Island that had developed since cat eradication, but a few birds continue to visit the colony. See Fig. 4. At the fuel farm colony that had been covered with flotsam when the lagoon surged, several individuals were seen and heard in June 2007. The main colony on Wilkes Island appears to be largely unharmed and continues to grow. Approximately 80 birds were counted at night on 1 June 2007. The newly formed Gray-backed Tern colony on the northshore of Peale Island was inundated and abandoned. Some of these birds probably moved to the Wake Island tern colony as that colony was now larger. It was also more diverse with Brown Noddies starting to nest on the ground adjacent to the main colony.

Typhoon Ioke's winds denuded virtually all the ironwood trees and many coconut trees snapped in two. Despite all the ironwood trees losing their needles, there were benefits to White Terns and Black Noddies. White Terns place their eggs on broken branches near the trunks of ironwoods while branch re-growth sprouting from all surfaces support Black Noddy nests. However, the spread of ironwood seeds around the atoll that resulted from the storm is a significant threat to the remaining patches of native vegetation, especially on Wake Island.

SPECIES ACCOUNTS

Laysan Albatross (*Phoebastria immutabilis*)

This wide-ranging North Pacific species regularly visits Wake Atoll but notes on its past occurrence are ambiguous. Wake Island was visited in 1841 by the U.S. Exploring Expedition, also called the Wilkes Expedition. Commander Charles Wilkes wrote: "Mr. Peale found here the short-tailed albatross, and procured an egg from its nest. The birds were quite tame, although they were not so numerous as we had before met with in uninhabited islands." (Wilkes, 1844). Titian Peale, the naturalist for the expedition, recorded:

“On the 20th of December, we found them breeding on Wake’s Island. The single egg of each pair was laid on the ground in a slight concavity, without any lining material; both sexes take turns in the labours of incubation; and neither the male nor the female abandoned the nest on our approach, but walked round us in a very dignified manner, and made but a few demonstrations of defense with their beaks, when taken up in our arms.”
 ... “It was not our fortune to observe more than this species of Albatross in the North Pacific It is subject to great variation of plumages, but is very distinct from those of the southern hemisphere...” (Peale 1841).

Peale evidently considered all North Pacific albatrosses to belong to a single species, the Short-tailed Albatross *Diomedea brachyura* [=P. albatrus, Short-tailed Albatross], under which Peale listed *D. nigripes* as a synonym. (The Laysan Albatross was not described until 1893 by Rothschild). Peale collected an albatross egg (USNM 949), now labeled *D. immutabilis*, although this may be no more than a surmise (S. Olson pers. comm.) The badly broken and patched albatross egg is smaller than Black-footed Albatross eggs, but there is almost complete size overlap between Laysan and Black-footed eggs and even some overlap between them and Short-tailed Albatross eggs. (B. Flint, pers. comm.). In addition to the egg, there is a skin of *D. nigripes*.” (National Museum specimen 15552) marked Wake’s Island, U.S. Exploring Expedition, field number 745. This is the only skin of either albatross from the expedition cataloged in the U.S. National Museum (Rice and Kenyon, 1962).

In 1908, Japanese bird harvesters raided Wake Island, the island they knew as *Otori-jima*: ‘white-bird island’. In 1923, the Tanager Expedition found the ruins of a Japanese camp with two large tin roofed houses, about 18 feet wide by 30 feet long, two smaller buildings, one tank, and a statement in Japanese characters that the island was abandoned 12 or 13 November 1908 [during the time albatross would return]. Figure 9 is a composite of three photographs of their camp. Regarding the occurrence of albatross, Rice and Kenyon (1962) report: “The pile of bird bones indicated great destruction of bird life over the years. The species identified from the bones were frigate birds, boobies, and terns [no albatrosses]...the fact that they were not among recent bones left by plume hunters indicates extermination long before 1923.” However in 1922, Lt. Comdr. Pickering observed Laysan Albatross were present. Wetmore had found several albatross bones in 1923 in an area that was used by Japanese feather hunters but he didn’t identified this material until September 1968 as belonging to Laysan Albatross. He writes in his journal: “Of definite importance as a record of this species on Wake.” (Olson, 1996).

The field notes of Torrey Lyons from 1939-1940 do not record Laysan Albatross, but note a few Black-footed Albatross (*P. nigripes*) (see next account.) A war diary written by a Japanese officer while they were under American siege has an intriguing reference. “August 22-Two night alarms and one day. The enemy seems to know how to harass us. What a life! An order has just come out forbidding us to catch gooney birds lest they be wiped out.” In 1951, Bailey wrote: “The effort of the officer to protect the ‘gooney birds’ must have been largely in vain. Most of the birds were destroyed by the starving soldiers...” (Bryan, 1959). Olson (pers. comm.) notes the August timeframe of the order is wrong for albatross to be on Wake, and suggests this refers to boobies instead, however, it could refer to albatross since they was already rare. Bryan (1959) thought that albatrosses could be found here, and Owens (1977) reported albatross sporadically occurred here after the war. In 1967, McFarlane records that local residents had never seen Laysan Albatross, but a band was read by POBSP biologists at Mejit Island in the Marshall Islands, a neighboring island relatively close to Wake (Amerson, 1969).



Figure 9. Photographs of the derelict Japanese feather poacher camp on Peale I. Upper left, jug and crockery; lower left, row boat skeleton, both photos by C. Koller, 1935; Upper right, camp sheds, courtesy of Hawaii State Archives.

It was not until 6 April 1980, that three Laysan Albatross were photographed together dancing on Wake Island (Jones 1995). Throughout the 1980s, Laysan Albatross were seen repeatedly and suspected to nest on Wake (Fefer and Harrison, 1983; Jones, 1995). Beginning in the 1980s, this large conspicuous seabird expanded its breeding range from the Northwestern Hawaiian Islands to include Wake, the main Hawaiian Islands and islands off NW Mexico (Gallo and Figeroa, 1996; Howell and Webb, 1992).

We confirmed the first Laysan Albatross breeding attempt in 1996 when two widely separate nests with eggs were found in ironwood groves, one at the west end of the runway and the other near the water treatment plant. It is not known if these eggs hatched, but no albatross chicks were fledged. All subsequent breeding attempts have been from the site at the west end of the runway. In 1998, a pair of Laysan Albatross again nested under the ironwood trees at the west end of the runway but a rare-20 foot storm surge wave flooded the nest and egg (L. Hitchcock, pers. comm.). In 1999, an egg was layed but subsequently abandoned (M. Timmons, pers. comm). In 2001, three



Figure 10. Laysan Albatross pre-fledgling, Wake I. 2001. Photo by R. Wheeler.

adults were reported from Wake Island and a pair again nested at the west end of the runway under ironwood trees. This nest successfully fledged the first albatross produced on Wake in over 50 years. (Fig. 10). A nest contained two eggs was found in December 2003, suggesting a female-female pair. One egg disappeared and the other egg was eventually abandoned and a third adult was seen regularly at Peacock Point. A chick was produced in 2004-05 season but later disappeared (T. Tiley, pers. comm). Although birds were present, no breeding attempts were made from 2006 to 2007. In 2008, three nests were produced, including another two-egg

clutch. Two of these nests survived a tidal surge in the ironwoods between the runway and the lagoon.

Black-footed Albatross (*Phoebastria nigripes*)

The historic range of Black-footed Albatross extends west of Wake Island to Torishima, Japan and south to include Taongi Atoll, Wake's nearest neighbor, where a Black-footed Albatross was seen flying offshore on two occasions (Fosberg, 1966; Amerson, 1969). There were no valid breeding records for Micronesia, except at Wake Atoll. Rice and Kenyon (1962) report that the Wilkes Expedition collected a specimen of a Black-footed Albatross in 1841. Olson (1996) writes: "This is the only evidence I know of to substantiate the species from Wake." During 1939-1940, several were seen on the ground. The field notes of Torrey Lyons record up to four Black-footed Albatross as visitors in 1940 but not as a nesting species.

There are dubious records of five Black-footed Albatross eggs housed in the USNM (41696-41673), reportedly collected on Wake, received from Nat. Zoo. Park and entered in the records on February 11, 1958. In spite of search efforts, the specimens were not found, and it seems unlikely they are from Wake since five eggs would be more than ever reported from Wake.

In December 1996, a pair of Black-footed Albatross nested on Wake Island under a *Tournefortia* shrub along the northeast shoreline near Peacock Point (Fig. 11). The fate

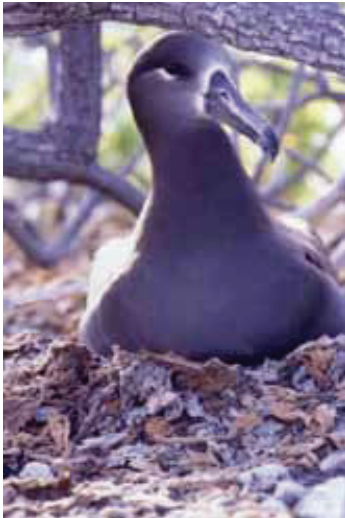


Figure 11. Black-footed Albatross nesting on Wake I. December 1996.

of the egg is unknown but island personnel never reported seeing a chick. On 12 December 1996, a dead Black-footed Albatross washed ashore. Autopsies suggest the individual was a male that died of a puncture wound to the neck. It had very low fat reserves, little pectoralis muscle was present, and crop was empty except for squid beaks (K. Lopez, pers. comm.).

In the winter of 1997-1998, up to six were observed and photographed roosting and flying over the north end of the runway apron (M. Henz, pers. comm.). We do not know if any of these attempted breeding. In March 1999, four albatross were repeatedly seen and photographed dancing together. A pair was photographed sitting on an empty nest, and another pair was photographed nuzzling each other. Three of the birds appeared to be all dark without white rumps indicating they were young birds. In 2000, two pairs laid eggs, but all deserted “as soon as the eggs hatched” (R. Wheeler, pers. comm.). In 2001, several were seen on Wake Island, but no nests were reported. Three

pairs were reported to have attempted breeding in 2002-03, with single pairs behind the medical dispensary, along the south coast of Wake and on the west coast of Wilkes, but we do not know if any produced viable eggs. A pair returned on 20 November 2003 to the site behind the medical dispensary and eventually laid an egg that was subsequently abandoned. There were no known breeding attempts in 2004-08, although several birds were seen (T. Tiley, pers. comm.). In February 2007, a dead bird was found (A. Hebshi, pers. comm.).

Wedge-tailed Shearwater (*Puffinus pacificus*)

Wedge-tailed Shearwaters are widely distributed throughout the tropical areas of the Pacific and Indian Oceans. In Micronesia, they breed at Taongi, Bikar, and Taka Atolls and may visit Eniwetok (Amerson, 1969). Wetmore reported that on 30 July 1923, he found a colony of about 50 pairs on Peale Island as well as a few burrows on the northern portion of Wake Island (Olson, 1996). Shearwaters were also found nesting on Peale Island in 1935 and were considered by Pan American surveyors to be a good place to build because they thought the nesting area would not be subject to tidal flooding:

“I had no idea that there were moaning birds (on Peale Island) until I broke through to my knees in one of their holes. I had thoroughly disliked the moaning birds at Midway, but now I could have wept for joy at finding them. I knew full well that those birds would never dig holes where they might be drowned out by high water.” (Grooch, 1936).

Torrey Lyons found Wedge-tailed Shearwaters to be fairly common in 1939-40. He collected an immature (MVZ-79426) in July 1940, and reported:

“two nests near the shore of the lagoon, north end of Wake 1/4 miles south the channel. This bird almost white underneath. Wing 17” tail 6”; confirming the light-phase was present.” On 19 November 1939, Lyons wrote: “None heard lately--holes seen at southern tip of Wake (Peacock Point). On 1 April, very many burrows in middle of Wake 3/4 mi. east of Peacock Point.”

The war eliminated the shearwater colonies. In 1967, Amerson lists Wedge-tailed Shearwaters as having formerly bred on Wake, and POBSP biologists reported only six were seen and only on Wake Island, not Peale or Wilkes Islands (King, 1973). A female (USNM 496548), found on the runway taxi area in front of the terminal, was collected 20 June 1966. The presence of subcutaneous blood clots suggests that the bird had flown into one of the nearby poles and died of internal injuries.

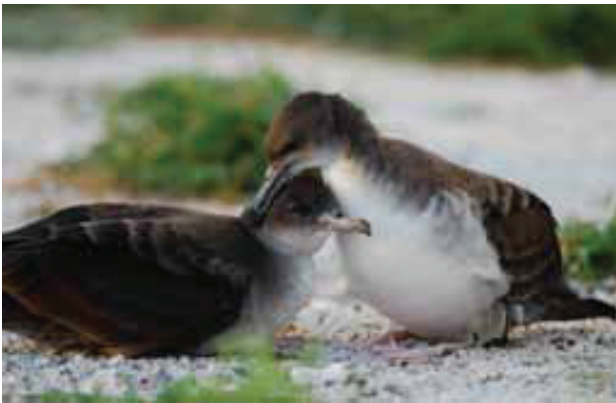


Figure 12. Wedge-tailed Shearwaters, Wilkes I.

For over 20 years, shearwaters were occasionally heard at night on Wake Island, but they were not known to breed there until we found about 15 burrows on Wilkes Island in July 1998, that were not observed in 1996. We estimated approximately 50 birds were on or under the ground calling and courting (Fig. 12). The burrows were made conspicuous by the piles of excavated white sand at the entrances and most appeared empty during the day. By August, the Wilkes Island

colony had increased to over 60 burrows and a hatched chick was observed. In early November 2003, we found approximately 15 fledglings in this colony.

In January 2001, one Wedge-tailed Shearwater was on the ground at Peacock Point, Wake Island where Lyons described a colony in 1939. On 9 July 2003, we found an adult on an egg in this colony consisting of approximately 50 burrows (See Fig. 4). In July 2004, another colony of 20 burrows was found in ironwoods near the fuel farm in the center of Wake. Shearwater sightings also increased and single birds were found south of the golf course, along the beach road by Heel Point and on Peale Island. The recent increase of shearwaters at Wake Atoll is probably due to a cessation of feral cat predation, beginning in 1996, combined with immigration from an increasing shearwater population in the main Hawaiian Islands. Several of the tropical dark morphs were seen but the majority were light-colored Hawaiian-types. A shearwater was found killed by cat on Wilkes Islands in 2003. It had been banded at Tern Island, French Frigate Shoals, Hawaii in 1996. Another band was read from a live shearwater in 2007, and it also was banded in 1996 at French Frigate Shoals.

Typhoon Ioke hit in August 2006 when chicks were ready to fledge and wiped out the recently established shearwater colonies on Wake Island. The Peacock Point colony was nearly inundated, but in 2007 a few birds continue to visit the colony. At the fuel farm site on Wake, the colony had been covered with flotsam when the lagoon surged but several individuals were seen and heard calling here in 2007. The main colony on Wilkes appears to be intact. On a night survey on 1 June 2007 of all the known places shearwater occurred, we found about 80 birds, compared to 176 birds counted in July 2004.

Christmas Shearwater (*Puffinus nativitatus*)

Christmas Shearwaters range into the western Pacific Islands. The species is reported from Taongi and Bikar in the Marshall Islands (Amerson, 1969; Brooke, 2004). Baker (1951) also lists it from Ailuk but Amerson (1969) considered this record wrong. They apparently have been extirpated from Marcus and the Bonin Islands. Owens (1977) reports Christmas Shearwaters from Wake in the checklist of the birds of Micronesia based on Wetmore collecting a pair from Peale Island on 30 July 1923. Figure 7 is a 1935 photograph of a possible Christmas Shearwater from Peale Islet. There is also one record



Figure 13. Christmas Shearwater, Wake I.

of this species from the POBSP era; a male (USNM 495852) collected on Wake during a heavy rainsquall on 20 May 1965.

We observed a single adult on 3-5 March 1999 on Wake Island in the abandoned housing area, where it roosted in a tangle of leaves under a large screwpine (*Pandanus orodatissimus*). Photographs of the birds' left foot show it was held off the ground, indicating it may have been injured. (See Figure 13). In August 2004,

a Christmas Shearwater was seen repeatedly in the Wedge-tailed Shearwater colony on Wilkes Island. In June 2007, one individual was observed there twice. On both occasions it was interacting with Wedge-tailed Shearwaters; once being mounted and another time harassed into a burrow. It may be the bird seen here in 2004 and 2007 is the same individual.

Newell's Shearwater (*Puffinus auricularis newelli*)

There are two records for Wake, both females (USNM 496561, 496562). These are the westernmost specimens of the species taken by the POBSP (King and Gould, 1967; POBSP unpub. data). These birds were found on the ground on the night of 15 June 1966 among Sooty Terns on Kuku Point, Wilkes Islet. Some measurements included in data sheets suggest they had small ovaries and presumably were immatures or non-breeding birds (R. Banks, pers. comm.) that strayed from the breeding colonies in the main Hawaiian Islands where laying occurs in early June (King and Gould, 1967).

Sooty/Short-tailed Shearwater (*Puffinus griseus/tenuirostris*)

McFarlane (1965 ms.) reported collecting a Short-tailed Shearwater in May 1965, but due to a lack of a specimen number, and the possible confusion with Sooty Shearwater, this species remained hypothetical. On 6 August 2004, David Boyle saw a Sooty Shearwater in a feeding flock with Black Noddies about a mile offshore. In late May 2007, dark shearwaters were observed migrating far offshore. Three specimens later

washed ashore around 1 June 2007 and their skulls were collected and represent the first proof of Sooty Shearwater in atoll waters.

Black-winged Petrel (*Pterodroma nigripennis*)

Petrels have been reported by past observers without specific information (Thorp, 1960). Lyons (1940) variously referred to petrels, shearwaters and “moaning birds.” We made the first documentation of petrels at Wake. A female Black-winged Petrel was found dead on 1 July 2003 under electrical wires near a street light along the main road. (Fig. 14) This study skin is in the San Diego Natural History Museum (#50794). Another



Figure 14. Black-winged Petrel. Wake I. July 2003.

individual was seen by David Boyle flying over Wake Island village on the nights of the 14 and 28 December, and early in the morning of 29 December 2003.

Black-winged Petrels are an Australian species of ‘gadfly’ petrel that nests in the Austral summer and are common in the northwest Pacific Ocean. This species is a rare example of a petrel that is expanding both range and breeding populations

and should be expected to pass Wake (Brooke, 2004). Bonin Petrels (*Pterodroma hypoleuca*) which nest at Midway and Kure Atolls, are recovering after rat eradication, and could also be expected to occur at Wake.

Leach’s Storm-Petrel (*Oceanodroma leucorhoa*)

There is one specimen of this species for Wake Atoll (USNM 494112). R.W. McFarlane collected a partial body skeleton with plumage fragments in the antennae fields on Wake Island in December 1964 (R. Banks, pers. comm.).

Lesser Frigatebird (*Fregata ariel*)

A previously unreported specimen, USNM 497832, was a male collected 15 June 1966 from Wilkes Island. Some testes size and descriptive data are also included with the specimen (R. Banks, pers. comm.).

Great Frigatebird (*Fregata minor*)

The Tanager Expedition found 2,000 or more frigatebirds on Wake Atoll during late July 1923. “A few have partly grown young in stick nests placed 8 or 10 feet from the ground. The majority however are not nesting...Rather wild and difficult to approach. Many were killed by the Japanese poachers.” (Olson, 1996). A rare 1939 photo of a frigatebird nest on Wilkes Island is in the Torrey Lyons collection at UC Berkeley (Fig.



Figure 15. Great Frigatebird female incubating on Wilkes Island in 1939 (Photo by T. Lyons).

with rusty head coloring was photographed (A. Hebsi, pers. comm). It may be that cat disturbance prevented them from roosting or nesting in *Tournefortia* since the 1960's and that frigatebirds were never common breeders. Most individuals we observed were immatures or females, with very few adult males present. From 1998 to 2007, we have observed 11 birds with a patigtal wing tag bearing an alpha-numeric code. These birds were all tagged at Tern Island, French Frigate Shoals, Hawaii. See Appendix 1 for band summary section.

Red-footed Booby (*Sula sula*)

Wetmore (1923) considered this species the second-most abundant bird on the atoll. Numbering at least 5,000 individuals, they were distributed throughout the atoll but were most common around the shores of the lagoon. Nests were under construction during his summer survey. After the war, few boobies were reported. In the 1960's, POBSP estimated 40 breeding pairs, with a total population of 400-500 birds. They also found band returns from Wake (85%) and one each from Laysan, Midway and Kure.

In 1996, breeding was confined to a relatively small patch of *Tournefortia* on Wilkes Island where 30 active nests were counted in December 1996; eight in July 1998; 50 in February 1999; 76 in January 2004, and eight in August 2004. Like Wetmore (1923), we found the birds "so scattered through the trees that it is difficult to get a true idea of their number." Nest surveys are disruptive and it is very difficult to locate nests in the dense canopy, and under-represent the number nesting. In addition to the small observed breeding population, an estimated 3,000 to 4,000 comprised a growing roosting population. Birds staged about 2 km off the SW tip of Wilkes Island before coming to roost a half hour before sunset. We counted them as they came ashore in small flocks, trying to avoid the frigatebirds. White phase birds predominate with about 80% of the roosting population; the remaining 20% had brown backs and/or tails of the equatorial races.

15). POBSP researchers found a maximum of nine nests in April 1964 and a high count of 350 in Sept. 1968. Breeding (one nest) was reported in March 1968 (Schreiber & Kleen, 1968).

Since we began observations in 1996, between 100-500 frigatebirds have roosted every night on Wilkes Island especially on old power lines over the tide channel. In the summer 2004, the use of the power line roost declined and birds moved into the booby colony in the *Tournefortia* forest. Great Frigatebirds were reported to have bred again on Wilkes Island in 2005 and 2008 when a juvenile

We found evidence of feral cats climbing into *Tournefortia* trees and killing adult boobies and nestlings. Cats also ate regurgitated squid and flying fish harassed from birds. The control and eventual eradication of cats may have aided booby population increases for the nesting and roosting areas now covers the width of Wilkes Island *Tournefortia* forest including the ironwood trees. With colony maturation, larger numbers may nest in the future.

Masked Booby (*Sula dactylatra*)

The Masked Booby population has been historically low. In 1923, Wetmore reported three birds: he shot two young and one adult on the windward side of Wake (Olson, 1996). McFarlane saw one in December 1964. His notes state: “the first I have seen here...Kuku Point, Wilkes Island, is overrun with rats. Saw three cats.” Residents showed McFarlane a photograph of a pair that nested in the winter of 1962-63. Casey (1966) reported they were rarely seen. On 29-30 March 1983, a pair with a chick was observed (Fefer and Harrison, 1982).

Masked Boobies have increased dramatically on Wilkes Islands since cat control began in 1996. Ten adults were seen on Wilkes Island in December 1996 and by January 2004, the number increased to 75 roosting birds and 19 nesting pairs (See Table 3). In June 2007, we counted 60 adults and juveniles with nesting just beginning. Six of the nesting boobies had been banded on Johnston Atoll (Appendix 2). Immigration combined with increased breeding success since feral cat eradication may account for the recent population increase.

Brown Booby (*Sula leucogaster*)

In 1923, Wetmore reported: “There are fully five hundred here, mainly found on the windward side of the large island. On the western end of the north half of Wake a few pairs have young.” (Olson 1996). During POBSP surveys, McFarlane counted 21 nests in 1964 with the highest estimate 110 birds in early 1965. Brown Boobies have increased since December 1996, when we found about 73 nests with eggs on the leeward side of Wilkes Island. (See Table 3). In July 1998, there were total of 107 nests. In addition, 220 more Brown Boobies roosted on rocks offshore at night, so as many as 500 were present in the population, reaching Wetmore’s initial estimate. Brown Boobies appear to nest year-round on Wake but nesting peaks in summer. On 2 July 2003, we counted 162 nests with about 15% eggs, 60% large young, 20 % pre-fledglings, and 5% fledglings. In 29 May 2007, 164 nests were counted with breeding stages ranging from courtship to large fledglings (Table 3).

In the 1960s, POBSP found 15 of 16 band returns were from Wake; the last one was from Pearl and Hermes Atoll. In 2007, six Brown Boobies found were originally banded on Johnston Atoll, suggesting that immigration combined with cat eradication is resulting in increased numbers. Individuals (or a single bird) of *S. l. brewsteri*, the white-headed race indigenous to the eastern tropical Pacific Ocean, have been seen at Wilkes Island on 19 July 1998, 25 August 2004 and 28 May 2007.

Table 3: Brown and Masked Booby Nesting Counts

Brown Booby	1996	1998	2003	2004	2007	2007	2008	2008
Date	12/7/96	7/22/98	7/20/03	7/29/04	2/22/07	5/28/07	1/13/08	7/29/08
Nest/egg	72	17	37	29			53	
Naked Chick		0	1	2				
Downy Back		0	2	1			6	
Downy Body		0	3	12				‘mostly’
½ Adult Size		8	13	9				
Adult Size		26	46	10				
Wing & Tail Fea	1	33	29	7			1	
Fully Feathered		23	31	4				
Total Nests	73	107	162	76	53	164	60	~200

Masked Booby	1996	1998	2000	2003	2004	2004	2007	2007	2008	2008
Date	12/7/96	7/22/98	9/30/00	7/20/03	1/5/04	7/29/04	2/22/07	5/28/07	1/13/08	7/29/08
Nest/egg	2	7	4	1	0	5			12	
Naked Chick	0	4		0	7	0				
Downy Back	0	0		0	6	1			10	
Downy Body	0	0		0	0	0				
½ Adult Size	0	0		1	0	0			7	
Adult Size	0	0		1	6	7				
Wing & Tail Feathers	1	3		4	0	0			2	
Fully Feathered	0	0		0	0	5				~20
All birds= no nests										
Total Nests	3	10	4	7	19	18	30	~30	31	+20

Red-tailed Tropicbird (*Phaethon rubricauda*)

Tropicbirds have been reported by many observers because the white birds are conspicuous in mid-day flight and primarily nest on Wake Island (Jones, 1995). Wetmore reported about 30 in 1923 and collected one incubating a fresh egg on 29 July 1923. About 10 were counted by POBSP in 1963. Jones (1995) reported a few tropicbirds nesting on Peale Island at Flipper Point and near the bridge to Wake Island. Tropicbirds were not breeding on Peale during our visits. In July 1998, we estimated 25 birds for the atoll. In February-March 1999, we estimated over 100 birds were present, with 20 nesting pairs in various stages, in the sand flat vegetation near the water catchment area and in the fuel farm on Wake. In July 2003 we counted about 40 nests containing large young in the sand flats. In December 2003 eight nests were found in this colony and two nests on Wilkes Island. In February 2004, a winter storm surge washed through the flats destroying several nests. In July 2004, the colony at the fuel farm held about 10 nests, with two chicks seen fledging on August 12th, but there were few nesting in the flats colony and none on Wilkes. In June 2007, we estimated 100 were present in the atoll, largely on Wake Island but several pairs were seen prospecting new areas on Wilkes Island, both in designated refuge area and along the shore near the POW memorial.

White-tailed Tropicbird (*Phaethon lepturus*)

Only a few pairs of this resident have ever been reported. Individuals are often seen flying at various points around the atoll and there may be as many as five pairs on Wake. (Table 2). POBSP counted <10 on each survey in the 1960s. In 1998 and 1999, two pairs were seen near the windward coast, evidently prospecting breeding sites under ironwood tree roots, where nests have been previously located (L Hitchcock, pers. comm.). We found an abandoned egg in 1999 under an ironwood tree across from the dispensary. In 2000, a nest was located in a concrete WWII “pillbox.” In July 2004, three nests were in shallow underground burrows under ironwood tree roots. One egg was subsequently abandoned and old carcasses were seen that may have been killed by cats. In June 2007, three individuals were seen flying and two were observed courting over the ironwood forest near the Wake Island where military personnel reside. These flying birds were the most counted at one time. The ironwood forest is used for tropicbird nesting and this population is expected to slowly increase with the removal of cats, but habitat may also have been lost to Typhoon Ioke.

Black Noddy (*Anous minutus*)

Black Noddies were first reported nesting along the beach of Wake Island on 27 July 1923 (Wetmore 1923). In 1939, two colonies in *Tournefortia* trees behind the Pan American hotel on Peale Island held about 6 nests each. On 4 June 1940, there were 20 nests behind the hotel (Lyons 1940). The species was evidently extirpated during the war. In 1963, McFarlane saw only two and did not consider them a breeding species, and no specimens were collected by POBSP. Pyle and Engbring (1985) considered Black Noddies (as well as White Terns) as having no recent breeding records. They were considered rare in 1993, when only two were observed (Jones, 1995).

Long-time island personnel suggested that the maturation of the ironwood trees prompted the noddy recolonization in the 1990s and also said the birds colonized the older trees in the golf course first (R. Wheeler, pers. comm). In 1996, we estimated about 300 Black Noddies bred on Wake Island in the ironwood grove near the housing area. In July 1998, we surveyed the ironwood grove near housing and found about 150 nests containing both Black and Brown Noddies, with a ratio of about 2/3 Black to 1/3 Brown Noddies. The nests held large chicks and fledglings, with no eggs evident. In late February 1999, very few noddies were seen during the day in the ironwood grove. However, on 1 March 1999, about one hour after sunset, with a rising full moon, over 715 noddies were observed returning for the night. Most appeared to be Black Noddies.

The combined noddy population may be over 3,000 birds and should increase as ironwoods mature and spread. Immigration may also be a factor. Noddies may be relocating from Midway Atoll where large ironwood removal has occurred. Feral cat removal may also enhance noddy numbers since we found 30 pairs of black, brown and white tern wings located in a cat lair. Now, without predation, noddies are spending more time on the ground, sunbathing, resting and searching for nest material. We also noted rat predation of chicks blown out of their nests and sightings of rats in ironwoods suggest egg predation may occur. Several adult Black Noddies with orange feet characteristic of the Hawaiian subspecies *H. m. melanogenys* were seen in 1996, 1998 and 2003/04,

suggesting connection to the main Hawaiian Islands. Wetmore (1923) also noted that the feet and legs varied from blackish brown to dark orange.

Brown Noddy (*Anous stolidus*)

In 1923, Wetmore estimated 6,000 Brown Noddies were present and evenly distributed over the atoll. Nests were placed in *Tournefortia* or *Pemphis* trees from three to fifteen feet above ground (Wetmore, 1923). Twenty-five years later, and after the war in 1952, Fosberg (1959) reported them nesting in very small numbers. In March 1968, there were “50+ on the Kuku Point rocks. All birds were adult and none exhibited courtship activity” (Schreiber and Kleen, 1968). McFarlane reports seeing 30 Brown Noddies on offshore rocks but none appeared to nest on the mainland.

Clapp et al. (1993) reported in the 1980s that “2000+ pairs on Johnston and Wake.” This seems a high count for Wake and most were likely from Johnston. In December 1996, less than 10 were seen flying or perched on offshore rocks. In July 1998, Brown Noddies were the most widely distributed bird on the atoll, nesting on all three islets. We estimated about 500 birds inhabited the atoll with about 100 nests in the ironwoods, and a few with large chicks on cement blocks in the Wake Island lagoon. On Wilkes Island, we found about 100 nests placed on the ground and one cat-killed noddy. Several scattered pairs nested in ironwoods on Peale.

The Brown Noddy population had about doubled to 1,000 by July 2003. They nested around the atoll, mostly in ironwoods but a few nests were placed on the ground at Kuku Point, Peale Island, and at Toki Point, Wilkes Island. We also discovered the remains of about 10 Brown Noddies that were killed by cats. During winter 2003, this species was largely absent from the atoll. In August 2004, noddies had large chicks and were widely distributed in ironwood trees around the atoll. They did not nest on the ground at Wilkes Island, perhaps due to the increase in Pacific Rats (*R. exulans*) after cat eradication. But in June 2007, eight nested on the ground on Wilkes, and several pair nested adjacent to the Gray-backed Tern colony on Wake Island. We estimate 600 birds also nesting in ironwoods.

White Tern (*Gygis alba*)



Figure 16. White Tern nesting on branch broken by Typhoon Ioke.

Wetmore found at least 2,500 on all Wake islets in 1923. In 1935-39, this species was reported breeding on Wake and Peale Islands, but not Wilkes. After the war, a few were seen by Fosberg “in both 1952 and 1953, flying around the *Pisonia* forest” on Peale Island (Bryan 1959). McFarlane saw four on 24 April 1964. Few were reported by other POBSP observers and even as recently as 1993 they were not reported as breeders (Jones, 1995).

In December 1996 we found a large fledgling and about 15 adults in the noddy colony near Heel Point, and several other White Terns were seen flying over Peale and Wake Islands. In 2003, we estimated about 200 were present on all islands, mainly on Wake Island but with very few nesting on Peale, and none on Wilkes Island. We noted feral cats up in *Tournefortia* trees at night that might explain why White Terns only nest in ironwoods. In 2007, we estimated approximately 500 White Terns nesting in the ironwoods on Wake and Peale, with Wilkes just being colonized. Typhoon Ioke snapped many tree branches, providing a convenient shelf-like nesting substrate for this species that lays a single egg directly on a branch. See Figure 16.

Sooty Tern (*Onychoprion fuscatus*)

Sooty Terns are the most persistent seabird on the atoll. Wetmore found about 300 terns nesting on Peale Island in July 1923, and reported: “This species suffered heavily at the hands of the Japanese poachers as the bones of thousands lie among the trees near the shacks on Peale Island.” Before the war in early 1941, Sooty Terns nested on the runway that was under construction until the colony was bulldozed. (A. Kahn, pers. comm.). During the Japanese WWII occupation of Wake, soldiers guarded a nesting colony to prevent egg poaching and insure the tern’s presence as a food source (Jughans ms. undated).

POBSP estimated there were 1.7 million Sooty Terns in 1967 and banded more than 60,000 on Wake from June 1963-January 1970. Robert W. McFarlane who studied the terns for the POBSP estimated one million terns were at Wake on 24 August 1964, and also reported four observations of sooty terns that had been red flagged on Johnston Atoll. Band recoveries indicate the Sooty Terns at Wake have non-annual, non-seasonal and non-predictive reproductive cycles. McFarlane (1967) wrote:

“The sooty tern is a pantropical pelagic sea bird whose reproductive periodicity varies in different parts of its range, being annual and seasonal in most areas, but semi-annual and seasonal, or predictably non-annual and non-seasonal (breeding every 9.7 months) at certain localities. Individuals of a single cohort within a colony may renest at eight to twelve month intervals. Nesting colonies may persist from five to eighteen months.”

In contrast to Wake, Ashmole (1963) writes: “The semi-annual reproduction at Christmas Island is the result of adults who successfully rear a chick reneesting in twelve months, while those who fail make a new attempt in six month, frequently interrupting their post-nuptial moult to do so. The almost total absence of interrupted moult at Wake Island and lack of recaptures at six-month intervals indicate that they do not do this on Wake (but apparently nest as they do in the Phoenix and Howland Islands).

The 1960s began a 20-year period of increasing cat predation on Sooty Terns, and decreases in tern populations until cat control was implemented in 1996. In 1993, Jones reported up to 25,000 terns were present on Wilkes and 300 young were on Peale Island next to Flipper Point in late April. On 6 December 1996, about 10,000 terns were thought to be present at Wilkes Island and over 100 were found killed by cats, with many left headless and maimed. In July 1998, we estimated 11,250 terns were on the ground during the day. About 50 fledglings were observed and about 25 eggs were present in late July as breeding got underway. The breeding colony measured about 30 square meters, with 25

birds per square meter. Cat predation was also noted. In February 1999, we measured the colony and determined it was 20,525 square meters (220,925 sq. ft.) and to contain about 175,000 breeding adults, with an unknown percentage of non-breeders. In 17 February – 5 March 2007 census of terns yielded a total of 192,370 nests covering the Tribulus field on Wilkes. At night the flock may double in size as more arrive to roost (A. Hebshi, pers. comm.)

Sooty Terns nest periodically on Peale Island, but primarily nest on Wilkes Island where a field was mowed annually to attract them there and not risk having the birds moving to the mowed apron of the runway. Nevertheless, the colony is in the flight path of landing aircraft. In 2005, the entire field was filled with nesting terns that may have numbered over a million. (T. Tiley, pers. comm.). In 2006, the field went unmowed because the road to Wilkes was damaged by Typhoon Ioke, but in 2008, the road was repaired and mowing was resumed.

Release from predator pressure may change tern habitat and nesting behaviors. Before cat control began, the terns nested as far from the trees as possible. By mid 2007, the colony of Sooty Terns was most active near the border of the *Tournefortia* forests where feral cats used to lurk. Rats have been noted to eat Sooty Tern nestlings. In February 2007, “We observed hordes of rats on Wilkes Island during a night-time survey of the seabird colony, where rats were penetrating the colony to prey on newly-hatched Sooty Tern chicks.” (A. Hebshi, pers. comm.). The phenomenon of an ‘exploding’ rat population and their increased predation of Sooty Terns has previously been observed following Typhoon Sarah on 15 September 1967: “All fresh eggs disappeared within 24 hours and on two occasions I actually saw rats dragging eggs away while the adult bird stood “helplessly” watching. We watched several rats chewing on young birds.” (R. Schreiber, POBSP unpubl. field notes). In 1967,

“residents of Wake reported that almost no rats were seen before typhoon Sarah struck the island on 15 September 1967. Since that time the people have become aware of rats not only in inhabited areas of the atoll but also in housing areas. Rat predation on Sooty Tern nestlings was extremely high prior to and during our survey. Apparently the typhoon disturbed normal activity of the rats and drove them from their burrows. (Schreiber and Kleen, 1968).

In the May/June 2007 visit, mass mortality of multi-age chicks was apparent. At first we thought that rats were to blame, but the range of ages suggest instead that local food resources crashed and reduced tern reproductive success at Wake.

Gray-backed Tern (*Onychoprion lunata*)

The 1923 Tanager Expedition found about 100 Gray-backed Terns in two colonies on the north and south side of the Wake Island in the rough coral of the outer beaches with some bushes (Olson, 1996). On 19 February 1939, about 400 were seen along Wake Island beaches from Heel Point to Peacock Point (Lyons, 1940). There are several POBSP references to Gray-backed Terns breeding on Wake. (Humphrey and Johnston, 1964; McFarlane, 1964; 1965; Huber, 1964, 1965). Observers counted 250 gray-backs with at least 100 nests on Toki Point and Flipper Point, Peale Island on 8-23 May 1965. In June

1966, 65 were counted, and in March 1968, Schreiber and Kleen (1968) report seeing 21 on Wake, “the largest number recorded at one time. No courtship activity was observed.”

After cat predation began in the late 1960s, Owens reported Gray-backed Terns occurred on Wake but did not breed in 1977. A high count of Gray-backed Terns was 200-300 pairs made in the 1980s but it is uncertain if they bred (Clapp et al., 1993). Jones (1995) saw a few but did not record them breeding in 1990. No Gray-backed Terns were seen on the 1996-1998 visits during the cat control efforts. On 23 February 1999, four were seen near the causeway between Wilkes and Wake Island. This is the area where Jones (1995) saw them in 1990. In July 2003, four adults and one juvenile were seen briefly at Toki Point, Peale Island. By July 2004 two colonies were re-established with about 20 birds on Peale Island’s northern shore and 60 birds on a small beach at the end of the runway on Wake, near where they were first seen. By 17 August 2004, at least two fledged juveniles were present on Peale and up to six at the colony on Wake, where two fresh eggs were also found. In 2007, there were no terns reported in February-March but in May-June, about 75 birds were present in the colony at the end of the runway (see Table 2). One nest was placed north of the colony along the runway perimeter. In 2008, about 15 tern nests were placed here (A. Hebshi, pers. comm.) and the eggs had to be destroyed for aviation safety’s sake.

It appears that increasing cat populations prevented nesting and the eradication of cats from Wake Island has allowed this species to recolonize quickly. Clapp et al. (1996) reports: “its extirpation there may typify its vulnerability to disturbance,” but it is also balanced by its ability to quickly recolonize after the disturbance is alleviated. For example, Typhoon Ioke destroyed the colony on Peale Islet but it reformed again in October 2007.

Glaucous-winged Gull (*Larus glaucescens*)

In 1967, POBSP biologist Richard Chandler tentatively identified an immature Glaucous-winged Gull. In the winter of 2002, a light colored gull was seen in the harbor (R. Wheeler pers. comm.). Throughout the winter of 2002, a large dispersal of immature Glaucous-winged Gulls occurred the central Pacific, including Hawaii and Christmas Island, (Rauzon and Jones, 2005) and could easily have reached Wake, but its occurrence remains hypothetical without better documentation.

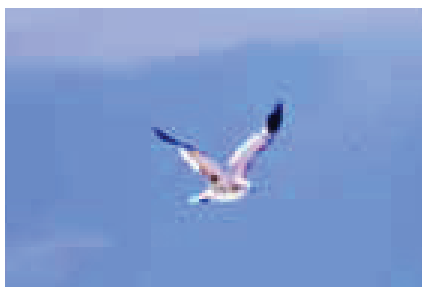


Figure 17. Laughing Gull. July 2003

Laughing Gull (*Larus atricilla*)

The Laughing Gull is a somewhat regular visitor (more than “casual”) throughout the Pacific, but most records are from the Hawaiian Islands. Elsewhere, it has occurred in the Phoenix Islands (Pratt et al., 1987), Line Islands (VanderWerf et al., 2004), and Bikini Atoll, Marshall Islands. Two individuals, one bird molting from 1st cycle to 2nd cycle, (Fig.17) and an adult in basic plumage, were seen together in the Wake Atoll lagoon for the month of July 2003, but they were gone by November (Rauzon and Jones, 2005).



Figure 18. Cattle Egret and Brown Boobies, 1996.

Cattle Egret (*Bubulcus ibis*)

Cattle Egrets are occasional visitors to Wake Atoll. There is a photograph of one taken on 16 October 1979 (L. Hitchcock pers. comm.). Jones (1995) reported them from the atoll in the 1980s. An immature was photographed in 1996 on Wilkes Island foraging in the Brown Booby colony. See Figure 18. Individuals were also reported from the winter of 1997 (B.R. Johnson, pers. comm.) and one in breeding plumage was seen in June 2004 (R. Wheeler pers. comm.)

Aleutian Cackling Goose (*Branta hutchinsii leucopareia*)

Two Cackling Geese, first seen on 16 November 2007, with one individual remaining at Wake until at least June 2008, represent a new island record. The short neck and small bill, and the combination of paler plumage and fairly distinct ring around the neck fit Aleutian Cackling Goose subspecies *leucopareia* better than *mimima*, *taverneri*, and *richardsonii*, which are darker and/or don't show as much of a neck ring (Figs. 19 & 20). Aleutian Cackling is the default subspecies/species in the Central Pacific, based on sightings of two banded birds in the Marshall Islands (Wiles 2005), one seen on Midway Island, Northwestern Hawaiian Islands was an Aleutian and one in Kiribati (P. Pyle, pers. comm.).



Figure 19. Aleutian Cackling Goose on Wake flight line, 16 Nov. 2007, Photo by Kevin Nichols.



Figure 20. Aleutian Cackling Goose on Wake. Photo by Eric VanderWerf.

Mallard (*A. platyrhynchos*, *superciliosa*, *poecilorhyncha*, or *oustalia*).

Four large Mallard-type ducks proved extremely wary and collecting efforts were unsuccessful when McFarlane encountered them in 1964. Due to the possible confusion between species, especially females, it is considered as a hypothetical occurrence.

Northern Pintail (*Anas acuta*)



Figure 21. Pintail-female. Photo by B. Johnson

Pintails regularly occur in low numbers on Wake (See Table 2). Three specimens are known from Wake (USNM 494106-108) collected McFarlane on 22 December 1964. A moribund female was found in the surf in 1999 (See Figure 21). In December 1996, four were observed; 3 females and one eclipse male, in the pond at the runway junction. Three pairs were counted on 22 February 1999. They foraged widely around the atoll, but they spent most of their time in the brackish runway ponds that supported growths of algae and brine flies.

In early November 2003, two females were seen at Wake. A flock of 26 pintails were also observed on 6 October 2007 (D. Vice, pers. comm.).

Common/Green-winged Teal (*Anas crecca*)

Two females were seen in December 1996, representing a new record for the atoll, but one anticipated by Bryan (1959). Six additional teal (two adult males, one immature male and three females) were present from December 2003 until at least 10 January 2004. Another one was reported in October 2007. Subspecies identification was not made.

Northern Shoveler (*Anas clypeata*)

Three shovelers were seen at Wake Island in 1964, and with a female collected on 14 April 1964, by R.W. McFarlane (USNM 493469). Some ovary size and descriptive data are also included. The bird had very worn plumage for April and retained what seemed to be some of its first feathers. Casey (1966) also reported a Northern Shoveler. Our record is a drake seen on 22 February 1999.

Eurasian Wigeon (*Anas penelope*)

Bryan (1959) predicted the species might occur but it was not until winter 1999 that two females were found on Wake Island. They were observed closely with a spotting scope and identified on the basis of their grayish-buffy heads, white wing patches and rounded tails. They segregated from the other ducks and frequented the freshwater/brackish ponds near the lagoon edge. Another five female-plumaged Eurasian Wigeons were seen in November 2003. Two more were reported from October 2007.

Garganey (*Anas querquedula*)

Two males known from specimens (USNM 493453-454) were collected by R.W. McFarlane at Wake Island, on 23 December 1963. Two more escaped collection (McFarlane 1963). Garganey were also reported by Casey (1966) and Johnston and McFarlane (1967).

Tufted Duck (*Aythya fuligula*)

On 21 December 1964, R.W. McFarlane tentatively identified a female Tufted Duck, included here as a provisionally identified species based on the following description:

“Smaller than pintail, larger than teal, uniform brown. Head and neck darker, sides lighter than wings at rest. Large white wing stripes across primaries and secondaries. Faint white blotch at base of bill on either side, not connected across top. Bill dark blue-black iris orange, head somewhat glossy.”

Common Goldeneye (*Bucephala clangula*)

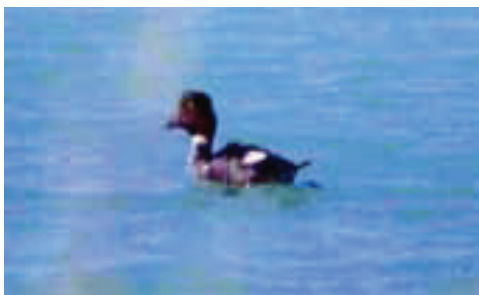


Figure 22. Common Goldeneye

Two immature goldeneye ducks were seen from November 2003 until January 2004 but could not be positively identified. One individual remained in July/August 2004, and had molted into a male plumaged Common Goldeneye (Fig. 22). This is a new island record, and only one of about five recent records for the Pacific Ocean region (R. Pyle pers. comm.) and does not appear in the standard bird field guide for the tropical Pacific (Pratt et al., 1985.)

Chicken (*Gallus gallus*)

These conspicuous birds went unreported in the literature before Jones (1995). The flock was introduced sometime in 1970s and had grown to near 200 by 2004. They are found around the recreational beach houses on Wake and Peale Islands where they were provided with feed. Some are feral on Peale but they do not occur on Wilkes Island or on Wake Island away from housing areas.

Rock Pigeons (*Columba livia*)

These birds were evidently introduced in the 1960s when Huber (1965) reported 25 pigeons seen during May 1965. In 1998, 13 pigeons roosted at a coop kept at a beach house near the golf course on Wake Island. There were about 13 in November 2003 and the flock had doubled by August 2004. They are only seen on Wake Island, often by the runway apron seeking grit and seed, where they are sometimes shot. After Typhoon Ioke, the flock size was about 10 birds.

Pacific Golden Plover (*Pluvialis dominica*)

An estimated 250-500 Pacific Golden Plovers winter at Wake every year, with a small number of first year birds remaining throughout the summer. “In 1963-64, more than 500 plovers were seen” (Johnston and McFarlane, 1967). A photograph taken in 1979 contained 148 plovers in the water catchment area on Wake Island, presumably gathering to migrate (Jones 1995). In July 1998, 31 were counted with two molting out of alternate plumage, suggesting most were young of the previous year summering on Wake.

We estimated about 200 occurred on the atoll in March 1999 (Table 2). Many more move through during migration. Wake Atoll, with extensive sand flats and mowed grasslands, is probably an important staging area for plovers migrating from further south to Alaska. Johnston and McFarlane (1967) calculated a flight from the Aleutians to Hawaii would require about 35 hours and 252,000 wing beats with a flight speed of 58 miles per hour.

Lesser Sand Plover (*Charadrius mongolus*)



One individual was well studied and sketched (See Figure 23) on the flats of the Wake lagoon in December 1996. Formerly called Mongolian Dotterel or Plover, this is a new record for the atoll, but predicted by Bryan (1959) for it has occurred in the Marshall Islands to the south (Baker, 1951; VanderWerf, 2006) and has occurred in the Northwestern Hawaiian Islands.

Figure 23. Field documentation made of Lesser Sand Plover at Wake lagoon.

Wandering Tattler (*Heteroscelus incanus*)

A common winter resident present in low numbers. A comprehensive island survey in March 1999 found approximately 75 birds scattered around the island on rocky reefs and in small wetland ponds that are primarily located on Wake Island.

Gray-tailed Tattler (*Heteroscelus brevipes*)

This species is a rare visitor to Wake. Also known as Siberian Tattler, this species is wary and very difficult to separate from the Wandering Tattler. Single individuals were distinguished by their calls, and heard in the runway ponds and sand flats of Wake Island in December 1996, July 1998, February 1999 and August 2004, and June 2007.

Bristle-thighed Curlew (*Numenius tahitiensis*)

An uncommon winter visitor, Wetmore (1923) collected three during his stay on Wake. Lyons (1939) reports small numbers of them from Wake Island. R. W. McFarlane saw one curlew in 1963 and 1965, and five in 1968. Island personnel, familiar with this species from their experience on Midway, reported up to six curlews at the golf-course ponds in September 1998 and four in 1999. We photographed one in November 2003 on Wake and saw it again on Wilkes. Curlews were also reported from November 2004 (T. Tiley, pers. comm.). In October 2007, four curlews were seen at one time, flying overhead and calling. This species becomes flightless during its winter molt and is subject to cat predation, thus the elimination of cats makes Wake Atoll an important wintering site for this increasingly rare shorebird.

Whimbrel (*Numenius phaeopus*)

New record seen in October 2007, one Whimbrel was observed in poor light and rain, but at close range, standing along the runway, immediately south of the infield pond. When approached, it took flight, giving a 5-6 note alarm call. The unmarked white stripe running down the middle of the lower back and rump was clearly visible, identifying the bird as most likely the Eurasian race (*alboaxillaris*). (D. Vice, pers. comm.).

Ruddy Turnstone (*Arenaria interpres*)

Turnstones occur in low numbers at Wake. Wetmore reported up to 20 seen in 1923. Fosberg found one here in 1953. Jones (1995) reports one in 1990. Four were on Wake Island in December 1996. Two were seen at the edge of the lagoon on 27 July 1998. One was observed at Flipper Point, Peale I. in February 1999. Two were seen in July 2003, five in August 2004, and three in June 2007 on Wilkes Island.

Common Sandpiper (*Actitis hypoleucos*)

A new record for Wake observed in October 2007. One was observed in the infield pond, along the northern shoreline, moving with distinctive bobbing of the tail. Its flight showed distinctive pump-glide pattern when flushed. Both bill and legs appeared dull grey, consistent with separation between Spotted Sandpiper (*Actitis macularis*) and Common Sandpiper. Its bill did not show any graduated color change from base to tip and the tail appeared substantially longer than the tips of wings. Plumage appeared consistent with a first year bird (D. Vice, pers. comm.).

Sanderling (*Calidris alba*)

An uncommon migrant at Wake; singles were seen in December 1963, 1964, 1965 (McFarlane ms.). We also saw single individuals in December 1996, November 2003 and January 2004 and June 2007 in and around the runway pond.

Dunlin (*Calidris alpina*)

A rare visitor to Wake (Casey 1966), McFarlane writes: “adverse weather frequently accompanied the arrival of uncommon species such as dunlin, sanderling, greater yellowlegs, snipe, pintail, garganey and shoveler.” He saw one in December 1963. We saw two individuals in the runway pond in December 1996. These were also seen foraging on the exposed sand flats of the lagoon. Two were again seen on 23 February 1999 in a small brackish pond near the fuel farm on Wake Island.

Sharp-tailed Sandpiper (*Calidris acuminata*)

Regular migrant at Wake, reported by many observers, and collected by Lyons (1940) and POBSP. See Figure 24. Previously reported in Jones (1995) as a visitor to the atoll, we saw two individuals at the runway ponds in December 1996. As many as 10

were seen in November 2003 but were gone by mid-December. At least 24 birds were present at one time in an ephemeral pond on the airfield on 4 October 2007 (D. Vice, pers. comm.).



Figure 24. Long-billed Dowitcher, center, flanked by Sharp-tailed Sandpipers.

Greater Yellowlegs (*Tringa melanoleuca*)

Mentioned as a possible species to be found here by Bryan (1959), one was reported by McFarlane (1963). He states in a personal letter that it arrived during a storm and remained for 11 days but he was not able to collect it. McFarlane's sighting is listed without detail by Johnston and McFarlane (1967). Pyle and Engbring (1985) treated it as a hypothetical occurrence because it is the only record for Wake and only one of two for Micronesia. It was reported from Jaluit Atoll in the Marshall Islands (Baker 1951).

Pectoral Sandpiper (*Calidris melanotos*)



Figure 25. Pectoral and Sharp-tailed Sandpipers Wake I.
Photo by J. Gilardi

Pectoral Sandpipers are rare migrants through much of the tropical Pacific and seven have been previously recorded in the Marshall Islands (VanderWerf 2006). Two Pectoral sandpipers were photographed with the Sharp-tailed Sandpipers in October 2007 for a new Wake Island record. (See Figure 25).

Ruff (*Philomachus pugnax*)

Two Ruffs seen in October 2007 are a new island record. The birds were observed along the shoreline of the infield pond, loafing on exposed mud. Both birds showed the characteristic upright posture, slightly pigeon shaped head structure with a relatively long black bill, buffy chest and flanks, and distinct scalloping of feathers along the back of the

bird. Both birds were substantially larger than tattlers, turnstones, and sandpipers located nearby. Leg color for both birds was dull grey plumage that is consistent with juvenile birds (D. Vice, pers. comm.).

Long-billed Dowitcher (*Limnodromus scolopaceus*)

This new island record was seen and photographed at the runway ponds from November 2003 to January 2004. It was distinguished from Short-billed Dowitcher (*L. griseus*) by its call. Another single Long-billed Dowitcher was viewed and photographed in the wetlands area north of the airfield on 6 October 2007. See Figure 24.

Common Snipe (*Gallinago gallinago*)



McFarlane collected a male specimen (USNM 494111) on 6 January 1965 on Wake Island. Another snipe was photographed on 13 January 2008 and identified as the Eurasian subspecies, *Gallinago g. gallinago*. Snipe are notoriously difficult to identify in the field. This individual showed an under wing with fairly broad white barring, which agrees more with Common Snipe than Wilson's Snipe. See Figure 26. (E. VanderWerf, pers. comm).

Figure 26. Common Snipe-Oct. 2007. Wake I. Photo by E. VanderWerf.

Short-eared Owl (*Asio flammeus*)

First reported in the literature by Jones (1995), several were seen by long-time resident Lou Hitchcock at night. We also observed another individual on Wake Island on 28 November 2003.

Sea-Eagle (*Haliaeetus* spp.)

A raptor with a huge beak, fan-shaped tail, reddish brown, long rectangular wings with white spots underneath and extending primaries was described by island personnel in the winter of 1997 (P. Fusco, R. Wheeler pers. comm.). Steller's Sea-Eagle fits the description and could occur at Wake as it has twice reached the Northwestern Hawaiian Islands, in 1978 and 1983 (Pratt et al. 1987), but this record remains hypothetical without documentation.

Black Kite (*Milvus migrans*)

Long-time island resident Lou Hitchcock provided photographic evidence of a Black Kite from 1980 that stayed around for about five years (Jones, 1995). Another Black Kite was photographed on Wake Island in the winter of 2004 and indentified by the



swept-back appearance of the primaries. See Figure 27. It remained until the end of 2005, preying on rats around the runway area, inadvertently benefiting from cat eradication (T. Tiley, pers. comm).

Figure 27. Black Kite from Wake I. (T. Tiley photo).

Long-tailed Cuckoo (*Eudynamis taitensis*)

This species is considered a regular but rare migrant in the Marshall Islands (Amerson, 1969). An adult male was collected by T. Lyons on 28 November 1939 from Peale Island. This specimen (MVZ#79443 Acct. 6339) was an unknown museum skin at U.C. Berkeley's Museum of Vertebrate Zoology until discovered by our research. A living individual was seen briefly flying across a road on Wilkes Island on 6 January 2004 by David Boyle.

Java Sparrow (*Padda oryzivora*)

First reported and identified by Fosberg (1959): "A cage of the attractive small finches with large conical bills, commonly called Java Sparrows, was seen on Wake Island in a house on April 15, 1952." The species was seen again by McFarlane in April 1964: "Two sparrows commonly seen believed introduced," and Casey (1966) reported there was "singly a lone wild sparrow."

Common Canary (*Serinus canaria*)

The record of a failed introduction is based on this note about Captain Sullivan, pilot of the inaugural Clipper flight in August 1935. "In the course of a second three-day rest period [at Midway], he picked up a case of canaries, yet another thoughtful diversion to brighten the lonely hours of the gang stranded at Wake." (Urwin, 1997).

CONCLUSIONS

The current avifaunal diversity (15 species breeding, or attempting to breed) and population size has returned to the conditions mentioned in Wetmore's account of the avifauna of 1923. Of the species found in 1923, only Christmas Shearwaters are not yet confirmed breeding species. Albatross, noddies, terns, shearwaters, tropicbirds, ducks and shorebirds now at their pre-World-War Two densities on Wake Island. Noddies and White Terns have recolonized and spread as the ironwood forest has matured. Albatross are visiting Wake Atoll and attempting to breed, albeit with little success. Red-tailed Tropicbirds appear to be increasing and colonizing other parts of Wake.

The seabirds of Wake Atoll began to increase as feral cat control efforts commenced in 1996, especially on Wake Island, the largest landmass in the atoll. White Terns, Gray-backed Terns, noddies, tropicbirds and albatross primarily nest here. Ironwood tree maturation have enhanced breeding habitat for arboreal terns and shearwaters. However, monotypic sites of ironwoods cover large portions of Wake Island and are invading the last patches of native beach plants, especially beach heliotrope forests. Tree management will limit noddy populations but is needed to maintain the native vegetation bird habitat.

The designated Bird Refuge on Wilkes Island is primarily used by Sooty Terns, shearwaters, boobies and frigatebirds. With diminished human disturbance, frigatebirds appear to have recently bred. Only Peale Island remains under-utilized by seabirds. Until recently, a few Brown Noddies and White Terns bred in the late 1990s. In 2002-2003, Sooty Terns nested and a Gray-backed Tern colony became established in 2004.

Population increases are also enhanced due to immigration from the eastern part of the Pacific. Brown and Masked Boobies banded at Johnston Atoll and immigrated to Wake demonstrate Wake is part of the Hawaiian/Johnston Island seabird population. Recoveries of marked frigatebirds and banded shearwaters and tropicbirds from Tern Island, French Frigate Shoals, and sighting of orange-footed Black Noddies from the island of Hawaii demonstrate the Hawaiian connection. Observations at Wake help define the extra-limital range of color-morph races of birds. Partial and complete dark morphs Wedge-tailed Shearwaters and Red-footed Boobies show a mixing of northern and southern forms. The furthest extent of range is demonstrated by the white-headed subspecies of Brown Boobies (*S. l. brewsteri*) whose nearest breeding areas are off Costa Rica were seen and a banded Masked Booby, not from US-owned colonies or Australia was also recorded, but band recovery data could not be confirmed.

With the eradication of feral cats, Wake Atoll is one of the best seabird colonies in the Western Pacific. Few atolls in the Marshall Islands support as diverse an avifauna as Wake. The super typhoon of 2006 damaged seabird habitat and the release of rodents from cat predation pressure has relatively insignificant impacts on colony distribution and success. With the planned eradication of rodents in 2010 (A. Hebshi. pers. comm.), Wake Atoll will become the premier seabird colony in Micronesia. It will also provide a unique opportunity to recover the full avian diversity of Wake by ecologically replacing the extinct Wake Rail. The endangered (and virtually ecologically extinct) Guam Rail (*Gallirallus owstoni*) is an excellent candidate as a surrogate species and the introduction of an experimental population, freed from legal restrictions of the Endangered Species Act, and freed from invasive predators, can reestablish the unique Pacific Island bird reserve that once Wake was.

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APPENDIX 1- Recent Sightings of Great Frigatebirds at Wake Atoll.

These birds were tagged at Tern Island, French Frigate Shoals, Hawaii by Dr. D. C. Dearborn, Bucknell University. (USFWS pers. comm.).

1- Great Frigatebird (GRFR)-July 24, 1998- male marked on the wing with a yellow patigial tag bearing the code *B02*. Seen again Mar. 4, 1999.

2-GRFR- tagged bird (*C27*) was observed in October, 1998 (C. Swenson USFWS, pers. comm.). Seen again Mar. 4, 1999.

3- GRFR- on Feb. 24, 1999 male was seen on Wilkes Island with yellow patagial wing markers *B75*. Seen again Mar. 4, '99.

4- GRFR- On Feb. 28, 1999, female *B43* recorded from Wilkes, Seen again Mar. 4, 1999.

5- GRFR- On March 4, 1999, female *B96* was recorded from Wilkes I.

6- GRFR- On March 4, 1999, immature male *C83* was recorded from Wilkes I.

7- GRFR- On March 4, 1999, male *C94* was recorded from Wilkes I.

8- GRFR- On March 8, 1999, male *D-51* was recorded from Wilkes I.

9- GRFR- On Jan. 6 '04 *E-19* white tags both wings. This bird was tagged as an adult female on Tern Island, FFS, on March 2, 1999 (at which time the patagial tag was yellow--now faded to white).

10- GRFR- On February 2007 - *L-92* seen in reported by A. Hebsi.

11- GRFR- On May 25, 2007, male *M-24* was recorded from Wilkes I. Bird was banded July 3, 2005 at French Frigate Shoals, HI

APPENDIX 2- Summary of banded boobies recorded on Wilkes Island.

1. Masked Booby (MABO)- July 9, 2003- female on egg.
1307-70382- reported to Patuxent- banded as immature at Hikina I. Johnston Atoll on 4/27/96. Seen again on 27 July 2004- female on an egg.
2. Brown Booby (BRBO)- seen 5 November 2003 - male w/ chick.
1307-70267. Banded as chick on East Island, Johnston Atoll on 5 April 1996.
3. MABO- Nov. 5, 2003- male on egg on Wilkes Is.
1307-70303. Banded as chick on East Island, Johnston Atoll on 5 April 1996.
4. MABO- Nov 7, 2003 female on egg on Wilkes Is.
1307-30131. Banded as young Mar. 13, 1991 at Hikina Is. Johnston Atoll.
5. BRBO- Jan. 6, 2004 male incubating two eggs on Wilkes Is.
1307-90458. Banded as immature on Sand Is. Johnston Atoll in June 1, 1996.
6. Red-footed Booby (RFBO)- Jan. 6, '04 brown phase on Wilkes Is.
xxxx-24713- incomplete read. Probably banded on Johnston I.
7. RFBO- Nov. 18, '03 brown phase
1304-xx443? incomplete read. Probably banded on Johnston I.
8. BRBO- female- from Wilkes Is. Seen July 27, 2004.
1307-70488. Banded at Sand I. Johnston Atoll as immature on 4/27/96.
9. MABO- female with large chick from Wilkes Is, seen July 29, 2004.
1517-03783. Banded as immature at Hikina I. Johnston Atoll on 4/19/99.
10. MABO- female with medium-sized chick, from Wilkes Is.: seen Aug. 3, 2004
1517-07687. Banded as immature on 7/31/2000 at Sand I. Johnston Atoll.
11. BRBO- male with large downy chick, seen Aug. 3, 2004 from Wilkes Is
1307-90514. Banded 3/28/97 as immature at Sand I. Johnston Atoll.
12. BRBO- male with fully feathered chick, seen Aug. 11, 2004 from Wilkes Is.
1307-70260. Banded as immature on Sand I. Johnston Atoll 3/09/96.
13. BRBO- female on egg; seen Aug. 11, 2004 from Wilkes Is.
1307- 70---- incomplete read, Banded 1996?
14. MABO – female seen on Wilkes Is. July 27. 2004. 3D1 31- odd band number.
15. BRBO – female on egg; seen Aug. 26, 2004 from Wilkes Is. 1307-03625.
16. Wedge-tailed Shearwater-found old cat-kill on July 7, 2003 from Wilkes Is.
794-47872- Banded in 1995 on Tern I. French Frigate Shoals, HI.
17. Red-tailed Tropicbird- Found Apr. 30, 2004. Wake Island, with broken wing, band collected by island personnel. 1025-00921. Banded at Sand I. Johnston Island, in 2002.
18. Gray-backed Tern- one seen in August 2004 wearing a band.