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THE NATURAL HISTORY OF NECKER ISLAND, NORTHWESTERN HAWAIIAN ISLANDS

by Roger B. Clapp and Eugene Kridler

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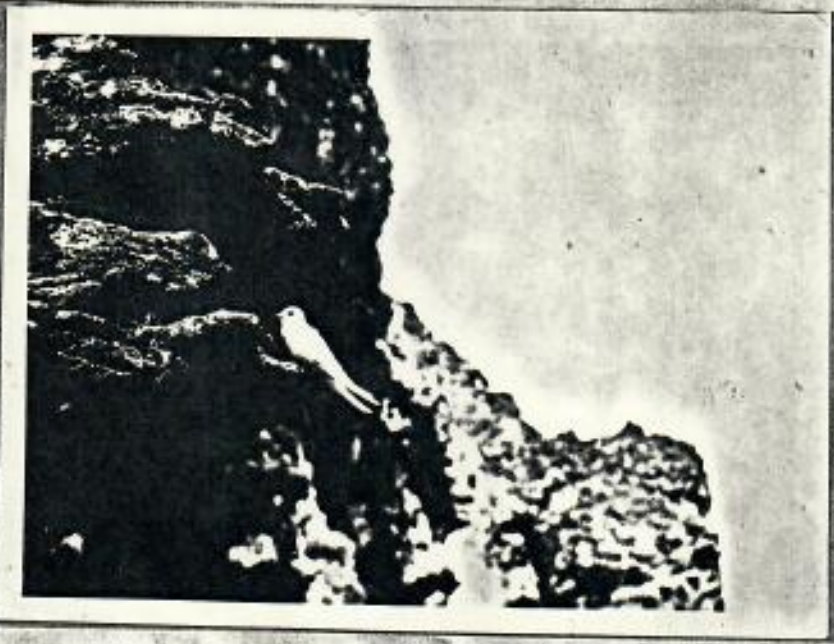
B. Mus. 9682. Necker Is. Turtles on the shore of Shark Bay (Caum)



B. Mus. 9663. Necker Is. Love-bird. (Caum)

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by Roger B. Clapp[2] and Eugene Kridler[3]

INTRODUCTION

Necker Island, now a part of the Hawaiian Islands National Wildlife Refuge, is a small, precipitous, rocky island that lies at 23°35' North, 164°42' West (Off. of Geogr., 1956: 58) near the eastern end of the northwestern Hawaiian Islands (Figure 1). Its nearest neighbors in the chain are French Frigate Shoals, lying about 75 miles to the westward, and Nihoa Island, some 155 miles to the east-south-east (Great. Brit. Hydro. Dept., 1946: 296-297).

Relatively little is known about the fauna of the island, in part perhaps due to the difficulty of making landings there. The principal previous surveys of the island were made by the Albatross Expedition in 1902, by Carl Elschner in 1914, and by the Tanager Expeditions of 1923 and 1924. The various scientific reports resulting from these expeditions, particularly those resulting from the Tanager Expeditions, and Bryan's (1942) summary of information supply most of what was previously known about the biota as well as the geology of the island.

Beginning in 1964 the Pacific Ocean Biological Survey Program (hereafter POBSP) of the Smithsonian Institution and the Bureau of Sport Fisheries and Wildlife (hereafter BSFW) began making periodic surveys of the fauna of the island. From 1964 through 1973 13 visits were made, all but five of them in the months of March and September, which together totaled only 7.0 days of observation (Table 1). Of these seven days, only three nights were spent on the island, which accounts, in part, for the paucity of data on petrels.

This report, one of a series on the northwestern Hawaiian Islands, is primarily intended as a summary of these and previous observations of

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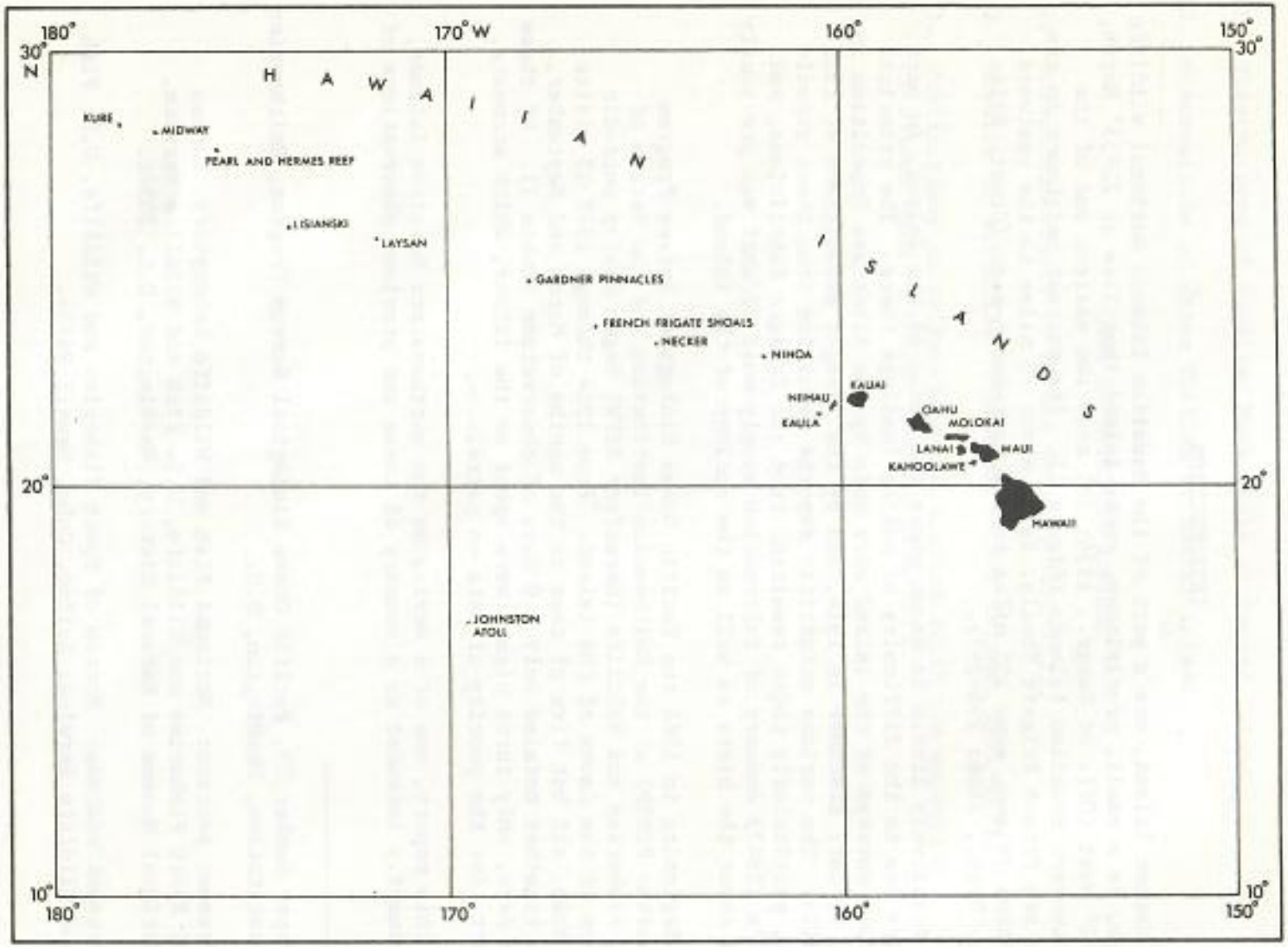


Figure 1 The Hawaiian Islands.

Table 1. Recent surveys of Necker Island by the POBSP and BSFW*

Month	Year 1964	1965	1966	1967	1968	1969	1971	1972	1973	Total Days of Observation
Mar.		BSFW POBSP (.4)		BSFW POBSP (.3)		BSFW (.4)				1.1
May						BSFW (.1)				.1
July	BSFW (.4)								BSFW (.3)	.7
Aug.					BSFW (1.4)		BSFW (.1)			1.5
Sept.	BSFW POBSP (1.4)		BSFW (1.3)	BSFW (.4)			BSFW (.3)	BSFW (.2)		3.6
Total Days of Observation	1.8	.4	1.3	.7	1.4	.5	.4	.2	.3	7.0

*POBSP is listed under BSFW when POBSP personnel accompanied BSFW field parties on one of their regular inspection trips. Figures in parentheses are the approximate number of days spent on the island. Table is complete through 1973 but does not include visits during which no landing was made.

the terrestrial vertebrates and vascular plants of the island. A brief description and history of the island are also included. Secondarily, this report should serve as a summary and reference (see Appendix Tables 1 and 2) to other biological and other information previously published about the island. Through the courtesy of Dr. Alexander Wetmore, the previously largely unreported observations on the birdlife made by him in 1923 are also included.

The present report was largely in final draft form in late 1970 and includes only slight emendation or addition after that period. Observations reported include those available through 1973. Except for botanical observations, this largely excludes the August 1968 survey, for which most data were not available.

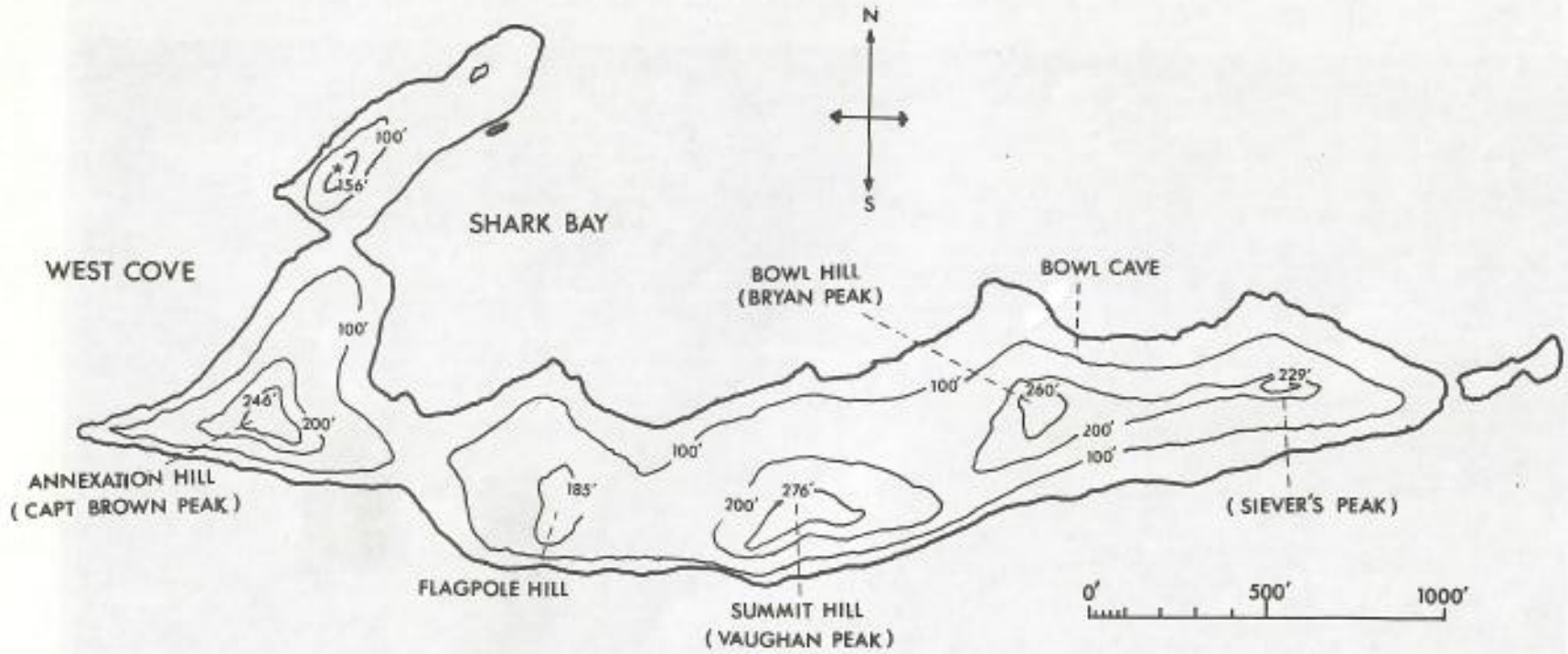
BSFW and POBSP field notes and trip reports concerning Necker are, respectively, stored in the Bureau of Sport Fisheries and Wildlife files, Kailua, Oahu, Hawaii, and the Pacific Ocean Biological Survey Program files, National Museum of Natural History, Washington, D.C.

DESCRIPTION

Necker, with an estimated area of 41 acres (Fig. 2), is a sharply rising ridge of volcanic rock (Figs. 3 and 4) which Palmer (1927: 22) reported to be the remnant of a volcanic cone that was formerly of much greater extent. Palmer's report on the geology also gives one of the best descriptions of Necker. He reported that the island "...consists of two parts. The principal one is a ridge extending nearly due east and west, 4,000 feet long and varying from 200 to 600 feet in width. On this ridge are five peaks....The saddles between the peaks are shallow [Figs. 5 and 6], except the most westerly [between Annexation Peak and Flagpole Hill], which drops to only 76 feet in elevation [Fig. 7]. From the westernmost peak a peninsula extends 500 feet north-northeast to a gap only a few feet above sea level [Fig. 8]." Landings are generally made here and are often particularly difficult and dangerous as the prevailing winds from the northeast often cause large breakers to break across this gap. "The lesser part of Necker Island, Northwest Cape [Fig. 9], extends about 800 feet northeast from this gap....At the east end of the main part of Necker is a low islet about 75 feet wide and 200 feet long. It is awash at high water and waves break over it continually."

On the north side of the islands the rocks rise precipitously to the peaks but on the north side are somewhat less steep and according to Emory (1928: 51) "are easily climbed."

The steep slopes of the island have little or no vegetation and are craggy and wave-sculpted where alternating layers of harder and more soft rock have been differentially eroded and bird droppings often whiten the face of the rock (see Fig. 9). Along the shallow valleys and on the rounded crests of the hills a few species of plants are well established in the thin soil (see Vegetation Section).


N
S
SHARK BAY
WEST COVE
BOWL HILL
(BRYAN PEAK)
BOWL CAVE
ANNEXATION HILL
(CAPT BROWN PEAK)
FLAGPOLE HILL
SUMMIT HILL
(VAUGHAN PEAK)
(SIEVER'S PEAK)
100'
156'
246'
200'
185'
276'
260'
229'
0'
500'
1000'

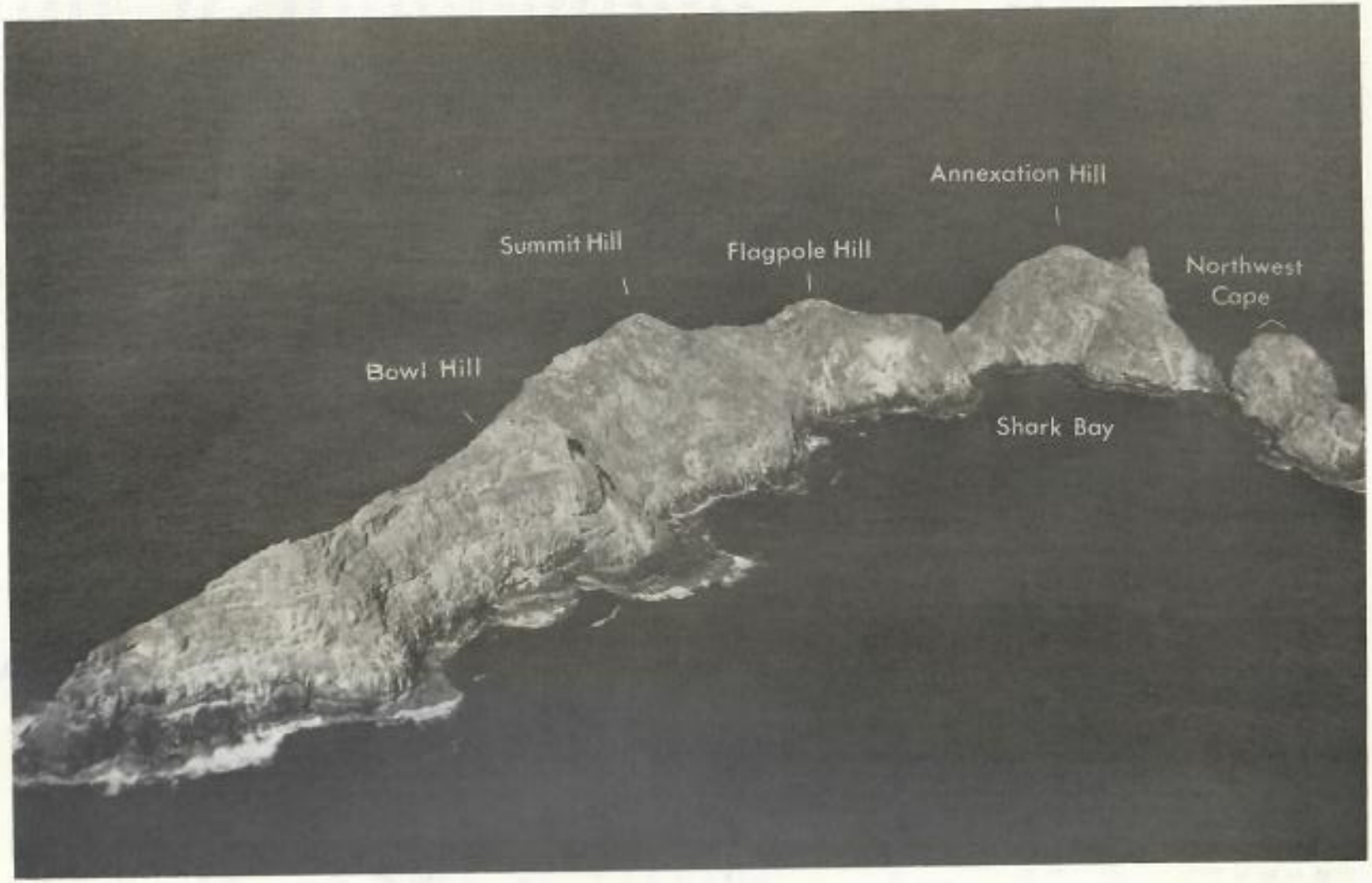


Figure 3 Aerial photograph of Necker Island showing prominent features of island. Official U.S. Navy photograph, January 1966.

West should be on left! or upside down - invert place-names.

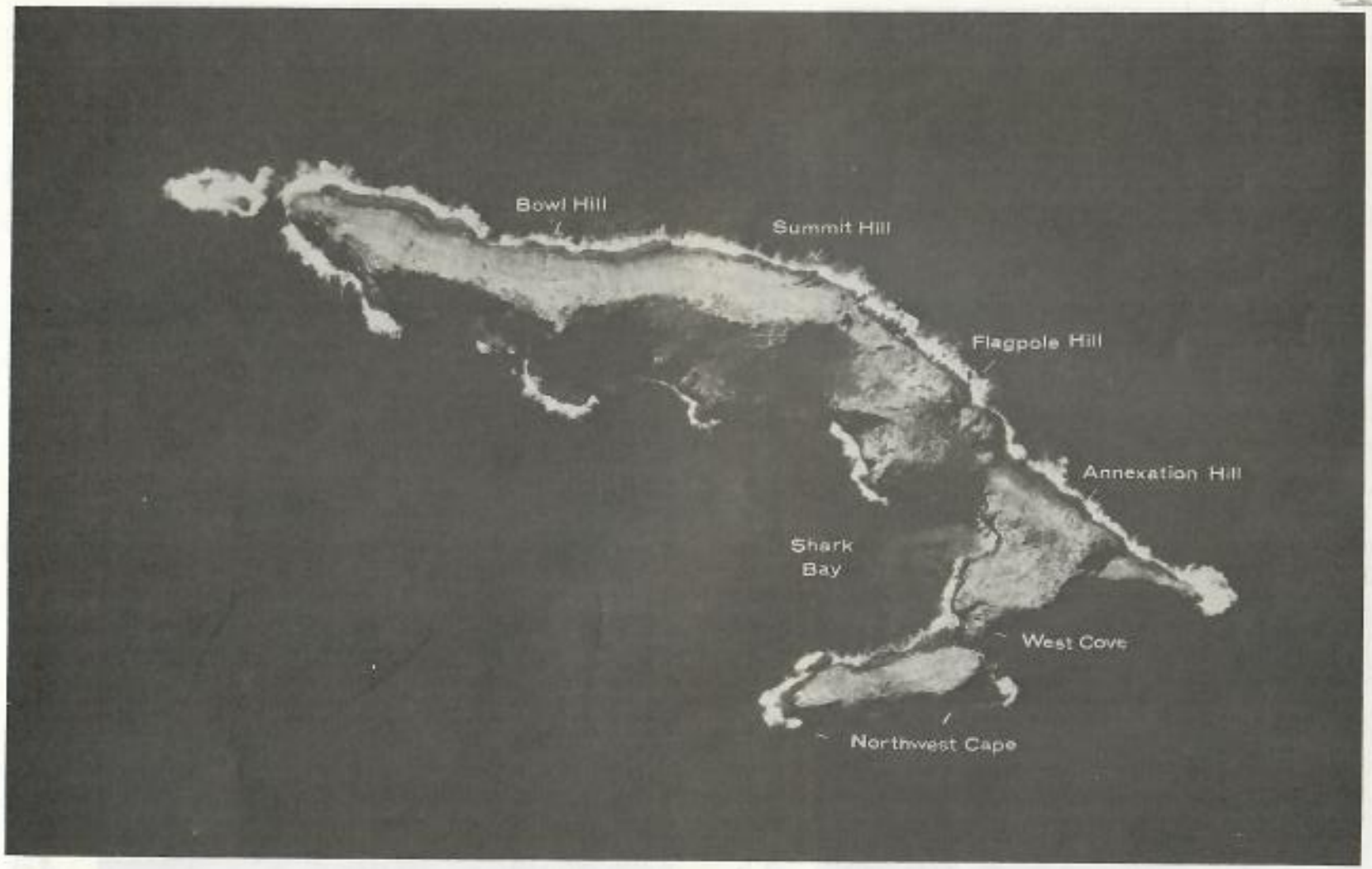


Figure 4 Oblique aerial view of Necker Island from the northeast. BSFW photograph by David B. Marshall, June 1962.

Figure 5 Shallow ridge between Flagpole (right) and Summit (left) Hills. Photograph by Derral Herbst, 28 August 1968.

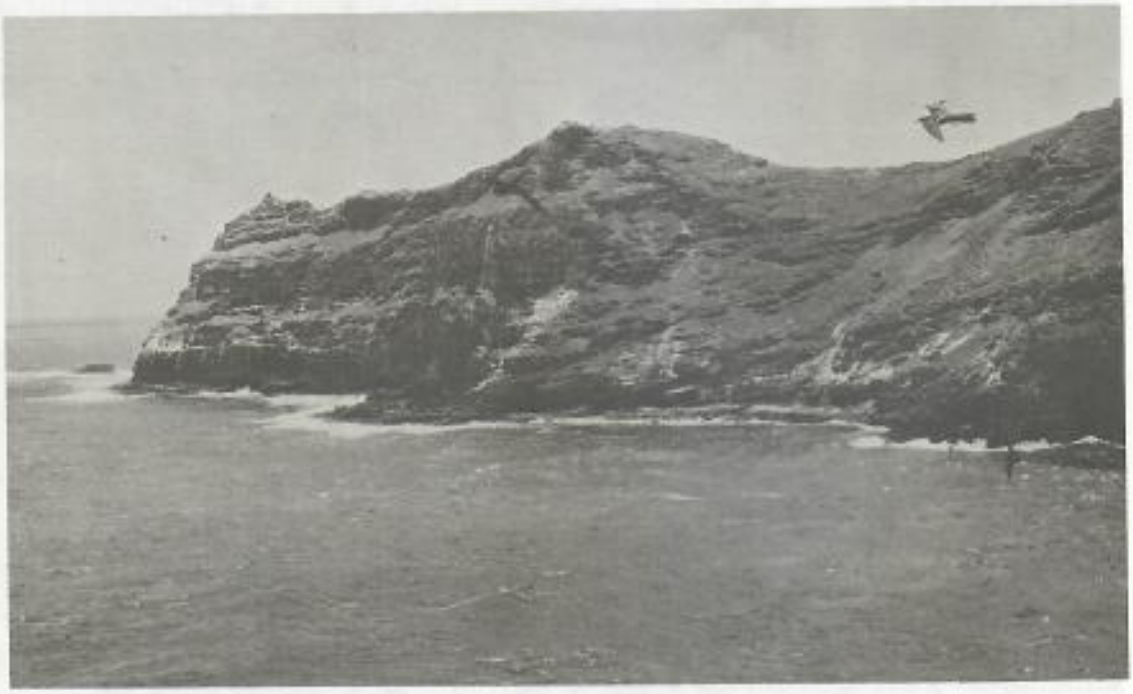


Figure 6 Shallow ridge between Bowl (middle) and Summit (right) Hills. Photograph by Derral Herbst, 28 August 1968.

Figure 7 Low gap between Flagpole (left) and Annexation (right) Hills. Photograph by Derral Herbst, 28 August 1968.

Figure 8 Gap between Northwest Cape and Annexation Hill as viewed from Bowl Hill. Shark Bay in right mid-ground and looking into the East Cove landing. Photograph by Derral Herbst, 28 August 1968.

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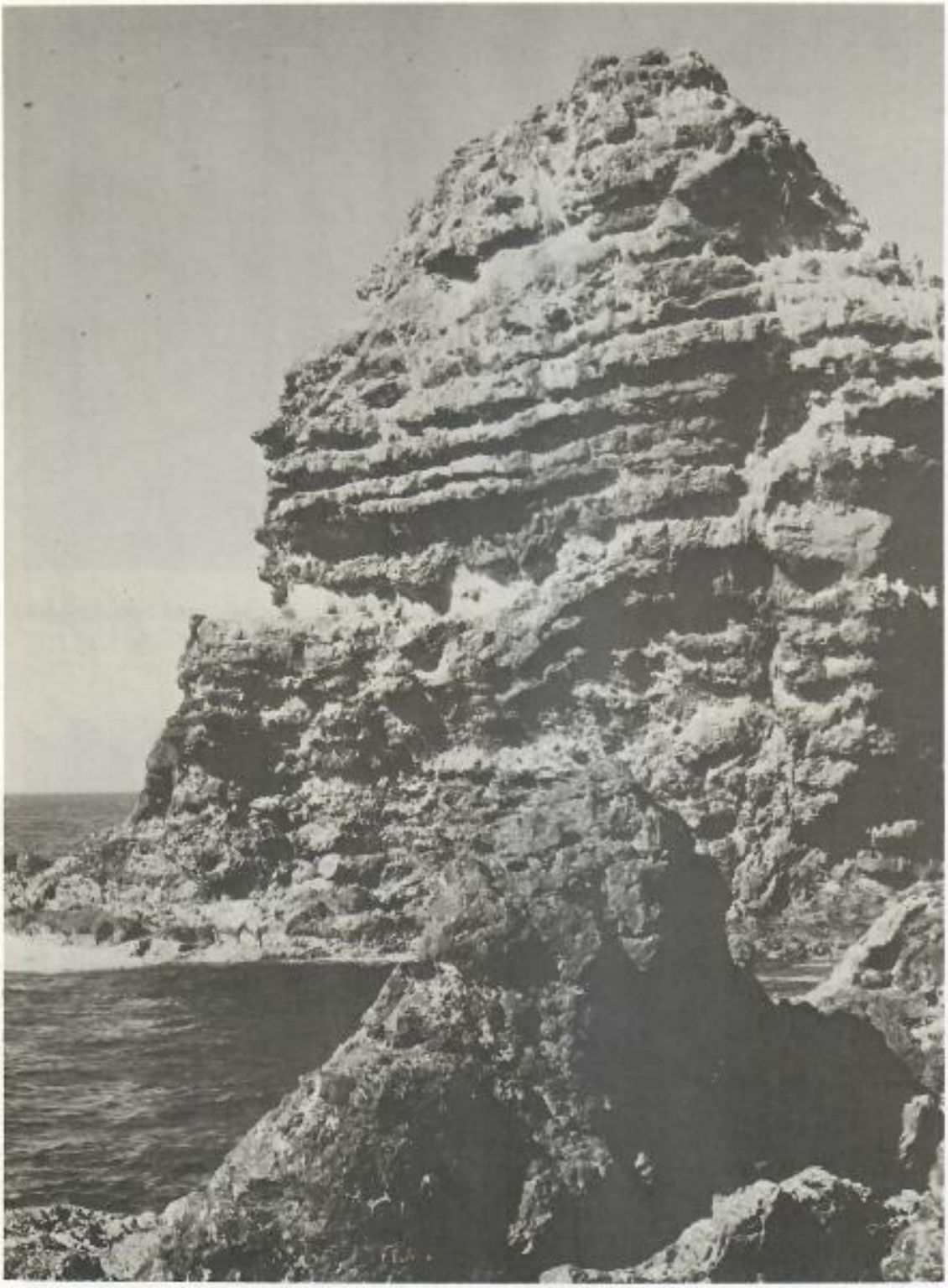

Figure 9 Frequently used landing area in the West Cove looking at the Southeastern Peak of Northwest Cape. Photograph by Derral Herbst, 28 August 1968.

GEOLOGY

Palmer (1927) is the only one who has written to any extent on the geology of Necker and our brief account here is largely taken from that paper. Although the remnant of a volcanic cone, no part of the original surface remains, all the present surfaces having resulted from the action of wind, sea, and running water. Palmer suggested that the deeper valley between Annexation and Flagpole Hills has resulted from greater wind erosion caused there by the funneling of the northwest trade winds by the main ridge of the island and by Northwest Cape. He (*op. cit.*: 23) considered it likely that

> at least a few hundred feet of overburden rocks have been removed from all parts of the island. There are now exposed at the surface various dikes and sills, some of which are entirely free of gas pores. This feature is usually taken to mean that the lava cooled and solidified under considerable pressure, which in turn implies a considerable overburden.

Necker has no definite stream channels and all rainwater either sinks into the rocks or runs off through unorganized channels. During his visit Palmer found two seeps of ground water, both evidently much contaminated by bird droppings. One was found near Bowl Cave (see Fig. 2) on the north slope of the island; the other was about 30 feet above sea level on the north side of the saddle between Flagpole and Annexation Hills.

Palmer also noted that the beds of lava composing the island are in general four to six feet thick and that they extend laterally for considerable distances. Two unusually thick beds, 15 to 20 feet thick, are to be found at the east end of the main island. He noted that in general the lava beds strike "N. 70° W., and dip 10° NE" and that the lava beds are

> cut by a number of nearly vertical dikes that strike about N. 70° E....The dikes vary from one to four feet in thickness. Some of them, notably the one on the northeast face of [Annexation Hill]...are dense and nearly free of vesicles, but others are moderately porous. Most of the dikes are fine grained at the margins and coarse grained in the interior. Some of the dikes branch one or more times, and one pair of dikes [is] connected by an oblique dike running about east-west. The dike on the southeast side of Northwest Cape connects with and seems to have fed a sill that outcrops on both sides of the cape. This sill meets the shore near the middle of the cape and extends upward toward the southeast end of the cape, cutting

> across several flows in one place. A sill about two feet thick crops out for about 150 feet on the summit of the main island near its east end, and was also presumably fed by the dike which is continuous with it.

Palmer concluded that the vent of the volcanic cone of which Necker is a remnant lay to the southwest of the present position of the island. He remarked, however, that his conclusion (1927: 24) "disagrees with the fact that Necker lies to the southwest of the axis of the ellipse outlined by the surrounding shoals," but suggested that this might be explained by the fact that the shoal "was composed of two or more volcanic cones....and that the windward cones have been removed as they were most exposed to attack by waves driven by the prevailing northeast trade winds. The area of the shoal around Necker is about 650 square miles which is large enough to have included two volcanic domes."

Palmer found no evidence of faulting in the beds composing Necker and noted that the beds along the westernmost saddle are continuous.

Analyses of the rock composition have been given by Palmer, Mühle (1902), Powers (1920) and Washington and Keyes (1926). All the rocks studied were basalts and within this classification consisted of four types, andesine, olivine-labrodorite, picrite and nephalitic basalts. Further details of chemical composition of these rocks can be found by consulting the literature cited.

Palmer also found gypsum stalactites and stalagmites in some of the shallow caves of the island. These differed from the usual in that they had fairly good crystal outlines rather than being more rounded in form. According to Palmer, these probably resulted from the evaporation of salt spray.

HISTORY

Prehistoric Habitation

Evidence of prehistoric habitation of Necker Island was noted during one of the earliest landings on Necker which occurred about 1879. Captain William C. Bruhn, then a young sailor, evidently on the schooner JULIA, landed and explored the island.[1] When he was interviewed by Atkinson many years later Bruhn remembered seeing marae (stone platforms with a conventional arrangement of uprights), four or five idols, a few stone adzes, and a stone "shaped like a rough dumbbell, two rough ends with a handle to clutch with the hand. The Hawaiians said that when sharks were led to shallow

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[1] Emory (1928: 55) found no evidence of a visit in 1879 but discovered that the JULIA had sailed to the South Pacific on 13 July 1882.

places that this dumbbell was used to kill them by beating them on the head." None of the idols was collected because of the superstitious fear of the Hawaiians on Bruhn's ship, but the dumbbell-shaped stone was taken and later transported to San Francisco (Emory, 1928: 54).

The presence of idols and images was again noted on 27 May 1894 when the island was annexed by the Hawaiian government. Seven idols were taken to Honolulu and a photograph of six of them was published in the Journal of the Polynesian Society (Alexander, 1894: 153).

Subsequent visits and collections are listed in detail by Emory (1928). Four images (two now in the British Museum) were collected by a party from the HBMS CHAMPION on 24 September 1894, but no idols were found on seven subsequent visits. The latter visits included one on 12 July 1895 by King, two of unknown date by George N. Wilcox, visits in 1910 and 1913 by personnel from the Revenue Cutter THETIS, and two visits by H.L. Tucker and party in 1917. Photographs were taken of several marae on the latter visit.

On 6 October 1919 Gerrit P. Wilder collected an image leg and a re-shaped image. In the summer of 1923 a number of artifacts (including a hammerstone, grindstones, adzes, a chisel, an awl and bowls) and skeletal material were found by members of the Tanager Expedition.

Observations made during the Tanager Expedition and on earlier visits were reported in great detail by Emory (1928) and need not be repeated at length here. Some records, however, are worth noting.

Emory reported finding 33 marae. Most were rectangular structures with a narrow elevated platform usually found at the rear, and a lower broader terrace at the front (see Fig. 25 in Emory, 1928: 60). Various stones standing upright were placed on the structure (Figs. 10 and 11). These platforms ranged in length from 17.5 to 64 feet. The length in 16 of these averaged about 25 feet, and in 11 about 40 feet. In 25 maraes the width of the platform was four to six feet, in two, three feet, and in three, eight to nine feet.

Emory also counted 25 terraces that were rectangular, unpaved, low, and usually narrow. Two were just west of the summit of Annexation Hill and a group of eight was south of Flagpole Hill. Another group of six terraces was found between Flagpole and Summit Hills, and seven were found just northwest of the crest of Summit Hill where a double terrace also was discovered.

Despite a considerable search for areas where people might have lived, only eight hollows were found in the bluffs of Necker that gave evidence of occupancy. Emory reported that all eight grottos could probably shelter no more than 24 persons. Only Bowl Cave, where most artifacts were found, had evidently been continuously occupied.

Figure 10 Adult and immature Red-footed Boobies and Great Frigatebird roosting on uprights of marae on Annexation Hill. Blue-faced Booby in mid-ground and large nestling Great Frigatebirds in background. Photograph by Derral Herbst, 28 August 1968.

Figure 11 Immature Red-footed Boobies roosting on uprights of marae on Annexation Hill. Nestling Great Frigatebirds and immature Red-footed Booby in foreground.

There human leg bones were found on the floor. Emory speculates that the bones may have been taken to the cave for use in making fish hooks, a common practice among Hawaiians.

Emory gives detailed descriptions of all images available to him and stated that all were "male human figures carved in the conventionalized form." The images, carved from vesicular basalt, varied in color from light to dark gray, and ranged in height from eight to 18 inches. They weighed from four to 25 pounds, "inclining equally to extremes."

After making a detailed comparison of the archaeology of Necker and nearby Nihoa, and of their cultures in comparison with other Pacific cultures, Emory concluded that

> this review of the cultural affinities of Nihoa and Necker, reveals the Necker culture as one which had been introduced to the Hawaiian Islands from southeast Polynesia, probably from Tahiti, and which, on the islands excepting Necker had become for the most part displaced, and for the rest, modified by the historic Hawaiian culture.

He ended by saying "it seems reasonable to adopt the view that the Necker culture is a pure sample of the culture prevailing in Hawaii before the thirteenth century...."

About 15 years after the publication of Emory's paper, charcoal and wood found in 1923 in Bowl Cave were carbon dated by Libby (1954: 742). The age of the charcoal was placed at 166 to 200 years and that of the wood at 0 to 250 years. Although the material was possibly contaminated, the results suggest a fairly recent occupation of Necker, but clearly do not rule out the possibility that the structures themselves were erected six or seven centuries ago. Certainly the charcoal and wood could have been brought to the island at a later date by fishermen or wandering natives.

European Discovery and Early Visits

All authors agree that the first European to discover Necker was the French navigator, Jean François de Galaup, Comte de la Pérouse. On 4 November 1786, en route to Macao, la Pérouse's frigate, the BOUSSOLE, and its companion the ASTROLABE sighted a small rocky island (Buck, 1953: 54). The vessels stood offshore all night. The following morning La Pérouse (1799) made the following notations:

> This very small island is little more than a rock of about five hundred toises [= 1,000 yards] in length, and sixty [= 120 yards] in elevation at the most.

> It does not exhibit a single tree, but there is a great deal of grass near the summit. The naked rock is covered with the dung of birds, and its white appearance affords contrast to various red spots, upon which the grass has not sprung up. I approached within the distance of a third of a league. The banks were perpendicular, like a wall, and the sea broke so violently against them, that it was impossible to land. As we sailed almost entirely around it, the plan of this island, as well as the different views, are perfectly accurate. Its latitude and longitude, as determined by Mr. Dagelet, are 23°34' north, and 166°52' west of Paris.[2] I called it Isle Necker [in honor of Monsieur Jacques Necker, French Minister of Finance under Louis XVI].

The exact date of the first historic landing on Necker is not precisely known but apparently occurred at the beginning of the 19th century. Bryan (1938: 22) reported that John Turnbull, who visited Hawaii December 1802 to January 1803 in the British ship MARGARET, learned that two Hawaiians had landed on Necker sometime previously and had noted a "range of stones, placed with some regularity in the manner of a wall, and about three feet high."

Necker was sighted at least four times in the mid-1800's but no landings were made. The PORPOISE and the OREGON, part of the U.S. Exploring Expedition, passed offshore on 1 December 1841. Charles Wilkes (1845: 389-390), commander of the expedition, remarked that "birds, especially the white tern, had been seen in numbers prior to [sighting the island]..." The vessels, three miles off the reef surrounding Necker, made soundings but did not attempt to land because of a "furious surf beating on all sides of the island." Necker's position was calculated as 164°37'00" W., 23°44' N.

Necker was again observed from offshore on 24 April 1857 by Captain John Paty of the schooner MANUOKAWAI. Paty (1857: 40) described Necker as "a precipitous rock, 300 feet high, 1 mile long and half a mile broad, with small patches of grass on its surface."

Two years later, on the morning of 1 January 1859, Lt. John M. Brooke (ms.) viewed the island from the U.S. schooner FENIMORE COOPER. Later that year, on 29 April, Captain N.C. Brooks of the GAMBIA sighted Necker and took its position. Of the island itself Brooks (1860: 499) remarked only that, "it is rocky, and about 1-1/2 to 2 miles long...."

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[2]The Greenwich longitude would be 164° 32'.

In 1886 the fishing schooner GENERAL SIEGEL fished off Necker (Farrell, 1928: 253). This trip is notable in that this was the first time seals were recorded for the island.

On 28 May 1891 the island was viewed from the KAALOKAI by Henry Palmer and George C. Munro, members of the Rothschild Expedition which was collecting bird specimens in the northwestern Hawaiian Islands. Although the party wished to land, it was prevented from doing so by heavy seas (Rothschild, 1893-1900: viii).

Hawaiian Annexation

The historical details of this period were carefully researched and analyzed by Pauline N. King (ms.). Our account follows hers closely, and we are deeply indebted to her. Her thesis should be consulted for further details and for citations of unpublished correspondence and official communications.

In the 1890's Necker became an island of international interest since it was not clear which if any nation held title to it. Great Britain was interested in laying claims to islands which would serve as mid-ocean stations for a cable connecting Canada and the Austral-Asian colonies. She already claimed Fanning in the Line Islands and she possessed many islands between the Lines and Australia which would serve adequately as stations. However, she needed an intermediate station between Canada and Fanning and the only possibility lay within the Hawaiian group.

In the fall of 1893 two Canadians, Mackenzie Bowell and Sanford Fleming, began inquiring into the feasibility of a cable station in the main Hawaiian Islands, and into the physical characteristics and international status of Necker. They concluded that the main Hawaiians would be unsuitable, partly because they felt that national pride demanded national ownership of an island station, and partly because they felt uncertain of the political future of the Hawaiian government. Fleming strongly recommended that Necker Island be secured as a British possession.

Some months of political maneuvering followed. During this period, British officialdom attempted to discover whether the Hawaiian government did, in fact, claim Necker, and, if not, whether the United States might object to Britain making such a claim. The United States government remained neutral and noncommittal on the matter, only indicating that it considered trans-Pacific telegraphic communication to be of benefit to the United States as well as to Great Britain and her colonies. The Hawaiian government was initially open to the idea but wanted to know more details about the British plan. Hawaii wished to do nothing detrimental to the interests of the United States.

On 24 May 1894 the presence in Honolulu of the CHAMPION, a British warship, and the visit of inquiry to the survey office of

the Hawaiian government by the acting British Vice-Consul, led to the rumor that the British were en route to claim Necker Island. As a result the Executive Council of the Hawaiian government decided that Captain James A. King, Minister of the Interior, should travel to Necker immediately and claim it for Hawaii. On 25 May King's ship, the chartered interisland steamer IWALANI, departed from Honolulu at 1710. The CHAMPION departed 50 minutes later. Many observers interpreted this as a race to claim Necker Island, a race that the CHAMPION would probably win since it was the faster ship. Subsequent events indicated, however, that the CHAMPION was on no such mission.

On 27 May the IWALANI reached Necker, and King, accompanied by members of the crew, went ashore to claim the island.

A quotation from the log of Captain Freeman (Emory, 1928: 55) describes the landing:

> At 11:00 AM arrived at the island and dropped anchor in 18 fathoms of water. We lowered a boat and proceeded to land at once with His Excellency, Capt. J.A. King, Capt. Freeman, C.B. Norton and nine sailors, leaving the vessel in charge of the second officer. After considerable difficulty the party was safely landed. A hard climb up a rugged cliff 260 feet high, was successfully accomplished, when His Excellency Capt. King hoisted the Hawaiian flag, read the Proclamation and took possession of the island in the name of the Hawaiian Government....after a stay of about four hours on the island, we left at 5:30 PM for home, steering E. by S., arriving at Honolulu on Tuesday evening [May 29].

While on the island, the party erected a flagpole and attached to it, within a copper tube, a copy of the paper claiming annexation. Tucker (ms.) reports the contents of this paper:

> I, James A. King, Minister of the Interior of the Provisional Government of the Hawaiian Islands, in pursuance of a commission granted to me by His Excellency, Sanford B. Dole, President of the provisional government of the Hawaiian Islands, do hereby in the name of said government take possession of this island, known as Necker Island as a part of the Hawaiian Territory; the same being within the Hawaiian archipelago in Lat. 23°35'18" North and Long. 164°39'00" west, and having been claimed by the Hawaiian territory since

the year 1845 when an expedition[3] under Capt. W.M. Paty was sent to survey said island.

Done at Necker Island the 27th day of May in the year of our Lord 1894.

Signed: J.A. King, Minister of the Interior
Wm. Freeman, Master of Hawaiian Str. Iwalani
Jas. Gregory, Chief Officer "Iwalani"
Albert Tullott, 2nd " "

Late 19th Century Visits

On 24 September 1894, the HBMS CHAMPION did pay a visit to Necker and landed a survey party. At least six men went ashore, but Captain Rooke was apparently not among them. Although the Hawaiian government had asked that no images or artifacts be disturbed, four were collected.

The British had not yet abandoned their intention of using Necker Island for a cable station. The British government sent a mission to Honolulu to engage in negotiations with the Hawaiian government but they did not achieve their aims. They failed in part, perhaps, because of anti-British sentiment in the Hawaiian Islands, and in part because of the unwillingness of the Hawaiian government to jeopardize possible ties with the United States.

Necker was again visited 12 July 1895 by Captain J.A. King (ms.) and a survey party on the ship LEHUA. While mapping the island, they

> landed and found that the flagpole...placed in position in May, 1894, had blown down. We replaced the staff in position. We found the Copper Cylinder which had contained the Proclamation open and the document on a rock under the staff. The Proclamation had been opened and a written memorandum in pencil was on the back of it, signed by Officers of the H.B.M.S. Champion. One name I was able to decifer as that of Lieut. Nugent, the others I could not make out. The memorandum stated as near as I can remember as follows: 'We, the undersigned officers of the H.B.M.S. Champion, on 24th of September 1894, surveyed Necker Island shoal; running S.E. 35 miles, N.E. 15 miles, and ten miles in all directions. We found no less than 15 fathoms of water one mile distance from shore.'

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[3]We have been unable to discover any other reference to this 1845 voyage.

> We returned the Proclamation to the Cylinder and made it fast to the base of the staff.

Tucker (ms.) in 1917 also saw this Proclamation and reported the text as "this island known as Necker Island was surveyed by the undermentioned officers of Her Hawaiian Majesty's ship Champion Sept. 1894 and also the bank extending 35 miles SE, 15 miles NE, ? miles in the other direction." The "Hawaiian Majesty's" part of this quotation is undoubtedly incorrect but the absence of a date for September 1894 throws some doubt on exactly when the island was visited. Tucker also deciphered a number of other names indicating that Lieut. Rowland Nugent, Lieut. Frederick, A.H. Walker, Richard Markham and three others including two midshipmen had visited the island.

George N. Wilcox evidently visited the island on at least two occasions at about this period (Emory, 1928: 48), but we have no information concerning his visits.

1900-1929

In 1902 Necker was visited by the U.S. Fish Commission Steamer ALBATROSS which was engaged in deep-sea investigations around the Hawaiian Islands. The ship arrived offshore on the afternoon of 30 May and anchored off the west end of the island. The following day the four naturalists aboard (Charles H. Gilbert, Walter K. Fisher, John O. Snyder, and Charles C. Nutting) landed and spent a few hours on the island (Thomas, ms.). Fisher later reported that 17 species of birds were seen and described one of them (Blue-gray Noddy) as a new species (Fisher, 1903a, b).

In response to considerable agitation over Japanese feather gathering in the northwestern Hawaiian Islands in the early 1900's, Necker was included in the Hawaiian Island Reservation. This reservation, established 3 February 1909 by President Theodore Roosevelt's Executive Order No. 1019, included all northwestern Hawaiian Islands but Midway. They were placed under the jurisdiction of the Department of Agriculture and set aside as a preserve for the native birds.

From 1909 to 1916 the U.S. Coast Guard Cutter THETIS voyaged frequently along the northwestern Hawaiian Chain. The visits had several objectives: apprehension of Japanese bird poachers who had been destroying birds on various islands; inspection of the islands to determine whether further poaching had occurred; transportation of various scientific parties who wished to study the fauna of the islands; and transportation of mail and supplies to Midway Atoll. Parties attempted to land on Necker on several occasions.

As the THETIS passed Necker on the morning of 13 January 1910, W. Jacobs, the vessel's commander, noted an absence of bird and human life on the island which was "covered with a growth of grass

on the central ridge." No landing was made because of dangerous surf (Jacobs, ms.). The THETIS visited Necker again on 22 May, 25 August, and 5 September but no evidence of molestation of the birdlife was seen.

In 1912, while transporting a U.S. Biological Survey party to Laysan, the THETIS passed offshore on 18 December. Heavy swells prevented landing. On 9 March 1913, during the return trip of the survey party, two of its members, George Willett and Alfred M. Bailey, attempted to land in a ship's boat but were again prevented from doing so by high surf. Willett, undaunted, swam ashore. Despite the inconvenience of being naked, Willett spent about two hours on the island and obtained a few notes on the kinds of birds present and their nesting status (Bailey, 1956: 32; Willett, ms.).

On 8 September 1914 Carl Elschner and others went ashore from the THETIS. Elschner (1915) made notes on minerals and geology and named a number of the prominent features of the island (see Fig. 2). Apparently these names were never in common usage and all were replaced by names subsequently applied to them by the Tanager Expedition.

In November 1914 W.A. Bryan (ms.), a noted ornithologist and sometime Honolulu politician, made application to H.W. Henshaw of the Biological Survey for the lease of Necker Island. His reasons for so doing were that "the longing to be 'monarch of all I survey' has always been with me and a lease to Necker seems to be about as near as I am liable to get to realization of the longing." Despite Bryan's longing the lease was never granted.

Bryan was not the only one to attempt to lease Necker. The Territory of Hawaii leased Necker to A.C. Lovekin on 2 June 1907 (Frear, ms.).

The THETIS again passed Necker on 19 March 1915 but once more heavy surf made a landing impossible.

In early 1916 the THETIS paid two visits to Necker and on both visits men landed on the island. On the first visit, late in the afternoon of 27 January, three officers landed by swimming to a shelf of rock in the East Cove (now known as Shark Bay). During their brief visit they explored only the westernmost peak of the island (Annexation Peak). An easier landing was effected on 11 February when slight swells allowed the survey party to step from the dinghy to a rock shelf edging Shark Bay. During the three hour visit most of the eastern portion of the island was explored. Lt. W.H. Munter, who visited the island on both occasions, later made a detailed report of this visit and included a considerable amount of information on the birdlife (Munter, ms.).

Necker was visited twice in 1917. H.L. Tucker and others landed from the power sampan NAKAIWA on 25 October, and Tucker and seven other members of the crew of the J.A. CUMMINS stopped there on

5 November (Tucker, ms.). They rediscovered the Annexation Documents and noted the few birds present. Tucker and Eben P. Low took a number of photographs of the birds.

The following fall, on 3 September 1918, the USS HERMES steamed around the island during an inspection trip of the northwestern Hawaiian Islands. In a report of this trip Diggs (ms.) briefly noted the presence of six species of birds. On 6 October 1919, Wilder, Warden of the Hawaiian Islands Bird Reservation, visited Necker in the lighthouse tender KUKUI (Emory, 1928: 59).

The visits made to Necker by the Tanager Expedition in June 1923 and in July 1924 resulted in a greater accumulation of knowledge about the island than did any previous or subsequent visit. Plans for this expedition, which visited all the northwestern Hawaiian Islands, Wake Island, and Johnston Atoll, were formulated in 1922 in conferences between the U.S. Navy National Research Council, the U.S. Biological Survey, and the Bernice P. Bishop Museum. The Navy provided the ship (the minesweeper TANAGER), a director of naval work (Commander S.W. King), and agreed to chart hydrographic data; the Biological Survey provided an ornithologist (Alexander Wetmore) to lead the party, a rabbit-killing specialist (E.C. Reno), and a movie camera. Other personnel were supplied by the Bishop Museum (Gregory, 1924: 19-22).

We are not certain of the exact itineraries of every individual but believe the following account, derived primarily from an examination of Wetmore's (ms.) field notes, is accurate.

In all, five voyages were made which included three visits to Necker (two on trip C and one on trip E). On trip C, while part of the field party remained on Nihoa, others including Anderson,[1] Atkinson,[3] Judd,[4] Palmer,[5] Caum, and[6] Cartright, proceeded to Necker where they set up camp on 12 June. On the 16th[1] Judd,[2] Palmer,[3] Caum, and[4] Cartright departed for Nihoa where they replaced Wetmore, Schlemmer, Grant, Bryan, and Thaanum who sailed to Necker where they remained from the afternoon of 17 June through the morning of 21 June. Atkinson departed Necker on the afternoon of 17 June. After a survey of French Frigate Shoals, part of that field party returned to Necker for a day's survey on 29 June. Those going ashore included Wetmore, Judd, Cartright, Anderson, Caum, Palmer, Bryan, and Schlemmer.

The following year, at the request of the National Research Council, the Navy provided the TANAGER for a resurvey of Necker and Nihoa. This survey placed most emphasis on archaeological work. The field party (Appendix Table 1) camped on Necker from the morning of 15 July until the afternoon of 18 July (Gregory, 1925: 19-20).

1930-1959

There are few records of landings on Necker during this period. The island was often sighted in the 1930's and '40's by U.S. naval vessels engaged in various fleet maneuvers (Amerson, ms.) or by U.S. Coast Guard vessels cruising up the chain.

On 4 March 1936 a landing was made by A.D. Trempe (ms.), co-operator for the Biological Survey, and members of the crew of the Coast Guard vessel RELIANCE, B.L. Bassham commanding. Trempe later wrote a brief report on birds seen on other islands visited (Nihoa, French Frigate Shoals, Laysan) during the cruise but for Necker reported only that "much the same birds" were seen as were seen on Nihoa.

The name of the Hawaiian Island Reservation was changed on 25 July 1940 to the Hawaiian Islands National Wildlife Refuge, and its jurisdiction was transferred to the U.S. Fish and Wildlife Service in the U.S. Department of the Interior. In December 1951 the Wildlife Service entered into an agreement with the Territory of Hawaii; one of the provisions of the agreement was that patrol of the refuge would be by Territorial personnel.

On 20 December 1953 Frank Richardson of the University of Washington visited Necker briefly from the Coast Guard vessel BUTTONWOOD. He covered only about half the island but recorded 12 species of birds (Richardson, pers. comm.). Some of his observations were later incorporated in a paper on the breeding cycles of Hawaiian seabirds (Richardson, 1957).

Dale W. Rice and Karl W. Kenyon made an aerial survey of the island on 28 December 1957. Albatross populations were estimated from counts in low-level photographs (Rice and Kenyon, 1962).

1960-1969

In 1961 Necker was visited 25 to 26 March by the USS DUVAL COUNTY (LST 758) which was determining exact locations of the northwestern Hawaiian Islands. During this visit the project known as HIRAN I was plotting first order astronomic strata and azimuth marks by conventional methods (Roach, ms.).

On 11 June of the following year Necker was visited from the USS STONE COUNTY by four biologists, two of them from the Hawaii Division of Fish and Game (Appendix Table 1). During their very brief visit a few notes were made on vegetation, birds, and the debris left from the HIRAN I operation (Kramer and Beardsley, ms.). At that time several military personnel were camping on the island and were engaged in the HIRAN II project (Marshall, ms.).

Responsibility for patrol and inspection of Necker was assumed in March 1964 by the U.S. Bureau of Sport Fisheries and Wildlife in

the U.S. Fish and Wildlife Service and a refuge manager was assigned to Hawaii. From then through July 1973 13 landings were made on Necker (see Table 1). Personnel from the Smithsonian Institution's POBSP participated in four of the surveys, those made in March and September 1964, March 1965, and March 1967.

Landings on this island have been exceedingly hazardous and inclement weather has often prevented landings or, in some instances, caused precipitate departures. Some idea of the difficulty and hazards of landing on Necker can be gotten from two recent first-hand accounts.

Concerning the departure on 22 March 1969, John Sincock noted that

> Viewing a 25 foot surge at the rock shelf [from which departures are made] and frequent 3-4-foot-deep waves crashing across [it] I suddenly agreed wholeheartedly with [the] recent memorandum... that hazardous duty pay was justified....[Eugene] Kridler, [David] Olsen and I had our share of being knocked off our feet, swept along the rock ledge, and then being swept toward the edge when the sea dropped 20-25 feet. Kridler's extended hand prevented me from going over once, and I think I reciprocated 2 or 3 waves later. We...lost track of how many times we were knocked down, or which way was up. Olsen jumped to the [rubber] boat in good shape and was taken to the life boat. Two knockdowns later the rubber boat returned for Gene and me...we both had decided a free dive into the rubber boat was preferable to another sluicing across the rocks. We waved off the bowline... because of the hazard of becoming entangled. I jumped into space like a skydiver and felt like I had forgotten my parachute, but I didn't catch up with the boat until it was at the bottom of the surge. Kridler...dove next, [and landed] spread-eagle on top of the coast guardsman in the bow.... Only one or two bags of equipment were lost and wounds were only superficial (BSFW).

On the next visit, 30 May 1969, Olsen described the perils of landing on Necker. Since the usual landing place (the northwest side of the low rock shelf connecting the main island and Northwest Cape) had proven hazardous on previous visits, an alternative landing place on Shark Bay was investigated and Olsen decided to swim ashore. His account of the attempt points out another of the hazards around the island.

> I was about 75 ft. from the shoreline when six sharks came rushing at me from my left front.

> I turned to face them as they went behind me --another 10 sharks came in from my right. The water was simply infested with sharks swimming round and round me in a...[frenzied] ...manner. Some were no more than a foot from me as they sped by me. At that time I was about 25 ft. from the ledge and I swam like I never had before, expecting to be attacked at any second. Fins [were] all around me on the surface, and the water was literally boiling with sharks...Finally, a wave swept me up on the ledge, but I was unable to hold on and I was washed into the surge again--[into a] mass of swirling fins. I caught the next swell and scampered to safety. As I stood there I counted 45 sharks swimming around in the waters at my feet (BSFW).

The primary purpose of most of these recent surveys has been inspection and patrol of the island. No survey has been longer than two days. Nonetheless, a considerable amount of information on the biota has been obtained and these data are the primary basis for the accounts of the wildlife that are presented in the following sections of the report. Itineraries, personnel, and a summary of the results of the surveys are presented in Appendix Tables 1, 2, and 3.

In February 1967 Necker was designated a natural area within the refuge system. This designation stipulates that the island's ecology is to be kept as free as possible from outside influence and disturbance. The island is dedicated to research. Visiting is limited solely to scientists on approved research programs and entry is only by permit from the Bureau of Sport Fisheries and Wildlife.

VEGETATION
by Derral Herbst

Although numerous parties have stopped at Necker, visits were brief and few botanical collections were made. La Pérouse (1799), who was the first to mention the vegetation of the island, stated that in 1786 "It [did] not exhibit a single tree, but there [was] a great deal of grass near the summit." Both Captain John Paty (1857: 40) and the annexation party who visited Necker in 1857 and 1894 respectively also noted patches of grass (Anon., 1894). Fisher (1903a: 777) of the Albatross Expedition gave a slightly more detailed description of the vegetation:

> The wider shelves of the island are sparsely covered with a flesh-stemmed, yellow-flowered portulaca (*Portulaca lutea*), and the summit is rather plentifully grown over with *Chenopodium*

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> *sandwicheum* bushes, on which large colonies of *Sula piscator* [= *S. sula*, Red-footed Booby] and *Fregata aquila* [= *F. minor*, Great Frigatebird] were nesting at the time of our visit.

Elschner (1915: 16) briefly mentions the vegetation as being "slight...and this...[is found] in higher, more flat parts of the island while the lower parts of the vertical walls and the shore rocks are bare." While he alludes to plant collections made--"my time being limited I was unable to gather many plants on this island"--the disposition of the specimens is unknown.

The first compenhensive botanical collections were made by the Tanager Expedition in 1923 and 1924. The resulting publication on the vascular flora (Christophersen and Caum, 1931) concurs with all earlier observations in that the vegetation of Necker is described as sparse and inconspicuous. During the 1923 Tanager survey, C.S. Judd, a forester, sowed seed of seven species of plants in the saddle between Flagpole and Summit Hills (Christophersen and Caum, 1931: 7; cf. annotated list below). None of these plants was found growing there subsequently.

Recent collections and observations were made by D. Herbst (ms.) (UH), E. Kridler (BSFW), and C.R. Long (POBSP).

In comparing past accounts of the vegetation, it appears that the composition has remained fairly constant over the years. Probably, differences can be attributed to the amount of rainfall prior to the visit. The vegetation cover was sparse on recent visits. Plants were restricted primarily to the top of the island, with some intermittently distributed on the natural terraces lower on the side.

Vascular plants have been collected on Necker by the following: J.O. Snyder, May 1902; E.L. Caum, June 1923; E. Christophersen, July 1924; E. Kridler, July 1964; and C.R. Long and J.W. Beardsley, September 1964. Specimens are deposited in the B.P. Bishop Museum Herbarium (BPBM), the Herbarium of the University of Hawaii (UH), or the U.S. National Herbarium of the National Museum of Natural History (USNM).

The following list notes all 13 species of vascular plants collected from, introduced to, or observed on Necker Island. Three of the five species now growing there, *Panicum torridum*, *Chenopodium oahuense*, and *Sesbania tomentosa*, are endemic to Hawaii, while the other two, *Sesuvium portulacastrum* and *Portulaca lutea*, are widespread throughout the Pacific islands. A list of lichens (eight species) from this island may be found in Magnussen (1942); Tsuda (1966) lists 17 species of marine algae.

Gramineae

Panicum torridum Gaud.

Caum 56 (BPBM), Christophersen 10 (BPBM), Kridler 3 (UH), Long 2445, 2450, 2455 (BPBM).

As would be expected, the amount and distribution of this annual grass have varied more than those of the other four phanerogams. Christophersen and Caum (1931: 7) report that it was fairly common on the north side of the main island in 1923, but one year later only two clumps were seen. In June 1962 (Kramer and Beardsley, ms.) small tufts were found everywhere on the island's crest, while in August 1968 the grass was found in moderate numbers only, and these primarily on Bowl Hill. This grass was also thought to be most abundant in the vicinity of Bowl Hill in September 1964 and 1966 (BSFW). The short growing period, the rapid wearing of dead tufts by the seabirds and the ease by which the wind can disperse the densely vestured spikelets can explain the varied distribution patterns.

Palmae

Livistonia australis Martius
Pritchardia pacifica Wendl.
Pritchardia sp.

Seeds of all three sowed in 1923; not found subsequently.

Casuarinaceae

Casuarina equisetifolia L.

Seed sowed in 1923; not found subsequently.

Chenopodiaceae

Chenopodium oahuense (Meyen) Aellen
C. sandwicheum Moq. f. *microsperma* Aellen

Snyder (Albatross Expedition, see Fisher 1903a: 807), Caum 58 (BPBM), Christophersen 14 (BPBM), Kridler 2, 5 (UH), Long 2447, 2452, 2454, 2458 (UH).

Since 1923, at least, it has been the most common plant on Necker. Christophersen and Caum list it as being "abundant on the sloping sides, but rare on the flat top." In August 1968 and on other recent visits *Chenopodium* formed an almost pure stand in the saddle between Flagpole and Summit Hills (Fig. 12); it was abundant on the portion east of this region (Fig. 13) but somewhat less common on the tops of the hills than on the sloping sides and the saddle between them. It occurred in small amounts on the top of Flagpole Hill and was rare on both Annexation Hill and Northwest Cape.

Figure 12 Saddle between Summit and Flagpole Hills, August 1968. Note dense growth of Chenopodium. Photograph by Derral Herbst.

Figure 13 Saddle between ~~Bowl~~ and Summit Hills, August 1968. Note Chenopodium and Blue-faced Boobies. Photograph by Derral Herbst.

Aizoaceae

Sesuvium portulacastrum L.

Caum 93 (BPBM), Christophersen 12 (BPBM), Long 2456 (UH).

The Tanager Expedition members found this species growing within reach of the spray on the southern slopes of Annexation Hill. In September 1966 *Sesuvium* was most prevalent along the lower elevations where it would receive spray from the ocean (BSFW). In 1968 Herbst noticed one or two isolated plants on the northeast side of Annexation Hill. The rest of the sparse population was limited primarily to the southern slope near the top of the saddle between Annexation and Flagpole Hills. A similar pattern of distribution was noted by Long in September 1964 (POBSP).

Portulacaceae

Portulaca lutea Sol.

Gilbert (Albatross Expedition, USNM 594972), Caum 59 (BPBM), Christophersen 13 (BPBM), Kridler 4 (UH), Long 2457 (UH).

As in previous reports, *Portulaca* was common on the flat tops and ledges of the cliffs in August 1968. Except for a rare *Chenopodium* shrub, it was the only plant growing on Northwest Cape--in cracks and in shallow pockets of soil (Fig. 14). Some plants on the summit of Flagpole Hill appeared intermediate between *P. lutea* and *P. oleracea*.

Leguminosae

Haematoxylen campechianum L.

Seeds sowed in 1923; not found subsequently.

Sesbania tomentosa H. & A.

Gilbert (USNM 594974), Caum 57 (BPBM), Christophersen 11 (BPBM), Kridler 1 (UH), Long 2449, 2451, 2453, 2460 (UH).

Christophersen and Caum (1931) observed a few plants along the top of the main part of the island. Kramer (*in* Kramer and Beardsley, ms.) concurs and adds that it seemed "to be holding its own quite well" in June 1962. Kridler (BSFW), Long (POBSP) and Herbst (UH) found this shrub on the tops of all of the hills of the main island and Kridler found a few plants on Northwest Cape in March 1967. *Sesbania* is evidently more common now than Christophersen and Caum indicated.

Figure 14 Portulaca lutea Sol growing on the Northwest Cape. Note nesting Red-tailed Tropicbird in the left background. Photograph by Derral Herbst, August 1968.

Euphorbiaceae

Aleurites moluccana L.

Seeds found on the shores of Shark Bay in 1923 (Christophersen and Caum, 1931: 7).

Malvaceae

Thespesia populnea (L.) Sd.

Seeds sowed in 1923; not found subsequently.

Solanaceae

Solanum lycopersicum L.

Seeds sowed in 1923; not found subsequently.

TERRESTRIAL VERTEBRATES

Birds

Twenty-four species of birds have been recorded from Necker Island (Table 2). Of these 24, 15 are species of seabirds that breed at many localities in the central Pacific and two (Christmas Shearwater, Sooty Storm Petrel) are seabirds that breed commonly at other localities in the northwestern Hawaiian Islands but which as yet have not been found breeding on Necker. It seems likely that the absence of breeding Christmas Shearwaters may be largely due to a lack of suitable nesting habitat but the lack of records for the Sooty Storm Petrel may result primarily from the infrequency with which the island has been visited during the species' breeding peak in mid-winter. If the latter species does nest on Necker its population is probably small.

Of the seven remaining species, five are migrant and possibly winter resident shorebirds. Three of these five, Golden Plover, Wandering Tattler and Ruddy Turnstone, probably occur at Necker every year. The two others, the Sanderling and Bristle-thighed Curlew, are regular visitors to most of the other northwestern Hawaiian Islands but probably occur at Necker only sporadically.

The two remaining species are vagrants. One, the Glaucous-winged Gull, wanders fairly frequently to the main and northwestern Hawaiian Islands. The other, the Mockingbird, certainly wandered to Necker from the main Hawaiian Islands where introduced populations are well established on six islands (Berger, 1972: 215).

In addition to the 24 species known from the island, one other species, the Bonin Petrel (*Pterodroma hypoleuca*), was seen flying near Necker in September 1971. There is no evidence that this species

utilizes the island for roosting or nesting. It seems likely that these birds belonged to populations breeding on the northwestern Hawaiian Islands to the west.

Examination of the available data suggests that the breeding cycles of most of the birds of Necker Island are essentially similar to those found on the other Northwestern Hawaiian Islands. Two species, the Laysan and Black-footed Albatross, have clearly defined winter breeding peaks. The Black Noddy, which has a late winter and early spring breeding peak on other northwestern Hawaiian Islands, may have such a peak on Necker but the evidence for this is far from conclusive.

All other species, with the possible exception of the Sooty Tern, have breeding peaks that occur either in spring or summer but several species (e.g., Red-footed Booby, Brown Noddy) have such extended nesting seasons that some birds may be found nesting in every month of the year.

One species, the Sooty Tern, apparently nests earlier on Necker than on most of the other northwestern Hawaiian Islands. It appears to have a clinal series of breeding peaks along the chain with populations laying progressively later as one moves to the westward. On Necker the egg-laying peak apparently usually occurs in the period from January through early March while on Kure at the westernmost end of the chain, the laying peak usually occurs in May (Woodward, 1972: 250).

It is clear that much is yet to be learned about the status, maximum populations and breeding cycles of the birds of Necker Island. More surveys made during the mid-summer and mid-winter months would greatly help to clarify these matters.

Table 2. The avifauna of Necker Island

Taxa	Current Status	Maximum Estimate since 1960 and when recorded
Order Procellariiformes		
Family Diomedeidae		
1. *Diomedea nigripes* Black-footed Albatross	Uncommon breeder	350* Mar. 1969
2. *Diomedea immutabilis* Laysan Albatross	Common breeder	1,650-2,000 Mar. 1965
Family Procellariidae		
3. *Bulweria bulwerii* Bulwer's Petrel	Common breeder	200+ Sept. 1966

Table 2. (continued)

Taxa	Current Status	Maximum Estimate since 1960 and when recorded
4. *Puffinus pacificus* Wedge-tailed Shearwater	Common breeder	4,000-5,000 Sept. 1964
Puffinus nativitatis Christmas Shearwater	Rare visitor (two records)	1 Mar. 1967, 1969
Family Hydrobatidae		
Oceanodroma tristrami Sooty Storm Petrel	Rare visitor (one record)	1 Mar. 1965
Order Pelecaniformes		
Family Phaethontidae		
5. *Phaethon rubricauda* Red-tailed Tropicbird	Common breeder	200 Sept. 1966
Family Sulidae		
6. *Sula dactylatra* Blue-faced Booby	Common breeder	500 Mar. 1969
7. *Sula leucogaster* Brown Booby	Uncommon breeder	50 Sept. 1972
8. *Sula sula* Red-footed Booby	Common breeder	1,400* Mar. 1969
Family Fregatidae		
9. *Fregata minor* Great Frigatebird	Common breeder	2,000 Sept. 1966, 1971
Order Charadriiformes		
Family Charadriidae		
Pluvialis dominica Golden Plover	Uncommon migrant	6 Sept. 1967
Family Scolopacidae		
Numenius tahitiensis Bristle-thighed Curlew	Rare migrant	1 Sept. 1972
Heteroscelus incanus Wandering Tattler	Uncommon migrant	3 Sept. 1966

Table 2. (continued)

Taxa	Current Status	Maximum Estimate since 1960 and when recorded
Arenaria interpres Ruddy Turnstone	Uncommon migrant	50 Mar. 1965
Calidris alba Sanderling	Rare migrant (one record)	0**
Family Laridae		
Larus glaucescens Glaucous-winged Gull	Vagrant (one record)	0**
Sterna lunata Gray-backed Tern	Abundant breeder	7,500* Mar. 1965
Sterna fuscata Sooty Tern	Abundant breeder	50,000 Mar. 1965
Procelsterna cerulea Blue-gray Noddy	Common breeder	2,000-3,000 Mar. 1967
Anous stolidus Brown Noddy	Abundant breeder	50,000 Sept. 1971
Anous tenuirostris Black Noddy	Common breeder	1,000 Mar. 1967
Gygis alba White Tern	Common breeder	600 Mar. 1967
Order Passeriformes Family Mimidae		
Mimus polyglottos Mockingbird	Vagrant (one record)	1 Sept. 1967

*Estimate is of the breeding population only.

†This, one of very few numerical estimates available, almost certainly understates the numbers of birds utilizing the island, as the estimate was made in a month (September) when the species was nearing the end of its breeding cycle. The maximum population inhabiting the island at any one time may well be five to ten times as great.

**A single bird was recorded in June 1923.

Species Accounts

Common names of seabirds follow King (1967) in the following species accounts. Taxonomic order follows that of Peter's (1931, 1934) Checklist of Birds of the World, volumes I and II, with the exception of Procellariformes which follow Alexander *et al.* (1965), the Charadriidae and Scolopacidae which follow Jehl (1968), and the Sulidae which follow the A.O.U. Checklist (1957). The scientific names of two shorebirds, the Wandering Tattler and Sanderling, have been modified following the latest supplement to the checklist (A.O.U., 1973).

The following species accounts are set forth in a standard format from which deviations are made only when warranted by lack of data. The section of the species accounts under Status lists maximum recent populations; delimits periods when birds occur most abundantly on the island, and, if the bird breeds there, briefly indicates the principal nesting habitat. It should be noted, except where otherwise indicated, that the population estimates are of the number of flying birds present on the island during any one visit; dependent non-flying young are not included. The section listed under Populations briefly evaluates recent numerical estimates, comparing them when possible with estimates or statements of abundance made by earlier visitors. In the Observation Tables a question mark indicates that the presence of birds was noted but that no estimates were made.

The section headed Annual Cycle uses all available data in an attempt to determine the regularity (or lack of it) in the breeding regimes of each species and by interpolation to determine periods during which birds breed. Data for Necker are less substantial than for most of the other islands considered in this series of reports and distinct conclusions sometimes could not be drawn. In the section headed Breeding Habitat is given a general summary of both previous and recent observations on nesting habitat. The section headed Banding lists all known bandings by the BSFW and POBSP. If the section is omitted, this indicates that no birds are known to have been banded. Very little banding has been done on Necker as compared with the other northwestern Hawaiian Islands. Only a total of 328 individuals of ten species was banded here by the POBSP and BSFW during the study period. Two interisland movements of banded birds involving Necker are known (see Great Frigatebird and Brown Noddy species accounts). Finally, the section headed Specimens lists the location of 91 specimens of 18 species, of which we are aware, that have been collected on the island. Hopefully this section will be of use to those interested in conducting taxonomic studies and will point out where further collecting might be useful.

BLACK-FOOTED ALBATROSS *Diomedea nigripes*

Status

Uncommon breeder (maximum recent breeding population estimate: 350). Known to be present from late December through late June, but probably present a month earlier and later; absent remainder of year. Nests on the ground on higher slopes of the island.

Populations

Estimates of breeding Black-footed Albatross are among the best obtained for any species for three reasons: the population is small and easily counted, the young are conspicuous, and albatrosses have been of particular interest to personnel visiting the island.

The estimate of June 1923 and most recent March estimates of breeding populations are much smaller than the estimate derived by an aerial survey in December 1957 (Table 3). On northwestern Hawaiian Islands the number of fledging young may be at times considerably less than the number of nests with eggs. This fact and variations in the number of young present on recent March visits make it impossible to be certain whether the 1957 estimate was erroneous, or whether the breeding population was actually larger then than in other years. The size of the albatross nesting population on Midway fluctuates from year to year; there is no reason to believe that the population on Necker does not vary also.

It is clear that the 1966-1967 population was either considerably smaller or considerably less successful than the 1964-1965 or 1968-1969 populations.

Annual Cycle

Too few data on breeding status are available to establish whether the breeding cycle on Necker is different from the cycle on other northwestern Hawaiian Islands. Available observations indicate a span of breeding from at least late December through June or perhaps early July. Young have been recorded from 10 March (1967) through 29 June (1923) but are probably present for at least a month prior to that period and for at least several weeks thereafter.

Breeding Habitat

In June 1923 Wetmore found young on the higher slopes among the Laysan Albatross. In March 1965 and 1969 Kridler noted that most nests were found on the upper slopes of Annexation and Flagpole Hills; no nests were found on Northwest Cape.

Banding

One young albatross was banded by the BSFW in March 1965.

Specimens

We have no record of any specimens of Black-footed Albatross from Necker Island.

Table 3. Observations of Black-footed Albatross on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	least abundant bird	Seen sparingly...(Fisher, 1903a: 777, 790).
1913 19 Mar.	?	Young present (Bailey, 1956: 32). A few nesting (Willett, ms.).
1916 27 Jan.	only a few*	Nesting (Munter, ms.).
11 Feb.	several hundred	Island estimate, with eggs or very young chicks (Munter, ms.).
1923 17-20 June	200**	No adults but *ca.* 100 nearly grown young; a few young had down clinging to head and neck but many lacked any trace of down (Wetmore, ms.).
29 June	200**	Young somewhat more developed (Wetmore, ms.).
1953 20 Dec.	200-300***	Nesting (Richardson, pers. comm.).
1957 28 Dec.	491(736)+	Nesting (Rice and Kenyon, 1962: 377).
1962 11 June	?	A few young seen (Kramer and Beardsley, ms.).
1964 8 Mar.	?	Numerous; *ca.* 130 seen in flight from offshore (POBSP).
25-26 Sept.	0	(POBSP; BSFW).
1965 15 Mar.	375-400 (188-200**)	94 young counted; 100 estimated present (POBSP; BSFW).
1966 10-11 Sept.	0	(BSFW).
1967 10 Mar.	75 (50-60**)	*Ca.* 25-30 1/4- to 1/2-grown young seen (POBSP; BSFW).
1969 22 Mar.	350**	175 young counted. No more than 10 or 15 missed (BSFW).

Table 3. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1971 14 Sept.	0	(BSFW).
1973 20 July	0	(BSFW).

*Only westernmost peak examined.

**Estimate is of number of breeding birds.

***Only about half of island seen during survey.

+Data from aerial observations; figures are count of total birds and an estimate of breeding birds, based on an allowance for 25 percent unoccupied birds (736 was rounded to 740 by Rice and Kenyon, *op. cit.*).

LAYSAN ALBATROSS *Diomedea immutabilis*

Status

Common breeder (maximum recent breeding population estimate: 1,650-2,000). Recorded present and breeding late December to late July, but probably present from October through early August; not present during remainder of year. Nests on ground, principally on summits of hills and along topmost ridge of island.

Populations

Estimates of breeding populations of this species, like estimates for the preceding species, are relatively accurate and show practically the same degree of variation from survey to survey (Table 4).

It seems likely that current breeding populations are considerably smaller than indicated by Rice and Kenyon. However, estimates from May 1902 and June 1923 compare quite favorably with the recent March estimates. Thus we cannot conclude that there has been any real change in population size during the period for which we have data. It seems possible that Rice and Kenyon's count was biased upward by an inadvertent inclusion of Blue-faced or Red-footed Boobies; at present both species occur among the Laysan Albatross (Fig. 15).

Annual Cycle

Data on breeding status are few and poorly detailed but indicate a breeding cycle no different from that found on other northwestern Hawaiian Islands. June 1923, July 1964, and March 1967 and 1969

Figure 15 Young Laysan Albatross among Red-footed Boobies and Great Frigatebirds nesting in Chenopodium. Northwest Cape in the background. BSFW photograph by David B. Marshall, 11 June 1962.

observations reveal that this species has a later breeding cycle than has the Black-footed Albatross, an observation often noted in other areas where both breed.

Breeding has been recorded from late December through late July, and young have been noted from 10 March (1967) through 26 July (1964). Laysan Albatross are probably present from about late October through August as on Laysan.

Breeding Habitat

Observers who recorded nesting areas indicated Laysan Albatross nest primarily on the hilltops of the ridge running along the island. Fisher (1903a: 789) also found young "over the shelves on the side of the north point," which is evidently the area now called Northwest Cape. In March 1967 Hackman similarly noted a few young on rock shelves on cliff sides and slopes.

One observer specifically indicated where young were found. In July 1964 Kridler noted five young on the top of Annexation Hill, 11 on Flagpole Hill, 35 on Bowl Hill, and ten on the ridge extending east of Bowl Hill. In March 1969 he noted that the majority of the young was found on the upper slopes of Summit and Bowl Hills, with a few young in various locations along the ridges of the main part of the island. Less than 30 young were seen on the Northwest Cape.

Banding

BSFW personnel banded 100 young in March 1965.

Specimens

We have records of four specimens of Laysan Albatross from Necker: two males (USNM 300852, 300854) and two females (USNM 300853, 300857) collected by Wetmore 18 June 1923.

Table 4. Observations of Laysan Albatross on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	1,000-2,000	Young present (Fisher, 1903a: 789).
1913 19 Mar.	800*	Large downy young present (Bailey, 1956: 32). (Willett, ms.).
1916 27 Jan.	in large numbers**	Most with eggs, a few with very young chicks (Munter, ms.).
11 Feb.	most numerous bird	Well incubated eggs and very young chicks (Munter, ms.).

Table 4. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1923 17-20, 29 June	1,200	Nearly grown young present; many with much down lost from head and neck and others with downy head and neck only (Wetmore, ms.).
1953 20 Dec.	600-800***	Nesting (Richardson, pers. comm.).
1957 28 Dec.	3,327 (4,990)+	Nesting (Rice and Kenyon, 1962: 377).
1962 11 June	?	Abundant young (Kramer and Beardsley, ms.).
1964 8 Mar.	numerous	From offshore *ca.* 800 seen on land and *ca.* 100 in flight (POBSP).
26 July	140*	*Ca.* 70 young counted (BSFW).
25-26 Sept.	0	(POBSP; BSFW).
1965 15 Mar.	1,650-2,200 (1,100*)	*Ca.* 550 young present (POBSP; BSFW).
1966 10-11 Sept.	0	(BSFW).
1967 10 Mar.	600 (300-400*)	*Ca.* 150-200 half-grown young seen (POBSP; BSFW).
15 Sept.	0	(BSFW).
1969 22 Mar.	1,020-1,050*	Count of 510 young, 10-15 perhaps overlooked (BSFW).
1971 14 Sept.	0	(BSFW).
1973 30 July	?	Count of 40 fully-feathered young (BSFW).

*Estimate is of the number of breeding birds.

**Only westernmost peak examined.

***Only about half of island surveyed.

+Data from aerial observations; figures are a count of total birds and an estimate of breeding birds, based on an allowance for 25 percent unoccupied birds (4,990 was rounded to 5,000 by Rice and Kenyon, *op. cit.*).

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BULWER'S PETREL *Bulweria bulwerii*

Status

Common breeder (maximum recent estimate: 200). Breeds from at least late May through mid-September. Nests in holes in the rocks.

Populations

Too little information is available (Table 5) to adequately determine numbers present. The only numerical estimates probably do not begin to represent maximum numbers, since estimates were not made when birds would have been most abundant. We suspect that 1,000 or more petrels occur on the island but considerably more work is needed even to approximate numbers.

Annual Cycle

The few available observations on breeding status indicate that the species breeds annually. We have no evidence that the cycle differs from that on other northwestern Hawaiian Islands. Eggs are present from at least late May through late July, and young are present from about mid-July through September.

Breeding Habitat

Few notes have been made about nesting sites on Necker. Fisher (1903a: 794) gave the most detailed description: "Here the birds nest in rather deep, bubble-like holes in the rocks, as far from the light as possible....The favorite site...is a hole about 2 feet deep, with a narrow entrance, and wider cavity at the rear....The nest, scarcely worthy of the name, consists of a few old tern feathers gathered rudely around the egg, as if merely to hold it in place. Sometimes there is no trace of a nest, and again I found a few wing bones of a tern, as though these had been used in place of sticks." More recent observers found them nesting under stones and crevices on the sides of cliffs.

Banding

Two adults were banded by the BSFW in September 1964.

Specimens

We have records of nine specimens. Five males (USNM 189409, 189411-189413; SUI 18596) and three females (USNM 189407, 189408, 189410) were collected by Snyder, Fisher, and Nutting on 31 May 1902. One female (USNM 300800) was collected by Wetmore on 18 June 1923.

Table 5. Observations of Bulwer's Petrel on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	considerable numbers	Eggs and pre-laying birds (Fisher, 1903a: 777-794).
1913 19 Mar.	0	(Bailey, 1956: 32).
1923 17-20 June	common	Nesting (Wetmore, ms.).
29 June	abundant	(Wetmore, ms.).
1953 20 Dec.	0*	None seen during diurnal survey (Richardson, pers. comm.).
1962 11 June	?	(Kramer and Beardsley, ms.).
1964 26 July	?	Eggs and young found (BSFW).
25-26 Sept.	75-100	No eggs or young noted (POBSP; BSFW).
1965 15 Mar.	0	(POBSP;BSFW).
1966 10-11 Sept.	200	Two downy young found, one of them almost full grown (BSFW).
1967 10 Mar.	0	(POBSP;BSFW).
15 Sept.	?	One young noted that was nearly fully feathered but retained a small amount of down on the head (BSFW).
1969 22 Mar.	0	None seen although a number of holes were examined (BSFW).
1971 14 Sept.	?	Several young found, all fully feathered except for large patches of down on the breast (BSFW).
1973 30 July	?	Many heard calling deep in burrows (BSFW).

*Only about half of island seen during survey.

WEDGE-TAILED SHEARWATER *Puffinus pacificus*

Status

Common breeder (maximum recent estimate: 4,000-5,000). Present from at least March through October; most breeding occurs from June through October. Most nest in holes or crevices at ground level, but a few dig burrows.

Populations

Since there are few numerical estimates (Table 6), and little banding has been done, it is impossible to state how many birds occur on the island. At least several thousand are present judging from the two maximal estimates. It is entirely possible that 10,000 or more may frequent the island.

Annual Cycle

Data on breeding are scanty but seem to conform to the general pattern found on other northwestern Hawaiian Islands. As on Nihoa, most birds evidently arrive in March but are not abundant until the latter half of the month. Birds probably court and dig burrows, where possible, for about two months before the first eggs are laid. Eggs are laid in June (1923) and are probably present through July (1964). The only observations made later in the breeding season were on three September visits (1964, 1966, 1967) when only downy young, most of them large, were seen. Most fledging presumably takes place in October and November.

Breeding Habits

On Necker these shearwaters nest mostly on or near the surface of the ground. Fisher (1903a: 792) stated that they nested in hollow cavities in the rocks. Kridler recently found them nesting in holes and depressions in rock rubble and along the upper cliff sides. He noted a number nesting under *Chenopodium* on the surface of the ground (particularly on the west slope of Flagpole Hill), and occasionally in burrows beneath the *Chenopodium*.

Banding

In March 1964 POBSP personnel banded 19 adult Wedge-tailed Shearwaters. None was recaptured.

Specimens

We have records of seven specimens of Wedge-tailed Shearwaters from Necker. Three males (USNM 240995, 250996, 240998) and one female (USNM 240997), collected by Willett, and one male (UMMZ 120133) collected by Bailey, were taken on 19 March 1913. A male (USNM 300722) and a female (USNM 300721) were collected by Wetmore on 18 June 1923.

Table 6. Observations of Wedge-tailed Shearwaters on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	?	Nesting but no eggs (Fisher, 1903a: 792).
1913 19 Mar.	abundant	Mating and nest building but no eggs found (Bailey, 1956: 32).
1916 27 Jan.	?	Some seen flying about at dusk (Munter, ms.).
1923 17-20, 29 June	6,000	Eggs present (Wetmore, ms.).
1953 20 Dec.	0*	None seen during diurnal survey (Richardson, pers. comm.).
1962 11 June	?	Kramer and Beardsley, ms.).
1964 8 Mar.	?	Few seen from offshore (POBSP; BSFW).
26 July	very common	Many nests contained eggs (BSFW).
25-26 Sept.	4,000-5,000	An estimated 1,500 downy young present (POBSP; BSFW).
1965 15 Mar.	2,000	No eggs or young found (POBSP; BSFW).
1966 10-11 Sept.	abundant	Only large downy young seen (BSFW).
1967 10 Mar.	10	Estimate represents number of birds seen, not number of birds present. No eggs found (POBSP; BSFW).
15 Sept.	common	*Ca.* 118 downy young counted, most of them large; 8 eggs found (BSFW).
1969 22 Mar.	4,000	Almost all birds observed were in pairs (BSFW).
1971 14 Sept.	very common	All chicks seen were large and downy (BSFW).
1972 15 Sept.	?	(BSFW).
1973 30 July	?	At least 275 nesting adults present (BSFW).

*Only about half of island seen during survey.

CHRISTMAS SHEARWATER *Puffinus nativitatis*

Status

Rare visitor, two March sight records.

Observations

Richardson (1957: 17) suggested that this shearwater breeds on Necker, but the near absence of records by several competent observers at times when breeding should be at its peak indicates that such is not the case. There are only two records, hitherto unpublished. On 10 March 1967 Kridler saw a single individual near the landing area; on 22 March 1969 BSFW personnel observed another.

SOOTY STORM PETREL *Oceanodroma tristrami*

Status

Rare visitor; one March sight record.

Observations

The only record is of an adult found by Kridler on 15 March 1965; it was thought to have been dead about a week.

RED-TAILED TROPICBIRD *Phaethon rubricauda*

Status

Common breeder (maximum recent estimate: 200). Present throughout most of year but probably much less abundant in late fall, winter and early spring. Most breeding probably occurs between early April and early October. Nests primarily in crevices and hollows in the rocks.

Populations

The maximum estimate given above is probably a poor indication of maximal numbers since it was made late in the year when populations should be smaller than during the probable breeding peak. Wetmore's estimate of 1,000 birds made in June 1923 probably better represents maximal numbers, both then and in recent years.

Annual Cycle

Tropicbirds on Necker evidently have an extended nesting season (Table 7) similar to that on other northwestern Hawaiian Islands. The presence of near-fledging young (at least two months old) in late July 1964 indicates that egg laying can occur by mid-April; it is likely that some birds lay even earlier. Eggs are presumably present from then at least through September. Young are present at least from late May through December or January.

Various March observations imply that populations and breeding decrease considerably late in the year and suggest that little breeding occurs until early April.

Breeding Habitat

On Necker these tropicbirds nest principally in rock crevices. Fisher (1903a: 796) noted that tropicbirds "accomodated [themselves] to the rocks and [laid eggs] in any rounded cavity" and Wetmore (ms.) noted that several pairs could be found nesting eight to 20 feet apart under a single over-hanging ledge. Kridler noted that shallow small caves on ledges along the upper portions of Bowl, Summit, and Flagpole Hills were favored as nest sites, as were crevices on the upper western slopes of Northwest Cape.

Banding

The POBSP banded three adults and 18 young in September 1964; none was subsequently recaptured.

Specimens

Two females (USNM 300986, 300987) were collected by Wetmore on 17 June 1923, and are now in the National Museum of Natural History.

Table 7. Observations of Red-tailed Tropicbirds on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	rather common	Nesting, at least some eggs (Fisher, 1903a: 796).
1913 19 Mar.	1	(Bailey, 1956: 32).
1923 17-20 June	1,000	Fresh eggs to recently hatched young (Wetmore, ms.).
1953 20 Dec.	?*	Still unfledged young present (Richardson, 1957: 19).
1962 11 June	?	(Kramer and Beardsley, ms.).
1964 8 Mar.	?	Four seen in flight from offshore (Walker, ms.).
26 July	?	Eggs to nearly full-grown young noted in ten nests found (BSFW).
25-26 Sept.	125	25 nests with near-fledging young counted and a few eggs seen (POBSP; BSFW).

Table 7. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1965 15 Mar.	0	(POBSP; BSFW).
1966 10-11 Sept.	200	72 nests with young, mostly large, and 1 nest with egg counted (BSFW).
1967 10 Mar.	15	Birds in courtship flight; no nests found (POBSP; BSFW).
15 Sept.	?	23 young from small downy chicks to near-fledging young seen, 15 adults seen (BSFW).
1969 22 Mar.	20	No eggs or young found (BSFW).
1971 14 Sept.	?	All young seen were very large (BSFW).
1972 15 Sept.	?	(BSFW).
1973 30 July	95**	Young seen (BSFW).

*Only about half of island seen during survey.

**Estimate is of adults and young.

BLUE-FACED BOOBY *Sula dactylatra*

Status

Common breeder (maximum recent estimate: 500). Present and breeding in all months, but most breeding occurs from February through late September or early October. Nests on the ground on the higher slopes.

Populations

Recent estimates from March and September surveys consistently indicate populations of 200 to 250 birds (Table 8). There are no recent summer estimates for Blue-faced Booby populations on Necker; however, comparisons of March, summer, and fall estimates on other northwestern Hawaiian Islands indicate that summer populations are not much larger than spring or fall populations. Thus we suspect that Necker mid-summer populations seldom exceed 500 to 600 birds. This figure is considerably less than that reported for June 1923 by Wetmore and may indicate that populations were formerly larger.

Annual Cycle

Data on the breeding cycle were primarily obtained during March and September but they afford us some idea of its duration and nature. Egg laying began as early as late November (1964) or early December (1913). Data on breeding status from March visits indicate that much greater numbers of eggs are laid from mid- or late January through March than in the preceding months.

The smallest young present on all recent September visits were probably no less than two or three months old. This suggests that most laying ceases by about mid-June, although eggs are possibly present through early August. This laying span is similar to that found on other northwestern Hawaiian Islands such as Nihoa and Laysan and implies that other features of the breeding season are also similar. If this is true, then we would expect that the hatching peak occurs about May and June and that the fledging peak occurs from about late August to perhaps early October.

The length of the periods during which hatching and fledging occur is considerably longer. Hatching has occurred from early or mid-January (1965) to as late as August. Fledging has probably occurred as early as May and certainly continues through October, with a few chicks possibly fledging in November.

Thus, on Necker, as on other northwestern Hawaiian Islands, the Blue-faced Booby has nested in all months of the year. It is possible, however, that breeding may not occur in all months every year and that there are yearly variations in the breeding cycle which cannot be detected from the available data.

Breeding Habitat

All observers who noted where these birds nested indicated they nested on the higher slopes of the island. Fisher (1903a: 797) stated that the Blue-faced Boobies were "nesting among the bushes on the top of the island, and also out on the bare rocks. They chose often a jutting crag, where they could obtain a good prospect of the surrounding island and sea." On several subsequent visits (June 1923, July 1964, March 1965, 1967, 1969) other observers reported these birds nesting on the higher slopes, the summit of the island, or along the ridge in more bare areas.

On Necker Blue-faced Boobies usually have well-separated nest sites.

Banding

Fifty adults were banded by the BSFW in March 1965.

Specimens

We have records of only two specimens from Necker, both of which are in the USNM. Both are adult females (USNM 300940, 300941) collected by Wetmore on 18 and 19 June 1923.

Table 8. Observations of Blue-faced Boobies on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	rather abundant	The few nests examined had young (Fisher, 1903a: 797).
1913 19 Mar.	common	Eggs to large young (Bailey, 1956: 32).
1916 27 Jan.	small numbers*	No eggs or young (Munter, ms.).
11 Feb.	large numbers**	A very few with eggs; two nearly full grown young (Munter, ms.).
1923 17-20 June	1,000	Young from half to nearly grown (Wetmore, ms.).
1953 20 Dec.	100-150***	(Richardson, pers. comm.).
1962 11 June	present	(Kramer and Beardsley, ms.).
1964 8 Mar.	25	Seen from offshore (POBSP; BSFW).
26 July	?	Eggs to flying young (BSFW).
25-26 Sept.	250	Count of 58 adults, 57 immatures and 60 locals (POBSP; BSFW).
1965 15 Mar.	230	Count of 110 nests; all with eggs except for one with an egg and recently hatched young and one with a large downy young (POBSP; BSFW).
1966 10-11 Sept.	200	Some young still dependent but all of fledging size (BSFW).
1967 10 Mar.	210	All on eggs except for three pairs with recently hatched young (out of a count of 103 nests) (POBSP; BSFW).
15 Sept.	240	Count of 204 adults and 32 flying immatures; 6 downy chicks counted (BSFW).

Table 8. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1969 22 Mar.	500	Count of 230 nests. Sample count of 101 nests: 6% without eggs; 63% with eggs; 16% with an egg and one young, and 15% with young (BSFW).
1971 14 Sept.	200	Estimate includes 40 young (BSFW).
1972 15 Sept.	?	(BSFW).
1973 30 July	190	Estimate includes young (BSFW).

*Only westernmost peak examined.

**Only the eastern part of the island surveyed.

***Only about half of island seen during survey.

BROWN BOOBY *Sula leucogaster*

Status

Uncommon breeder, but poorly known (maximum recent estimate: 50). Present and probably has bred in all months of the year. Nests on ground along the higher elevations of the island or on cliff ledges.

Populations

Recent estimates consistently suggest that 50 or fewer Brown Boobies occur on Necker (Table 9). These estimates are possibly too low since at least some proportion of the population nests in inaccessible and seldom-observed areas on the rock cliffs. Wetmore's estimate (100 birds in June 1923) is considerably larger than recent estimates and may best represent current populations.

Annual Cycle

We have too few data on breeding to accurately delineate the major features of the breeding season. Available data suggest that breeding can occur in all months of the year and that eggs and young have been present in all months, although not necessarily during any one year. The data also suggest that most nesting occurs in spring and summer, as on other northwestern Hawaiian Islands.

Breeding Habitat

Very little information on nesting habitat has been recorded here. Fisher (1903a: 798) merely noted that "The two eggs [were] laid on a level place, where there happens to be a little soil, upon a shelf of the rock." Wetmore and more recent visitors observed them nesting on rock ledges and along the top of the island. Observations from two recent surveys (March 1965 and September 1967) indicate that these boobies nested more commonly on the Northwest Cape than on the main portion of the island.

Specimens

We have found records of three specimens of Brown Boobies from Necker: a female (USNM 189414), collected by Fisher on 31 May 1902, and a male and female (USNM 300858, 300859), collected by Wetmore on 19 and 20 June 1923, respectively.

Table 9. Observations of Brown Boobies on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	not at all abundant	Fresh eggs to large downy young (Fisher, 1903a: 798).
1913 19 Mar.	2	(Willett, ms.).
1923 17-20 June	100	One or two half-grown young seen (Wetmore, ms.).
1953 20 Dec.	0*	(Richardson, pers. comm.).
1962 11 June	present	(Kramer and Beardsley, ms.).
1964 8 Mar.	?	*Ca.* 50 seen from offshore (POBSP; BSFW).
26 July	?	A nest with two eggs found (BSFW).
25-26 Sept.	15	Count of eight adults and three flying immatures. No nests seen (POBSP; BSFW).
1965 15 Mar.	25	Ten nests counted, most with eggs. One nest with a near-fledging chick and one with a small downy young observed (POBSP; BSFW).
1966 10-11 Sept.	?	No young or eggs found (BSFW).

Table 9. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1967 10 Mar.	10	Not breeding (POBSP; BSFW).
15 Sept.	10	Count of six adult and three flying immatures. A large downy young and a nest or nests with eggs seen (BSFW).
1969 22 Mar.	40**	Count of 20 nests, all containing eggs (BSFW).
1971 14 Sept.	10	Four adults and two flying immatures seen (BSFW).
1972 15 Sept.	50	(BSFW).

*Only about half of island seen during survey.

**Estimate is of the number of breeding birds.

RED-FOOTED BOOBY *Sula sula*

Status

Common breeder (maximum recent estimate: 1,400). Present and may breed throughout the year, but most nesting usually occurs from February or March through September or October. Builds bulky nests in the tops of *Chenopodium* bushes.

Populations

The few recent numerical estimates (Table 10) are reasonably consistent except for the differences in the March estimates for 1965 and 1967. The difference in these estimates is partly a result of the difference in the breeding cycle in these two years (see Annual Cycle below).

A single early estimate (2,000 in June 1923) is larger than any recent estimate (1,400 in March 1969) but is not enough so that we can conclude that there has been any change in numbers. Since the largest recent estimate was made relatively early in the breeding season, when all birds might not have returned to the island, we suspect that maximal populations at the present time may be as much as a third or a half again larger (to perhaps as many as 2,000 birds).

Annual Cycle

This species has a very extended breeding season on Necker and, in some years, may nest in all months. Most of the population, however, nests from March (or perhaps February) through about mid-October.

Laying has begun at least as early as early January (1913) and has probably occurred in all subsequent months through September. Since nothing larger than small young was seen on any of four March visits (1913, 1965, 1967, 1969), it is likely that eggs are usually not laid from October through December. Observations from those four March visits also indicate that the timing of the initiation of laying varies from year to year. Initiation of breeding appears to have been earlier in 1965 and 1969 than in 1967 (see also Great Frigatebird account).

In most years most fledging probably occurs from August through October. If the eggs seen in September 1964 and 1967 were viable and produced young, however, fledging could have occurred in December and January.

Breeding Habitat

Various observers agree that most Red-footed Boobies on Necker nest in the tops of *Chenopodium* bushes. A few nests have been found on the stone ruins and in *Sesbania*. Several observers (Fisher, 1903a: 797; BSFW) indicated that this species nests principally on the higher slopes of the island. On various March visits and in September 1966 Kridler noted that most nests were found on the north slopes of the main portion of the island. Red-footed Boobies have not been recorded nesting on Northwest Cape where no *Chenopodium* grows.

Banding

A single adult was banded by the BSFW in March 1965.

Specimens

We know of only three specimens (USNM 300906-08); they were collected 19 June 1923 by Wetmore.

Table 10. Observations of Red-footed Boobies on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	abundant	Eggs and young common (Fisher, 1903a: 797).
1913 19 Mar.	common	New nests to small young (Bailey, 1956: 32).

Table 10. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1916 11 Feb.	quite common*	None found nesting. About 30 immatures seen (Munter, ms.).
1923 17-20 June	2,000	Most nests with 1/3 to 1/2 grown young, a few with eggs, and some recently built nests (Wetmore, ms.).
1953 20 Dec.	200-300**	(Richardson, pers. comm.).
1962 11 June	?	(Kramer and Beardsley, ms.). A photograph by Marshall shows birds on nests and a near-fledging young.
1964 8 Mar.		Few seen from offshore (POBSP).
26 July	?	Eggs to downy young (BSFW).
25-26 Sept.	650	Most nests contained young. 97 nests were counted but contents are known for only 72: 27 (38%) contained eggs; 22 (31%) contained small or medium-sized young, and 23 (32%) contained large young. 64 immatures capable of flight were also counted (POBSP; BSFW).
1965 15 Mar.	1,000***	Count of 412 nests and an estimated 500 present. All contained eggs (POBSP; BSFW).
1966 10-11 Sept.	?	More than 95% of young had fledged. Some dependent immatures and less than ten downy young observed (BSFW).
1967 10 Mar.	350	Mostly pre-breeding birds, three nests of 100 checked had eggs (POBSP; BSFW).
15 Sept.	550	Count of 420 adults and 95 flying immatures. 76 nests counted: 17 (22%) with eggs and 59 (78%) with young. An additional 17 new nests as yet lacking eggs counted (BSFW).
1969 22 Mar.	1,400***	Count of 700 nests with perhaps a few having been overlooked. Of 118 nests inspected, 30% were new, but empty, and 70% contained eggs (BSFW).

Table 10. (Continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1971 14 Sept.	425	47 nests contained chicks, most of them 1/2 grown (BSFW).
1972 15 Sept.	700	(BSFW).
1973 30 July	108	Estimate is of adults and dependent young (BSFW).

*Only the eastern part of the island explored.

**Only about half of island seen during survey.

***Estimate is of the number of breeding birds present.

GREAT FRIGATEBIRD *Fregata minor*

Status

Common breeder (maximum recent estimate: 2,000). Present throughout the year but less abundant in winter. Breeding birds present in all months but primary nesting period is from March through October or November. Builds bulky nests in *Chenopodium* bushes, primarily at higher elevations.

Populations

Recent estimates consistently indicate populations in the low thousands (Table 11). The single December estimate suggests that populations may decrease by as much as three-quarters when breeding is mostly completed. The remarkable similarity in the nest counts of March 1965 and 1969 (832 vs. 850) suggests a similar correspondence in the breeding cycles these years. The distinct difference between the 1965, 1969 March estimates and the 1967 March estimate parallels the difference in Red-footed Booby estimates for those months and probably has the same cause, an earlier initiation of breeding in 1965 and 1969 than in 1967.

The single early numerical estimate (600 in June 1923) is lower than most recent estimates, enough so that it seems likely that either the size of the population has increased or possibly that 1923 was a particularly unfavorable year for breeding.

Annual Cycle

Populations breed on an annual basis but exhibit an extended breeding season in which nesting probably occurs in all months. The near absence of observations from winter months limits our analysis of the nesting season but observations from March and September indicate that only a very small proportion of the nesting population has unfledged young in January and February and that no eggs are present from September through about February.

A few eggs may be laid in late February but most egg laying occurs in March and April. The presence of eggs in late July (1964) implies that egg laying continues from March at least through May. Hatching occurs primarily in May or June but may occur as late as early August.

The first young probably fledge in early or mid-September but may remain dependent on the adults for at least several more months. Most young fledge from about late October through November but Richardson's observations indicate that some young may not have fledged by January or even February. The immatures seen by Kridler in July 1964 were young from the preceding nesting seasons.

Breeding Habitat

On Necker Great Frigatebirds nest in the same areas and habitat as do Red-footed Boobies. Most build bulky nests about a foot to a foot and a half above the ground in dense *Chenopodium* bushes and in almost every *Sesbania* bush found along the ridges and higher slopes. Fisher (1903a: 799) reported that "A few had nests on the rocks, generally on jutting crags." On recent March visits frigatebirds were found nesting all over the north slopes of Summit and Flagpole Hills among the Red-footed Boobies and other nests were found scattered over the ridges and tops of the other parts of the main island. In March 1965 Kridler noted that the majority nested on the north slopes of Summit Hill but that none nested on the Northwest Cape.

Banding and Movements

No frigatebirds have been banded on Necker. However, on 10 and 11 September 1966 Kridler saw an immature bird with an orange streamer on its left leg. Orange plastic leg streamers were placed on frigatebirds by the POBSP only on Sand Island, Johnston Atoll, about 560 nautical miles to the south-southwest.

Specimens

We found records of three Great Frigatebird specimens from Necker. An immature male (USNM 189416) was collected 31 May 1902 by Fisher and Snyder, and a male and a female (USNM 465205, 300971) were collected 18 June 1923 by Wetmore.

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Table 11. Observations of Great Frigatebirds on Necker Island

Date of Survey		Population Estimate	Breeding Status, Remarks and References
1891	28 May	?	Seen offshore (Munro, 1941b: 51).
1902	31 May	large numbers	Nesting, displaying males seen (Fisher, 1903a: 777, 799).
1913	19 Mar.	several small colonies	Eggs present (Bailey, 1956: 32).
1916	27 Jan.	?*	No nests found. Only seen roosting (Munter, ms.).
	11 Feb.	very numerous**	None found nesting. Females apparently more common than males (Munter, ms.).
1923	17-20 June	600***	Eggs to one-third grown young (Wetmore, ms.).
1953	20 Dec.	400-600+	All young flying except for two half-grown young (Richardson, 1957: 23; and pers. comm.).
1962	11 June	present	Nesting (Kramer and Beardsley, 1962).
1964	8 Mar.	?	Males with inflated throat pouches seen from offshore. *Ca.* 2,000 seen on land and *ca.* 1,500 in flight (POBSP).
	26 July	*Ca.* 500**	Eggs to half-grown young. Many immatures seen flying (BSFW).
	25-26 Sept.	1,500-1,800	Eight small downy nestlings; 85 large young and 375 immatures counted. Observations indicate a *ca.* 50% nest failure (POBSP; BSFW).
1965	15 Mar.	2,000	832 nests counted and an estimated 850 present (POBSP; BSFW).
1966	10-11 Sept.	2,000	*Ca.* 200 dependent young still on nests, a few of which were downy young (BSFW).
1967	10 Mar.	500	Most birds building or with recently completed nests. Thirty-seven of 100 active nests with eggs. An estimated 200 nests present (POBSP; BSFW).

Table 11. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1967 15 Sept.	1,200	Many half- to nearly full-grown young (BSFW).
1969 22 Mar.	1,900-2,000	Count of 850 nests. Of 112 nests whose contents were checked, 42% were new but empty; 56% contained one egg and 2% contained two eggs. One almost full-grown young with a trace of down on the head and more than two hundred flying immatures also seen (BSFW).
1971 14 Sept.	2,000	A minimum of 478 nests present containing two-thirds to almost full-grown young (BSFW).
1972 15 Sept.	835	Estimate believed to be low. Most birds seen were adults and flying immatures (BSFW).
1973 30 July	374	Partial count of chicks and adults (BSFW).

*Only westernmost peak examined.

**Only the eastern part of the island visited.

***Estimate is of the number of breeding birds.

+Only about half of island seen during survey.

GOLDEN PLOVER *Pluvialis dominica*

Status

Uncommon migrant (maximum recent estimate: 6). Recorded in March, June, and September.

Observations

All observations are listed in Table 12.

Specimens

The only specimen (USNM 301057) is a female collected 20 June 1923 by Wetmore.

Table 12. Observations of Golden Plovers on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	0	(Fisher, 1903a).
1913 19 Mar.	0	(Bailey, 1956: 32).
1923 17-20 June	?	One female collected on 20 June (Wetmore, ms.).
1953 20 Dec.	0*	(Richardson, pers. comm.).
1964 26 July	?	(BSFW).
25-26 Sept.	3	(POBSP; BSFW).
1965 15 Mar.	0	(POBSP; BSFW).
1966 10-11 Sept.	4	(BSFW).
1967 10 Mar.	2	(POBSP; BSFW).
15 Sept.	6	(BSFW).
1969 22 Mar.	0	(BSFW).
1971 14 Sept.	0	(BSFW).
1972 15 Sept.	0	(BSFW).
1973 30 July	0	(BSFW).

*Only about half of island seen during survey.

BRISTLE-THIGHED CURLEW *Numenius tahitiensis*

Status

Rare migrant (maximum recent estimate: 1). Recorded in September.

Observations

A single bird seen near the east end by Kridler on 15 September 1972 constitutes the only record for Necker Island. The species is of regular occurrence on the other Northwestern Hawaiian Islands.

WANDERING TATTLER *Heteroscelus incanus*

Status

Uncommon migrant (maximum recent estimate: 3). Recorded in March, May, June, and September.

Observations

All observations are listed in Table 13.

Specimens

The only specimen (USNM 301028) is a male collected 19 June 1923 by Wetmore.

Table 13. Observations of Wandering Tattlers on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	?	(Fisher, 1903a: 778).
1913 19 Mar.	0	(Bailey, 1956: 32).
1923 17-20 June	1-2	Seen daily; a male collected 19 June (Wetmore, ms.).
1953 20 Dec.	0*	(Richardson, pers. comm.).
1964 26 July	?	(BSFW).
25-26 Sept.	1	(POBSP; BSFW).
1965 15 Mar.	0	(POBSP; BSFW).
1966 10-11 Sept.	3	(BSFW).
1967 10 Mar.	1	(POBSP; BSFW).
15 Sept.	0	(BSFW).
1969 22 Mar.	0	(BSFW).
1971 14 Sept.	0	(BSFW).
1972 15 Sept.	0	(BSFW).
1973 30 July	0	(BSFW).

*Only about half of island seen during survey.

RUDDY TURNSTONE *Arenaria interpres*

Status

Uncommon migrant (maximum recent estimate: 50). Recorded in March, May to July, September, and December.

Observations

Although never occurring in large numbers, turnstones are the most abundant and most frequently seen shorebird that visits Necker (Table 14).

Specimens

The only specimen (USNM 393503) is a male collected 20 June 1923 by Wetmore.

Table 14. Observations of Ruddy Turnstones on Necker Island

Date of Survey	Population Estimate	Observations, Remarks and References
1902 31 May	a few	(Fisher, 1903a: 803).
1913 19 Mar.	1-2	(Willett, ms.).
1916 11 Feb.	fairly common*	Scattered about island (Munter, ms.).
1923 17-20 June	20	A male collected 20 June (Wetmore, ms.).
1953 20 Dec.	20-30**	(Richardson, pers. comm.).
1964 26 July	several	Seen at the top of the easternmost peak (BSFW).
25-26 Sept.	23*	(POBSP; BSFW).
1965 15 Mar.	50	30 seen in one flock (POBSP; BSFW).
1966 10-11 Sept.	11*	(BSFW).
1967 10 Mar.	22	One flock of 12 seen flying over Shark Bay. Solitary birds observed along the ridge (POBSP; BSFW).
15 Sept.	37***	A flock of 30 seen. Another flock of seven seen on Northwest Cape (BSFW).
1969 22 Mar.	2	(BSFW).

Table 14. (continued)

Date of Survey	Population Estimate	Observations, Remarks and References
1971 14 Sept.	<10	(BSFW).
1972 15 Sept.	2	(BSFW).
1973 30 July	30	Seen in one flock (BSFW).

*Only eastern part of the island explored.

**Only about half of island seen during survey.

***Count.

SANDERLING *Calidris alba*

Status

Rare migrant; one June sight record.

Observations

Wetmore (ms.) noted that one was reported by Grant on 19 June 1923. This record, hitherto unpublished, constitutes the only known occurrence of the Sanderling on Necker Island.

GLAUCOUS-WINGED GULL *Larus glaucescens*

Status

Vagrant; a single June specimen record.

Observations and Specimens

A dead immature, found on the beach 18 June 1923, and subsequently collected by Wetmore (USNM 489329), was reported by Clapp and Woodward (1968: 27).

GRAY-BACKED TERN *Sterna lunata*

Status

Abundant breeder (maximum recent estimate: 7,500). Present from at least February through September or October, probably absent or

occurring only as a visitor during the rest of the year. Breeds from at least March (and occasionally February) through September or October. Nests on the ground, on rock cliffs, or open slopes.

Populations

No recent numerical estimates (Table 15) are available for months when the population is presumably near its peak (April-June). The largest recent numerical estimate (March 1965) was very similar to that obtained in June 1923 suggesting that present populations are as large if not larger than in 1923. Since few birds were seen in September (1964, 1966, 1967) and December (1953), it seems likely that the entire population departs the island after breeding.

Annual Cycle

No observations are available that indicate when birds first arrive at the island but data from March surveys indicate that egg laying usually begins in March but may occasionally occur in February (1916, 1967?). Some egg laying occurs during succeeding months through about July but the peak laying period occurs from about late March through mid-May. Hatching young are present from about early April through about late August and young fledge from about early or mid-June through late September.

Breeding Habitat

Gray-backed Terns nest primarily on ledges on the cliffs and upper slopes of the island. Fisher (1903a: 781) found them nesting "in shallow cavities and hollows of the rock on more exposed portions of the island, and only very sparingly on the broad shelves with *Sterna fuliginosa* [=*fuscata*]." Wetmore (ms.) stated "they were nesting on ledges of cliffs and open slopes of the island." More recently, observers have found them nesting commonly on broad rock shelves, particularly on the Shark Bay side of Northwest Cape. Others nested on the inaccessible cliffs and on the various slopes of the main island as well as the upper portion of Northwest Cape. On Necker, the Gray-backed Terns seem to favor more elevated areas for nesting to a greater degree than does their congener, the Sooty Tern.

Specimens

Wetmore is apparently the only visitor who collected Gray-backed Terns on Necker Island. On 18 and 20 June 1923 he collected five specimens, three males (USNM 300630, 300631, 300645) and two females (USNM 300632, 300646). Two of these (USNM 300645, 300646) were young birds.

Table 15. Observations of Gray-backed Terns on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	many observed	Nesting (Fisher, 1903a: 781).
1913 19 Mar.	common	Eggs (Bailey, 1956: 32).
1916 11 Feb.	not very numerous*	Only eggs found (Munter, ms.).
1923 17-20 June	8,000	From eggs to near fledging young (Wetmore, ms.).
1953 20 Dec.	2**	Not breeding (Richardson, pers. comm.).
1962 11 June	present	(Kramer and Beardsley, ms.).
1964 8 Mar.	?	*Ca.* 200 seen in flight from offshore (POBSP; BSFW).
26 July	at least several thousand	Many near-fledging young present (BSFW).
25-26 Sept.	3	Not breeding; 2 immatures still present (POBSP; BSFW).
1965 15 Mar.	7,500***	Eggs (POBSP; BSFW).
1966 10-11 Sept.	?	Few adults seen. Over 25 flightless but nearly full-grown young observed. Several 2/3-grown young seen (BSFW).
1967 10 Mar.	500	Fresh to lightly incubated eggs (POBSP; BSFW).
15 Sept.	20	17 adults counted. Three large near-fledging young seen (BSFW).
1969 22 Mar.	1,300	About 25% on eggs (BSFW).
1971 14 Sept.	?	No adults seen. A number of large young, some fledged, present (BSFW).
1972 15 Sept.	?	(BSFW).
1973 30 July	370***	160 chicks of varying sizes seen and about 25 birds were on eggs. Estimate probably too low (BSFW).

Table 15. (continued)

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*Only eastern part of the island explored.

**Only about half of island seen during brief survey.

***Estimate is of the breeding population.

SOOTY TERN *Sterna fuscata*

Status

Abundant breeder (maximum recent estimate: 50,000). Present from about December or January through about late September; probably absent during remainder of year. Has bred from early December through September but most breeding probably occurs from February through August. Nests on the ground in bare areas on slopes and cliff ledges or under dense *Chenopodium* bushes.

Populations

Recent estimates (Table 16) indicate that the Sooty Tern is the most abundant breeder on Necker. As with the Gray-backed Tern, the smaller September and December estimates indicate this species is absent from the island during the non-breeding season.

Annual Cycle

Sooty Terns breed annually on Necker Island, but their nesting season is significant in that here it apparently regularly begins earlier than on almost any of the other northwestern Hawaiian Islands. The March 1913 observations indicate that laying must have occurred at least as early as mid-February while the presence of near-fledging young on two recent March visits (1965, 1967) indicates some laying began at least by early December (1964) or early January (1965). The beginning of laying may vary considerably from year to year. The size of the young reported by Fisher suggests that laying did not begin until about late April in 1902.

Laying continues from January or February through June (1923) and in some years (1966) possibly occurs into early July. Hatching has occurred from about mid-January to early February through about late July or early August and fledging young have occurred from early March through about mid-September. The small numbers of fledged and near-fledging young seen on September visits, however, suggest that most fledging was completed at least a month earlier.

Breeding Habitat

Sooty Terns have been recorded nesting in many different areas of the island (Fig. 16). Fisher (1903a: 780) reported that these terns laid "their eggs on the shelves of rocks where there [were] some soil and matted succulent portulacas....A few eggs...were laid in cavities in the face of the rock...many eggs were laid out on the bare rock in the full glare of the sun...a few perilously near high-water mark, in fact wet with spray." On recent visits colonies were found all over the island. Birds nested on bare rocks on Northwest Cape and the main part of the island and under *Chenopodium* from above the cliffs to the tops of the ridges. In September 1966, when the breeding season was nearly over, a few young were found on the west slope of Flagpole and Summit Hills and on the north slope of Annexation Hill.

Specimens

We have found records of six specimens collected on Necker Island: Fisher collected a juvenile male (USNM 189430) on 31 May 1902 and Wetmore collected three males (USNM 300541, 300545, 300547) and few females (USNM 300542, 300546) on 18 and 20 June 1923. Two of these birds (USNM 300546-547) are juveniles.

Table 16. Observations of Sooty Terns on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	most abundant bird	Heavily incubated eggs and recently hatched young, some chicks 7-10 days old (Fisher, 1903a: 780).
1913 19 Mar.	thousands	Eggs and small young (Bailey, 1956: 32).
1916 11 Feb.	very abundant*	Fresh eggs to near-fledging young (Munter, ms.).
1923 17-20 June	30,000	Fresh eggs to grown young; fledged young present on 29 June (Wetmore, ms.).
1953 20 Dec.	1**	Not breeding (Richardson, pers. comm.).
1962 11 June	most abundant bird	(Kramer and Beardsley, ms.).
1964 8 Mar.	?	Hundreds seen from offshore (POBSP; BSFW).
26 July	?	Many young chicks seen (BSFW).

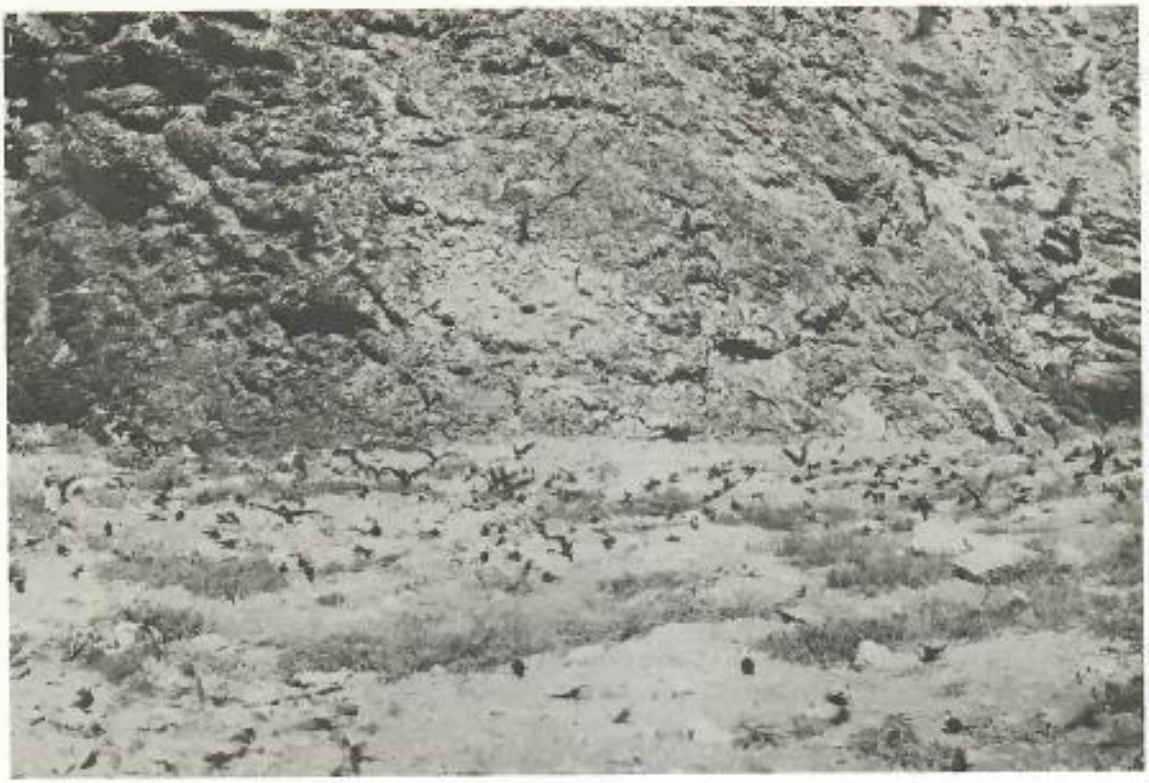

Figure 16 Sooty Tern nesting area in the saddle between Flagpole and Annexation Hills. Looking toward Annexation Hill. Photograph by Derral Herbst, 28 August 1968.

Table 16. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1964 25-26 Sept.	4	Not breeding. Four birds flew over island in the evening (POBSP; BSFW).
1965 15 Mar.	50,000	80% with eggs, 20% with chicks overall; about 50% with young on the Northwest Cape and 15-20% with young elsewhere; *Ca.* three near-fledging young seen (POBSP; BSFW).
1966 10-11 Sept.	300	Present by day, more present at night. A few unfledged chicks observed (BSFW).
1967 10 Mar.	15,000	All stages from eggs to fledged young (POBSP; BSFW).
15 Sept.	100	*Ca.* 100 adults flying about with a few immatures among them (BSFW).
1969 22 Mar.	16,600	About 75% on eggs which appeared to have been newly laid. No young noted (BSFW).
1971 14 Sept.	<100	Less than five adults seen. All others seen were immatures (BSFW).
1972 15 Sept.	?	(BSFW).
1973 30 July	several thousand	190 fully feathered young still present (BSFW).

*Only eastern part of island explored.

**Only about half of island seen during brief survey.

BLUE-GRAY NODDY *Procelsterna cerulea*

Status

Common breeder (maximum recent estimate: 2,000 to 3,000). Present and breeding throughout the year but periods of peak breeding either non-existent or not yet established. Nests primarily in holes in cliffs and rocks.

Populations

Estimates (Table 17) are too few and too variable to draw any valid conclusions about changes in numbers from season to season or even to be certain about maximal numbers present. All that may be safely concluded is that the species is a common resident and that populations fluctuate considerably.

Annual Cycle

Various observations on breeding status are only complete enough to indicate that Necker Blue-gray Noddies have a very extended breeding season. Eggs were found during four of the months that the island has been surveyed (March, May, July, and September) and possibly in a fifth (December, 1953). Wetmore found only fledged young in June, suggesting that the breeding season had been completed but some recent September observations (1964, 1967) show that birds may be found breeding much later in the year.

Breeding Habitat

All observers reported or suggested that these birds nest over much of the island, and, in particular, on the steeper slopes and cliffs. Fisher (1903a: 781) reported that "The single egg is laid in a shallow bowl-like cavity or recess in the rock with no nest, but occasionally a few stray quills and rubbish scattered about." More recent observers frequently noted that they nested in holes in the cliffs; on at least two occasions (September 1966 and 1967) these noddies were considered more abundant on Northwest Cape than on the main part of the island.

Banding

Six adults were banded by the BSFW: three adults and a local in September 1964 and two adults in March 1965.

Specimens

Blue-gray Noddies were originally described from Necker Island as a new species (*Procelsterna saxatilis*) by Fisher (1903b). The species was since reduced to synonymy with *P. cerulea* but retained subspecific identity as *P. c. saxatilis*. Consequently, since Necker is the type locality, a large series of specimens has been collected by many observers.

In all, we have been able to find records of 35 specimens, most of them (29) now located in the National Museum of Natural History (USNM). Four specimens, the type, an adult male (USNM 188651), and three cotypes, an adult female, an immature female, and a juvenile male (USNM 188652-654), were collected by Fisher on 31 May 1902.

Four females and two males were subsequently collected by Bailey and Willett on 19 March 1913. Two of these, a male and a female, are located in the University of Michigan Museum of Zoology (UMMZ 121850-851) and the rest are located in the USNM (USNM 239016, 239996, 240015, 240017).

The largest series, consisting of eight males and 14 females, was collected by Wetmore on 19 June 1923. Twenty-one of these specimens (USNM 300363-367, 300369-382, 300448, 300449) are now located in the USNM but one (USNM 300362) was subsequently exchanged with the Paris Museum of Natural History.

Three additional specimens (BPBM 4853-4855) are located in the B.P. Bishop Museum, Honolulu, but we do not know when or by whom they were collected.

Table 17. Observations of Blue-gray Noddies on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	fairly common	Eggs, all heavily incubated; downy young including one recently hatched, and juveniles (Fisher, 1903a: 777, 781-782).
1913 19 Mar.	common on cliffs	Only one egg found (Bailey, 1956: 32).
1916 27 Jan.	a few*	(Munter, ms.).
11 Feb.	quite common**	Only eggs found (Munter, ms.).
1923 17-20 June	800	Apparently all young fledged (Wetmore, ms.).
1953 30 Dec.	4-8***	Apparently beginning to lay (Richardson, 1957: 25; and pers. comm.).
1962 11 June	?	(Kramer and Beardsley, ms.).
1964 8 Mar.	?	Hundreds seen from offshore (POBSP; BSFW).
26 July	200	Some nests with eggs found (BSFW).
25-26 Sept.	450-500	From eggs to immatures present (POBSP; BSFW).
1965 15 Mar.	100+	One nest with a fresh egg found (POBSP; BSFW).

Table 17. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1966 10-11 Sept.	?	No eggs or young found (BSFW).
1967 10 Mar.	2,000-3,000	Mostly eggs and small downy chicks; one chick about a week from fledging seen (POBSP; BSFW).
15 Sept.	>254	254 counted. Population stated to be probably larger than this figure. One bird found incubating an egg (BSFW).
1969 22 Mar.	750	375 counted. Estimated based on other available but inaccessible nesting habitat. In most nests birds were incubating eggs (BSFW).
1971 14 Sept.	<50	No nests found (BSFW).
1973 30 July	40	(BSFW).

*Only westernmost peak of island examined.

**Only eastern part of island explored.

***Only about half of island seen during brief survey.

+Kridler considers that this estimate was low in view of observations made on subsequent visits.

BROWN NODDY *Anous stolidus*

Status

Abundant breeder (maximum recent estimate: 50,000). Probably present throughout the year but evidently much less common from about late December through at least late March. Breeding may occur in all months but in most years it apparently occurs principally between April or May and October or November. Nests on ground on open slopes.

Populations

Recent numerical estimates (Table 18) are usually somewhat larger than the estimate made by Wetmore in 1923, but not enough so that we

conclude that there has been any change in the size of the population. The very low numbers seen in December 1953 and on recent March visits indicate great variation in the numbers of birds present at different times of year.

Annual Cycle

Observations from three recent March visits (1965, 1967, 1969) indicate that few birds had returned to the island or begun to breed by early and mid-March, but observations from December 1953 and January and February 1916 indicate that breeding began earlier than March. Observations from July 1964 show that laying began by at least mid-May and suggest an egg peak in late June. The September 1964 observations and those from September 1966 indicate laying occurred into August or September and suggest a fledging peak about late September or early October. On the other hand, observations from September 1967 indicate that a larger proportion of the breeding population laid eggs in August and September that year than in 1964 and 1966. If, as the data suggest, there was a late August-early September laying peak in 1967, a fledging peak probably occurred in October and November.

The data available indicate that breeding can occur in *all* months but also suggest that the number breeding in some periods (December through March) is considerably reduced. On Necker this species evidently nests later in the year in larger numbers than on islands toward the northwestern end of the Hawaiian Chain (*e.g.*, Laysan and Lisianski Islands).

Breeding Habitat

Brown Noddies were found nesting in most areas on Necker but seemed to prefer open slopes. On three occasions (July 1964, September 1964 and 1966) Kridler noted that Brown Noddies nested in greatest abundance on Northwest Cape. Conversely, in September 1967 more than twice as many nests were seen on the main part of the island as on Northwest Cape.

No observer reported this species nesting in bushes and only Fisher (1903a: 783) described the nest. He reported that "the nest was smaller than on Laysan, the material being restricted from necessity to the fleshy stems of *Portulaca lutea*, which grows abundantly on the shelves of the rocks."

Banding

The POBSP banded 97 Brown Noddy chicks in September 1964. One of these (USFW band number 793-29149) banded 25 September 1964, not 24 September 1965 as reported by Amerson (1971: 381), was recaptured as an adult at Trig Island, French Frigate Shoals, on 8 June 1967 by POBSP personnel.

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Specimens

We know of two specimens from Necker, both adult females, collected by Wetmore on 18 and 19 June 1923 (USNM 300520, 300501).

Table 18. Observations of Brown Noddies on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	fairly common	Nests and eggs (Fisher, 1903a: 783).
1913 19 Mar.	fairly common	Nesting (Bailey, 1956: 32; Willett, ms.).
1916 27 Jan.	very numerous*	Only eggs present (Munter, ms.).
11 Feb.	quite common**	Only eggs found (Munter, ms.).
1923 17-20 June	6,000	Eggs found (Wetmore, ms.).
1953 20 Dec.	100-150***	A definite breeding season beginning (Richardson, 1957: 26; and pers. comm.).
1962 11 June	present	(Kramer and Beardsley, ms.).
1964 8 Mar.	?	*Ca.* 10-25 seen from offshore (POBSP; BSFW).
26 July	>20,000	At least 10,000 nests on the Northwest Cape. Most contained eggs but chicks in all stages of growth seen (BSFW).
25-26 Sept.	8,000-10,000	Eggs to flying young. An estimated 3,000 chicks present (POBSP; BSFW).
1965 15 Mar.	*Ca.* 25	Only three birds actually seen. No evidence of breeding noted (POBSP; BSFW).
1966 10-11 Sept.	10,000	From eggs to fledged chicks. Only about one percent of breeding birds with eggs. An estimated 4,000+ young present. Chicks in all stages of growth seen but most 1/3 to 1/2 grown. Very few had fledged (BSFW).
1967 10 Mar.	0	None seen (POBSP; BSFW).

Table 18. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1967 15 Sept.	9,100	*Ca.* 2,200 nests with eggs; 950 with downy chicks counted and/or estimated. Notes state that these figures are less than actual totals present (BSFW).
1969 22 Mar.	25	No nests found (BSFW).
1971 14 Sept.	50,000	Most abundant bird on island. Nests contained eggs to full grown young (BSFW).
1973 30 July	11,000	Eggs and an estimated 800 young present Estimate possibly low (BSFW).

*Only westernmost peak examined.

**Only eastern part of the island explored.

***Only about half of island seen during survey.

BLACK NODDY *Anous tenuirostris*

Status

Common breeder (maximum recent estimate: 1,000). Present and has bred in all months, but probably does not breed in all months every year.

Populations

Recent estimates (Table 19) consistently indicate that only small numbers of Black Noddies occur on Necker. Maximal populations are evidently on the order of 1,000 birds but considerably fewer birds were recorded on visits when no active nests were found. The largest recent estimates are about three to five times as large as the single early estimate (June 1923) but we cannot be certain whether there has been any real increase in numbers.

Annual Cycle

Available data on breeding status indicate that breeding has occurred in all months but not necessarily in all months every year. No well-defined pattern of annual breeding can be deduced from the data.

Eggs have been laid in November or December (1953), January (1967), February (1965, probably 1967), June or July (1964), and August or September (1964). However, data from two of three September surveys suggest that breeding was largely completed by then. Clearly, more detailed data on breeding status are needed from many months to determine breeding peaks and the breeding schedule.

Breeding Habitat

Wetmore (ms.) noted that Black Noddies nested in clefts in the rocks in June 1923. Recent observers have found these birds nesting most commonly in small holes in the cliffs on Northwest Cape with smaller numbers nesting on steep, inaccessible slopes of the main part of the island. Others probably nest in the steep cliffs of the north side of the island.

Specimens

Apparently only three specimens have been collected. Wetmore collected two adult males (USNM 300446, 300459) on 19 June 1923 and an adult female (USNM 300460) on 20 June 1923.

Table 19. Observations of Black Noddies on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1902 31 May	?	No nests found (Fisher, 1903: 784).
1913 19 Mar.	fairly common	(Bailey, 1956: 32).
1923 17-20 June	200	Nesting (Wetmore, ms.).
1953 20 Dec.	400-500*	Eggs and young present (Richardson, 1957: 26; and pers. comm.).
1964 8 Mar.	?	*Ca.* 25-50 seen from offshore (POBSP; BSFW).
26 July	600**	*Ca.* 300 nests found; all contained eggs (BSFW).
25-26 Sept.	300-400	Eggs to flying young in seven nests found on the Northwest Cape (POBSP; BSFW).
1965 15 Mar.	250-300	Six of ten nests checked on Northwest Cape contained eggs, one a small downy chick (POBSP; BSFW).

Table 19. (continued)

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1966 10-11 Sept.	20	No eggs or young noted (BSFW).
1967 10 Mar.	1,000	Some nests with eggs and at least one half-grown nestling seen on Northwest Cape (POBSP; BSFW).
15 Sept.	150	Seen in one flock at the end of the Northwest Cape. No active nests found (BSFW).
1969 22 Mar.	500	About 80% of birds present on eggs (BSFW).
1971 14 Sept.	not too common	No nesting noted (BSFW).

*Only about half of island seen during brief survey.

**Estimate is only for the number of breeding birds present.

WHITE TERN *Gygis alba*

Status

Common breeder (maximum recent estimate: 600). Present and breeding throughout the year. Lays single egg in holes in rocks or on rock ledges, particularly on the steeper cliffs.

Populations

Numerical estimates (Table 20) indicate neither seasonal change in numbers nor that numbers have changed since 1923. This apparent lack of seasonal variation is quite different from that observed on other northwestern Hawaiian Islands such as Laysan and Lisianski. However, estimates may be less accurate than those obtained on Laysan and Lisianski, because Necker has much nesting habitat that is inaccessible and which is observed with difficulty, if at all. Few numerical estimates have been made in mid-summer or winter; it is possible that there are seasonal differences in size of populations which are not revealed by the available data.

Annual Cycle

Our data indicate that breeding may occur throughout the year and that eggs and young may be found in all months. Since proportions

of nests containing eggs and various sizes of young were almost never recorded, we cannot determine whether there is a regular, seasonal breeding peak. Data from the only survey where such information was recorded (September 1966) suggest a late summer breeding peak.

Breeding Habitat

All observers who mentioned nest sites agree that White Terns nested principally on the steep rocky cliffs of the island. Some have also been found nesting along the higher ridges (March 1967). On at least two surveys (March 1965, September 1966), this species was thought to be more abundant on the Northwest Cape than on the main part of the island.

Banding

In September 1964 the BSFW banded 31 White Terns (nine adults, two immatures, and 20 locals).

Specimens

Three specimens, all collected by Wetmore, are in the USNM. One (USNM 300390) is a juvenile female; the other two (USNM 300408, 300419) are adult males.

Table 20. Observations of White Terns on Necker Island

Date of Survey	Population Estimate	Breeding Status, Remarks and References
1891 28 May	?	Seen offshore (Munro, 1941a: 2).
1902 31 May	one of the commonest terns	Eggs, a hatching young, and many small nestlings (Fisher, 1903a: 785).
1913 19 Mar.	abundant	Nesting (Bailey, 1956: 32).
1916 27 Jan.	a few*	(Munter, ms.).
11 Feb.	a few**	None found nesting (Munter, ms.).
1923 17-20 June	800	Eggs and young present (Wetmore, ms.).
1953 20 Dec.	300-400***	Eggs and few newly fledged young seen (Richardson, 1957: 27; and pers. comm.).
1962 11 June	present	(Kramer and Beardsley, ms.).
1964 8 Mar.	?	Hundreds seen from offshore (POBSP; BSFW).

Table 20. (continued)

Date of Survey		Population Estimate	Breeding Status, Remarks and References
1964	25 July	500-600	Eggs to nearly fledged young. An estimate of at least 50 nests in the vicinity of the top of Bow Hill (BSFW).
	25-26 Sept.	400-500	Eggs to immatures (POBSP; BSFW).
1965	15 Mar.	200	Nests with eggs found (POBSP; BSFW).
1966	10-11 Sept.	500-600	Eggs to fledged young seen. 75-80% of nests contained young (BSFW).
1967	10 Mar.	600	Eggs and small chicks present (POBSP; BSFW).
	15 Sept.	> 363	Count of 363 stated to be a minimum figure. A few seen on eggs. Both small downy young and large chicks also seen (BSFW).
1969	22 Mar.	500	150 birds counted. Estimate based on additional nesting habitat which could not be censused. Eggs to nearly fledged young (BSFW).
1971	14 Sept.	400-500	(BSFW).
1972	15 Sept.	?	(BSFW).
1973	30 July	200	An estimated 50 young present. Estimate almost certainly too low (BSFW).

*Only westernmost peak of island examined.

**Only eastern part of island explored.

***Only about half of island seen during survey.

MOCKINGBIRD *Mimus polyglottos*

Status

Vagrant; one September sight record.

Observations

Kridler and others saw a Mockingbird fly over the lower southeast slopes of Flagpole Hill on 15 September 1967. Although seen but briefly, and not observed subsequently that day, all relevant field characters were clearly seen.

This species has not been recorded previously from Necker but has been recorded at least three times previously in the northwestern Hawaiian Islands, all at French Frigate Shoals (Clapp and Woodward, 1968: 33; Amerson, 1971: 302). All these records were presumably of birds that wandered from resident populations in the main Hawaiian Islands.

Mammals

The only mammal ever recorded from Necker Island is the Hawaiian Monk Seal which occurs and breeds on most of the northwestern Hawaiian Islands.

HAWAIIAN MONK SEAL *Monachus schauinslandi*

Status

Regularly present in small numbers. Maximum count: 20.

Observations

Observations of seals at Necker (Table 21) suggest that the species has occurred there regularly for almost a century. While no pups have yet been recorded, the consistency with which animals have been seen there in recent years, as well as the observation of four pregnant females, suggest the possibility that the seal may breed there.

Table 21. Observations of Hawaiian Monk Seals at Necker Island

Date of Survey	Number Seen	Remarks and References
1886 late summer or early fall	a few	One or more killed for shark-bait (Farrell, 1928: 253).
1894 27-29 May	?	A few seals seen by annexation party (Emory, 1928: 56).
1964 26 July	6	Swimming in Shark Bay (BSFW).
25-26 Sept.	12	Adults hauled out on rocky shelf 25 September: six females, sex of rest not determined (BSFW; POBSP).

Table 21. (continued)

Date of Survey	Number Seen	Remarks and References
1965 15 Mar.	7	Basking on Shark Bay side of shelf connecting the two parts of the island: six adults (two sexed were male and female), one subadult female (BSFW, POBSP).
1966 10-11 Sept.	6	In same locality as previous observation: four adults (two females, one male), two subadults; one female molting (BSFW).
1967 10 Mar.	12	Six adults (at least one male; two females), six yearlings (at least one male; one female) (BSFW).
15 Sept.	15	Basking in same locality as above. Thirteen adults (two males, five females), one yearling male, one yearling female (BSFW).
1968 28-29 Aug.	?	Several seen (BSFW).
1969 22 Mar.	20	On Shark Bay side of junction between Northwest Cape and mainland: seven adult males, four pregnant females, three subadults (one male, two females), six not aged or sexed (BSFW).
1971 18 Aug.	10	Counted in Shark Bay (BSFW).
14 Sept.	16	All adults. Twelve were on the flat shelf on the Shark Bay side of the cut separating Northwest Cape from the main island; the other four were on a ledge on Shark Bay below Summit Hill (BSFW).
1973 30 July	18	All adults (BSFW).

Reptiles

Only one species of reptile, a sea turtle, is known to occur at Necker. The inhospitable habitat and infrequency of landings on Necker presumably account for the absence of lizards, which are found on a number of the other northwestern Hawaiian Islands.

GREEN TURTLE *Chelonia mydas* [=*agassizi*]

Status

Regular visitor in small numbers. Maximum count: 6.

Observations

Recent observations of turtles at Necker (Table 22) suggest that the dearth of early records is probably more the result of lack of interest in recording their presence than the result of a lack of turtles. These turtles do not breed at Necker but the remarkable frequency with which they have been seen on recent visits suggests that the area offshore is a much used feeding area.

Tagging

BSFW personnel tagged ten turtles at Necker (Table 22). The tag return obtained by the BSFW also suggests that some turtles may remain for awhile in the vicinity before continuing their pelagic wandering or returning to their natal island, which, for most Necker turtles, is probably French Frigate Shoals.

Table 22. Observations of Green Turtles at Necker Island

Date of Survey	Number Seen	Remarks and References
1923 12-21 June	a few	Found hauled out on rock shelves (Wetmore *in* Mellen, 1925: 161).
1964 26 July	1	Seen near the island in Shark Bay (BSFW).
25-26 Sept.	2	One *ca.* 35" and one *ca.* 18" (BSFW; POBSP).
1965 15 Mar.	5	*Ca.* 2.5-3' long; resting on low ledge on Shark Bay side of island (BSFW: POBSP).
1966 10-11 Sept.	6	Five noted, *ca.* 2.5-3' turtles seen (and tagged) on same ledge as above. Another *ca.* 3' seen subsequently in west cove (BSFW).
1967 10 Mar.	3	*Ca.* 3'; two tagged; in same location as above (BSFW; POBSP).
15 Sept.	3	Same size and locality as above; two tagged, one a recovery of a turtle tagged the previous visit (BSFW).

Table 22. (continued)

Date of Survey	Number Seen	Remarks and References
1969 22 Mar.	4	In same area as above; one tagged (BSFW).
1971 21 Aug.	1	Seen swimming offshore (BSFW).
14 Sept.	3	Two large females and one smaller turtle were hauled up on the ledge on the Shark Bay side of the cut separating Northwest Cape from the main Island (BSFW).
1973 30 July	3	A dead turtle found on shelf adjacent to Shark Bay. Three other turtles observed at a depth of about 45 feet (BSFW).

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Appendix Table 1. Scientific visits to Necker Island, 1891-1973

Date	Personnel	Vessel
1891 28 May	Rothschild Expedition* Henry C. Palmer George C. Munro	KAALOKAI
1894 27 May	Capt. James A. King Capt. William K. Freeman 1st Off. James Gregory Eng. Benjamin H. Norton Eight Hawaiian sailors	IWALANI
24 Sept.	Members of the crew	CHAMPION
1895 12 July	James A. King William D. Alexander William T. Brigham (BPBM) Frank Dodge	LEHUA
1902 31 May	Albatross Expedition Charles H. Gilbert (SU) Walter K. Fisher (SU) Charles C. Nutting (SUI) John O. Snyder (SU)	ALBATROSS
1913 19 Mar.	A.M. Bailey (BBS)* George Willett (BBS)	THETIS
1914 8 Sept.	Carl Elschner Members of the crew	THETIS
1916 27 Jan.,	William H. Munter (CG) Members of the crew	THETIS
11 Feb.	William H. Munter (CG) Members of the crew	
1918 3 Sept.	Members of the crew*	HERMES
1919 6 Oct.	Gerrit P. Wilder	KUKUI
1923 12-17, 21,29 June	Tanager Expedition Alexander Wetmore (BBS) (ornithologist) William G. Anderson (collector) A.L.C. Atkinson (HBAF) Edwin H. Bryan, Jr. (BPBM) (entomologist) Bruce Cartwright (BPBM) (assistant in hydrographic work)	TANAGER

Appendix Table 1. (continued)

Date		Personnel	Vessel
		Tanager Expedition (cont.) Chapman Grant (BBS) (naturalist) Charles S. Judd (forester) Edward L. Caum (BPBM) (botanist) Harold S. Palmer (BPBM) (geologist) Eric L. Schlemmer (assistant to Wetmore) David L. Thaanum (BPBM) (conchologist)	
1924	15-18 July	Tanager Expedition Harold S. Palmer (BPBM) (geologist) William G. Anderson (collector) William Bush (collector) Erling Christophersen (BPBM) (botanist) Theodore T. Dranga (BPBM) (conchologist) Kenneth P. Emory (BPBM) (ethnologist) Kenneth I. Hobson (collector) A. Landgraf (topologist)	TANAGER
1953	20 Dec.	Frank Richardson (UW)	BUTTONWOOD
1957	28 Dec.	Karl W. Kenyon (BSFW) Dale W. Rice (BSFW)	Aerial Survey
1962	11 June** (0630-0900)	Raymond J. Kramer (HDFG) David H. Woodside (HDFG) David B. Marshall (BSFW) John W. Beardsley (HSPA)	STONE COUNTY
1964	8 Mar.	Eugene Kridler (BSFW) A. Binion Amerson, Jr. (POBSP) Loren Kroenke (UH) Edward O'Neill (BSFW) Ronald L. Walker (HDFG) George S. Wislocki (POBSP)	PLANETREE

Appendix Table 1. (continued)

Date	Personnel	Vessel
1964 26 July (0900-1845)	Eugene Kridler (BSFW)	CHARLES H. GILBERT
25-26 Sept. (0830-1300)	Eugene Kridler (BSFW) John W. Beardsley (UH) Robert R. Fleet (POBSP) Charles R. Long (POBSP) Ronald L. Walker (HDFG)	BASSWOOD
1965 15 Mar. (0900-1800)	Eugene Kridler (BSFW) Winston Banko (POBSP) Chandler S. Robbins (BSFW) Ronald L. Walker (HDFG)	BLACKHAW
1966 10-11 Sept. (0700-1520)	Eugene Kridler (BSFW) Sherwin Carlquist (CC) Karl W. Kenyon (BSFW) Warren Roll (HSB) Ronald L. Walker (HDFG)	IRONWOOD
1967 10 Mar. (1040-1715)	Eugene Kridler (BSFW) C. Douglas Hackman (POBSP) Ernest Kosaka (HDFG) John Maciolek (BSFW) Richard Wass (UH)	BUTTONWOOD
15 Sept. (0910-1840)	Eugene Kridler (BSFW) Robert Ballou (BSFW) John L. Sincock (BSFW) Ronald L. Walker (HDFG)	BUTTONWOOD
NO REPORT 1968 28-29 Aug. (0830-1845)	Eugene Kridler (BSFW) G. Brent Dalyrymple (CGS) Richard R. Doell (CGS) Robert Eddinger (UH) Derral Herbst (UH) John L. Sincock (BSFW)	BUTTONWOOD
1969 22 Mar. (0900-1740)	Eugene Kridler (BSFW) Karl W. Kenyon (BSFW) George Laycock (NAS) David L. Olsen (BSFW) John L. Sincock (BSFW)	BUTTONWOOD
30 May (0900-1200)	David L. Olsen (BSFW)	MAHI

Appendix Table 1. (continued)

Date	Personnel	Vessel
1971 21 Aug. (1230-1500)	David L. Olsen (BSFW) David Childs (SI) Richard Grigg (HIMB) Robert J. Shallenberger (OI) James Vansant (UH) William Worcester (UH)	TERITU
14 Sept. (0900-1500)	Eugene Kridler (BSFW) Erwin A. Bauer Kenneth S. Norris (OI) John L. Sincock (BSFW)	BUTTONWOOD
1972 15 Sept. (1000-1500)	Eugene Kridler (BSFW) Bruce Benson (HA) Ernest Kosaka (HDFG) David L. Olsen (BSFW) John L. Sincock (BSFW)	BUTTONWOOD
1973 30 July (1100-1830)	David L. Olsen (BSFW) John L. Sincock (BSFW) Leighton Taylor (BSFW) Thomas Telfer (HDFG)	BUTTONWOOD

*No landing made on island.

**Times of arrival and departure, where known, are listed under the dates of visit for surveys made during the 1960's and 1970's.

Glossary of Abbreviations:

BBS	Bureau of Biological Survey
BPBM	Bernice P. Bishop Museum
BSFW	United States Bureau of Sport Fisheries and Wildlife
CC	Claremont College, Claremont, California
CG	United States Coast Guard
CGS	United States Coast and Geodetic Survey
HA	Honolulu Adviser
HBAF	Hawaiian Board of Agriculture and Forestry
HDFG	Hawaii Division of Fish and Game
HIMB	Hawaii Institute of Marine Biology
HSB	Honolulu Star Bulletin
HSPA	Hawaiian Sugar Planters Association
NAS	National Audubon Society
OI	Oceanic Institute, Waimanalo, Hawaii
POBSP	Pacific Ocean Biological Survey Program

Appendix Table 1. (continued)

SI	Smithsonian Institution
SU	Stanford University
SUI	State University of Iowa
UH	University of Hawaii
UW	University of Washington

Appendix Table 2. Results of scientific visits to Necker Island, 1891-1973

Date		Results
1891	28 May	Bird observations made from offshore (Munro, 1941a,b).
1894	27 May	Hawaiian domain proclaimed and documents left on island. Seven stone images and a stone bowl collected.
	24 Sept.	Four images collected.
1895	12 July	Topographic survey made by Frank Dodge, and a number of specimens of birds and their eggs collected by W.T. Brigham.*
1902	30 May	Observations of birds (Fisher, 1903a), collection of plants. Blue-gray Noddy described as new species (Fisher, 1903b). Extensive offshore marine survey. Twenty bird specimens of five species collected.**
1913	19 Mar.	Observations on birds and their breeding status (Bailey, 1956). Eleven specimens of two species collected.**
1914	8 Sept.	Observations on geology and guano; map drawn.
1916	27 Jan.	Observations of birdlife.
	11 Feb.	Observations of birdlife.
1918	3 Sept.	Scanty observations of birds.
1919	6 Oct.	Image leg and a reshaped image collected.
1923	12-21, 29 June	Ornithological observations (Wetmore, 1925);*** archaeological investigations; observations and collections of: vascular plants, crustacea, echinoderms, annelids, foraminifera, fish, chilopods, insects, molluscs, lichens and sponges. Geological and petrological observations and a topographic map made.
1924	15-18 July	

Appendix Table 2. (continued)

Date		Results
1923 1924	(cont.)	*Ca.* 58 bird specimens of 17 species collected; seven species of plants sowed by Judd.
1953	20 Dec.	Observations on birds and their breeding status (Richardson, 1957).
1957	28 Dec.	Aerial photographs taken to determine size of albatross populations (Rice and Kenyon, 1962).
1962	11 June	Brief notes on vegetation, birdlife, effects of military occupation of island; insects and arachnids collected.
1964	8 Mar.	Observations of birds made from offshore. Patrol of refuge.
	26 July	Observations of birds, turtles, seals; erection of refuge sign. Patrol of refuge.
	25-26 Sept.	Observations of birds, census of turtles and seals. Collected: plants, crustacea (isopods), arachnids, and insects. 174 birds of six species banded.*** Patrol of refuge.
1965	15 Mar.	Survey of birdlife; censuses of turtles and seals; 153 birds of four species banded. Patrol of refuge.
1966	10-11 Sept.	Observations of birds; censuses of turtles and seals; five turtles tagged; refuge sign erected. Patrol of refuge. look up report
1967	10 Mar.	Studies and censuses of vertebrates, vegetation and marine life; patrol of refuge; two turtles tagged. look up report
	15 Sept.	Patrol of refuge; observations of birds; two turtles tagged. look up report
1968	28-29 Aug.	Studies and censuses of vertebrates, vegetation and marine life. Botanical survey for purpose of studying *Portulaca*; rock samples collected for a study of their magnetic properties; refuge sign erected; patrol of refuge.
1969	22 Mar.	Studies and censuses of vertebrates, vegetation and marine life; cover map made of island vegetation; current meters established offshore; patrol of refuge. one turtle tagged.

Appendix Table 2. (continued)

Date		Results
	30 May	Marine investigations around island; retrieval of current meters. No observations made of wildlife as only one observer landed on the island for a very brief period.
1971	21 Aug.	Coralline algae collected. Seals and turtles censused. No observations made of birds. Patrol of refuge.
	14 Sept.	Studies and censuses of vertebrates, vegetation and marine life; patrol of refuge.
1972	15 Sept.	Cursory observations of birds; seals censused; patrol of refuge.
1973	30 July	Studies and censuses of vertebrates, vegetation and marine life; patrol of refuge.

*Present location of these specimens unknown.

**We cannot be certain if this total is correct since the original papers reporting the visit did not report all collections.

***A new bird distributional record from this trip was reported by Clapp and Woodward (1968).

Appendix Table 3. Publications on collections and studies (with the exception of birds) made on Necker Island, 1891-1973*

	Protozoa
Cushman *in* Edmondson *et al.*, 1925	Records 27 species of foraminifera from offshore.
	Mollusca
Pilsbry, 1927	Reports two species of barnacles collected by the Tanager Expedition
	Annelida
Treadwell *in* Edmondson *et al.*, 1925	Reports a polychaete collected by the Tanager Expedition

Appendix Table 3. (continued)

Arthropoda

Arachnomorpha (Arachnida)

Bryan *et al.*, 1926	Mentions occurrence of spiders and bird ticks.
Beardsley, 1966	Records four species of Araneida and one of Acarina from collections made in June 1962 and September 1964.
Amerson, 1968	Reports the distribution of hosts of ticks from collections made by the POBSP.

Crustacea

Rathbun, 1906	Reports two species of brachyuran crabs collected at Necker and offshore by the Albatross Expedition.
Edmondson *in* Edmondson *et al.*, 1925	Reports nine species of decapods collected by the Tanager Expedition.
Bryan *et al.*, 1926	Mentions that isopods were collected.
Beardsley, 1966	Reports one isopod from a collection made in September 1964.

Labiata

Myriapoda

Bryan *et al.*, 1926	Describes a new species of Chilopoda from collections made by the Tanager Expedition.

Hexapoda - Insecta

Kellogg and Paine, 1910	Reports one species of mallophaga collected by the Albatross Expedition.
Bryan *et al.*, 1926	Reports *ca.* 39 species of insects collected by the Tanager Expedition.
Aldrich, 1931	Describes a new ephydrid fly from specimens collected by the Tanager Expedition.

Appendix Table 3. (continued)

Hexapoda - Insecta (cont.)	
Lopes, 1938	Describes a new species of sarcophagid fly from material collected by the 1923 Tanager Expedition.
Usinger, 1942	Describes two new species of *Nysius* (Hemiptera, Lygaeidae) from specimens collected by the Tanager Expedition.
Zimmerman,** 1948a	Lists six species (one thysanuran, a cockroach, an embiompteran, an earwig, and two mallophaga).
Zimmerman, 1948b	Lists two species of Hemiptera (Lygaeidae).
Zimmerman, 1958a	Lists a noctuid moth and a lycaenid butterfly.
Zimmerman, 1958b	Lists a pyralid moth.
Hardy, 1964	Lists a dolichopodid fly.
Hardwick, 1965	Describes a noctuid moth from collections made by the Tanager Expedition.
Maa, 1962	Reports specimens of hippoboscid collected by the Tanager Expedition.
Beardsley, 1966	Records 28 new records from collections made in June 1962 and September 1964, and summarizes earlier records excluding Mallophaga.
Echinodermata	
Fisher, 1906	Reports one species of starfish (Asteroidea) collected by the Albatross Expedition.
Fisher, 1907	Reports four species of sea cucumbers (Holothuroidea) collected by the Albatross Expedition.
Agassiz and Clark, 1907-1912	Reports five species of Echinoidea collected by the Albatross Expedition.

Appendix Table 3. (continued)

Echinodermata (cont.)	
Clark *in* Edmondson *et al.*, 1925	Reports two species of Ophiuroidea, three species of Echinoidea, and two species of Holothuroidea collected by the Tanager Expedition.
Clark, 1949	Summarizes records of echinoderms.
Chordata	
Vertebrata	
Pisces	
Snyder, 1904	Reports five species of fishes collected by the Albatross Expedition; most had been carried to the island by birds.
Fowler and Ball, 1925	Reports 17 species collected by the Tanager Expedition.
Fowler, 1927	Lists two species collected by the Tanager Expedition and previously reported in Fowler, 1925.
Strasberg, 1956	Revises taxonomy of Hawaiian blennioid fishes, recording one species from Necker.
Reptilia	
Mellen, 1925	Reports that Green Turtles were found by the Tanager Expedition in 1923.
Emory, 1928 see page 55 EMORY	Erroneously stated that "Turtles... abound."
Mammalia	
Emory, 1928	States that "The Hawaiian seal has been shot on Necker."
Farrell, 1928	Reports that seals were seen at Necker in 1886.
Tomich, 1969	Reports occurrence of monk seal in March 1965.
Laycock, 1970	Mentions occurrence of monk seals in March 1969.

Appendix Table 3. (continued)

	Flora
Fisher, 1903a	Reports three species of vascular plants collected by the Albatross Expedition.
Christophersen and Caum, 1931	Reports five species of vascular plants collected by the Tanager Expedition and lists seven species planted in 1923 which were not present in 1924.
Magnusson, 1942	Lists eight species of lichens, six of which are newly described, from collections by the Tanager Expedition of 1924.
Tsuda, 1966	Reports collection of 17 species of marine benthic algae collected in July 1924 and September 1964.
	Geophysical
Möhle, 1902	Describes three specimens of lava.
Elschner, 1915	Gives comments on the geology and chemical composition of guano from observations made in September 1914.
Powers, 1920	Describes a specimen of lava collected in 1914.
Washington and Keyes, 1926	Reports results of studies of rocks collected by the Tanager Expedition.
Palmer, 1927	Gives geological and topographical observations made by the Tanager Expedition.
	Archaeology
Alexander, 1894	Gives a photograph of idols collected in 1894.
Emory, 1928	Reports work done by the Tanager Expedition and summarizes all available earlier information.

*Authors are in chronological order within taxa.

**Zimmerman and Hardy, in the Insects of Hawaii series, present distributional records derived primarily from the Tanager collections, but extensively revise taxonomy, re-identify specimens, and identify to species hitherto unidentified specimens.

Pencil in ARB

3/9/79

Mokumanamana

S. Albert – got name from Mrs. Pukui.

Pele and Hiiaka legend mentions it

Hoomanamana means "worship idols"

ker Aug 20-21, 1955

ec

olcanoes in the Sea

MacDonald and Abbott

Adv. July 9, 1956

Dr. Eaton Cites Algae Discovery

Necker, Earlier Oahu 'Eruptions' Now in Doubt

The man who tends Hawaii's active volcanoes said yesterday he now doubts there have been underwater eruptions in or near the Hawaiian Islands during the past year.

A series of discolorations in the water near Necker Island, between Kauai and Oahu and off Oahu to the south, said Dr. Jerry Eaton, probably are all the result of the same thing: floating plant life.

DR. EATON, volcanologist on the Big Island, said his tentative conclusion is based on the recent verdict of Dr. Agatin T. Abbott of the University of Hawaii geology and geophysics department. Dr. Abbott last week examined material taken from the sea 12 miles off Koko Head and pronounced it plant life—algae. He said it definitely was not volcanic in origin.

Dr. Eaton's statement yesterday was the first from a responsible scientific source dealing with the August and September, 1955, phenomena near Necker Island, 430 miles northwest of Honolulu and between Midway and Oahu.

EARLIER, there had been widespread speculation that these surface discolorations might be indications of underwater eruptions in an area where no volcanic activity has been known to occur for 10,000 years.

The 1955 discolorations and those reported in May this year off Kaena Point between Oahu and Kauai were similar. The sea was said to be stained yellowish-green over wide areas. In some cases, low-flying observers said they smelled sulphurous fumes. Some bubbling and boiling was reported. In several cases witnesses agreed that the water around the discolored areas was abnormally calm.

When the first reports from Necker island came in, the scientists said the evidence pointed to an undersea eruption. However, they did say their conclusions were based on visual evidence and not on analysis of material floating in the sea.

DR. EATON NOTED yesterday that the material dredged up off Oahu last week by Dr. Abbott was the first sampling to be taken from the ocean at a point where any discoloration was sighted.

At the same time, he said, still further evidence would be desirable. He said there still is no definite proof of a tangible nature that none of the underwater disturbances was not volcanic.

However, he said, he now is inclined to believe that there have been no underwater eruptions anywhere in or near the Hawaiian Chain.

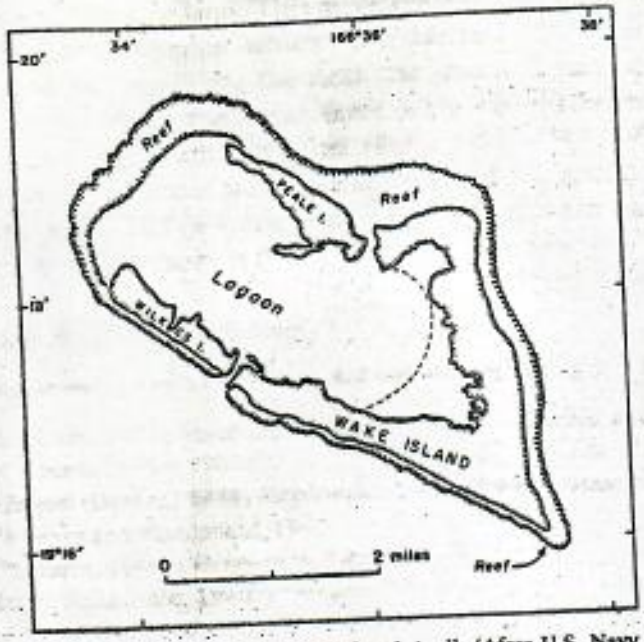


Figure 288. Map of Wake Island and Atoll. (After U.S. Navy Hydrographic Office chart.)

tains (see chap. 11), then curves to the northwest and extends beyond Marcus Island. Wake lies about 2,300 miles N 85° W of Honolulu. A large portion of the atoll has been built above sea level by sand (fig. 288). The main island (Wake) is V-shaped, each leg of the V being about 3 miles long. Lying northwest of the legs of the V, Wilkes and Peale islands are each about 1.5 miles long. The tops of sand dunes on Wake and Peale islands reach about 21 feet above sea level, and those on Wilkes Island, about 18 feet. The airport is located on Peale Island. Like the atolls of the Hawaiian chain, Wake lies on the summit of a great wave-truncated shield volcano.

VOLCANIC ACTIVITY

Before leaving the Leeward Islands mention should be made of an apparent volcanic eruption in the area in 1955. On August 20, persons aboard a plane bound from Tokyo to Honolulu sighted what appeared to be a column of smoke rising from the ocean about 55 miles N 85° E of Necker Island. On close approach they saw an oval patch of steaming turbulent water about a mile across, surrounded by a thin line of yellowish surf, with yellowish water drifting away from it. Near one end of the oval was an area of several thousand square yards of

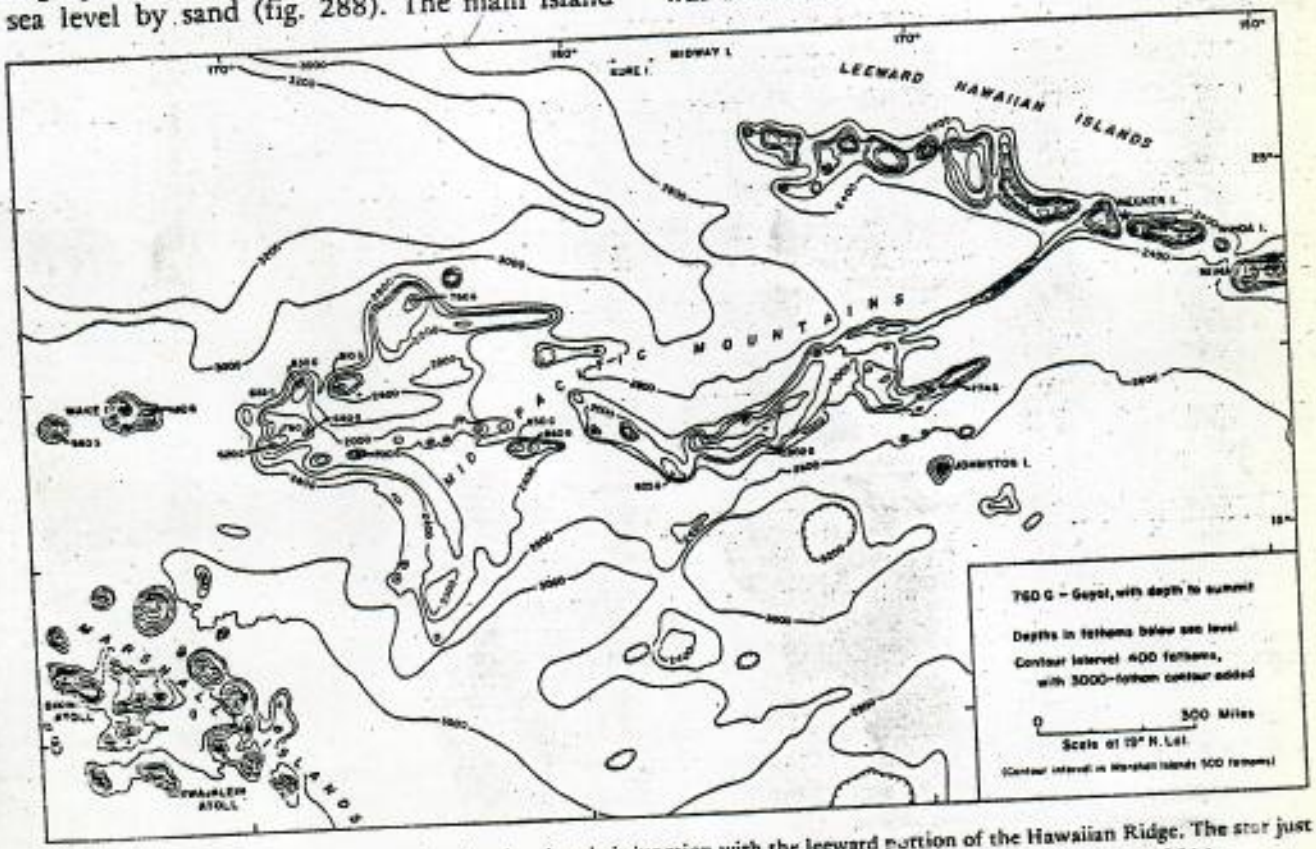


Figure 289. Map of the Mid-Pacific Mountains, showing their junction with the leeward portion of the Hawaiian Ridge. The star just east-northeast of Necker Island marks the site of a submarine volcanic eruption in 1956. (Modified after Hamilton, 1956.)

what looked like dry land. This probably was a raft of floating pumice which soon became waterlogged and sank. By the next day, when other planes visited the area, there were no further signs of disturbance other than a slick appearance of the water surface in the formerly turbulent area and a series of long swells sweeping outward from it nearly to Kauai. The locus of the eruption lies just north of the Hawaiian Ridge on the northeastward projection of the Mid-Pacific Mountains and the Necker Ridge (fig. 289), in a depth of about 12,000 feet of water. This is the only volcanic activity which has occurred in the northwestern part of the Hawaiian chain in historic time.

Suggested Additional Reading

(principal references for each island are marked with asterisks)

General: Hinds, 1931; Macdonald, 1949*a*, 1968; Macdonald and Katsura, 1964; Malahoff and Woollard, 1966, 1968; Stearns, 1946, 1966*a*

Hawaii Island: Dutton, 1884; Macdonald, 1947*a*, 1949*b*; Stearns and Clark, 1930; *Stearns and Macdonald, 1946

Maui: *Stearns and Macdonald, 1942

Lanai: *Stearns, 1940*c*; Wentworth, 1925*a*

Kahoolawe: Macdonald, 1940*b*; *Stearns, 1940*c*

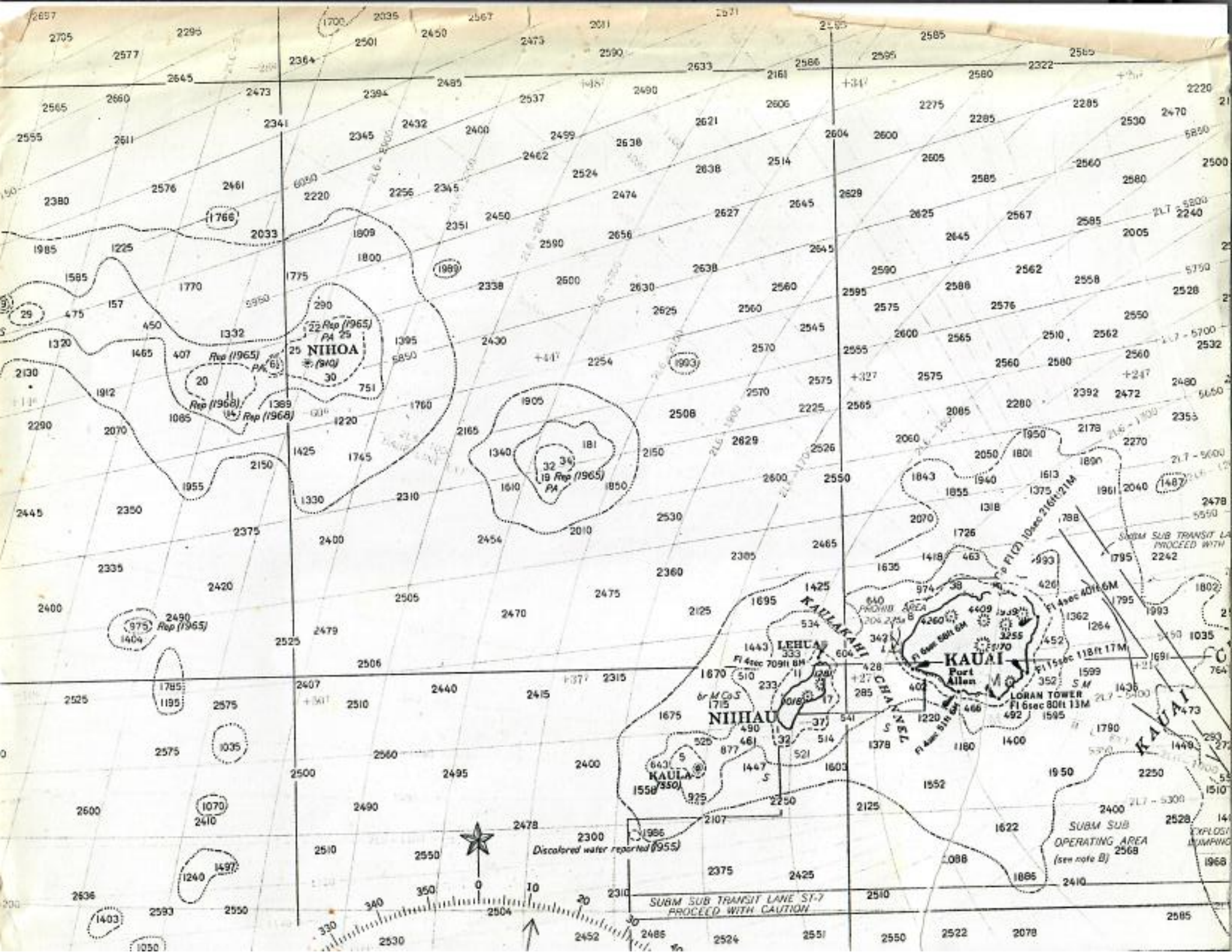
Molokai: Lindgren, 1903; *Stearns and Macdonald, 1947

Oahu: *Stearns, H. T., 1939, 1940*b*; *Stearns and Vaksvik, 1935; Stearns, N. D., 1935; Wentworth, 1926, 1951; Wentworth and Winchell, 1947; Winchell, 1947

Kauai: Hinds, 1930; *Macdonald, Davis, and Cox, 1960

Niihau: Hinds, 1930; Macdonald, 1947*b*; *Stearns, 1947

Leeward Islands: Bryan, 1942; Ladd, Tracey, and Gross, 1967, 1969; *Palmer, 1927, 1936; Washington and Keyes, 1926


NIIHOA
(Ni'ihau)
Rep (1965)
Rep (1968)
Rep (1965)
Rep (1968)
Rep (1965)
Discolored water reported (1955)
NIIHAU
KAULA
(Kaula)
KAULAKAHI CHANNEL
LEHUA
(Lehua)
Fl 4sec 709ft 8M
KAUAI
Port Allen
Fl 4sec 401ft 6M
Fl 5sec 118ft 17M
LORAN TOWER
Fl 6sec 801ft 13M
Fl 4sec 518ft 8M
Fl (2) 10sec 216ft 21M
640 PROHIB AREA
SUBM SUB TRANSIT LANE ST-7
PROCEED WITH CAUTION
SUBM SUB
OPERATING AREA
(see note B)
KAUAI

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Branch of Isotope Geology (MS 18)
345 Middlefield Road
Menlo Park, California 94025

November 7, 1977

Dr. George H. Balazs
University of Hawaii at Manoa
Hawaii Institute of Marine Biology
P. O. Box 1346, Coconut Island
Kaneohe, Hawaii 96744

Dear Dr. Balazs:

I trust that your visit to Necker Island was as enjoyable as mine. I hope you follow through with your intended publication on the condition of the archeological remains. It will be an important contribution. Although those sorts of observations would be best recorded by an archeologist, it is most important that they be recorded by someone. Too often we pass up valuable opportunities because it is not our field of expertise--and the observations never get made!

It is probably not possible to definitely attribute the rock slide on the northeast side of Flagpole Hill to faulting. Rock and debris slides are a natural phenomenon on cliffs and steep slopes. Often, the lava flows that are contributing material to the slide are slightly more fractured at the slide location than elsewhere. Undercutting of the source flow(s) by erosion of softer material beneath may also be a contributing factor. From the way you describe the color of the rock, I would hazard a guess that the slide was probably catastrophic, but it could have happened simply because the face of certain lava flows passed an initial point in their stability at that place in the cliff.

Like Dr. Emory, I saw no evidence of faulting on Necker, but the island is only a small subaerial remnant of a huge volcanic structure more than 100 km in diameter at its base. Activity on a large fault anywhere on that structure could cause tremors on the island. Although there is no bathymetric evidence of such a fault that I know of, it is still a possibility that cannot be precluded. Such a shock could trigger a rock slide but is not a necessary condition for a rock slide to occur.

Other possible causes for tipping of the stone uprights are thermal expansion and contraction of the uprights themselves and of the supporting stones, and expansion and contraction of the soil due to wetting and drying. These mechanisms can move surprisingly large amounts of material. In fact, next to man, they could be the principle reason for toppling of the uprights. High winter storm winds are another contributing agency to consider. Repeated buffeting by gusty winds might loosen the uprights and eventually topple them. You might check the weather records at French Frigates Shoal to see what kinds of winds occur on Necker during the winter.

It might be worthwhile to establish some precisely located photographic stations that could be reoccupied yearly during one of Gene Kridler's semiannual visits there. This could provide a valuable record for future study of the sites.

One final observation is the comment on p. 15 of your manuscript concerning the evidence of recent volcanic activity on Necker. The position given in Macdonald and Abbot (1970) would place the activity nearly 20 miles east of the base of Necker Volcano and nowhere near an existing seamount. Perhaps the location is wrong, but as given the activity could not apply to Necker.

Hope this information will be of some use to you. I have enclosed a reprint of a paper concerning Necker that might interest you. Please keep me in mind when your report on the Necker archeological sites is ready for distribution.

Sincerely,

G Brent Dalrymple

G. Brent Dalrymple
Geologist

Encl.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Geologic Division
Branch of Isotope Geology
345 Middlefield Road, Menlo Park, California 94025

December 22, 1977

Dr. George H. Balazs
University of Hawaii at Manoa
Hawaii Institute of Marine Biology
P.O. Box 1346, Coconut Island
Kameohe, Hawaii 96744

Dear Dr. Balazs:

Thank you for the various articles and especially the copy of your delightful book on the wildlife of the Leeward Islands. My oldest teenage daughter is very enthusiastic about birds and sealife, and latched onto your book quite quickly.

After looking at the color photo you sent, I am convinced that the white patch on the slope is a natural phenomenon. It appears to me that the white material is highly altered and is covered by a mantle or cap of either cemented slope wash or a very thin lava flow. The altered material could be either talus or lava flows. In either case, it is probably quite soft and forms a small unstable cliff that sloughs off as the harder cap is eroded. Some close-up color photos might help clear this up. Of particular interest would be the contact (and 2-3 feet both sides) of the white material with the lava flows in the cliff, and several of the cap rock. I have marked several suggested places on the enclosed copy of your photo. As for the reported eruption near Necker, I am skeptical. Everything we know about the origin of Hawaiian volcanoes suggests that eruptions do not occur that far away from the active end of the chain. Likewise, as far as we know, the volcanoes scattered at "random" about the central Pacific formed at or very near the East Pacific Rise and should not be active now. As for the underwater pinnacle, navigation charts are purposely conservative, i.e., if there is even the slightest chance that a hazard exists, it will be shown and once put on a C & GS chart may stay there forever. They do not necessarily depict the best available bathymetry. If the TOWNSEND CROMWELL and the EASY RIDER have searched for and failed to find it, then it probably doesn't exist. I doubt if a bottom sample would do much good unless the pinnacle could be located and a sample collected from there.

GO TO ORIGINAL SOURCE

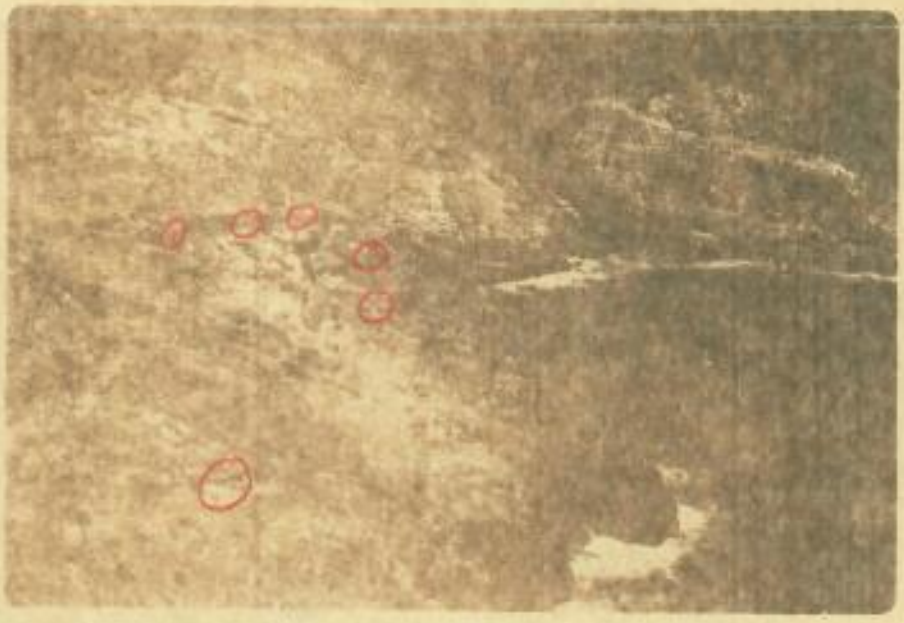
The best person to contact about water analyses would be Dan Davis of the Geological Survey in Honolulu. His office is on Ward street, if I remember correctly. I would bet that the contamination is from bird droppings.

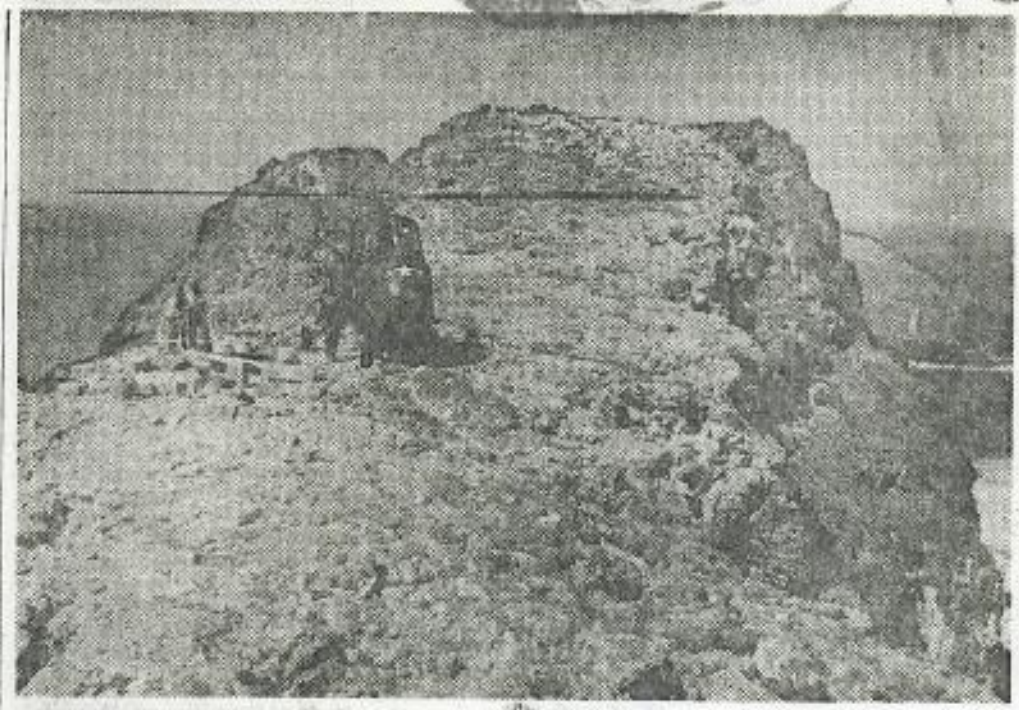
Necker contains no unusual minerals as far as I know, and that type of basalt usually does not introduce much in the way of contaminating minerals into ground water.

Have a Merry Christmas and a Happy New Year.

Sincerely,

G. Brent Dalrymple





Navy hydrographic survey crews required the use of a helicopter to get ashore on Gardner Pinnacle, which is about half way between Oahu and Midway Islands.—Navy Photo.

Navy Team Maps Remote Mid-Pacific

A Navy hydrographic survey team has invaded some of the most remote and barren land areas in the mid-Pacific area during a survey of such little known areas as Lisianski Island, Nihoa Island, the Pearl and Hermes Reefs and Gardner Pinnacle.

Working from the Pacific Fleet tank landing ship Duval County, the survey team recently completed a three-month odyssey from Oahu to Kure Island, charting every reef, pinnacle and island along the route.

At some of the locations the survey crew found it impossible to make a boat landing with survey equipment, so a helicopter was used to ferry men and equipment ashore.

In one location, however, this also proved impossible until the Duval County's men could build a makeshift landing pad.

This was on Gardner Pinnacle, halfway between Oahu and Midway Islands.

The work crew was lowered from a hovering helicopter and within hours had carved an improvised landing area on the barren 200 by 75 yard volcanic pinnacle.

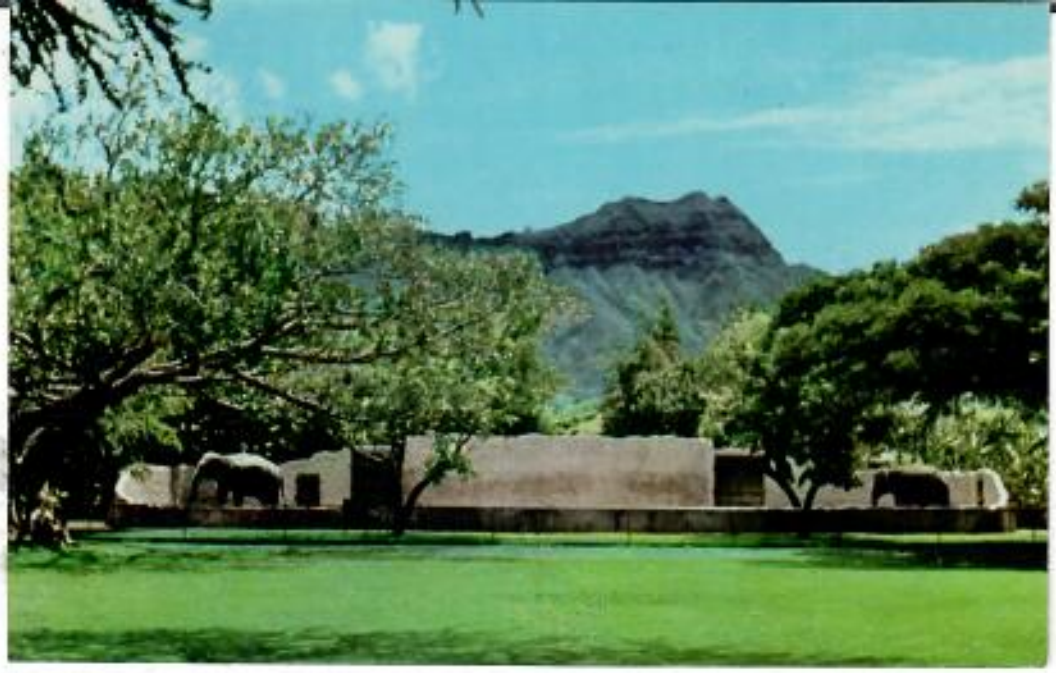
At Necker Island, crews encountered live bombs believed dropped by training planes during World War II. These had to be cleared away before the survey could be made.

The Duval County has completed the trip that started January 23 from Pearl Harbor and is enroute to San Diego, California.

She is commanded by Lieutenant Francis L. Roach.

Honolulu Star Bulletin

May 23, 1961



Aloha George,
Received your 1977 PM
Necker Island photo of
a Lepidodactylus lugubris
mabelo.
Yes, a note in the
'Elepaio or similar nat. hist.
newsletter would be appropriate
Jotted down your #'s for future
reference. Best regards, Jean

INDIAN ELEPHANTS

The Honolulu Zoo, with Diamond Head in the background and fronting on Waikiki Beach, is one of the outstanding places to visit for residents and visitors to the Islands. Tropical trees and shrubs give a realistic setting for the jungle animals and make the Zoo a beautiful tropical park. The Zoo is a division of the city's Board of Public Parks and Recreation.

PRINTED FOR THE HONOLULU ZOO
BOARD OF PUBLIC PARKS AND RECREATION

POST CARD

George Balazs
Hawaii Institute of Marine Biology
P.O. Box 1346
Coconut Island
Kaneohe, Hawaii
96744

Jean McKeown, Supervising Herpetologist
DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
HONOLULU ZOO KAPIOLANI PARK
HONOLULU, HAWAII 96815

PLACE STAMP HERE

HAWAIIAN NENE

This unique bird is the official bird of Hawaii, and is found nowhere else in the world. A century ago these Nene (pronounced Nay-Nay) or Hawaiian Geese, were fairly abundant on Maui and Hawaii. Nene have declined greatly in numbers due largely to hunting, before they were protected by law, and to being eaten by animals such as wild pigs and wild dogs that were introduced by man. In 1949, the Hawaii Board of Agriculture and Forestry very wisely established a Nene restoration project using birds loaned by Mr. Herbert Shipman of Hilo, who had the world's only captive Nene flock. This program to increase Nene in the wild, involves rearing captive birds, releasing them to join wild Nene, setting aside special sanctuary areas, rigid protection, and continuing research on these rare birds.

The Honolulu Zoo has actively cooperated with this successful and vigorous conservation program that has attracted world-wide interest.

PRINTED FOR THE HONOLULU ZOO
BOARD OF PUBLIC PARKS AND RECREATION

POST CARD

George,
That's a neat looking Lepidodactylus lugubris (Mourning Gecko) you photographed.
Is it from the Leeward Islands?
Regards, Jean

B. Mus. 9780. Necker from W by N. (Note turtle shape.) 6-20-23.(Bryan)

B. Mus. 9781. Necker from due W. 6-29-23. (Bryan)

Nos. 206-207 May 1977

ATOLL RESEARCH BULLETIN

206. THE NATURAL HISTORY OF NECKER ISLAND, NORTHWESTERN HAWAIIAN ISLANDS

by Roger B. Clapp and Eugene Kridler

207. THE NATURAL HISTORY OF NIHOA ISLAND, NORTHWESTERN HAWAIIAN ISLANDS

by Roger B. Clapp, Eugene Kridler and Robert R. Fleet

Issued by
THE SMITHSONIAN INSTITUTION
Washington, D.C., U.S.A.

September 16, 1977

Mr. Brian Giezentanner
U.S. Fish & Wildlife Service
Box 50167
Honolulu, HI 96850

Dear Mr. Giezentanner:

Mr. George Balazs has just given me a specimen of a large grasshopper which he collected on Necker Island on August 24, 1977. He reported seeing numerous grasshoppers of this type both on Necker and on Nihoa which he visited on Aug. 17.

The grasshopper is a specimen of Schistocerca nitens nitens Thunburg, a North American form which was first found established in the main Hawaiian Islands during 1965. Although this species has not developed into a major agricultural pest in Hawaii, it belongs to a genus of grasshoppers which contains a number of serious pest species. It is quite possible that biological factors, such as the predacious ant, Pheidole megacephala (Fabricius), may be controlling it on the main islands. It is also possible that in the relatively simple terrestrial ecosystems of Nihoa and Necker, this grasshopper may build up sufficiently large populations to cause serious damage to the vegetation. I believe that you should be aware of the potential this grasshopper may have for causing serious damage to the flora of Nihoa and Necker so that you and your assistants can keep an eye open for large populations, and also for any changes in the condition of the vegetative cover on these islands which could be caused by it.

To my knowledge, the last insect survey of the HINWR islands was made by me in 1964. As I pointed out in a 1966 paper on insects of the Leeward Hawaiian Islands (copy enclosed), these small islands are very vulnerable to invasion by new insect pests. May I suggest that you consider including a qualified entomologist on one of your field trips to these islands, within the next year or two? I believe it would be prudent to resurvey the insect faunas of the HINWR islands to assess the status and impact of the new grasshopper and to determine whether other new pests have become established on these islands.

Yours sincerely,

John W. Beardsley
Entomologist & Professor

Enc.

cc: George Balazs

23(2). 1980

considered to be established in Hawaii. **J.W. Beardsley.**

Schistocerca nitens nitens Thunburg: Mr. George Balazs, Univ. of Hawaii, Institute of Marine Biology, submitted an adult female specimen of the vagrant grasshopper, *Schistocerca nitens nitens* Thunburg, which he collected on Necker Island in the Leeward Hawaiian Island group on August 14, 1977. The specimen was determined by Dr. Beardsley. Mr. Balazs reported seeing numerous adults of this immigrant grasshopper on Necker and also on Nihoa Island. Necker is a confirmed new island record for *S. nitens*, but specimens from Nihoa are needed for confirmation. The possibility exists that large populations of this grasshopper could develop on these isolated leeward islands and cause serious damage to their vegetation. **J.W. Beardsley.**

Meteorus sp.: Dr. Beardsley exhibited two specimens of a braconid wasp which he has determined as a *Meteorus* sp. not previously known from Hawaii. Both specimens were collected in a light trap at Kailua, Oahu. The first was taken on July 22, 1977 and the second on October 8. The most common *Meteorus* species in Hawaii is *M. laphygmae* Viereck. *M. humilis* (Cresson) and *M.* sp. near *icterius* Nees are known to occur in Hawaii only on Maui. The species reported here is none of these, and apparently represents a recently established immigrant. **J.W. Beardsley.**

Leucania striata Leech: At the September meeting I reported on a newly discovered immigrant noctuid moth which had been determined by Dr. E.L. Todd, USDA Insect Identification Laboratory, as *Leucania* sp. probably *insecuta* Walker. At Dr. Todd's suggestion I sent a pair of specimens of this moth to Dr. Klaus Sattler at the British Museum, for comparison with the types of *L. insecuta* and related forms. Dr. Sattler has written to me concerning these specimens in a letter dated October 4, 1977 as follows:

"Mr. A.H. Hayes and I have examined your specimens, and believe they are *Leucania striata* Leech. Hampson synonymized *striata* with *insecuta* Walker. However, they appear to be distinct species.

Ogata's figures (Icones....) represent *striata* as Todd suspected. The genitalia figure is rather crude, but it agrees well enough with the type of *striata*. The clasper plate of your specimen differs slightly from that of the type. Without a proper taxonomic study it is difficult to say what the significance of this difference is. I suspect it merely means that the type and your specimens orginated from different geographic areas.

According to our information, *striata* is known only from Japan."

The "Icones" reference mentioned above is according to Todd, Ogata in Esaki et al. 1958, Icones Heterocerorum Japonicorum in Coloribus Naturalibus, p. 90, Fig E, Pl. 91, fig. 1986.

Since *L. striata* was synonymized with *L. insecuta* by Hampson (1905, Cat. Lepidoptera Phalaenae in British Museum, 5:534), and apparently has not been resurrected from synonymy before now, its use here constitutes a renewed status for this name which should be credited to Hayes and Sattler. Reference citations for the original description of *L. striata* is: Leech, 1900, Trans. Entomol. Soc. London for 1900, p. 127 **J.W. Beardsley.**

Panicum torridum Gaudichaud Gramineae, grass family.

A native Hawaiian grass, called kakona-kona, "Torrid panic grass".

It is endemic to the Hawaiian chain and thrives in dry localities. It is good forage for cattle. It is characterized by a thick covering of long silky hairs, even on the dense flowering panicle.

The attached illustration and page of data are from "Flora Hawaiiensis" by Otto Degener. There is also an article and illustration of it in A.S.Hitchcock, The grasses of Hawaii, Bishop Museum Memoirs, VIII (3): 184-185, 1922.

Chenopodium oahuense (Meyen) Allen. Chenopodiaceae, Goose-foot family. Synonym: (Chenopodium sandwicheum) Aheanea is one of several Hawaiian names.

A low shrub, the branching stems and angled leaves so covered with short white hairs that it makes the plants look pale green, almost white.

Sesuvium portulacastrum L. Aizoaceae, carpetweed family.

A prostrate herb, usually found near beaches. It is a prostrate herb, with fleshy narrow leaves and small flowers and fruits. The fleshy parts of the plant can be eaten like spinach or greens, raw. This drawing id from E.D.Merrill's "Plant Life of the Pacific World." Hawaiian name:"'akulikuli."

(over)
#20

Portulaca lutea Solander, "Ihi" Family Portulacaceae. Indigenous to Pacific Islands.

A fleshy herb, erect, with soft, thick fleshy, edible stems and light green leaves, and yellow flowers. Native name "ihi", and is one of the "pig-weeds". The sketch, from Merrill, is of Portulaca oleraceae, which is more slender, low and bushy, with purplish stems.

(over)
#122

Sesbania tomentosa Hooker & Arnott, "ohai". Family Leguminosae, "bean family".

A nearly prostrate shrub, with silky, wool-covered branches and leaves. The flowers are red to orange, about an inch long. The accompanying plate and description are deom J.F.Rock, The leguminous plants of Hawaii, plate 65 and pp.155-156.


20


122

edge of the southern cliff, about the middle of the island, and the other in the pocket of a stream bed just above the sand beach.

Sicyos sp. Observed only below Tanager Peak.

NECKER ISLAND

Necker Island, like Nihoa Island, is the remnant of a volcanic cone. It is much smaller, covering an area of about 41 acres only, and with a maximum elevation of 276 feet (29, p. 20). The backbone of the island forms a gently rounded plateau from which the cliffs descend steeply, especially toward the south and west. The soil is shallow, coarse, and most of it mixed with a great amount of loose rock. It is basaltic with some admixture of bird guano.

The vegetation on Necker Island is very inconspicuous (Pl. III, *A*). In no place do the higher plants form a closed cover, and great parts of the island are destitute of any plant life whatsoever. Only five species of vascular plants are found:

Panicum torridum. In 1923, moderately common on the north side of the main part of the island, but most of the plants were dead. In 1924 only two clumps were observed: one on the slopes of Annexation Hill; another on the east side of Bowl Hill.

Chenopodium sandwicheum. The commonest plant on the island; abundant on the sloping sides, but rare on the flat top; plants low and straggling; few exceed a height of 2 feet.

Sesuvium portulacastrum. Found only on the southern slopes of Annexation Hill where it grows in great abundance in the talus within reach of the spray.

Portulaca lutea. Common on the flat tops, as well as on the small ledges of the precipitous cliffs; most of the plants are rather small and poor.

Sesbania tomentosa. A few plants, low and widespreading, along the flat top of the main part of the island; most of these less than 2 feet high, but spreading as much as 6 to 10 feet in diameter; much favored as nesting site by boobies and frigate birds. (See Pl. III, *B*.)

On the shores of Shark Bay seeds of *Aleurites moluccana* were found. In June, 1923, C. S. Judd sowed seeds of the following species in the saddle between Flagpole Hill and Summit Hill: *Haematoxylum campechianum* Linnaeus, *Thespesia populnea* Solander, *Casuarina equisetifolia* Linnaeus, *Pritchardia pacifica* Seemann et Wendland, *Pritchardia* sp., *Livistonia australis* Martius, and *Lycopersicum esculentum* Miller. In July, 1924, no seed plants of these species were found.

FRENCH FRIGATES SHOAL

French Frigates Shoal is a crescent-shaped atoll consisting of 16 sand and 2 rock islets, the last remnants of a volcanic cone. The total area of the sand

Family: 47
Genus: Panicum
Species: Torridum

GRAMINEAE
GRASS FAMILY

PANICUM TORRIDUM Gaud.
TORRID PANIC-GRASS; KAKONAKONA

Panicum torridum Gaud. Voy. Freyc. Bot. 411. 1829.*
Panicum torridum Hitchc. in Mem. B. P. Bishop Mus. 8.3:185. 1922. (In part.)

Tufted annual. Culms 25-80 cm. tall, villous, erect, simple or often with one 10-15 cm. long branch at each node. Sheaths 3-10 cm. long, shorter than internodes, densely villous with silky pale yellowish or fawn-colored hair, chartaceous, often loosely clasping the culm; ligule a line of bristly hair about 1 mm. long; blades flat, 8-20 cm. long, 1-2.5 cm. wide, densely villous with silky hair, chartaceous, abruptly acute, erect. Panicles 4-12 cm. long, 2-5 cm. wide, dense, pyramidal, erect, often partially included within its sheath, bearing fertile branches from nearly all older nodes; with densely villous crowded suberect 1-3 cm. long branches usually in fascicles of 3-5. Spikelets 4-6 mm. long, readily disarticulating, borne on 1-1.5 mm. long thickish pedicels. Glumes conspicuously unequal, densely papillose-villous with ascending or spreading hair 1-3 mm. long: first glume 4-6.5 mm. long, lanceolate, acute, 3- to 5-nerved, very conspicuous, second glume 2.5-3.5 mm. long, ovate, 5- to 7-nerved. Sterile lemma slightly shorter than second glume, 7-nerved, densely long papillose-villous, with slightly involute margins, with its obtuse hyaline palea about 1 mm. long. Fertile lemma about 2 mm. long, narrowly ovate, coriaceous, nerveless, shiny, slightly beaked, becoming brownish with age, with its palea of the same length and texture. Anthers about 1 mm. long, narrowly ovate, pale yellow. Stigmas 0.5-0.7 mm. long, narrow, very inconspicuous, sparingly plumose, yellowish. Grain 1.5-1.7 mm. long, narrowly ovate, somewhat compressed, whitish.

Type Locality: *"Insulis Sandwicensibus."*

Local Range: A grass limited to the arid lowlands of Maui, for example about Wailuku, and of Molokai especially in the western part. The closely related *P. cinereum* is found in less abundance in the same general regions, but is quite common on Oahu about Kaena Point, Diamond Head and Koko Head. *P. torridum* is plentiful enough locally to be of some value as forage.

Extra Range: Not known elsewhere.

*Many plants described in Gaudichaud's work are still commonly cited with the incorrect date of publication. The following table supplies this little known information. Though certain plates properly illustrate certain pages, these plates were not necessarily issued according to their numeration but in a somewhat haphazard manner from time to time. For instance, Plate 85 (according to Gaz. Dict. Nat. 5:475. 1827.) was published with the first livraison in 1826 though the plant it illustrates was not described until three years later.

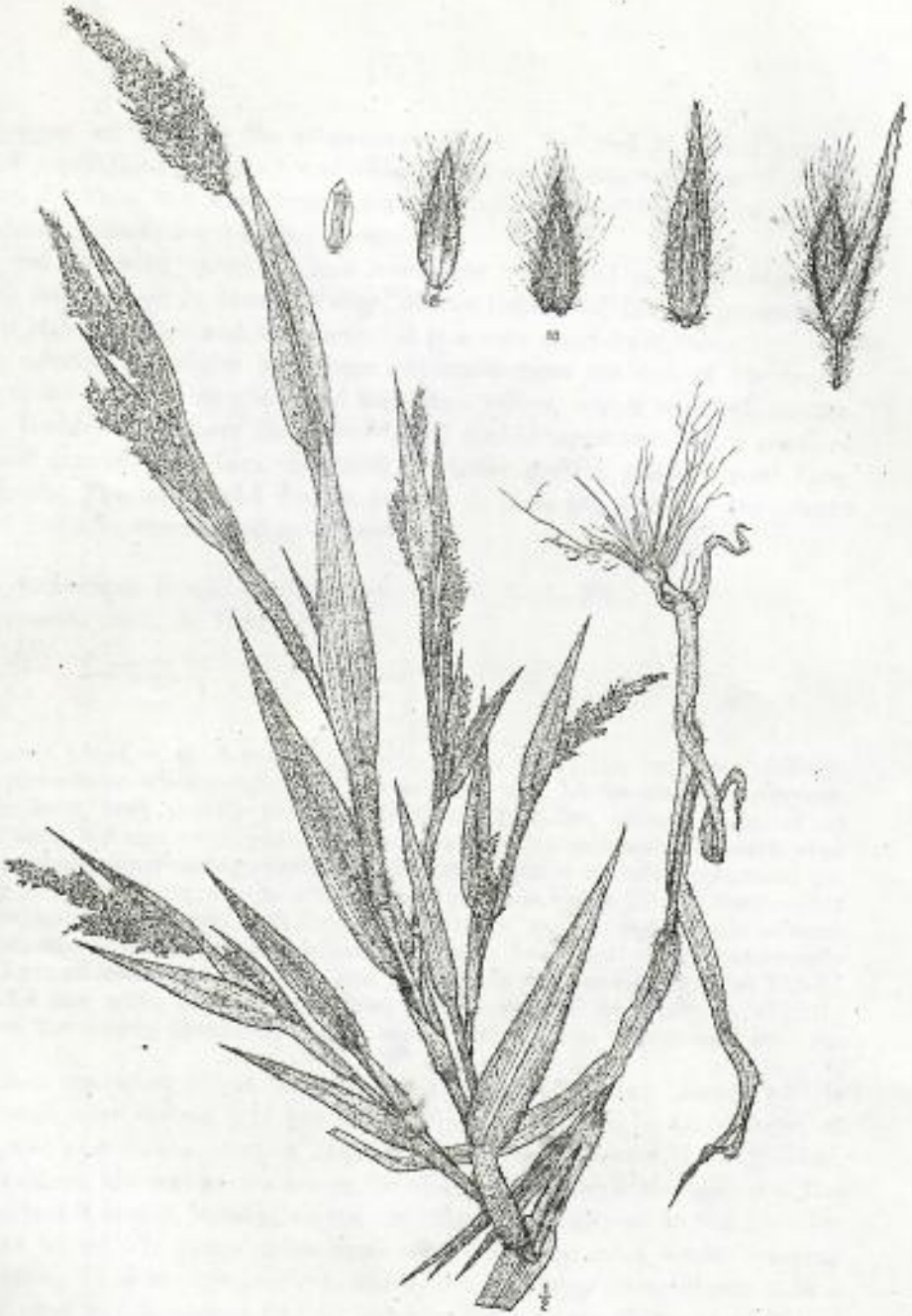
PART	PAGES	YEAR	(illustrated by) PLATES
1	1— 88	1826	1— 20
2	89—216	1827	21— 50
3	217—360	1828	51— 80
4	361—464	1829	81—110
5	465—522	1833 ('30?)	111—120

(Illustrated on following page)

(Otto Degener & Leo D. Whitney, 11/2/'38)

Family: 47
Genus : Panicum
Species: Torridum

GRAMINEAE
GRASS FAMILY



PANICUM TORRIDUM Gaud.

(Original)

(Otto Degener, 11/2/38) (Described on preceding page) (Hoolehua, Molokai)

on the vacant lot opposite the Pleasanton Hotel. The red flowering variety (*Sesbania grandiflora coccinea*) was looked upon as a distinct species, *S. coccinea* (Linn. f.) Pers., but is nothing but a mere color form of the widely distributed *Sesbania grandiflora* (Linn.) Pers.

The red flowering variety is now commonly cultivated in the islands and specimens can be seen in Manoa Valley, at the College of Hawaii grounds, as well as in Makiki Valley and elsewhere. It is a very short-lived tree.

Two coloring principles have been extracted from the sap of the trunk, one red, which is called *agathin*, and the other yellow, which is called *xantho-agathin*. Besides these there have been found *arabin*, some *bassorin*, a resinous matter, and tannin. The bark, of which the inner portion yields a good fibre, is astringent. The leaves and flowers as well as pods are eaten by the poorer natives of India in curries and as a vegetable.

Sesbania tomentosa Hook. et Arn. Bot. Beech. Voy. 286. 1842.
Agati tomentosa Nutt. in Herb. Hook.

Ohai.

Plate 65.

A woody plant, with decumbent stems, 5-7 m long; the branches, foliage, etc., silky-tomentose when young, but less so when old; leaves abruptly pinnate, 10-17.5 cm long, very shortly petiolate, leaflets 8-16 pairs, oblong elliptical up to 28 mm long, 6-8 mm wide, pale, glabrous above, silky pubescent beneath even when old, retuse, mucronate; rhachis pubescent; stipules minute, caducous; peduncle up to 25 mm long, two to six-flowered, pedicels about 15 mm long, calyx cyathiform, about 1 cm long, with short deltoid teeth; corolla red or pale salmon-colored; standard orbicular, emarginate reflexed; keel and wings moderately falcate 2.5 cm or more long; stamens and pistil as in *S. grandiflora;* pod 12.5-17 cm long, 3-4 mm wide, glabrous, torulose, and constricted at intervals, slightly stipitate in the nearly persistent calyx; seeds 8-20 oblong, compressed shining.

Sesbania tomentosa H. et A. is endemic in the Hawaiian Islands and is usually found near the sea. It has been collected on Oahu in the district of Waianae, and also on the coast of Hawaii; Hillebrand collected it on Molokai. Specimens of his Molokai plants are in the College of Hawaii Herbarium. The writer collected it also on Molokai, on the sand dunes at Moomomi on the dry west end of that island. It forms dense mats over the white coral sands, covering quite an area. It is always prostrate there, but on Kauai, near Mana, it is a branching erect shrub several feet in height. Mrs. Annie Knudsen of Kauai has kindly sent specimens from the latter locality to the writer. In the Kauai specimens the raceme is six flowered, and the stems are white woolly.

The plant is not known to occur outside the Hawaiian Islands. Specimens are growing and flowering at the College of Hawaii grounds, grown from seed collected by the writer on Molokai.

Recently the arborescent type of *Sesbania tomentosa* has been discovered by Mrs. L. M. Dunbar on the slopes near Mahana on the west end of Molokai. She reports it as a tree 12 to 15 feet in height. The leaves are longer, the leaflets smaller and more numerous than the creeping variety on the same island at the beach sands of Moomomi. It is, however, identical with it with the exception of being arborescent; it may be distinguished as Sesbania tomentosa forma arborea Rock.

PLATE 65.

SESBANIA TOMENTOSA Hook. et. Arn.

Ohai.

Lonely Fishhook

By Russ and Peg Apple

NECKER ISLAND is a fishhook shaped volcanic rock, standing alone in an empty ocean, some 400 miles northwest of Honolulu.

Through some legal quirk, it is officially a part of the City and County of Honolulu, although no voters live there.

No one has lived there since the early Hawaiians abandoned it, probably centuries before Cook found Hawaii in 1778.

Necker's steep sides and usually rough water make landings on the island hazardous.

Once on a narrow ledge, there is no way to climb but up.

NECKER'S narrow ridge runs 150 to 200 feet above the ocean, with one point at 218 feet.

No trees. No shade. A little grass grows, just bare rocks and sea birds.

No drinking water. Any puddle of rain water that collects is contaminated by bird droppings.

THE FRENCH explorer La Perouse found Necker in 1786, and since he was heading west, made no direct report back to the Hawaiian people. Necker found its way onto maps made in Europe, and the maps eventually got to Hawaii.

LaPerouse sailed around Necker, decided not to try to land—the seas were too rough, but he named his discovery after Jacques Necker, the French finance minister of the time.

WHAT THE Hawaiians called the island is unknown.

Necker's existence, and the name the early Hawaiians used for it, were forgotten before the time of Kamehameha the Great.

If Kamehameha the Great had known about Necker island, he probably would have included it in the Kingdom of Hawaii he founded.

It was his grandson, Alexander Liholiho, ruling as Kamehameha IV, who first claimed it for the kingdom.

By 1854, the first year of the reign of Kamehameha IV, all the world, including Hawaii, was searching for guano, the "magic" fertilizer formed by the combination of bird droppings, sand, pressure and time.

Guano speeded up the growth of Hawaii's sugar cane, and it was hoped a supply of guano could be found close to Hawaii.

To find out if guano in commercial quantities could be found on the islands northwest of Kauai island, the King's privy council directed the minister of the interior to select a person to make the survey, and guano or not, to claim the islands in the name of Kamehameha IV.

CAPT. JOHN PATY was chosen.

There's a street named for him in Manoa valley.

Aboard the schooner *Manu-o-kawai*, Paty reached Necker on April 24, 1857, and sailed around the almost

vertical rock ten times in two days trying to find a landing place through the high surf. He finally gave up and sailed on.

Had he been able to get ashore, he had his official notice of taking ready.

PATY HAD made out forms ahead of time, ready to leave on the various islands. All Paty had to do was fill in the dates. The unused forms are still in his log, now safely kept by the Archives of Hawaii.

Paty's forms read:

"Visited and taken possession of, by order of His Majesty, King Kamehameha IV, for him and His Successors on the Hawaiian Throne, by the undersigned in the Schooner Manuokawai. This (blank) of (blank), A.D. Eighteen hundred and fifty seven. John Paty, Commander."

His first mate was supposed to sign as witness.

BUT ON NECKER, Paty could not get ashore to leave his official notice.

And the Americans who overthrew the monarchy years later suddenly needed Necker, and were not sure the government they had assumed really had a legal claim to the rocky island 400 miles northwest of Honolulu.

(To be continued)

Laying Claim to Necker

By Russ and Peg Apple

CAPT. JOHN PATY, aboard the schooner Manuokawai, had claimed Necker Island in 1857 for the Kingdom of Hawaii.

Or had he?

Paty had sailed ten times around the rocky islet some 400 miles northwest of Honolulu, looking for a place to land and deposit his official notice of taking.

High surf beating against the steep sides of Necker during the two days he sailed circles around it discouraged any attempts at even trying a landing.

Paty sailed on.

INTERNATIONAL law in those days required that a notice be placed ashore of any Pacific island claimed by a government.

There was no magic nor legal "taking" in ten turns around Necker in a schooner.

As long as no other nation wanted Necker — and, who would want that barren uninhabited volcanic rock sitting alone in a wild ocean? — Hawaii considered it owned Necker through the intention of Paty, and through owning the adjacent islands. These were Nihoa, closer to Honolulu, and French Frigate Shoals, on the other side of Necker.

But when England and Canada started to eye Necker in the 1890s, the government of Hawaii decided to remove all doubt as to ownership by planting an official notice-of-taking on Necker.

PATY'S TEN circumnavigations of Necker had given Hawaii's throne some claim to Necker. Whatever claim there was transferred at the overthrow of Queen Liliuokalani in 1893 to the Provisional Government.

Two British warships were in Hawaiian waters, and paying attention to Necker island. The ships were making soundings.

England wanted a Pacific cable to tie together her growing empire of Pacific Islands.

As early as 1888, England had talked about using Necker as a cable station.

England might claim Necker. There was no Hawaiian "paper" on the island.

Hawaii must plant the official notice before England did.

THEN ENGLAND made an offer. If the Provisional Government of Hawaii would permit England to use Necker as a cable station between Canada and Australia — New Zealand, then, without cost, England would lay a submarine cable from Necker to Honolulu and add Hawaii to her Pacific communications network.

The American businessmen who had overthrown the Hawaiian monarchy wanted a cable badly. Instant communication with American markets, suppliers and government was a business necessity.

But a tie to a British cable could put Hawaii back under British influence. Hawaii's sheep raisers wanted to sell their wool in America, at 20 cents a pound, rather than in London, for 10 cents. The United States paid Hawaii sugar planters a $40 a ton bonus. Many missionary descendants were against royalty, and had helped eliminate the Hawaiian variety. Already a British company ran Honolulu's street cars and held an exclusive franchise. British business interests were investing in Hawaii and buying land.

TO ELIMINATE the ownership question, and to get into a bargaining position on a cable to Hawaii, or to use the English offer as a way to force the U.S. to lay its own cable, the Provisional Government acted.

The Hawaiian steamer Iwa-lani put a government party ashore on Necker on May 27, 1894. Surf was down, and the group climbed to the highest peak to plant the Hawaiian flag and leave the "paper" near it in a copper cylinder. They posed for a picture doing it.

FOUR MONTHS later the British landed on Necker, too late to claim it. They found the copper cylinder and added the notation that they were making depth soundings in the vicinity.

The British cable deal? The U.S. Congress told Hawaii not to lease Necker to the British. Hawaii went along — the Provisional Government was promoting U.S. annexation in 1894. England later laid an undersea cable from Canada down under, but dealt Hawaii by then annexed to America, out.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Branch of Theoretical Geophysics
345 Middlefield Road
Menlo Park, California 94025

September 5, 1968

Mr. E. H. Bryan, Jr., Manager
Pacific Scientific Information Center
Bishop Museum
Honolulu, Hawaii

Dear Mr. Bryan:

On behalf of Dr. R. R. Doell and me, I would like to thank you once again for your help in obtaining maps and information concerning the Leeward Islands. The maps especially proved to be invaluable and of reasonably good quality.

Our trip to Nihoa and Necker Islands with Mr. Kridler and Mr. Sincock, U.S. Bureau of Sport Fisheries and Wildlife, was very successful and we were able to obtain the rock samples needed for our study. Landing proved to be much easier than expected as the seas were unusually calm. We were able to spend four days on Nihoa and two days on Necker.

You expressed some interest in rumors of military debris on the two islands and we can verify that these rumors are indeed true. The enclosed photographs show most of what is left on Nihoa. Mr. Kridler and Mr. Sincock spent some time disposing of an additional half-dozen or so rusty 55 gallon drums by throwing them into the sea. Several of these drums had rusted out on top, collected water, and become death traps for unwary birds. Other than the debris shown in the two photographs, Nihoa appears to be in fine shape.

The situation on Necker Island, however, is quite different. We found extensive remains of a military camp on Bowl Hill and on the flat ridge extending to the east. These remains include a half-full drum (55 gallon) of gasoline, an old triangular platform and standard (?), a tent platform measuring about 12-15 feet square, several cases of unopened rations (now rusted), and a rather extensive tin-can dump. Obviously the military had made no effort to clean up their disgraceful mess. Apparently, this debris is from an Air Force operation of several years ago--Mr. Kridler knows the details if you are interested.

In addition to the camp debris, there is bomb damage on Necker. Dr. Doell and I counted four distinct bomb craters in the vicinity of Annexation Peak and there are other pits that are probably due to bombs as

well. Some of these craters still contain what appears to be bomb fragments and all are near stone platforms. In fact, one heiau had suffered a direct hit. In addition, we found 50 caliber bullets (apparently fired from an airplane) and there is an unexploded bomb on the NE end of Northwest Cape. Unfortunately, we neglected to take our polaroid camera and so did not get any photos on Necker for you.

We thoroughly enjoyed our visit to Nihoa and Necker. Both Dr. Doell and I especially liked Necker because of the magnificent scenery available from any view and the well developed and numerous heiaus.

Thank you again for your help. We look forward to seeing you again on one of our trips to the islands.

Sincerely,

G. Brent Dalrymple

G. Brent Dalrymple
Geologist

Nihoa debris (1968)