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THE NATURAL HISTORY OF GARDNER PINNACLES,
NORTHWESTERN HAWAIIAN ISLANDS

by Roger B. Clapp

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THE NATURAL HISTORY OF GARDNER PINNACLES,

NORTHWESTERN HAWAIIAN ISLANDS¹

by Roger B. Clapp ^{2/}

INTRODUCTION

Gardner Pinnacles, located at 25°00'N, 167°55'W, (Figure 1) consists of two small volcanic rocks situated in the middle of the Northwestern Hawaiian Islands. Its nearest neighbors are the islands of French Frigate Shoals, 117 nautical miles to the southwest and Laysan Island, 204 nautical miles to the east-northeast. Barren, of no commercial value, and difficult to land on, these pinnacles are on the least visited islands of the chain.

Prior to recent investigations, almost all that was known of the biology of the Pinnacles was based on work done by the Tanager Expedition in 1923. Except for an aerial survey of the albatross population in 1957, no further biological work was done until 1963 when the Smithsonian Institution's Pacific Ocean Biological Survey Program (POBSP) undertook extensive surveys of the islands of the Central Pacific. During the study period (1963-1969) Gardner Pinnacles was visited twice by the POBSP and twice by personnel from the Bureau of Sport Fisheries and Wildlife. The latter visits were part of regular inspection patrols of the Hawaiian Islands National Wildlife Refuge of which Gardner Pinnacles is a part. Observations made on these four visits and the largely unpublished data obtained by Alexander Wetmore during the 1923 Tanager Expedition are the source of most new biological information presented in this report.

My purposes in preparing this report, one of a series on the islands and atolls of the Northwestern Hawaiian Islands, are several.

One aim is to present hitherto unreported observations on the vertebrate fauna and vascular flora, and to report the current status of these groups. These data are compared with previous information and, where possible, historical changes are indicated.

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2.

Another aim is to present a history of the islands that reports in detail biological work conducted there.

Much of the information on the biology of the Northwestern Hawaiian Islands is in unpublished manuscripts or is widely scattered throughout the literature. No single publication gives a concise summary of information on Gardner Pinnacles. Hopefully, this report will enable future workers quickly to assess the value of new data in various disciplines and will indicate areas of study that are still poorly known or are as yet unstudied.

I also hope that this report will stimulate further work on the biota of the island, particularly studies of a more quantitative nature than has been possible previously.

HISTORY OF GARDNER PINNACLES

All authorities on the discovery of the Northwestern Hawaiian Islands (e.g., Bryan, 1942; Stackpole, 1953; Sharp, 1960) agree that Gardner Pinnacles were discovered and named (as Gardner Island) by Captain Joseph Allen of the Nantucket whaler Maro. The Maro on its previous (and first) voyage to the Pacific had been the first American whaler to cross the mid-Pacific and had on that voyage the honor of being the co-discoverer of the famous Japanese whaling grounds. On this, its second voyage, the owners had given Allen specific orders to sail northwest from the Sandwich [Hawaiian] Islands.

On June 2, 1820, Allen found "a new island or rock not laid down on any of our charts -- Lat. $25^{\circ} -3'$ North, and by a good lunar we found the Longitude when within 3 miles of the land to be $167^{\circ} -40'$ West -- judge it to be 150 feet high,^{1/} about 1 mile in circumference. It has two detached humps...We call it Gardner's Island" (Stackpole, 1953: 269).

Gardner was sighted in 1826 by Lieutenant Hiram Paulding of the U.S. Schooner Dolphin. He reported his observations as follows:

"At three, P.M., on the fourth of January, a rock was reported from the mast-head, eight leagues from us. It proved to be Ballard's Island, as it is called. At eight on the following morning, we passed within two hundred yards of it. It is about two or three hundred yards in circumference, and rises two hundred feet from the sea. On one side it has a considerable inclination, where seals had crawled up, and several were basking in the sun, almost to the very top. Large flocks of birds were perched on its ragged sides, or wending their flight around it. Not the least sign of vegetation was any where to be seen. Near its base, was a small rock,

^{1/} Bryan (1942: 180) indicated that Allen had reported that the Pinnacles were 900 feet high. The height quoted in Stackpole (above) agrees with the original sources.

from ten to twenty feet above the water level. Ballard's Rock rises in three equi-distant peaks, the centre of which is the highest, and all of them, to the very base, are white with bird-lime. A high surf breaks all around it. Our observations placed it in north latitude, twenty-five degrees two minutes; west longitude, one hundred and sixty-seven degrees fifty minutes." (Paulding, 1831: 191-192).

The first recorded landing on the island occurred in March 1828 when crew members of the Russian vessel Moller, under the command of Captain Stanikowitch, went ashore. During this visit the ship's surgeon, C. Isenbeck, made observations of the avifauna which were later summarized by F.H. von Kittlitz (1834). Kittlitz's account was later translated and reprinted by Rothschild (1893-1900). Isenbeck reported the presence of at least 8 different species of birds but his identifications of some birds are clearly inaccurate.

No subsequent landings on the Pinnacles are known to have occurred until 1923. However, during this more than 90 year period, the island was observed from offshore on a number of occasions. In early 1857 Captain John Paty, who had been commissioned to visit the Northwestern Hawaiian Islands and determine the worth of their guano deposits, sailed by the island on a schooner Manuokawai. He reported that the island was 607 miles W-NW from Honolulu and that it was "merely two almost inaccessible rocks, 200 feet high, extending north and south about one-sixth of a mile. A bank extends off to the southwest some 15 or 20 miles. The bottom seemed to be covered with detached rocks, with sandy spaces between; I had 17 fathoms of water 10 miles south of the island." (Paty in Bryan, 1942: 180).

Two years later, on 10 January 1859, Lieut. John M. Brooke, commanding the U.S.S. Fenimore Cooper, visited the island and determined its position.

On 9 June 1891 Gardner was visited by the Kaalokai which was transporting members of the Rothschild Expedition to different islands of the Hawaiian Chain. The field party had intended to land at all islands of the Chain but had already failed to do so at Nihoa and Necker Islands, and could not land on Gardner Pinnacles because of rough seas (Palmer in Rothschild, 1893-1900: ix; Munro, 1941: 34-35). Palmer and Munro, members of the field party, did make a few bird observations.

On 3 February 1909, Gardner Pinnacles was included in the Hawaiian Islands Bird Reservation (Bryan, 1942: 182) as a result of Executive Order 1019 by Theodore Roosevelt. At that time the refuge was under the jurisdiction of the U.S. Bureau of Biological Survey, but it is now administered by the Biological Survey's successor, the Bureau of Sport Fisheries and Wildlife.

On 25 July 1940, Franklin D. Roosevelt's Presidential Proclamation 2416 changed the name of the Reservation to the Hawaiian Islands National Wildlife Refuge. Gardner, today, is still part of the

refuge and was given added protection in 1967 when it was designated a natural area within the refuge system by the Bureau of Sport Fisheries and Wildlife. Entry is by permit only and is limited to scientists on research programs.

The first significant biological survey of Gardner Pinnacles was made by the Tanager Expedition in May 1923. This expedition, which surveyed all the Northwestern Hawaiian Islands, was a cooperative venture organized and staffed by the U.S. Biological Survey and the Bernice P. Bishop Museum. Logistic support was provided by the U.S. Navy in the form of a 1,000-ton minesweeper, U.S.S. Tanager.

The ship arrived at the island on the evening of 21 May but did not land a field party until the following morning. At this time eight persons went ashore and remained on the island until about noon. These were Alexander Wetmore, leader of the field party, Stanley C. Ball, John Baker, Theodore Dranga, Eric L. Schlemmer, Ditlev Thaanum, Gerrit P. Wilder, and a Dr. Wilson.

Despite their short stay on the island, they obtained a wide variety of specimens. Thaanum and Dranga collected marine invertebrates; Baker and others caught fish; Wilder collected some algae and a specimen of the only vascular plant present; and Wetmore and Schlemmer collected some 22 bird specimens. Geological observations and collections of arthropods were made by Ball.

Many of the observations and collections were subsequently reported. Ball's geological observations were reported by Palmer (1927) and comments on the nature of the rocks were made by Washington and Keyes (1926). Fish were reported by Fowler and Ball (1925), various insects by Bryan et al. (1926), vascular plants by Christophersen and Caum (1931) and echinoderms and crustacea by Edmondson et al. (1925).

The only bird observations that were recorded, however, were a few brief comments and personal communications by Wetmore (1925; in Rice and Kenyon, 1962). Nonetheless, Wetmore made detailed notes on the birds, recording 15 species of which 8 were breeding. His observations and specimens, several of which constitute the earliest valid records of occurrence or breeding, are recorded in the body of this paper.

Since the Tanager survey, four short visits have increased our knowledge of the biota; two surveys made by the POBSP (June 1963, May 1967) and two inspections conducted by the Bureau of Sport Fisheries and Wildlife (September 1966, June 1969).

On 16 June 1963 a POBSP survey team aboard the Naval vessel U.S.S. Tawakoni (ATF-114) arrived at Gardner Pinnacles. The survey team, composed of Fred C. Sibley and A. Binion Amerson, Jr., landed by whale boat at the southeastern tip of the larger island at 0800 and spent the next seven hours surveying the fauna of the island. Most effort was expended in surveying the avifauna but a small sample of some of the arthropods present (earwigs, silverfish, flies, dermestids, other beetles, ticks) was collected as well. Occurrence of ticks was later reported by Amerson (1968).

Fifteen species of birds, 11 of which were breeding, were recorded. Of ornithological note was the discovery of breeding populations of Bulwer's Petrels, Wedge-tailed Shearwaters and Brown Boobies, species previously not known to breed on Gardner Pinnacles. No bird specimens were collected but 416 individuals of 8 species were banded (Table 1).

Table 1. Birds banded on Gardner Pinnacles 16 June 1963 by POBSP personnel

Species	Adults	Immatures	Chicks	Totals
Laysan Albatross	1	--	7	8
Bulwer's Petrel	7	--	--	7
Wedge-tailed Shearwater	21	--	--	21
Red-tailed Tropicbird	20	--	--	20
Blue-faced Booby	34	16	45	95
Gray-backed Tern	--	--	99	99
Brown Noddy	--	--	152*	152
White Tern	<u>11</u>	<u>--</u>	<u>3</u>	<u>14</u>
Totals	94	16	306	416

*An undetermined number of these birds were misidentified; they were actually young Black Noddies (See page 21).

On 16 September 1966 Gardner was visited for about two hours (c. 0910-1100) by a field party that arrived on the U.S. Coast Guard Cutter Ironwood (WAGL-297). The field party was composed of Eugene Kridler and Karl W. Kenyon (Bureau of Sport Fisheries and Wildlife), Ronald L. Walker (Hawaiian Division of Fish and Game) and Sherwin Carlquist (Claremont College, Claremont, California). A few limpets and arthropods were collected but most effort was directed toward bird observation. Fourteen species of which 7 were breeding were observed. The presence of Golden Plovers was recorded for the first time.

POBSP personnel surveyed Gardner Pinnacles for three hours (0830-1130) on 26 May 1967. The field party, which had been transported by three Navy tugs, included Robert L. DeLong, David L. Burckhalter, Dennis L. Stadel, F. Christian Thompson, and Robert Tuxson. Fourteen species of birds of which 11 were breeding were recorded. One species, the Blue-gray Noddy, was recorded breeding for the first time. No birds were banded but four returns (2 from Blue-faced Boobies, 1 from a Red-tailed Tropicbird, and 1 from a White Tern) and one recovery (of a Blue-faced Booby) were obtained.

On 1 June 1969 the island was visited from the University of Hawaii vessel Mahi by a field party led by David L. Olsen of the Bureau of Sport Fisheries and Wildlife. Olsen and two university scientists, James McVay and Thomas Clark, spent about four hours (c. 0750-1140) on the island and in surrounding waters. Eight species of birds were noted; five of these were found breeding.

Observations of the birds of Gardner Pinnacles have been made in recent years on a number of other occasions, either by aerial survey (December, 1957) or from offshore (June 1962; March, 1964, 1966, 1967). Few of these observations added anything of significance to our knowledge of the avifauna. Those that did are included in the species accounts.

DESCRIPTION

The two islands of Gardner Pinnacles are the westernmost volcanic islands in the Hawaiian area and stand on the northeastern part of a bank 20 by 50 miles in extent and with depths of from 9 to about 40 fathoms (Gr. Brit., Hydrographic Off., 1946: 299).

The smaller, more northwestern of the two islands is about 250 feet long and 100 feet wide and rises to about 100 feet at its peak (Fig. 2). The larger island, about 150 feet to the southeast, is about 700 feet long, 500 feet wide and rises to two distinct peaks (Palmer, 1927: 32; Bryan, 1939: 15). The larger of these peaks was formerly about 170 feet high but blasting away of the top of the peak by military personnel reduced its height somewhat. This was done in March 1961 to provide sites for first order astronomic and HIRAN stations (Roach, ms.) Between them the two islets have an area of about 3 acres (Freeman, 1951: 330). Between these two islets is a small rock that rises but a few feet above sea level (Palmer, op. cit.).

The rocks are liberally coated with guano, which from a distance gives them a snowcapped appearance. The cliffs are steep, but, once a landing has been affected, one can walk around the base of the larger island and to both peaks (Figs. 3-6).

GEOLOGY

Gardner Pinnacles is one of the several Northwestern Hawaiian Islands composed solely of volcanic rock. The Pinnacles, like other volcanic islands of the chain, stand on an extensive submerged platform that suggests that they are the eroded remnants of a formerly much larger volcanic island. Palmer (1927: 33) suggested that the area of the island had originally been about 80 square miles intermediate in size between Lanai and Kahoolawe. Gardner Pinnacles are believed to be intermediate in age between the older, more northwesterly Leeward islands and the younger Main Hawaiian islands (Bryan, 1954: 7-8).

Palmer (op. cit.) stated that all exposed rocks are basalt, most of which originated from flowing lava. Most of the rock is a "fine grained, very dark gray or nearly black basalt, with few if any vesicles, and with a few small phenocrysts of olivine." A detailed petrographic description of a rock specimen was given by Washington and Keyes (1926: 349) as follows: "the rock is dark gray, very dense, aphanitic and aphyric, with some very small vesicles filled with calcite." The rock was much decomposed and was "very fine grained,

containing many granules of augite with smaller ones of magnetite, which lie in a colorless base, of rather high refractive index, that Dr. Bowen thinks is probably prehnite. No unaltered feldspar, or at least very little, is present, and no olivine is visible."

BOTANY

The only vascular plants that grow on Gardner are some small patches of a Portulaca found in various locations on the slopes. Bryan (in Bryan et al., 1926) reported that these patches of plants were Sesuvium but his comment is evidently a lapsus calami. These plants were recorded by the Tanager Expedition in May 1923 and on the recent surveys of June 1963, September 1966, and May 1967. The only specimen that has been collected was one collected by Gerrit P. Wilder on 22 May 1923.

Regarding this specimen, Christophersen and Caum (1931: 8) wrote that it "had disappeared from the general collection of the Tanager Expedition" leaving the duplicate field label as the only record. Recently, the long missing specimen (Wilder No. 10) returned to the Herbarium of the B.P. Bishop Museum from the Netherlands. In August 1969, R. Geesink identified the specimen as Portulaca lutea Sol. (D.L. Herbst, pers. corres.), a plant of widespread distribution in the central Pacific area.

Spiney seeds of Tribulus cistoides L., apparently brought to the island on the feet or plumage of seabirds, were also found in 1923 (Wetmore, 1925: 82), but the plant is not known to grow on Gardner.

VERTEBRATE FAUNA

Reptiles and Mammals

POBSP personnel saw a single Green Turtle (Chelonia mydas) swimming offshore 16 June 1963 and another individual, about two feet long, was seen offshore on 16 September 1966 (Kridler, ms., b.). This turtle, not previously recorded from Gardner Pinnacles, does not breed there since the pinnacles afford no suitable nesting habitat. Presumably the turtles seen in 1963 and 1966 were wandering individuals from populations on other of the Northwestern Hawaiian Islands.

The only mammal occurring on Gardner is the Hawaiian Monk Seal which was first noted in 1826 by Hiram Paulding (1831: 191). These seals were not seen there again for over 130 years. This absence of records probably stems from a paucity of observations of the Pinnacles rather than an absence of seals since these mammals have been seen quite regularly during recent visits to the islands.

On the first POBSP survey (16 June 1963) the field party saw two seals sunning themselves on the smaller of the two islands. On 16 September 1966, Kridler's field party saw five seals, four resting on the smaller island, another swimming nearby. Six were seen on the

second POBSP survey (26 May 1967), again on the smaller island. These seals were hauled out on a ledge about 2 feet above the water surface which was reached by riding the swells. On 1 June 1969 Olsen saw six hauled up on the small island. No evidence that breeding occurs on this island has been found.

Birds

Composition of the Avifauna

At present 19 species of birds have been reported from Gardner Pinnacles, not including two species (Christmas Shearwater, Harcourt's Storm Petrel) recorded only from offshore (Table 2). The record for one (White-tailed Tropicbird) of the 19 species recorded from the island is of doubtful validity with the result that only 18 species are certainly known to have occurred there.

Twelve species are known to breed on Gardner Pinnacles but five (Laysan Albatross, Bulwer's Petrel, Wedge-tailed Shearwater, Brown Booby, Blue-gray Noddy) are uncommon with none having breeding populations much exceeding several dozen birds.

Two other species (Red-footed Booby, Great Frigatebird) that breed commonly on other Northwestern Hawaiian Islands occur on Gardner only as visitors. The reason that neither species breeds there may well be that the island lacks sufficient vegetation to permit either to build nests.

Only a few species of shorebirds and vagrants are known from Gardner, partly because so few observations have been made, partly because the Pinnacles lack habitat that would attract shorebirds and the kinds of vagrants most commonly occurring in the Northwestern Hawaiian Islands (ducks and gulls).

Historical Changes in the Size of Populations

Few of the breeding populations appear to have changed much in the last 45 years. Gray-backed Terns, Sooty Terns, and particularly Brown Noddies apparently have increased significantly in numbers since 1923. The number of Blue-faced Boobies, on the other hand, evidently has decreased substantially.

Recent estimates are somewhat larger than in 1923 for three other breeding species (Laysan Albatross, Red-tailed Tropicbird, Black Noddy) and somewhat smaller for another (White Tern) but the differences in the estimates from the two periods are not sufficiently large so that any real change is clearly indicated.

Four other species (Bulwer's Petrel, Wedge-tailed Shearwater, Brown Booby, Blue-gray Noddy) were not known to breed on Gardner until very recently but it is likely that they have bred there in small numbers for many years.

Table 2. The avifauna of Gardner Pinnacles

Species	Current Status	Maximum Population Estimate	Date when Maximum Estimate Recorded
RESIDENT SEABIRDS OF THE NORTH CENTRAL PACIFIC			
Laysan Albatross	Uncommon breeder	14	June 1963
Bulwer's Petrel	Uncommon breeder	25	June 1963
+ Wedge-tailed Shearwater	Uncommon breeder	c. 25	June 1963
Red-tailed Tropicbird	Common breeder	100	June 1963
Blue-faced Booby	Common breeder	800	May 1923
Brown Booby	Uncommon breeder	20	June 1969
Red-footed Booby	Occasional visitor	12	May 1923
Great Frigatebird	Common visitor	250	May 1923
Gray-backed Tern	Abundant breeder	4,000	May 1967
*+ Sooty Tern	Common breeder	500-1,000	June 1963
+ Blue-gray Noddy	Uncommon breeder	c. 20	May 1967
Brown Noddy	Abundant breeder	5,000	June 1963
Black Noddy	Common breeder	400	May 1967
+ White Tern	Common breeder	300-400	May 1923
SHOREBIRDS			
* Golden Plover		2	September 1966
Wandering Tattler		1-2	May 1923, 1967, 1969
* Ruddy Turnstone		15	May 1923
VAGRANTS			
* Gull sp.		1	March 1967
HYPOTHETICAL AND RECORDED ONLY OFFSHORE			
Harcourt's Storm Petrel	Hypothetical offshore visitor	--	--
White-tailed Tropicbird	Hypothetical visitor	--	--
Christmas Shearwater	Offshore visitor	--	--

+Breeding not reported previously

*Not previously reported from Gardner Pinnacles

Banding

Only four of the 416 birds banded by the POBSP (Table 1) were recaptured at Gardner Pinnacles by the POBSP; a very few were recaptured in other areas. Returns, where significant, and movements are given in the various Species Accounts.

Specimens

The only bird specimens collected on Gardner Pinnacles are those obtained by Wetmore on 22 May 1923. All are now located in the National Museum of Natural History. These specimens are listed in Table 3.

Table 3. Bird specimens collected by Wetmore on Gardner Pinnacles

Species	No. of Specimens Collected	Sex and Museum Numbers of Specimens
Wedge-tailed Shearwater (<u>Puffinus pacificus</u>)	1	♂, USNM 300726
Red-tailed Tropicbird (<u>Phaethon rubricauda</u>)	3	♂, USNM 300989; ♀, USNM 300998; juv. ♂, USNM 300990
Blue-faced Booby (<u>Sula dactylatra</u>)	2	♂, USNM 300946; ♀, USNM 300945
Great Frigatebird (<u>Fregata minor</u>)	1	♀, USNM 465204
Ruddy Turnstone (<u>Arenaria interpres</u>)	2	♂♂, USNM 367383, 393507
Gray-backed Tern (<u>Sterna lunata</u>)	3	♂♂, USNM 300649, 300650; ♀, 300651
Sooty Tern (<u>Sterna fuscata</u>)	3	♂, USNM 300358; ♀♀, USNM 300539, 300540
Blue-gray Noddy (<u>Procelsterna cerulea</u>)	3	♂, USNM 300387; ♀♀, USNM 300428, 300429
Brown Noddy (<u>Anous stolidus</u>)	1	♀, USNM 300521
Black Noddy (<u>Anous tenuirostris</u>)	2	♂, USNM 300458; ♀, USNM 300454
White Tern (<u>Gygis alba</u>)	2	♂, USNM 300415; ♀, USNM 300416

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Species Accounts

In the following species accounts, **brackets** around accounts indicate that occurrence on the island is not adequately substantiated.

LAYSAN ALBATROSS

Diomedea immutabilis

Although Rice and Kenyon (1962: 376) state that they found no published references to albatross on Gardner Pinnacles other than a statement that Laysan Albatrosses breed there (A.O.U., 1957: 9), there are at least two earlier published references, one of which (Bryan, 1901: 266) probably derives from the other (Rothschild, 1898-1900: iii). Rothschild's translation of the account of Isenbeck's visit in March 1828 stated that an albatross "white, with flesh-coloured

bill, varying with white; grey and black wings...[was] plentiful on Gardner, where they seemed to live on the highest parts." This description best fits the Laysan Albatross but other observations and descriptions in this account are often inaccurate or incomplete. Possibly Isenbeck's observations were of Blue-faced Boobies. Recent observations of the birds of Gardner Pinnacles indicate that these boobies are abundant near the tops of the larger pinnacle, while albatrosses are scarce (Table 4).

Table 4. Recent observations of Laysan Albatrosses on Gardner Pinnacles

<u>Date of Survey</u>	<u>Estimated Adult Population</u>	<u>Remarks</u>
22 May 1923	4	Two nearly grown young found on the northwestern slope in small depressions in the rock about 100 feet above the water (Wetmore, ms.)
28 December 1957	3	Two seen on pinnacle, one flying nearby, during aerial survey by Rice and Kenyon (1962: 376). Nesting could not be ascertained but Rice and Kenyon believed that a pair might be breeding there.
16 June 1963	14	Seven large chicks banded on the higher slopes of the pinnacles (POBSP).
26 May 1967	2	One large chick found (POBSP).
1 June 1969	0	None present (Kridler, <u>pers. comm.</u>)

BULWER'S PETREL

Bulweria bulwerii

There are only two certain records, both recent, of Bulwer's Petrels from Gardner Pinnacles, but an earlier observation, interpreted by Rothschild (1893-1900: v) as a record of the Christmas Shearwater (which see), may have been of this species. On 16 June 1963 POBSP personnel found ten nests, all containing eggs, and estimated an adult population of about 25 birds (Clapp and Woodward, 1968: 7). On 16 September 1966, Kridler (ms., b) saw an adult in a crevice and found three young, all nearly fledged. These observations suggest that egg-laying occurs in May or June and that the breeding season is completed sometime in September which agrees well with the nesting cycle proposed by Richardson (1957: 18) for other breeding stations in the Northwestern Hawaiian Islands.

WEDGE-TAILED SHEARWATER

Puffinus pacificus

Wedge-tailed Shearwaters were reported from the Pinnacles by Rothschild on the basis of observations made in March 1828 by Isenbeck. In this instance, as in several others, the description was not detailed enough for reliable identification, and re-examination of it suggests that Rothschild's identification may have been incorrect.

The bird that Rothschild (1893-1900: v) identified as a Wedge-tailed Shearwater was described as "[a] Petrel, a little larger [than 9 inches long], breast, abdomen, and neck white; upper surface mixed white and brown; the forked tail only moderately emarginate." This description could apply as easily to a young Gray-backed Tern, which has a speckled back, white underparts, and a forked tail, as it could to a Wedge-tailed Shearwater, which has a cuneate tail and whose upperparts show little white and only on new feathers. Isenbeck did not distinguish between terns and petrels in his vernacular identifications. Another bird whose description clearly identifies it as an adult Gray-backed Tern (and identified as such by Rothschild) was referred to as a "Petrel" by Isenbeck.

Recent observations confirm that Wedge-tailed Shearwaters occur and breed on Gardner Pinnacles but suggest that the population is small. Wetmore (ms.) found a single bird deep in a crevice on the western face of the island, but his companion, Stanley C. Ball, saw two others. Wetmore's notes do not indicate that he found any nesting birds.

On 16 June 1963 POBSP personnel discovered nesting Wedge-tailed Shearwaters. Twenty-one adult shearwaters were taken from rocky crevices and banded. Stage of incubation was not checked but the presence of only eggs in mid-June suggests that most laying occurs about June in this colony as in other colonies in the Northwestern Hawaiian Islands (see Richardson, 1957: 17).

Kridler (ms., b) found four downy young in mid-September 1966. This indicates that the breeding season would not have been completed for at least another month.

In late May 1967, POBSP personnel again recorded these shearwaters on Gardner Pinnacles. Several birds flushed from holes in the rocks, but the single cavity examined was empty. About 20 shearwaters were believed present but nocturnal populations may have been larger. The total breeding population, however, is certainly not very large, and is probably comprised of less than 100 birds.

[CHRISTMAS SHEARWATER]

Puffinus nativitatus

In March 1828 Isenbeck saw a petrel on Gardner Pinnacles that he described as "about 9 inches long; all over deep chestnut-brown, with blackish bill and feet and a cuneate tail" (Isenbeck in Rothschild, 1893-1900: v). Rothschild believed that this description referred to the Christmas Shearwater and therefore recorded that species from Gardner Pinnacles.

This description fits Bulwer's Petrel better than it does the Christmas Shearwater, and, since in at least one other instance Isenbeck identified a tern as a petrel (Rothschild, 1893-1900: v), could conceivably have referred to an immature Brown Noddy.

Rothschild's interpretation of Isenbeck's observation is the only record of Christmas Shearwaters on Gardner Pinnacles. Neither Wetmore

nor any subsequent observer found any of these shearwaters on the island. The only recent record of their occurrence in the vicinity of Gardner is Wetmore's observation (ms.) of one or two flying around the Tanager offshore.]

[HARCOURT'S STORM PETREL

Oceanodroma castro

Peterson (1961: 318) gives the range of Harcourt's Storm Petrel in the Hawaiian Islands as from Gardner Pinnacles to the main islands. His inclusion of Gardner Pinnacles apparently has as its basis Munro's observation (1944: 29) that he and Palmer had seen a white-rumped storm petrel on 10 June 1891, the day before their ship, the Kaalokai, reached Gardner Island. Munro (and apparently Peterson after him) assumed that a white-rumped storm petrel could only be Oceanodroma castro. Recent observations and collections in the Northwestern and main Hawaiian Islands indicate that Leach's Storm Petrel (Oceanodroma leucorhoa) occurs regularly at sea in the area (Bryan, 1965: 79; Throp, 1967: 83; Clapp and Woodward, 1968: 9-10) and suggest that many early sight records of castro were actually of O. leucorhoa. In any case there is no evidence that Harcourt's Storm Petrel occurs or has occurred on Gardner Pinnacles.]

RED-TAILED TROPICBIRD

Phaethon rubricauda

Red-tailed Tropicbirds are stated to occur on Gardner Pinnacles in both the A.O.U. Checklist (A.O.U., 1957: 28) and Richardson (1957: 19). These records (for which no further details are given) probably are based on the otherwise largely unpublished observations of Alexander Wetmore.

The only other published record that I have found is Henry Palmer's comment (in Rothschild, 1893-1900: ix) that he had seen "the Tropicbird" (presumably the Red-tailed Tropicbird) when he passed Gardner Pinnacles in June 1891.

Other observations of this species on Gardner Pinnacles are presented in Table 5.

R.R. Fleet (pers. comm.) states that the incubation period of Red-tailed Tropicbirds is about 43 days. Using this datum I can interpolate from the nesting data given below and arrive at crude estimates of peak egg laying periods in each year. A peak of egg laying evidently occurred in April 1923 and another peak occurred in May or June 1963. The 1967 observations may indicate an April or May peak of laying. The breeding cycles in both 1963 and 1967 (barring disruption of nesting cycles through nest failure) evidently began later than in 1923.

A Red-tailed Tropicbird banded as a nestling, 16 June 1963, was found incubating an egg on 26 May 1967, demonstrating that age of first breeding may be as little as four years. (Unpublished POBSP data from other Northwestern Hawaiian Islands indicate that age of first breeding may be as little as three years.)

Table 5. Recent observations of Red-tailed Tropicbirds on Gardner Pinnacles

Date of Survey	Estimated Population	Remarks
22 May 1923	c. 30*	One or two birds with eggs found; others seen with young from four days to a week old (Wetmore, ms.)
16 June 1963	100	Many nesting in crevices and holes and under rocky overhangs. All nests examined contained eggs (POBSP).
16 September 1966	?	Four adults seen. Two large young with nearly-complete juvenal plumage were found two-thirds of the way up the main pinnacle (Kridler, ms., b).
26 May 1967	35	16 of 17 nests found contained eggs; the other contained a chick about a week old. Nests in caves or under rock piles. Considerable egg mortality caused by eggs being displaced from nest sites (POBSP).
1 June 1969	24	Seen flying about the island. No nests found (Olsen, ms.)

*Estimate is of the number of breeding birds.

[WHITE-TAILED TROPICBIRD

Phaethon lepturus

Only a single observation suggests that the White-tailed Tropicbird could be included in the avifauna of Gardner Pinnacles. In March 1828 Isenbeck (Rothschild, 1893-1900: iv) saw a single "Phaethon (an candidus?) [sic] with white, somewhat broad tail-feathers" flying high in the air near Gardner Pinnacles. If this observation was indeed of a White-tailed Tropicbird, the bird may have been a wanderer from the populations breeding in the main Hawaiian Islands.]

BLUE-FACED BOOBY

Sula dactylatra

All data on Blue-faced Boobies on Gardner Pinnacles, aside from a statement that it breeds there (Richardson, 1957: 20) are observations made by Wetmore on 22 May 1923, and those made by the few subsequent observers (Table 6).

These data indicate a marked decrease in the number of breeding birds between 1923 and 1963. This decrease may have been caused by the demolition of the top of the main pinnacle by military personnel. Both Wetmore and the POBSP observers noted that these boobies nested primarily on the upper third of the larger pinnacle. In May 1967, in fact, the area of greatest nest density was the area leveled by the blasting (Fig. 7).

Table 6. Observations of Blue-faced Boobies on Gardner Pinnacles

Date of Survey	Estimated Population	Remarks
22 May 1923	800*	Nesting varied from nest-site selection to well-grown young. Some post-fledging young also seen (Wetmore, ms.).
16 June 1963	150	72 nests and recently fledged young counted, including 3 nests with eggs (4 percent of the breeding population), 53 nests with small to large young (74 percent) and 16 immature birds (22 percent) (POBSP).
16 September 1966	80	15 immatures, all capable of flight, and one small downy young (about a week old) counted (Kridler, ms., b.).
26 May 1967	250	An estimated 120 breeding pairs were present, 15 percent with nests with eggs, 15 percent with naked and small downy young, 60 percent with medium-sized to large downy young, and 10 percent with immatures (POBSP).
1 June 1969	75	Most with half-grown young (Olsen, ms.).

*Estimate is of the number of breeding birds.

By interpolation from known incubation and fledging periods (together about 170 days [Dorward, 1962]), some statements may be made about the length of the breeding season, and, in the case of POBSP observations, when most egg-laying occurred. The presence of well-grown young in May 1923 indicates that some birds must have been nesting in the preceding March or even earlier. The POBSP data suggest that in 1963 most egg-laying occurred in March-April and that in 1967 most egg-laying occurred in a roughly similar period. The presence of recently hatched young in June 1963 and May 1967 and of downy young in September 1966 indicates that an occasional pair of Blue-faced Boobies may be found breeding in almost any month of the year. It seems likely that relatively few nest during the late fall and winter months and that most nest during spring and summer.

In only one instance has a club, a tightly packed aggregation of roosting birds, been seen on Gardner Pinnacles. Eight birds were roosting together on top of the larger pinnacle when the POBSP survey team arrived at the island at 0830, 26 May 1967. It is likely that larger aggregations roost on the island at night.

Two Blue-faced Boobies of the 95 banded by the POBSP were subsequently recaptured on other islands. One banded as an adult was recaptured 18 September 1964 on Laysan Island, 204 nautical miles to

the west-northwest; the other banded as a nestling was recaptured 28 February 1965 (as an adult) on Sand Island, Johnston Atoll, 495 nautical miles to the south-southwest.

BROWN BOOBY

Sula leucogaster

The Brown Booby is the least common breeding bird on Gardner Pinnacles and apparently has been uncommon there for at least the last 45 years. A single Brown Booby was seen on the western rock by members of the Tanager party in May 1923 (Wetmore, ms.). POBSP survey teams saw few during their two surveys. On 16 June 1963 one was found incubating two eggs (Clapp and Woodward, 1968: 12) and on 26 May 1967 three adults and a nestling were seen. Kridler (ms., b.) saw four adults and a flying immature on 16 September 1966, and on 1 June 1969 Olsen (ms.) recorded 20, most of which had young.

RED-FOOTED BOOBY

Sula sula

Red-footed Boobies apparently occur on Gardner Pinnacles only as visitors. On 22 May 1923 Wetmore (ms.) saw about a dozen flying about the island at daybreak but found none roosting on the island. POBSP personnel found a single immature or subadult bird roosting on the island on 16 June 1963 (Clapp and Woodward, 1968: 11) and Kridler (ms., a.) saw two flying above the pinnacles in March 1966. Judging from nocturnal observations on other of the leeward islands, it is probable that larger numbers may be found roosting there at night.

GREAT FRIGATEBIRD

Fregata minor

Great Frigatebirds occur at Gardner Pinnacles only as visitors. They were first recorded in March 1828 by Isenbeck. Kittlitz (in Rothschild, 1893-1900: iii-iv) believed that the immature and sub-adult-plumaged birds that were seen comprised a different species from what are now known to be adults. He reported that Isenbeck had seen a single "Tachypetes aquilus" (= adult Great Frigatebird) and that the other species (= immature and sub-adult Great Frigatebirds) was common.

All recent visitors to the island have seen Great Frigatebirds flying over the pinnacles or roosting upon them but have found none nesting. Wetmore saw about 250 frigatebirds in May 1923. POBSP personnel found several hundred roosting there in June 1963 and saw about 70, some of them roosting on the outer pinnacle, in May 1967. Kridler (ms., b.) estimated that about 200 roosted on the island in September 1966.

It seems likely that the near-absence of vegetation and the concomitant reduction in nest sites, or perhaps more importantly the lack of nest materials, has prevented the colonization of Gardner Pinnacles by both this species and the Red-footed Booby.

GOLDEN PLOVER

Pluvialis dominica

Two plovers seen by Kridler (ms., b) on 16 September 1966 constitute the only record for Gardner Pinnacles.

WANDERING TATTLER

Heteroscelus incanum

Tattlers have been seen on the five most recent surveys on Gardner Pinnacles and are evidently the shorebird most likely to occur there. Wetmore (ms.) saw one or two of these birds running about the rock ledges near the edge of the water on 22 May 1923. POBSP personnel saw a single tattler three separate times on 16 June 1963. In one instance this bird was seen on top of the island. Kridler (ms., b.) saw another tattler 16 September 1966, POBSP personnel saw two on 26 May 1967 and Olsen (ms.) saw one on 1 June 1969.

RUDDY TURNSTONE

Arenaria interpres

Ruddy Turnstones have been seen three times on Gardner Pinnacles. On 22 May 1923 Wetmore recorded a flock of about 15 near the water. Kridler (ms., b.) saw six on 16 September 1966 and POBSP personnel reported a single turnstone on 26 May 1967.

A turnstone that Wetmore collected had recently eaten a tern's egg.

GULL

Larus sp.

On 15 March 1967, while passing north of Gardner Pinnacles, Kridler observed what he believed was a Glaucous-winged Gull (Hackman, pers. corr.), but substantive details are lacking. Isenbeck reported that "a large gull, with flesh-coloured beak [was seen] in great numbers around the top of Gardner Island" (Rothschild, 1893-1900: v). Although gulls frequently occur in the Northwestern Hawaiian Islands, they are never seen in such numbers as Isenbeck indicated. Presumably Isenbeck's observation referred to some other species, possibly the Red-footed Booby.

GRAY-BACKED TERN

Sterna lunata

Kittlitz (in Rothschild, 1893-1900: v) reported a bird that Isenbeck indicated was numerous and breeding on the Pinnacles in March 1828. From Isenbeck's description, Kittlitz identified it as a "Sterna (?)." Rothschild (op. cit.) translated the description as "about 9 inches long; white, with greyish wings, back and crown; tail with two long lateral rectrices" and identified the bird as the Gray-backed Tern. Table 7 presents subsequent observations of Gray-backed Terns from survey parties that landed on Gardner.

Richardson (1957: 24) summarized available information on breeding cycles of Northwestern Hawaiian Islands birds and stated that "adults apparently arrive at breeding islands in late February or early March." He further indicated that egg-laying occurred in March or April. Although a large proportion of the 1967 population seems to have been following this regime, nearly half the population apparently laid eggs in months other than March or April. (Most of the eggs in the 400 nests with eggs probably were laid in May and some of the flying immatures probably came from eggs laid in February). Similarly, since the Gray-backed Tern incubation period is about one month, the many eggs present in June 1963 could not have been laid earlier than May although most of the young probably came from eggs laid in March or

April. The 1923 and 1969 observations, on the other hand, agree well with the breeding cycle proposed by Richardson. The data thus indicate that the peak laying periods are somewhat variable from year to year and that eggs may be laid from as early as late February through at least late May.

Two of the 99 young Gray-backed Terns banded 16 June 1963 by the POBSP were later recaptured on other islands. One was recaptured 31 August 1965 on Whale Island, French Frigate Shoals, at a distance of about 117 nautical miles to the southeast of Gardner Pinnacles. The other was stoned to death on 8 September 1963 by boys at the Mission at Kieta ($6^{\circ}13'S$, $155^{\circ}38'E$) on Bougainville Island in the Territory of New Guinea. This locality is approximately 4,600 nautical miles to the southwest of Gardner Pinnacles.

Table 7. Recent observations of Gray-backed Terns on Gardner Pinnacles

<u>Date of Survey</u>	<u>Population</u>	<u>Remarks</u>
22 May 1923	1,400	Some terns sitting on eggs but most with young, some of these more than a week old (Wetmore, ms.).
16 June 1963	2,000	Many incubating eggs; others observed with young (POBSP).
16 September 1966	--	One immature seen flying overhead (Kridler, ms., b.). The breeding population evidently had left the island.
26 May 1967	4,000	Perhaps no less than 3,400 breeding birds present. All stages of nesting observed. <u>Ca.</u> 400 nests with eggs; 800 small to large downy chicks, and 500 flying immatures seen. Eggs found varied from fresh to heavily incubated (POBSP).
1 June 1969	750	Most numerous bird on island; most birds with young varying in age from recently hatched young to fledged birds. Some pipped eggs present (Olsen, ms.).

SOOTY TERN

Sterna fuscata

Bryan and Greenway (1944: 119) indicate that the occurrence of Sooty Terns on Gardner Pinnacles is based on a sight record published by Rothschild (1893-1900). I checked this volume thoroughly but was unable to discover any mention of the occurrence of Sooty Terns on the pinnacles. That this record was in error was overlooked by Clapp and Woodward (1968). Hence, the observations given below constitute the first valid report of Sooty Terns from Gardner Pinnacles (Table 8).

Table 8. Observations of Sooty Terns on Gardner Pinnacles

<u>Date of Survey</u>	<u>Size of Breeding Population</u>	<u>Remarks</u>
22 May 1923	100-150	Most breeding on higher ledges with smaller numbers breeding among nesting Gray-backed Terns (Wetmore, ms.).
16 June 1963	500-1,000	Most incubating eggs but a few with chicks. A very few immatures seen flying about the island (POBSP).
16 September 1966	--	One half-grown young seen and a single adult heard (Kridler, ms., b.). Breeding season evidently completed.
26 May 1967	800	Most nesting birds with young, a few incubating eggs. Most young several weeks old but young from about a week old to near-fledging seen. About ten times as many rotten eggs as live young present (POBSP).
1 June 1969	--	A single dead bird found (Olsen, ms.).

Data presented in this table suggest that the population may have increased since 1923, and may also indicate that the peak of egg-laying varies from year to year. In 1963 the predominance of incubated eggs suggests that most eggs had been laid in the preceding May. In 1967 the predominance of chicks and rotten eggs suggest that most egg-laying occurred in April. The absence of these terns in June 1969, though unexpected, is perhaps explicable in terms of a complete nesting failure, or failure to nest, earlier in the year.

BLUE-GRAY NODDY

Procelsterna cerulea

Blue-gray Noddies have been seen three times on Gardner Pinnacles but only the June 1963 observations were previously reported (Clapp and Woodward, 1968: 29). POBSP personnel saw 8 to 10 of these birds 16 June 1963. Most were sitting on the north side of the sheer cliffs but four were seen on the cliffs on the east side where Wetmore saw them.

Previously, on 22 May 1923, Wetmore (ms.) saw "about a dozen" Blue-gray Noddies and collected three of them.

On neither of these visits to Gardner Pinnacles was any confirmation of their breeding status obtained. On 26 May 1967, however, POBSP personnel found two eggs deposited on the exposed surface of the rocks near a nesting colony of Gray-backed Terns. On that date an estimated 20 Blue-gray Noddies were seen.

BROWN NODDY

Anous stolidus

Clapp and Woodward (1968: 30) first reported Brown Noddies from Gardner Pinnacles on the basis of a visit made by the POBSP in June 1963 and also reported offshore observations made in March 1967. Table 9 adds more recent POBSP observations and previously unreported observations made by other survey parties landing on the island.

Table 9. Observations of Brown Noddies on Gardner Pinnacles

<u>Date of Survey</u>	<u>Estimated Population</u>	<u>Remarks</u>
22 May 1923	250	Most nesting on the ledges in open colonies. Most terns were on eggs but one or two nearly grown young were observed as well (Wetmore, ms.).
16 June 1963	5,000	Many nests with eggs; about 400 nestlings present (POBSP).
16 September 1966	700-800	About 100 young from half-grown to nearly fledged were observed (Kridler, ms., b.).
26 May 1967	4,000	A census of part of the colony (487 nests and young) revealed 78 percent nests with eggs; 12 percent small downy chicks, 6 percent medium-sized downy chicks, and 4 percent with large downy chicks. Personnel estimated that 2,000 to 3,000 breeding birds were present (POBSP).
1 June 1969	500	Most had young; some almost ready to fly (Olsen, ms.).

The few available observations suggest that Gardner Brown Noddies nest primarily during spring and summer with most egg-laying usually occurring in April or May. Extrapolations from the presence of eggs and chicks in different numbers indicate that nesting takes place from at least March through October.

Some of the Brown Noddies observed by the POBSP constructed flimsy, flat nests of feathers and bits of Portulaca. Most, however, laid their eggs on bare rocks.

BLACK NODDY

Anous tenuirostris

The only previously published report of this species from Gardner Pinnacles is an account of observations made in June 1963 by the POBSP (Clapp and Woodward, 1968: 30). These and more recent observations, and observations made by Wetmore in 1923, are summarized in Table 10.

Table 10. Observations of Black Noddies on Gardner Pinnacles

<u>Date of Survey</u>	<u>Estimated Population</u>	<u>Remarks</u>
22 May 1923	210	About 10 nesting pairs found. Some 200 birds found roosting in flocks near the water (Wetmore, ms.).
16 June 1963	15	At least two young birds present (POBSP).
26 May 1967	400*	About 200 nests found in small colonies on rock ledges. The largest colony contained about half a dozen nests. Nests were composed of feathers, bits of <u>Portulaca</u> , and an unidentified seaweed. All stages of nesting from eggs through downy young to flying immatures were observed (POBSP).
1 June 1969	--	None seen (Kridler, <u>pers. comm.</u>).

*Estimate is of the number of breeding birds

These data suggest that Black Noddies regularly breed on Gardner. The data are too fragmentary and inconsistent from the 1963 to the 1967 survey for me to determine more of the nature of the breeding cycle than that some breeding has occurred in the months from March through at least July.

On 31 August 1965 an adult Black Noddy, misidentified as a local Brown Noddy when banded, was captured on Whale Island, French Frigate Shoals, about 110 miles southeast of Gardner Pinnacles. This bird had been banded on Gardner Pinnacles in June 1963. This error indicates that the number of breeding Black Noddies present in June 1963 was higher than reported earlier (Clapp and Woodward, 1968: 30). One of the banders states, however, that the error in numbers reported was confined to young Black Noddies and that the estimate of the number of adults seen was correct.

WHITE TERN

Gygis alba

The only previously published record of White Terns on Gardner Pinnacles is a single sighting from offshore on 7 June 1891 (Palmer in Rothschild, 1893-1900: ix). To this I add a number of more recent observations (Table 11).

Interpolation from these few visits suggests that breeding occurs from at least as early as March through November or December and very likely throughout the year.

Table 11. Recent observations of White Terns on Gardner Pinnacles

Date of Survey	Estimated Population	Remarks
22 May 1923	300-400	Nesting on the rocks. A collected female contained a developing egg (Wetmore, ms.).
16 June 1963	150-200	Nesting in stages from egg to immature (POBSP).
16 September 1966	75-100	Stages of nesting observed included eggs and from newly hatched young to flying immatures (Kridler, ms., b.)
26 May 1967	150-300	Nests with eggs; small, medium, and large downy chicks and flying immatures were observed. No one stage of breeding seemed any more numerous than any other (POBSP).
1 June 1969	300	Only eggs seen, no young noted (Olsen, ms.).

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GARDNER PINNACLES

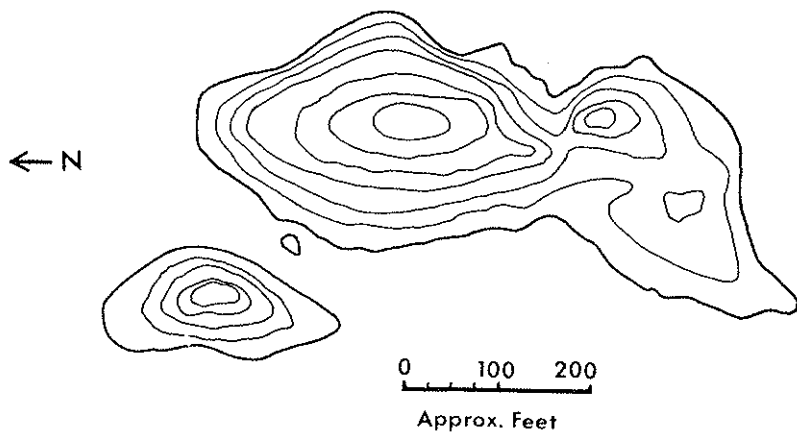


Figure 1. Map of Gardner Pinnacles. Contour interval -- 25 feet.
After Palmer, 1927

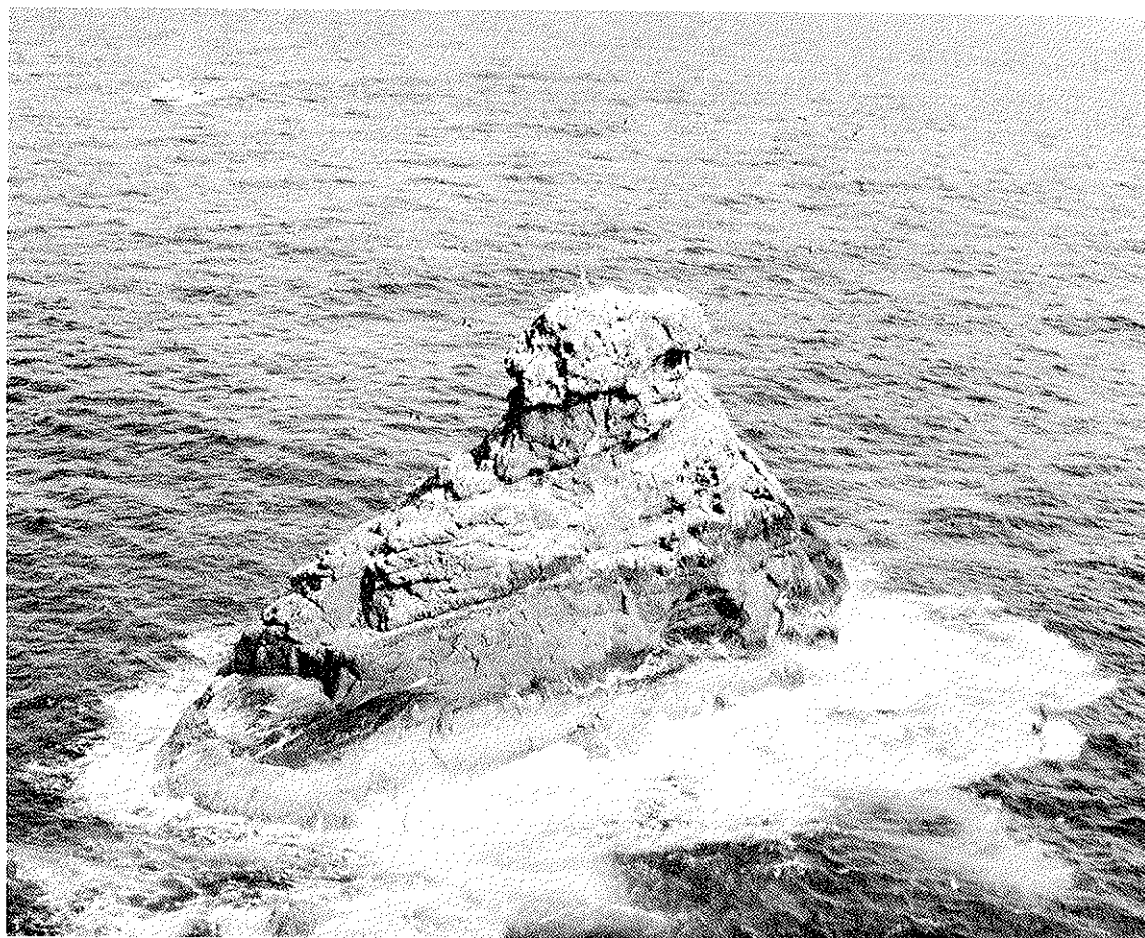


Figure 2. The smaller of the two pinnacles as seen from the larger,
May 1967. POBSP photograph by F.C. Thompson.

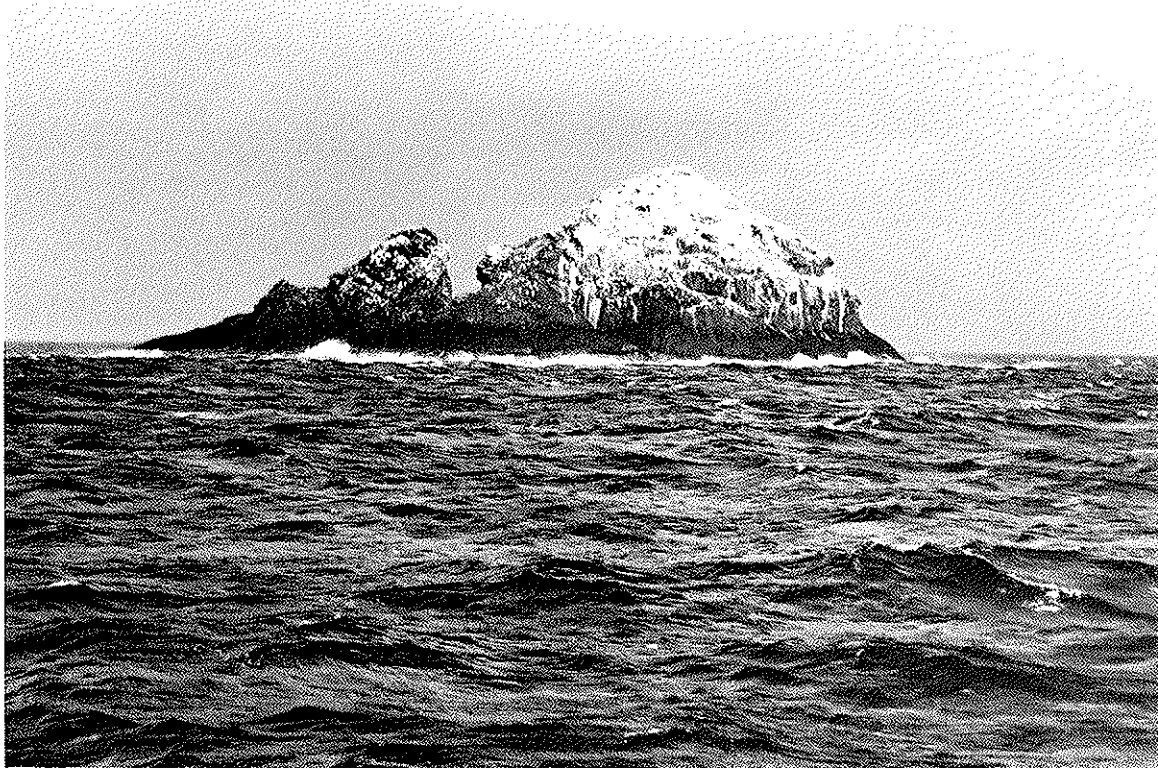


Figure 3. Gardner Pinnacles from the southeast, March 1964. POBSP photograph by A.B. Amerson, Jr.

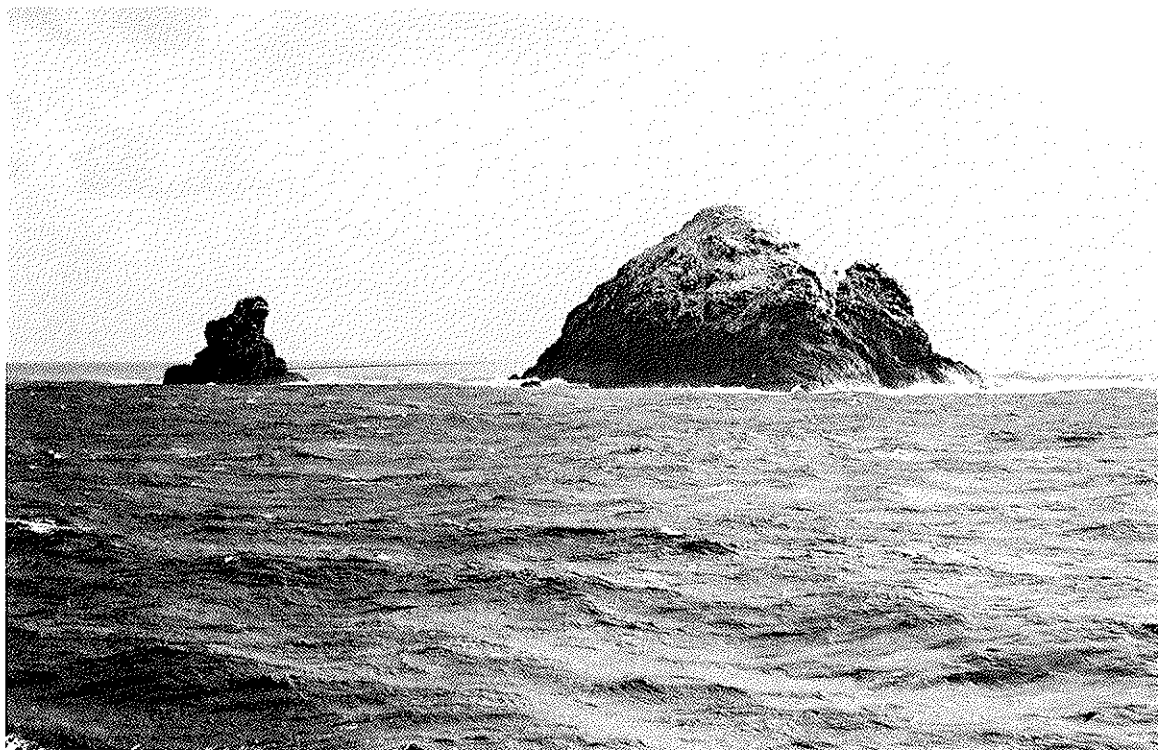


Figure 4. Gardner Pinnacles from the southwest, March 1964. POBSP photograph by A.B. Amerson, Jr.

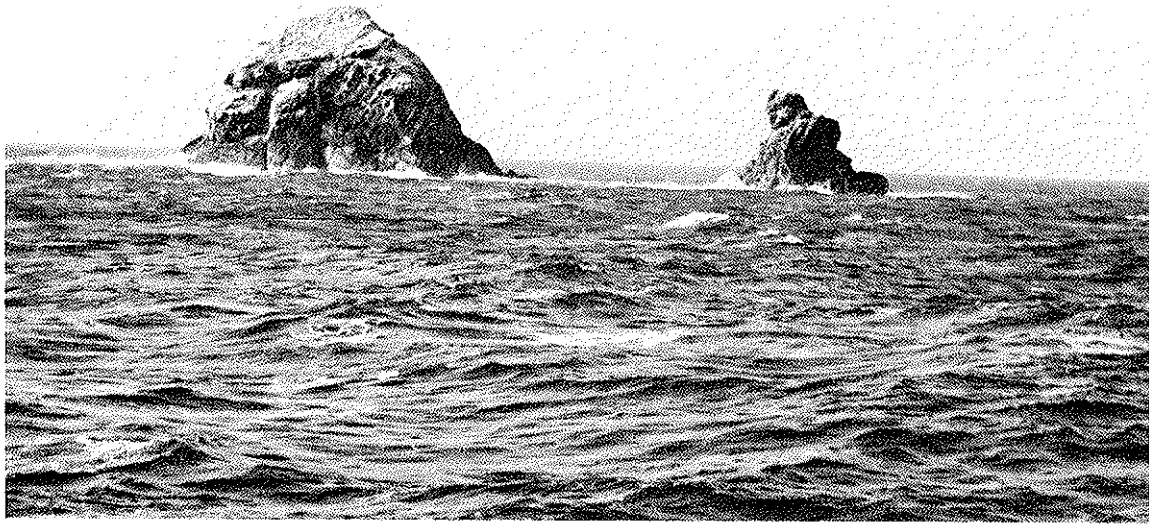


Figure 5. Gardner Pinnacles from the north, March 1964. POBSP photograph by A. B. Amerson, Jr.

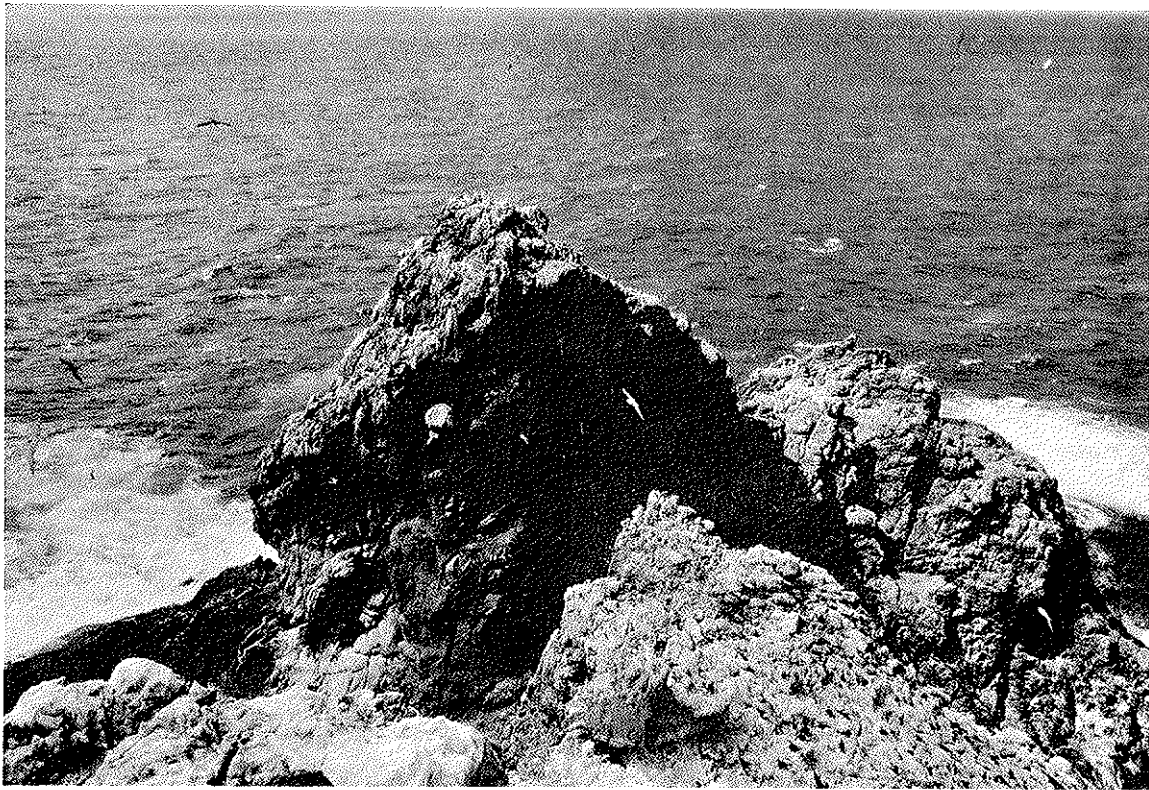


Figure 6. Looking toward the smaller peak of the larger pinnacle from the taller peak, May 1967. POBSP photograph by D. L. Burckhalter.

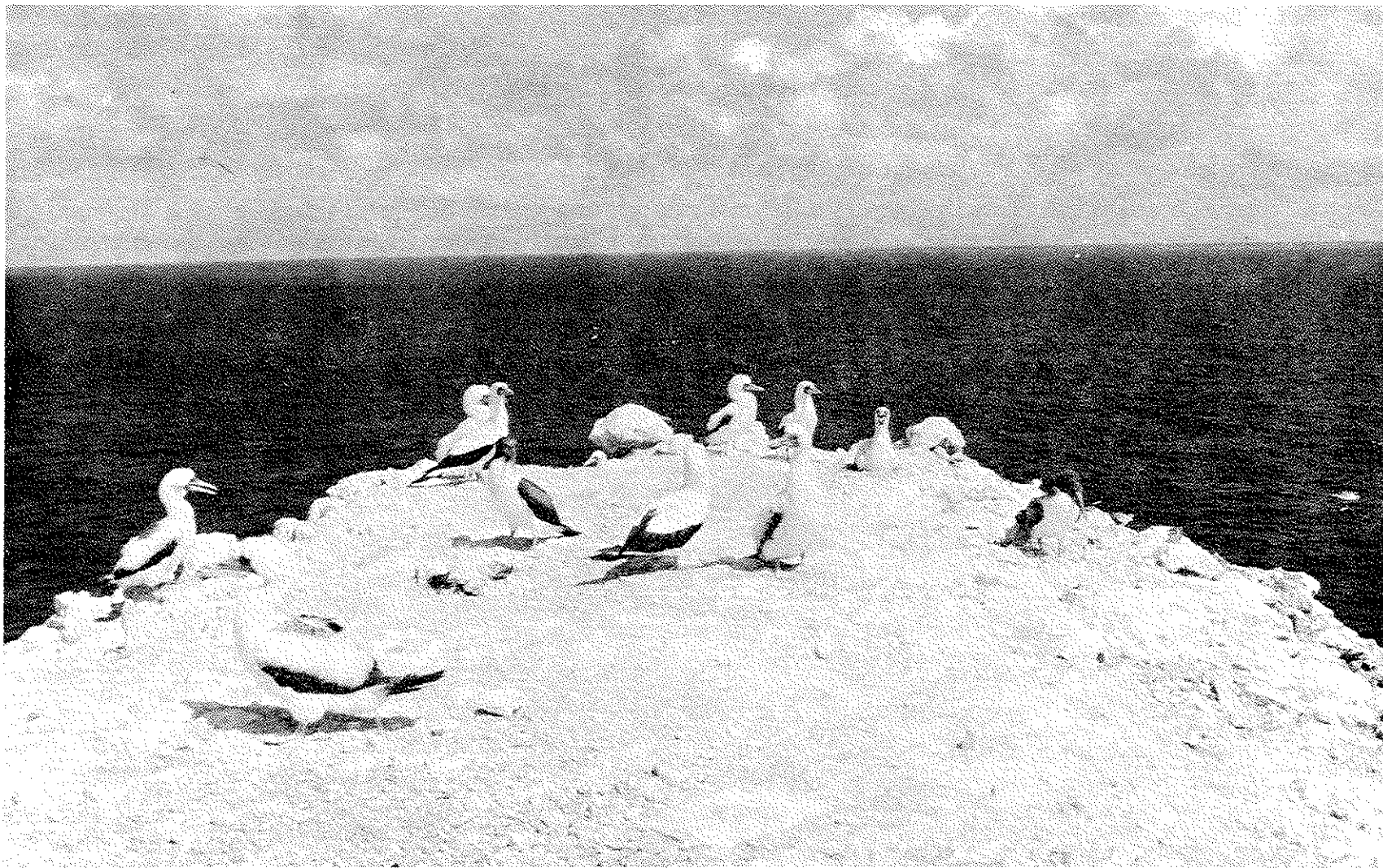


Figure 7. Nesting and young Blue-faced Boobies on the flat summit of the larger pinnacle, May 1967.
POBSP photograph by D. L. Burckhalter.