

## GENERAL NOTES

**Data on the body temperature of tropical sea and water birds.**—On two expeditions (July, 1959, and September, 1961) to Laysan Island in the Leeward Hawaiian Chain (25° 46' N and 171° 44' W), I collected a few data on body temperatures of the nesting birds of the island. These may be compared with similar but more extensive data in the recent literature. To my knowledge, the temperatures of the Bulwer's Petrel, Masked Booby, and Laysan Duck have not been taken previously.

Table 1 gives the results of temperature measurements. In 1959 I used a standardized mercury thermometer calibrated to 0.2°C and read to the nearest 0.1°C. In 1961, measurements were taken by a portable, battery-powered, multi-channel thermister telethermometer, calibrated to the mercury thermometer used in 1959. The measurements were taken on wild birds immediately (5 to 20 seconds) after capture by hand, inserting the thermometer through the cloaca not less than 25 mm into the rectum. A series of measurements on the chick of the Bulwer's Petrel was taken in the proventriculus as well as rectally. Air temperatures at ground level were recorded at the beach-crest, and are included in Table 1. Notes on the species follow.

**Black-footed Albatross.** *Diomedea nigripes* Audubon.—The fully grown, but not yet fledged, young were already abandoned by their parents, and all were found on the open sand beach, exposed to the sun and wind. Their rectal temperatures agree well with the average deep body temperature of 39.2°C found by Howell and Bartholomew (*Condor*, 63: 193, 1961) in chicks of similar age; exposure to the wind certainly moderated the heat stress from the overhead sun.

**Laysan Albatross.** *Diomedea immutabilis* Rothschild.—The adults were all active in the sun shortly after they arrived from the sea to feed their young. The data from the three downy but full-grown chicks measured in the morning, as well as the adults, corroborate the findings of Howell and Bartholomew (*op. cit.*: 187).

**Wedge-tailed Shearwater.** *Puffinus pacificus* (Gmelin).—The adult night temperatures, taken rectally, were higher than those of June birds measured by Howell and Bartholomew (*Auk*, 78: 347, 1961), but not as high as the daytime deep body temperatures reported by those authors. On Laysan the Wedge-tailed Shearwater tends more to inhabit burrows than it does on Midway, judging from reports of the Midway population. The birds, however, often nest near the entrance of a larger burrow system, presumably excavated by Bonin Island Petrels, which on Laysan nest just as abundantly but at another season. Yet the Wedge-tails I investigated were not incubating birds. Most came in from the sea and roosted, "moaned," or slept beside the burrows on the open, warm sand. According to my observations, both sexes incubate and the partner on duty spends more than 24 hours at a time incubating, up to 38 hours being observed. The other bird stays on the surface near the nest burrow at night. The birds are more crepuscular than nocturnal; their moaning and other activity mostly subsides by 2200–2300 hours, at which time they are asleep. Five resting birds (three fast asleep) averaged 38.2°C, while five fully awake, moving, and moaning birds (one of which had just flown in from the sea) averaged 39.7°C. These observations, compared with those of Howell and Bartholomew (*loc. cit.*), suggest that the temperature of non-incubating birds is high when they are active, but during the later part of the night, when the birds calm down and roost or sleep, their temperatures drop.

TABLE 1  
BODY TEMPERATURES OF BIRDS IN °C\*

Species	Age	Number	Date	Time	Rectal temperature		Air tem- perature	Time
					Mean with S. E.	Range		
Black-footed Albatross	adult	1	7/27	1520	39.2	—	31.8	1200
"	subadult	9	7/27	1525-1655	39.0 ± .35	38.5-40.0	31.8	1200
Laysan Albatross	adult	11	7/26-27	1220-1840	40.55 ± 1.09	39.0-42.0	32.0-33.0	1200
"	juvenile	3	7/27	0840-0850	37.5	37.0-37.9	25.0	0900
Wedge-tailed Shearwater	adult	10	7/25	1946-2145	39.0 ± .92	37.4-40.4	24.3	1900
Christmas Island Shearwater	adult	10	7/24	0010-0100	38.4 ± .65	37.4-39.3	23.4	0000
Bonin Island Petrel	adult	10	9/8	2030-2342	38.2 ± .54	37.5-39.1	23.3	2100
Bulwer's Petrel	adult	10	7/24	1910-2012	37.8 ± .59	37.0-38.5	23.9	1900
"	juvenile	7	9/8	2245-2315	37.1 ± .88	36.0-38.2	23.3	2100
"	juvenile ( <i>proventriculus temp.</i> )	9	9/8	2245-2315	39.0 ± .64	38.1-39.7	23.3	2100
Masked Booby	adult	3	7/25-27	1700-2035	39.1	38.2-39.9	23.0-24.5	1900
Laysan Duck	adult	10	7/24	2053-2308	40.6 ± .55	39.9-41.6	23.9	1900

\* The July data (?) are from 1959; those of September (9) from 1961.

Christmas Island Shearwater. *Puffinus nativitatis* Streets.—Howell and Bartholomew (*op. cit.*: 349) measured temperatures of incubating birds in June. The night temperatures of Laysan birds in July, after the incubation period, were the same as those found by the above-mentioned investigators, and corroborate their conclusion that this species shows striking uniformity of the body temperature.

Bonin Island Petrel. *Pterodroma hypoleuca* Salvin.—This was a strictly nocturnal species on land, arriving at Laysan Island only after darkness had fallen. In the first week of September, 1961, they appeared every night in increasing numbers. The birds were not nesting, but were inspecting the burrows, pairing, or, in a few cases, excavating burrows or cleaning old ones. Their activity subsided in the hours immediately after midnight, and the birds were found quietly sitting, or sleeping on the ground; but by dawn, they had all flown out to sea.

The rectal temperatures of 10 birds show a discrepancy with the (proventriculus) temperatures that Howell and Bartholomew (*op. cit.*: 345) found during the night. These authors, however, worked with incubating birds during the winter months. They found that incubating birds had a low body temperature during the day (mean 38.5°C), and the night temperatures of birds, captured after returning from feeding flights, were high (mean 39.9°C). Farner and Serventy (*Condor*, 61: 427, 1959) studied the Slender-billed Shearwater (*Puffinus tenuirostris*) and attributed the low body temperature of the incubating birds (mean 38.0°C) to their quiet life in the burrow. In view of these data the low temperatures I found on non-incubating Bonin Island Petrels resting on the ground at night (mean 38.2°C) may indicate that they had a rhythm; high during the day (feeding at sea) and low during the night (resting on the ground). All the scattered records just discussed for the Bonin Island Petrel, as well as Farner and Serventy's suggestions would be explained by the supposition that these birds have an incubation rhythm, such as that which I found in the Wedge-tailed Shearwater. In this species one bird incubates for several days; its partner comes in at night, even when it does not incubate. The low temperature of incubating birds found by Howell and Bartholomew in the burrows and those I found on the ground at night, indicates resting temperature. The high temperature of the Slender-billed Shearwater and of the Bonin Island Petrel at night reflects the metabolic status of an active bird prior to or after feeding flights.

Bulwer's Petrel. *Bulweria bulwerii* (Jardine and Selby).—The temperature of this species had not been taken until I recorded it in incubating adults taken from their shallow burrows under phosphate rocks and pieces of corrugated iron on the ground, and the low temperatures recorded correspond to those of the incubating Leach's Petrel (Folk, *Anat. Rec.*, 105: 590, 1949; 111: 541-542, 1951), Fairy Prion (Farner, *J. Applied Physiol.*, 8: 546-548, 1956), Slender-billed Shearwater (Farner and Serventy, *loc. cit.*), and the Wedge-tailed Shearwater and Bonin Island Petrel (Howell and Bartholomew, *op. cit.*: 345-347).

The young studied in September, 1961, were almost or quite full-sized chicks sitting in front of their burrows at night. They all had complete plumage, with some down on the neck. The rectal and proventricular temperatures were taken for each of seven chicks, and the proventricular temperature was significantly higher for each bird. The deep body (proventriculus) temperature compares with active adult night temperatures of other procellariid species.



Figure 1. Laysan Ducks feeding on *Agrotis* sp. (a noctuid moth) larvae at night. The cutworm larvae burrow into the sand beneath the prostrate *Boerhaavia* plants during the day, coming out at night to feed on the succulent leaves. Photograph by Richard E. Warner, for whose extensive study of this duck see *Condor*, 65: 3-23, 1963.

Masked Booby. *Sula dactylatra* Gould.—The data are the first for the species. Judging from these few data, temperatures are within the range measured in the Red-footed Booby (*Sula sula*) by Howell and Bartholomew (*Condor*, 64: 13, 1962).

Laysan Duck. *Anas laysanensis* Rothschild.—This species is a nocturnal feeder, and the birds were observed by the use of a concave reflector. They were collected with a "dip-net" or with a hat, and their temperatures taken immediately. The temperature of this rare endemic species has not been taken previously. The temperatures found (mean 40.6°C) are surprisingly low, considering that Wetmore (*Smiths. Misc. Colls.*, 72: 1-52, 1921) found the mean rectal temperatures of six species of the genus *Anas* to be between 41.2°C and 41.7°C. However, among the few anatids I measured in Sweden in 1950 (Udvardy, M. D. F., *Zool. Bidrag Uppsala*, 30: 25-42, 1953), there were three teals (*Anas crecca*) with an average standard rectal temperature of 40.7°C, and one of them had a temperature of 40.8°C at the beginning of the measurements.

The assistance in capturing of the ducks of Mr. R. E. Warner and Mr. C. H. Daniels, and the technical assistance of Mr. P. Grant and Mr. O. Horvath is gratefully acknowledged. These studies were financed by a grant of the National Research Council of Canada.—MIKLOS D. F. UDVARDY, *University of Hawaii, Honolulu, U. S. A.*, and *University of British Columbia, Vancouver, Canada.*