LAYSAN ALBATROSS BREEDING BEHAVIOR

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ABSTRACT.—Discusses post-nest-relief tossing behavior and speculates on its adaptive value. Also discusses an apparently successful case of foster parenthood.—*Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901.* Accepted 21 October 1975.

FOR portions of three breeding seasons on Midway Atoll, incidental to studies of bioenergetics of flight, I also studied the breeding behavior of the Laysan Albatross, *Diomedea immutabilis*. This article discusses two aspects of behavior I noted of sufficient interest to warrant description and comment.

POST-RELIEF 'TOSSING' BEHAVIOR

During intensive observations to determine exactly which partner was destined to go to sea and which one was to remain at the nest, I watched many exchanges between paired birds at the nest. As Rice and Kenyon (1962: 543) reported, the incubating mate is reluctant to leave the nest and the newly arrived bird succeeds in relieving its mate only after considerable mutual preening and vocalizing. Others have reported this pattern in the Laysan and in other albatrosses (Sorenson 1950, Richdale 1952, Meseth 1968, Fisher 1971). This section discusses a feature of post-relief behavior following the exchange at the nest that I designate as 'tossing' behavior.

During 37 nest exchanges observed from 24 January to 10 February 1971, I found that post-relief 'tossing' or 'nest-materials grasping,' when it occurred, was invariably (less than 3% error) by the relieved parent. Tossing occurred in 31 (84%) of the 37 exchanges, and was done by both members of the pair. This period includes the late incubation and guard phase of nesting for most of the breeding birds on Sand Island, Midway. Post-relief tossing was not often seen after nesting progressed to the post-guard phase in mid-February, even at nests relatively delayed in the nesting cycle (i.e. containing eggs or very young chicks) by that date.

Post-relief tossing by the bird relieved from its span of incubating or brooding occurs in a rather characteristic manner not fully noted by previous investigators. Also the concomitant actions of the relieving bird have not been evaluated relative to the tossing behavior. Following the nest exchange, the relieved bird often circles its mate (now on the nest) and begins to pick debris which it drops or tosses rearward. Sometimes the bird returns to the nest, sits close by for several minutes, preening and nibbling its mate's neck. Usually this activity is brief and the relieved bird stands and gradually moves away, stopping frequently to pick up *Casuarina* needles, grass, and similar debris and toss it rearward. Generally tossing occurred in bouts from 1 to 2 min dispersed intermittently for periods up to 1 hour.

Meanwhile the relieving mate, after settling on the egg or young chick, works at the side of the nest by reaching into the 'moat' area pulling pieces of grass and debris up on the nest wall as described by Rice and Kenyon (1962: 537).

The following field notes of 5 February characterize my observations:

"805 hr: Bird on nest (BON) reaches over moat, picks debris, places it on rim. Occasionally, scratches inside nest tending to deepen it as described by Harvey (H. I. Fisher, pers. comm.). Picks stick. Circles, raises, sets down again. This activity has continued for about 10–15 minutes."

Later, up to 0900 hours, the bird repeated the above pattern once or twice, but no longer pursued the activity consistently. Continuing:

"Relieved bird (RB): 2–3 ft from nest and normal to nest circumference, picks up debris, intention movement for tossing rearward. Moves away slightly and tosses. Returns to mate and the pair preen each other. Time: 0817 hr.

"RB, 2 ft from nest, tosses debris rearward and preens itself. Repeats this several times within one minute. Obtains a large tuft of grass and roots and moves head back and forth repeatedly as if undecided what to do. Duration about 30–45 seconds. Finally tosses rearward to its left.

"RB approaches mate, 'eh-ehing,' 0823 hr; places foot on rim, but doesn't force way on egg. Pair preening 0829 hr.

"Again, RB picks up and holds large tuft of debris (pine needles, dried grass, small twigs) . . . , head moved back and forth repeatedly, finally tosses to rear. BON again begins to pick debris at base of moat and drops on rim, time 0832 hr. RB continues 'tossing.' Distance, about 4 ft from nest.

"0835 hr: RB returns to nest, preens, BON works on nest.

"0855 hr: Birds preening. RB has *never* been more than 4 ft from nest, now walks around nest. BON preens, no longer working walls, RB no longer 'tossing'."

At 0900 h, the relieved bird walked to the beach area presumably to leave the island.

These notes should be compared to the observations on the Royal Albatross (*D. epomorphora*) by Richdale (1939: 471; *cf.* 1952: 17–18). He noted:

"Building material is not carried from a distance, as only that material within reach of the bird on the nest is used. The bird off the nest does not carry material to its mate, but will certainly pick up vegetation and drop it around itself. Sometimes this material falls within reach of the bird on the nest and may be used, but that is only accidental."

In his later paper, Richdale (1952) suggested its function:

"I have suggested elsewhere . . . that the plucking of grass immediately following duty on the nest is a 'substitute activity' or 'displacement reaction' as defined by Tinbergen."

Variation exists in the reported behavior and interpretations of activity immediately following the exchange at the nest in the Laysan Albatross. Rice and Kenyon (1962: 543) noted that "once displaced, the previously incubating bird does not attempt to get back on the nest; it shortly leaves and heads to sea." Meseth (1968: 171) conducted a detailed study of the Laysan Albatross breeding behavior at Midway and noted two instances of post-relief tossing. For one of these, his field notes included the following remarks of interest:

"Male . . . just got off nest, pulled at some grass, as female got on . . . they both throw nest material, she around nest.

"Male walks away picking at grass and throwing it behind him. This takes him farther away from the female.

"Male still throwing nest material. Female exhibits no unusual behavior."

At this point, Meseth's field notes no longer refer to either bird handling grass or debris, and he made no attempt to interpret the function of the tossing behavior, but he believes (pers. comm.) its primary function is to help reduce agression between the nesting bird and the newly arrived mate. Very occasionally the relieving bird displays tossing upon arrival (as noted by Fisher 1971: 57) and tossing does occur during some courtship displays (Fisher 1971: 44); in these instances (which are not post-relief tossing) Meseth's view appears more valid. It is difficult to evaluate Meseth's statement that, "both throw nest material, she around nest." It is unlikely that the female tosses material in the manner I have described *after* ascending the nest.

Fisher's (1971) most comprehensive published account of Laysan breeding behavior includes information on the relief and post-relief activity at the nest. Fisher (1971: 55–59) noted tossing of nest material in some individuals, but simply stated this may be done "in any direction" and, "may be regarded as displacement activities," apparently adopting Richdale's suggestion applied to the Royal Albatross. The related activity of the relieving bird on the nest was not noted as he asserts (1971: 49) that nest maintenance ceases with the hatching of the egg. My observations suggest maintenance through the guard phase, agreeing with the conclusion of Rice and Kenyon (1962: 537).

The suggestion that tossing or throwing is displacement activity may be premature, because the necessary detailed analysis of behavior from which this activity may be derived has not been accomplished. More importantly, even if tossing is displacement activity, this knowledge does not preclude learning more of its adaptive value and retention. True, the observed post-relief pattern appears very similar to displacement activities Tinbergen (1952: 8) described in his classical work on derived activities. It very well may be an activity that has been modified precisely because tossing had acquired an adaptive value beyond that of providing an outlet for conflicting thwarted drives.

Watching the actions of the relieved and relieving birds in juxtaposition, I speculated on the adaptive value of this behavior. Prior to the plantings of abundant vegetation on Midway, the *Scaevola* and bunch grass habitat probably provided relatively sparse ground debris over much of the sandy islands. Such sparsity can be envisioned readily on portions of Sand and Eastern Islands. The tossing adults tend to gather gradually what debris occurs in an expanding area beyond the nest, bringing it toward the moat where it then is incorporated into the nest structure. Meseth (pers. comm.) questions this hypothesis; he doubts that sufficient material is gathered in the 7 to 8 exchanges that would normally occur prior to the period when mortality from inundation of a poorly maintained nest might occur. Relative to the nest structure itself, the amount of material gathered may indeed be moderate, but the need must compensate only for the attrition occurring at the nest; it is adaptive as a maintenance activity. The difference between a nest susceptible to flooding and one surviving a flash inundation may be rather slight, but the small selective advantage tossing behavior bestows would maintain the pattern in the repertoire of the population.

The value of a well maintained moat structure was easily seen during sporadic rainfalls in the nesting season. Three times during my study period (January through March) brief downpours inundated portions of the nesting grounds. Nests in moderate depressions and many that were inadequately built or maintained flooded. I noted that during the first week after hatching, young Laysan chicks succumbed quickly when exposed to temporary flooding, and consequently mortality increased. In one area approximately 16 chicks out of 133 died from flooding and subsequent cold exposure. The adults did not sit on a flooded nest even though chicks were being brooded prior to the rainfall. Earlier in the nesting cycle, adults apparently do remain attentive to the flooded nest site as Fisher (1971: 34, Fig. 11) clearly demonstrated. I did not note this degree of attachment in late January and February. Hence a chick in an unusually low spot and a poorly maintained nest may not survive.

Fisher (1971) analyzed the mortality factors in the Laysan Albatrosses of Midway extensively, and did not cite deaths from nest flooding as of major importance. He in fact assigned a value of 0 to 5% to losses associated with storms. The loss I observed

of nearly 12% in one area in one storm indicates the relative potential of flood-induced deaths to the species. It does not apply to the entire population, as all parts of the island are not equally susceptible to flooding. The evolution of the moat structure and, I suggest, post-relief tossing behavior serves to reduce the incidence of flood-induced mortality.

Foster Parenthood

On Midway, we had excellent cooperation from many naval and civilian personnel who had developed interest in the "gooney birds." One of these men, Lon Brocklehurst, an advanced technician in electronics, assisted me by obtaining, with telemetry techniques, daily body temperatures in a growing Laysan chick during its first month. Simultaneously, parental attentiveness was recorded electronically and visually. As the body temperature study progressed, Brocklehurst observed an extremely interesting situation.

Rice and Kenyon (1962), Fisher and Fisher (1969), and Fisher (1971) stated convincingly that both parents are essential to the successful incubation and care of the young. During incubation, desertion or death of one parent results in nest loss. During the guard phase, the lack of either parent generally will result in unsuccessful rearing of the chick. Therefore, it was surprising to observe the successful rearing of the telemetry-instrumented chick when first one and then both parents ceased to visit the nest.

On 22 February 1972, temperature monitoring of a chick approximately 9 to 10 days of age was begun using a small commercially available temperature-sensitive AM transmitter (900–1000 kHz). Simultaneously each parent was equipped with a UHF transmitter (approximate freq. 222 MHz, sufficiently varied to distinguish each) and each was color-marked to identify it. A receiver placed under the nest and connected with appropriate instrumentation permitted recording both the chick's body temperature and the parent's presence or absence for 1-minute samples every 15 minutes throughout the 24-hour period. On 29 February, the female was no longer recorded attending the nest and was not seen again. On 17 March, 17 days later, in the post-guard phase, the male was no longer seen or recorded visiting the chick.

In the absence of its parents the chick nevertheless continued to grow and maintain its normal activity. This bird was seen daily until 20 June at which time it was changing its resting site frequently and began heading toward the beach, presumably preparing to leave the island. Brocklehurst was no longer able to locate the moving chick with his hand-held receiver and lost contact.

After the parent's disappearance, from 17 March to 20 June, the chick was attended by a total of six other adult albatrosses. All birds that seemed to adopt the chick were color-marked to differentiate individuals. One adult merely sat with the chick from 1 March through 4 April and preened it repeatedly. Five other individuals visited the chick every 2 to 3 days and fed it. One fed the chick for 2 weeks and ceased attentiveness. The chick apparently received sufficient care and feeding through a fortuitous combination of random feedings and solicitations of many individuals. Toward the end of the observations, the chick was being fed daily; on one day it was fed six times by several adults that converged upon it.

It is undoubtedly true, as Rice and Kenyon (1962: 556) suggest, that an abandoned chick adopted by another adult will usually die as a result of retarded development,

but the combined attention of several birds apparently sufficed to provide adequate care for the instrumented chick. It is interesting that the chick was fed on the average once daily which is the median interval Fisher and Fisher (1969: 183) reported for successfully reared chicks.

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