

laboratory on a fresh sample of estuarine mud. Probe holes were bored to known depths by an assistant using the closed bill of a dead Dunlin. I then attempted to measure these depths by the casting technique described (using the needle "pump").

RESULTS

Figure 1 shows that the casting technique allowed precise measurement of probe holes (up to 4 cm deep) in estuarine mud. Drawings made from casts taken both in the laboratory and in the field illustrate that the technique can even show up the interception of invertebrate burrows by probes (Figure 2).

DISCUSSION

Although the technique proved reliable and easy to use, it should be retested on each substrate used, since collapse of probe holes must occur on some softer sediments. In the field the compound proved dense enough to expel all water from flooded holes and give good casts. The method might be usefully employed to measure probe depths in the field after a foraging bird has left an area on which it was feeding (even if only to assess the accuracy of the direct observation method of estimating probe depths). Additionally the technique could be used to make precise measurements of foraging patterns of captive birds.

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NEW WORLD SECTION



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ABSTRACTS OF DOCTORAL AND MASTERS THESES

PARENTAL BEHAVIOUR AND ROLE DIFFERENTIATION IN THE BLACK OYSTERCATCHER *Haematopus bachmani*

by Margaret Anita Purdy

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science, University of Victoria, Canada, November 1985

ABSTRACT

An understanding of patterns of evolution and adaptive radiation of parental behaviour within a group such as shorebirds (sandpipers, plovers and their kin) requires adequate documentation of the characteristics and existing patterns of variation in parental behaviour, both within

and among species. To this end, monogamously breeding Black Oystercatchers *Haematopus bachmani* were studied on Cleland Island, British Columbia from April-September, 1982 and 1983. The emphasis of the study was a comparison of the behaviour of males and females during six stages of the breeding season. Data were collected during day-long (16-h) sampling periods on thirteen pairs, simultaneously recording the behaviour of both pair members.

Prior to egg-laying, females spent approximately 6 per cent more time foraging than did males. During this period, males were more aggressive, spending almost twice as much time in piping behaviours with conspecifics. Males were also more alert than females, as indicated by comparison of the amount of time they spent in alert standing behaviours (females 23%, males 30%), and by the shorter bouts of foraging, preening, and sitting, which

were considered to be non-vigilant behaviours. Both sexes were more aggressive toward conspecifics during this period.

Males did almost all the egg-covering during egg-laying. During the first half of incubation, females incubated twice as much as males, but the sexes shared incubation duties about equally in the latter half. There was no dual sharing of incubation between the sexes. Females incubated in longer bouts (average 58 min) than did males (39 min). During incubation, oystercatchers rarely sat when off the nest, and most other behaviours showed a corresponding decrease in the percentage that they comprised of the total time-budget during these stages. Males continued to respond to intruding oystercatchers even if it meant leaving the nest. This was in contrast to females, which responded to fewer of these intruders and usually did so only after their mates had responded.

Chicks were brooded almost continuously for about the first three days after hatching and intermittently until they were 15 days old. Females did almost 70 per cent of the brooding. During the brooding period, males took a dominant role in feeding and foraging for the chicks, but the sexes participated equally in this after the chicks ceased to be brooded. After hatching, both sexes showed a sharp increase in interspecific aggression, particularly toward gulls. Both sexes were more alert during chick rearing stages than during previous ones, as indicated by their shorter foraging, preening and sitting bouts and the increase in the amount of time spent in alert standing behaviours. Chicks continued to be fed even after they fledged, at approximately 40 days of age.

Behind the general trends in role differentiation there was considerable inter-pair variability. This was exemplified by the arrangement of individuals in two-dimensional space by Multidimensional Scaling. These analyses showed that, prior to egg-laying and during chick rearing stages when chicks were brooded, pair members were more similar to each other than to birds of the same sex in other pairs. In contrast, during incubation and early chick-rearing stages the sexes tended to be grouped together.

It appears that, even though males and females adopt different parental roles, parental investment is equalized between sexes over a given breeding season. When compared with other shorebirds, the pattern of the parental behaviour exhibited by oystercatchers appears to be related to their relatively large size, long-term mate fidelity, longevity, and sedentary life style.

INTRASPECIFIC VARIABILITY IN NESTING PHENOLOGY, CLUTCH SIZE AND EGG SIZE IN THE BLACK OYSTERCATCHER *Haematopus bachmani*

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science, University of Victoria, Canada, December 1985

ABSTRACT

Despite their importance in evolutionary ecology, relatively few studies have documented intraspecific variability in life-history traits. The Black Oystercatcher, *Haematopus bachmani*, is a species of Haematopodidae (Aves:

Charadriiformes) resident from Alaska to southern California. This study investigated geographic and local sources of variation in the nesting phenology, clutch size and the egg size of this species. Museum egg collections provided information from nesting populations for the entire range of this species, while detailed field observations (May-July) of 39 (1982) and 35 (1983) breeding pairs on Cleland Island (B.C., Canada, 29° N, 126° W) provided information on within-population variation.

Data from museum collections were pooled according to their geographic origin into five samples (regions) of almost identical latitudinal range and number of observations. Dates of clutch collection were used as estimates of dates of laying of museum clutches. Egg length (L) and maximal width (W) were measured to the nearest 0.1 mm, and indices of egg volume ($(\pi/6) * L * W^2$) and egg shape (L/W) were subsequently computed. Egg measurements were averaged for each clutch for among-clutch comparisons.

Results indicated that populations from Alaska nested, on average, 15 days later than those from Southern California. There was no geographic trend in the estimated average length of laying seasons. Average laying dates for the whole population of Cleland Island did not differ significantly in 1982 and 1983. Individual females tended to lay at similar dates in both years.

There was no geographic variation in clutch size. Eighty-seven percent of the clutches contained either two or three eggs and no clear seasonal trend in clutch size could be detected in any of the five regions. The average clutch size for Cleland Island remained close to 2.1 eggs from 1970 to 1983. In 1982, there was a decline in clutch size later in the season but, in 1983 this tendency was less pronounced.

The weak geographic trends found in timing of breeding and clutch size of *H. bachmani* are explained by the buffered seasonal and latitudinal variations found in the coastal habitat of this species. Its timing of breeding is little affected by increase in day length and it is suggested that clutch size is limited primarily by the optimal working capacity of adults at the chick-rearing period.

There was no significant geographic variation in size of eggs. In general, egg size was not related to clutch size except in northern California where two-egg clutches had longer eggs than three-egg clutches. Similarly, a seasonal decline in egg width and egg volume was detected only in Washington, Oregon and northern California.

On Cleland Island, eggs were less voluminous than eggs from other parts of the range of *H. bachmani*. Fifty-one percent of the variance in chick weight at hatching was explained by egg weight at laying. There was no significant effect of clutch size on egg size, but three-egg clutches had larger eggs than two-egg clutches. There was no seasonal decline in the size of eggs of initial clutches and the replacement clutches of individual females tended to have smaller eggs than their initial clutches. There was no apparent ordering of egg size with laying sequence although eggs laid by individual females were less variable than eggs laid by different females.

The weak seasonal variation and absence of geographic variation in egg size of *H. bachmani* are explained by the buffered latitudinal and seasonal variations of the coastal habitat of this species. It is suggested that the parental behaviour of Oystercatchers, especially during the chick-rearing period, is more important to the survival of the progeny than differential investment in eggs through egg-size manipulations.