BEHAVIOUR OF THE ANTARCTIC BLUE-EYED SHAG Phalacrocorax atriceps bransfieldensis

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ABSTRACT

An ethogram for the Antarctic Blue-eyed Shag is described with emphasis on behavioural comparisons with other shags and cormorants. Data regarding mate and nest-site retention are also presented.

INTRODUCTION

Van Tets' (1965) study of social communication of the Pelecaniformes demonstrated the value of behavioural comparisons in evaluating phylogenetic relationships within, as it was then, a poorly known order. Although Nelson (1978) remedied the lack of data for the Sulidae, little is known about the behaviour of most species within the Phalacrocoracidae, especially the lower southern hemisphere representatives of the blue-eyed shag complex *(Phalacrocorax atriceps, P. albiventer, P. verrucosus, P. carunculatus,* and *P. campbelli).** The taxonomy and phylogenies of these species are in question (Devillers & Terschuren 1978, Bernstein & Maxson 1981), and to help clarify these questions, we gathered ethological data for the Antarctic Blue-eyed Shag *(P. atriceps bransfieldensis),* along with ecological studies (Berstein & Maxson, in prep.) that may form the basis for comparisons within the group as well as with related northern species.

METHODS

A colony of up to 800 Antarctic Blue-eyed Shags was observed from mid-January 1979 to mid-March 1980 at Cormorant Island, 5 km south-west of Palmer Station, Anvers Island, Antarctica (64°46'S 64°03'W), near the Antarctic Peninsula. Travel to the island was limited during the austral winter (April to September) and most data were collected during the remaining months. Additional data were collected in austral summer 1981 by P. Pietz and S. Stone. Behavioural data were recorded by written notes, on magnetic tape, with 35 mm film, super-8 movies and 16 mm movies. In total over 3000 bird-hours of time-budget data were collected. Behavioural notes were taken of birds under direct observation as well as all shags in view from the hide. Therefore, in reality a minimum of 9000 to 12 000 bird-hours

* Although the genus **Leucocarbo** is also used for this group, for ease of comparison with recent literature we prefer to use **Phalacrocorax** in this paper.

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of behavioural data were collected. In addition, we lived for week-long periods near the colony, during which time the shags were under observation most of the day. Since courtship displays occurred synchronously at all nests, observations of this period were conducted from the sea or from high points to view as many of the nests as possible. Approximately 15 hours of intense courtship were observed or filmed.

We sexed birds by body and bill size, behaviour, and vocalisations. Males were larger, more aggressive, and were the only sex that vocalised. Fifteen pairs of shags were colour-ringed in both 1979 and 1980, and a few individuals were marked with indelible black dye on their white chest and neck for identification in film records. We attempted to mark individual nests with numbered metal markers and colour-coded dowels, but most were incorporated into nests by the birds. Nests were mapped to help locate them within the colony between years. In 1980, all juveniles received numbered strainless-steel rings, as did all adults captured throughout the study.

Nomenclature of the blue-eyed shags follows that of Watson (1975) for reasons presented in Bernstein & Maxson (1981), and the trinomial scientific name is used to prevent confusion with other species or subspecies. Most displays discussed are illustrated in van Tets (1965) for other cormorants and shags. Except when noted, we follow his terminology.

HABITS

Locomotion

Like the other cormorants and shags, the Antarctic Blue-eyed Shag walks with a high-stepping gait or waddle. The Cormorant Island colony is relatively free from rocks, and the shags can easily walk from the nest to the cliff edge. However, when moving across rocks by the sea edge, they hop with both feet together. Both feet are also used simultaneously when " running " across the water for take-off at sea and when swimming (cf. van Tets 1965: 16-17).

Bathing

As described for Double-crested Cormorants *(P. auritus)* (e.g. Lewis 1929, Mendall 1936) Antarctic Blue-eyed Shags bathe regularly. Bathing usually took place daily in groups of 5 to 20 shags before the birds left the colony. The slapping of wings on the water and splashing appeared to create a social stimulation for other birds to bathe, and once a shag 5 km away from the colony began bathing near two Southern Black-backed Gulls *(Larus dominicanus)* that were splashing in the water during a fight.

Spread-wing behaviour

The Antarctic Blue-eyed Shag does not display the Spread-wing behaviour typical of the Phalacrocoracidae, which is thought to dry waterlogged plumage. Explanations for this unusual behaviour are outlined in Bernstein & Maxson (in press). The spread-wing behaviour

also does not occur in the New Zealand species of the blue-eyed shag complex (van Tets, in press).

Nest-building

Antarctic Blue-eyed Shags build their nests on level cliff tops and rocky outcrops in the Antarctic Peninsula region. Males collect algae from the ocean floor in nearby littoral waters at midday daily during the first part of the breeding season. *Desmarestia menziesii* composed over 95% of all nests, but *Plocamium cartilagineum* and *Gigartina skottsbergii* were also used.

The alga is presented to the female, who incorporates it into the nest with quivering motions of the bill. Gradually, as guano is deposited, the nest becomes cemented together and resembles a clay pot. Moulted feathers may also be incorporated into the nest. Although there are no sticks or twigs in Antarctica, the shags proved adept at using wooden-dowel nest markers as nest materials, and the daily migrations of these purloined markers testified to the frequency of nest material theft within the colony.

Mate retention

Mate retention between breeding seasons is common for seabirds (see Cuthbert 1981 for a review). However, several authors (e.g. Snow 1963, Kepler 1972, Harris 1979) have noted high incidence of mate changes between consecutive breeding seasons for Pelecaniform birds.

Of the 30 colour-ringed pairs, 18 shags (30%) were not seen the following year and were presumed dead. While this is high adult mortality, Potts (1969) stated that high mortality may follow a low food year, and 1980 was believed to be such a year (Maxson & Bernstein 1980). However, this makes mate retention hard to analyse since loss of a mate is good reason to re-mate.

A central question of mate retention studies is whether past reproductive success influences mate fidelity in the next breeding season. Unfortunately, both members of the pair survived in only 12 nests, all previously successful. Therefore we cannot compare effects

TABLE 1 — Mate retention and nesting success 1979-1980 and 1980-1981

	Successful	Unsuccessful
1980		
Pairs that switched	2	2
Pairs that did not	1	3
1981		
Pairs that switched	2	1
Pairs that did not	0	1

TABLE 2 — Site fidelity in the Antarctic Blue-eyed Shag

	Nest Site		
	Same	Different	Unknown
Pairs that do not switch mates	5	0	0
Males that switch	18	0	1
Females that switch*	6	1	0

*Females were considered at the same nest site if they nested within 5m of previous nests, thus within a nest area, rather than on a nest site.

of successful or unsuccessful nesting. Of the 12 surviving pairs, 7 switched mates.

Another important question is whether birds that switch are more successful than those that do not. Although sample sizes were small, data in Table 1 indicate no significant difference in nesting success between pairs that switch and those that do not.

Nest-site retention

As noted by Nelson (1978) and by Morse & Bucheister (1979), nest-site retention in seabirds may be as strong as if not stronger than mate retention. Our data on nest-site retention (Table 2) indicate that, except for one female, there was a strong tendency to nest each year in the same area of the colony. A similar pattern was noted by Derenne *et al.* (1976) in the King Shag *(P. albiventer)*, although sexes were not positively distinguished. Shags were on territory and paired throughout the non-breeding season, which certainly contributes to site tenacity.

DISPLAYS

Take-off from land

Van Tets (1965) divided the take-off into three phases: Look, Crouch, and Leap. Movies show that Antarctic Blue-eyed Shags do raise their heads with the bill slightly elevated in a Look phase, but the Crouch is greatly reduced and inseparable from the Leap. Owre's (1967) description of a cormorant diving into flight seems more appropriate. No calls were made before take-off.

Post-landing

As van Tets (1965) noted, the Post-landing display is a combination of recovery after landing and submissive posture. However, the display for the Antarctic Blue-eyed Shag is more exaggerated than that of some other species. Immediately upon landing they extend their inflated head and neck forward and lower than their back, which is held horizontal to the ground (Fig. 1a). This display differs slightly from the arched neck position described for the Great Cormorant or Black Shag (*P. carbo*).

Although van Tets (1965) mentioned that the display may

partially be preparation for attack, he and Dorward (1962) believed that the display reduces chance of attack by promoting individual recognition among neighbouring birds. However, shags in adjoining nests gave little attention to one another until they were immediately adjacent to the nest. Furthermore, the display was used when birds landed on rocks by the sea, where non-neighbours were present and individual recognition would have been unlikely. For these reasons, we prefer to consider the display as mainly having a submissive function. Moreover, whenever shags landed precisely at the edge of their nests, as they often did, the Post-landing display immediately graded into Pair-bond maintenance, a derivative of appeasement behaviour. No Gape display during Post-landing was observed in the Antarctic Blue-eyed Shag similar to Snow's (1963) observations for the Shag *(P. aristotelis)*.

Hop

The Hop is described by van Tets (1965) as an abbreviated symbolic flight that can grade between short hops around the nest to Circle-flying, short flights away and back to the nest. Once a male slightly bounced in place before departing the nest site, but a distinct Hop was never seen. Circle-flying, however, was common. Although its function was not apparent, van Tets (1965) believed that it may familiarise the bird with its nest location early in the breeding season. This is not a totally satisfactory explanation since Circle-flights occurred throughout the breeding season.

Stepping

This display is an exaggerated, often rapid, high-stepping walk that a shag used while moving through the colony (Fig. 1b). Females held the bill tightly against the chest during the walk, whereas males did not depress the bill directly against the chest and their steps were slower and less exaggerated. When the shag stopped, it performed the low neck extension typical of the Post-landing display. Stepping was most often observed in females during the courtship period when they

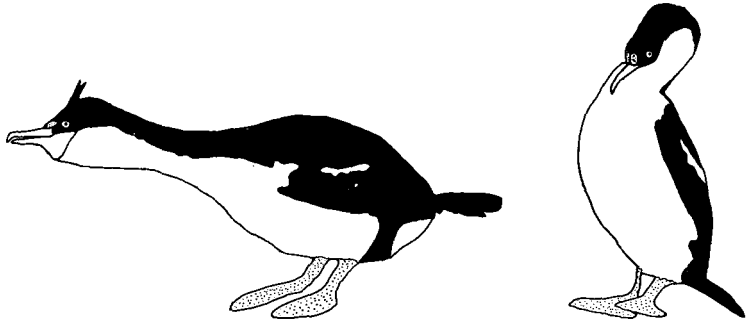

FIGURE 1 — (a) Post-landing posture, (b) Stepping

had to move close to nests in choosing mates, during which time it served as an appeasement function. The display was observed less often during other periods as the spacing of nests allowed movement through the colony without certainty of attack.

Kink-throating

At no time was the display regularly noted during Pre-landing, although photographs show that a few shags were in the Kink-neck posture as illustrated in van Tets (1965, Fig. 37). Van Tets (pers. comm.), however, has noted the behaviour in New Zealand species of blue-eyed shags and believes that we may have failed to recognise the behaviour.

Fighting

The three fights seen were quite violent and in two instances ended with the loser bloody. One shag would clamp its bill around the neck or wing angle of another and jerk and twist while forcing its narrow beak tighter. The aggressor often persisted in the attack long after its opponent was trying to escape. Fights were uncommon and none was seen after territories had been established. One fight lasted 8 minutes and involved up to four male shags. The other fights, however, lasted less than 3 minutes and involved two males contending for a nesting territory.

Threatening

Threat displays were directed not only at other shags but also at other birds and at humans. Antarctic Blue-eyed Shags are extremely tenacious to the nest site, unlike the King Shags *(P. albiventer)* in Tierra del Fuego (pers. obs.). Instead of fleeing the nest site, they oriented the head toward an intruder in a Threat display with the throat and head expanded and the mouth opened to expose the orange gape. The head was waved slowly from side to side. As females had no vocalisation, they hissed, while males uttered the *aark.* The plumage was raised during the display with the nuptial crests extended, and the wings were often partially opened. The nest site must be defended because, early in the breeding season, an unguarded nest is subject to immediate dismantling by neighbours and later, small chicks or eggs in unattended nests may be taken by Brown Skuas *(Catharacta lonnbergi),* South Polar Skuas *(C. maccormicki),* Greater Sheathbills *(Chionis alba),* or Southern Black-backed Gulls.

Male advertising

The male advertising display of cormorants was termed Wing-waving by van Tets (1965). The wing movement is thought to enhance the white dorsal patches present in some species. In this display, the wing tips are raised simultaneously upwards and outwards with the primaries folded behind the secondaries. Despite a prominent white dorsal patch in the Antarctic Blue-eyed Shag, only slight wing movements were noted for a few individuals; most shags kept their wings

FIGURE 2 — (a) Gaping, (b) Gargling

motionless. This conforms to van Tets' (1974) update of his behavioural descriptions in which he described the male advertisement display of the King Shag as Gargling with no mention of wing movements. The King Shag is closely related to the Antarctic Blue-eyed Shag (Watson 1975) and may be conspecific (Devillers & Terschuren 1978, Bernstein & Maxson 1981). Although some birds began the display in a semi-upright position (van Tets 1965), most started in a squat position with the back horizontal and the head elevated in the Gape position (Fig 2a). The Throw-back component of the display occurs when the head is rapidly jerked backwards so that the bill is pointed upwards and the neck lies across the bird's back (Fig. 2b). The tail is raised to varying degrees with the most intense display indicated when it points toward the head of the shag (van Tets 1965). Any wing movement is synchronised with the Throw-back. Only male Antarctic Blue-eyed Shags vocalise, and a characteristic *aark* is sounded during each Throw-back. The display is performed only by males at the nest site while they stand on one or both legs.

Recognition

Van Tets (1965) noted that during courtship male cormorants deterred unacceptable females by threat displays, and the female could be thrown from the nest. Females were, therefore, cautious in approaching an alternately advertising and threatening male, but if they persisted, the male's threats became less intense. Van Tets (1965) thought that the above behavioural sequence was responsible for the ritualisation of threat into recognition displays.

In cormorants, the recognition is known as the Gape, a bisexual display of the "in" bird at the nest (van Tets 1965). We did not observe the gradation from male threat to courtship behaviour described above. Pair-bond maintenance began immediately after chicks fledged in mid-March. At this time, females departed the nest shortly before males each day and would display with several males while walking through the colony. Many birds continued pair-bond maintenance and site fidelity throughout the austral winter (Glass 1979 and pers.

obs.), and, in contrast to van Tets' (1965) description, pairs appeared well established at onset of courtship in mid-September, as Poncet (pers. comm.) also noted.

Pointing and Darting are behaviours described by van Tets (1965) as recognition displays in some cormorants but were not observed in this context in Antarctic Blue-eyed Shags. Darting, however, the rapid, horizontal, back and forth movement of the head, often with the mouth open, was noted in threat (see above). This supports van Tets' (1965) hypothesis that recognition and threat behaviours are closely related in some cormorants.

Nest-indicating

Van Tets (1965) and Snow (1963, 1966) regarded nest maintenance and movements such as drawing nearby objects, worrying nest material, or prodding the bill into the nest as Nest-indicating movements that emphasise ownership. Tinbergen (1953) and Berry (1976), however, thought that these may be redirected fighting movements. At no time during our observations were these movements associated with threat or intrusion. While they could be redirected aggression, we conclude that they were merely nest maintenance behaviour. In the New Zealand species of blue-eyed shags there are also no Nest-indicating movements associated with threat or intrusion, although in some species they serve as recognition displays (van Tets, in press).

Bowing

Bowing is thought to be a recognition display derived from nest maintenance behaviour (van Tets 1965). Antarctic Blue-eyed Shags did not have a Bow display. This is in agreement with Berry's (1976) observations of the Cape Cormorant *(P. capensis)* and those of van Tets (in press) of New Zealand species of blue-eyed shags.

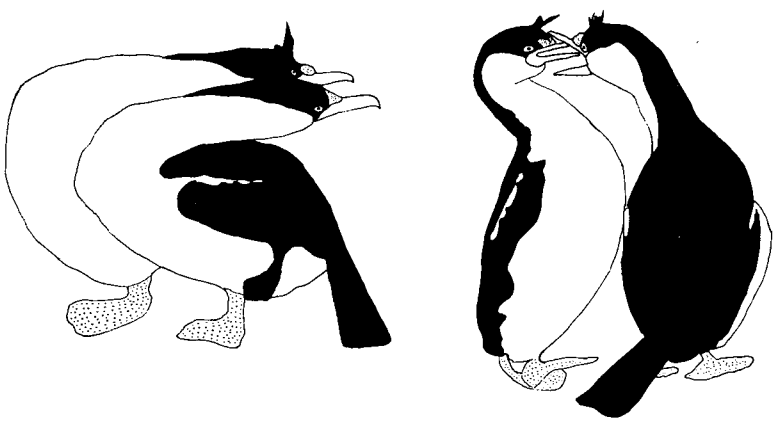

FIGURE 3 — (a) Head-wagging, (b) Pair-bond maintenance display (see text for details)

Head-wagging

Head-wagging in Sulidae is believed to be derived from chick food-begging (van Tets 1965). A typical sequence of Head-wagging would begin with the shags slowly crossing their necks back and forth, usually without any vocalisation. Simultaneously, they would fully extend their necks in one direction, often immediately followed by another extension 180° away from the first (Fig. 3a). Their necks were usually parallel during the extension but sometimes crossed. Head-wagging was primarily a pair-bond maintenance and courtship behaviour. Although we saw it all year when the pair was present on the nest, it was most common during courtship and nest building.

Other pair-bond maintenance behaviours

Throat-clicking (Snow 1963) was similar to another pair-bond maintenance behaviour observed in the Antarctic Blue-eyed Shags. The behaviour resembled van Tets' (1965) description for Kink-throating in the Anhinga *(Anhinga anhinga)*. Both birds wave their heads rapidly back and forth with the female holding her bill wide open and the male maintaining a slight gape (Fig. 3b). Unlike the Head-wag, where the head and neck are moved, only the head is moved in a horizontal plane during this display. Van Tets (1965) correctly noted the resemblance to chick begging in the Anhinga. As Snow (1963) observed in the Shag, we noted the display before, during, and immediately following copulation, as well as before one member of the pair departed or arrived at the nest. In addition, it was a common pair-bond maintenance behaviour during courtship. At this time, the female seemed to initiate the display, which often resulted in the male shag's departure to gather nest material. Van Tets (pers. comm.) does not believe we observed a single display, but, rather, several displays. Although van Tets' interpretation may be valid, the same patterns were observed repeatedly in the same behavioural contexts that Snow (1963) observed.

Allopreening

Another form of pair-bond maintenance that may serve a useful function was simultaneous Allopreening. Allopreening was directed to the head and neck regions, and, unlike Snow's (1963) description, Allopreening was often directed close to the eyes. While Allopreening might remove feather and skin parasites, Nelson (1978), who found no evidence to support this hypothesis in sulids, considered Allopreening an appeasement behaviour between members of a pair. Nelson's (1978) explanation is plausible, but bouts of Allopreening were interspersed between bouts of individual preening, and so it probably also functions to a degree in feather maintenance.

Juvenile water-begging

Both van Tets (1965) and Nelson (1978) noted that juvenile cormorants begged for water, which was supplied by the parent. The

juvenile Antarctic Blue-eyed Shags did not use this behaviour, which probably reflects physiological adaptations, but we have no supportive evidence. Nor do the chicks of other species of blue-eyed shags that have been studied beg for water (van Tets, in press).

CONCLUSIONS

With few exceptions, Antarctic Blue-eyed Shags conformed closely with the basic behavioural patterns described for the Pelecaniformes by van Tets (1965).

While our data on mate fidelity are limited, they suggest several tendencies. Males tended to breed on the same nest each year and females rarely moved farther than 15 m away from the nest where they had bred the previous year. Mate switches appeared common, but did not necessarily result in greater reproductive success.

Phylogenetic relationships are difficult to determine from behaviours because of lack of similar studies. Observations of morphological characters such as plumage and skin colour do not provide conclusive answers to these questions either (Bernstein & Maxson 1981), and we encourage future researchers of the blue-eyed shags to collect ethological data for comparison. Such fundamental data are sorely needed before questions of taxonomic and phylogenetic relationships within the group can be fully answered.

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SHORT NOTE

A WHITE-NECKED HERON IN THE FAR NORTH

On 3 October 1981, I was called by Mrs Mae Petera to identify a strange bird seen near her house on the Land and Survey farm of Onepu, 16 km north of Houhora.

The heron was feeding in a shallow weed and rush covered pond near a raft of fish floats. Also feeding in the pond were two Pied Stilts *(Himantopus h. leucocephalus)*, which the heron avoided; yet it ignored two horses feeding nearby.

From notes and photographs which I was able to take the bird was identified as a White-necked Heron *(Ardea pacifica)*. It was about the height of a White Heron *(Egretta alba)* and later, after it was disturbed, it moved toward a standard seven-wire fence where I was again able to photograph it and also get a good estimate of its height.

Its legs and bill were dark grey to black and its head and neck were wholly white. Each wing had in flight two white patches, the larger one just inside the carpal bend. I gained the impression, in flight, a reddish-brown tinge was on the inner wing and the secondaries. The bird was very like that shown by Slater (1970, *A field guide to Australian birds,* Vol. 1) but lacked the dark spots down the neck and the chestnut patches mentioned as being on the crown, hind neck and upper breast.

All these observations were made during mid-morning in perfect sunlight without any wind. In the weeks before, bad weather with predominant south-west winds to 35 knots had prevailed.