

# A COMPARISON OF METHODS IN A BEHAVIOUR STUDY OF THE SOUTH AFRICAN GANNET

M.J.F. JARVIS

*Department of Zoology, University of Cape Town.*

## ABSTRACT

During a detailed study of the South African gannet, *Sula capensis*, various methods of behaviour analysis were tried. Three methods are outlined in this paper and the results obtained from each method were in general agreement. The significance of the Sky point posture is considered in some detail.

This paper gives a broad outline of techniques used in this study. Greater detail may be obtained from Jarvis (1971). The statistical techniques were mainly taken from Bishop (1966). The study was undertaken on a full-time basis at Bird Island, Lambert's Bay (32°05' S, 18°18' E), between April 1966 and December 1968. The methods used to accumulate and analyse the data are best described with the aid of actual examples. These methods will be referred to as 'A', 'B', and 'C'.

### *Analysis method A*

The first set of observations involved the recording of all behaviour performed by a pair between one bird returning to the colony and its mate leaving, some 20 minutes or more later. A typical sequence of behaviour would be transcribed as shown in Table 1.

Many such observations enable determination of the usual sequence of events when males (or females) land at the nest, and show whether typical sequences vary at different stages of breeding. It was found that a Mutual greeting ceremony invariably followed the return of one bird to its mate. However, the first behaviour (or activity) after the Mutual greeting varied considerably. The three main activities, performed by one or other bird of a pair, immediately after the Mutual greeting in the courtship period of breeding, were Sky point, an Impassive posture, or Soliciting headshake.

Of the many hundreds of sequences recorded, 236 involved birds with nest sites (no eggs yet laid, i.e. courtship period). In all cases the sex of a landing bird was known from coloured ring combinations or from features of the subsequent behaviour. During this courtship period, Sky point behaviour followed the Mutual greeting in 31,3% of observations. The Impassive posture was seen in 19,9% and Soliciting headshake in 10,1%. The behaviour sequences were then analysed further, depending on which of these three common activities or postures had been witnessed. For convenience these analyses are called group 1, 2 or 3. Each of these were then subdivided further, depending on the sex of the bird that had performed the Sky point (see Table 2).

A similar analysis was made of behaviour sequences in groups 2 and 3. The activities recorded under each of these three groups were then summarised as shown in Fig. 1. This figure shows the behaviour sequences that were most often witnessed after a bird landed and after the Mutual

TABLE I  
THE METHOD OF RECORDING DATA FROM TAPE RECORDINGS OF BEHAVIOUR SEQUENCES

Date	Time	State of nesting	Sex of landing bird	Following behaviours of male and female			
20/12	0930	Nest but no egg	Male	♂ sky point sky point			
				♀ nest build shakes head			
	♂ bites ♀ on head						
	♀ at mate shakes head vigorously						
	♂ sky point preens chest						
	♀ nest build preens back						
	♂ shakes head at						
	♀ sky point						
	♂ preens chest impassive posture						
	♀ moves few feet away low intensity sky						
	♂ nest build						
	♀ point suddenly dashes to edge of colony.						
	0942					♂	MUTUAL GREETING → sky point → sky point
	0950					♀	at mate → shakes head vigorously

greeting had ended.

A similar analysis was made of other behaviour sequences. One of the activities investigated in detail was Sky point. In this, a bird walks through the crowded colony (either away from or towards its nest) with its head and beak pointed vertically towards the sky. Analysis was made of the activities most often preceding and following the Sky point and also of the simultaneous activity of the mate. It became clear from this analysis, and from Fig. 1, that when either bird performed Sky point, the mate either showed no reaction i.e. was Impassive, or else it performed a Soliciting headshake (an activity that appears to draw the mate back towards the nest (Jarvis 1971)). There was definitely no aggressive response towards the Sky pointing mate. Jarvis (1971) showed that if a bird dashed up to its mate without performing a Sky point it was often bitten on the back of the head (if it was a female) or else a Mutual greeting was performed. There is considerable

TABLE 2  
SHOWING GROUP I ACTIVITIES, I.E. WHEN SKY POINT FOLLOWED IMMEDIATELY AFTER THE  
MUTUAL GREETING

<i>Sex of bird sky pointing immediately after the mutual greeting</i>	<i>Behaviour shown after the sky point</i>	<i>Percentage occurrence</i>	<i>Number of observations</i>
MALE	More sky point .. .. .	17,9	40
	Soliciting headshake .. .. .	10,7	24
	Nest building .. .. .	8,5	19
	Copulation .. .. .	7,1	16
	Impassive posture .. .. .	7,1	16
	Sky point + Groan .. .. .	5,3	12
	Other minor beh's. (All performed less often than the activities listed above.)	43,4	98
FEMALE	More sky point .. .. .	18,1	30
	Impassive posture .. .. .	9,0	15
	Soliciting headshake .. .. .	7,8	13
	Sky point + Groan .. .. .	6,0	10
	Self preening .. .. .	5,4	9
	Other minor beh's. (All performed less often than the activities listed above.)	53,7	89

evidence to support the idea that this Mutual greeting is a means of reducing aggression between birds of a pair. Since a bird performing the Sky point is not greeted by a Mutual greeting ceremony when it returns to the nest, this may indicate that the Sky point in the pair bond context may be acting to reduce aggression. The fact that Sky pointing is characteristically performed while the bird is moving away from or towards the nest, past hostile neighbours, also suggests that it may

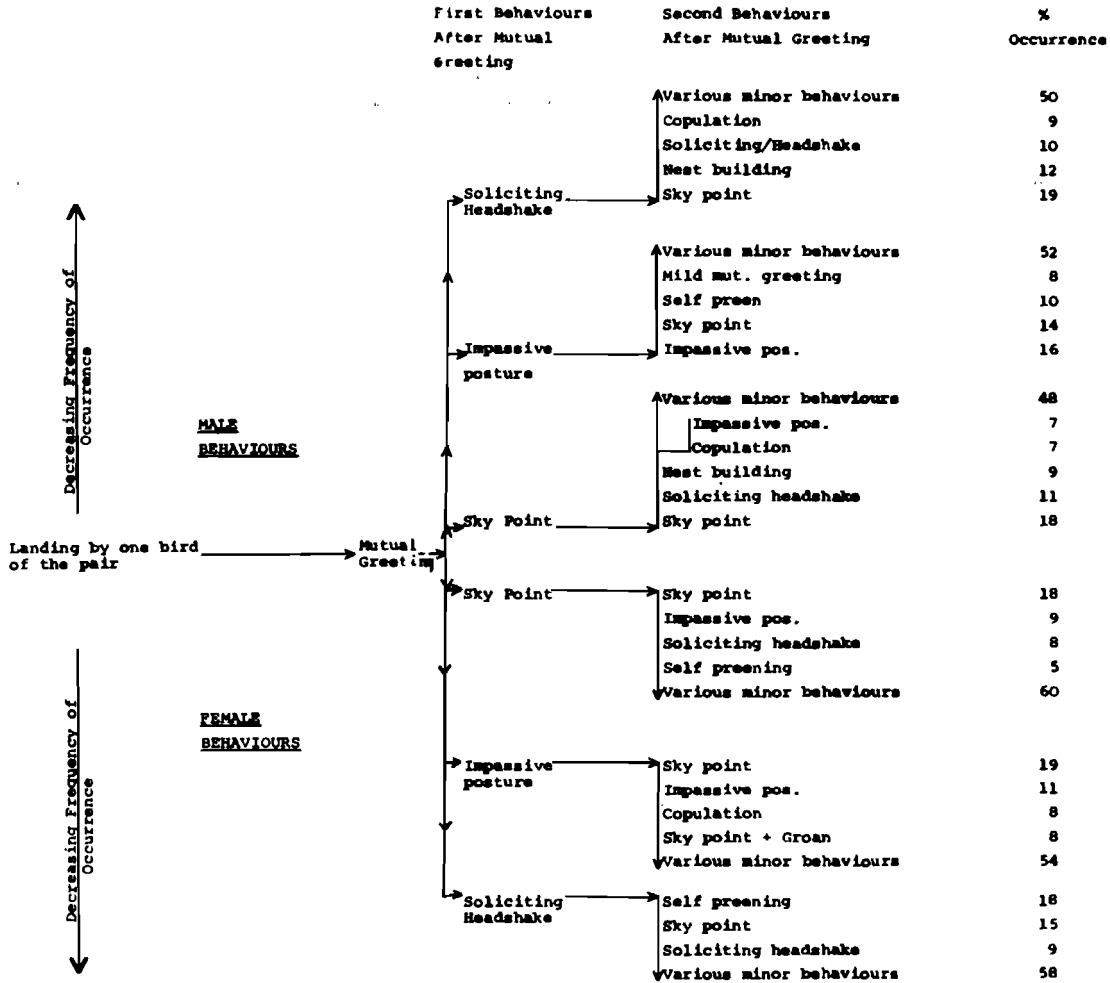


FIGURE 1

Summary of the main behaviour sequences that may follow after birds land and greet their mates.

fulfil an appeasing role. Further light was thrown on this question by the results of the following method of investigation.

#### *Analysis method B.*

This method involved watching birds performing various activities and noting if the neighbours showed any reaction towards them. In one such set of observations a record was made of the number of aggressive responses made towards birds performing a variety of activities (Table 3). Aggressive responses included: Aggressive beak point, Thrust threat, Threat and Peck. These are

described in detail by Jarvis (1971). Briefly, Aggressive beak point is when a bird suddenly moves its beak slightly towards a neighbour, as if to threaten it, but the beak is kept closed. Threat is a similar movement but the beak is opened and the head turned directly towards the threatened neighbour. In Thrust threat the beak is opened and the head and neck are thrust towards the neighbour. In the Peck, contact is made between the neighbour and the beak of the aggressor.

At first glance, Table 3 seems to indicate that Sky pointing birds actually draw considerable aggression from neighbours. Nevertheless, a more critical analysis of the situation suggests that Sky pointing does in fact act to reduce aggression from neighbours, even though it does not eliminate this aggression entirely. This conclusion was deduced from the following considerations. First, it was noted that Sky pointing is generally performed when birds are off the nest site, while all the other activities, that drew an appreciable number of aggressive responses, were performed on the nest site (except Running the gauntlet). A bird is far more likely to be threatened or attacked when it is off its nest and intruding into a neighbour's territory. Solo bowing, Mutual greeting and Copulation all drew between 20% and 25% aggressive responses from neighbours. The aggressive responses shown towards Sky pointing birds were only 10% higher, even though this Sky pointing was performed off the nest. Further, a more detailed analysis of the data revealed that only 9% of these aggressive responses towards the Sky pointing birds actually involved a peck at the Sky pointer. Generally the neighbours merely threatened but seemed inhibited from actually making contact. It was also noticed that 27% of the Sky pointing birds were not seen to draw any reaction from neighbours, even though they were watched for the duration of the Sky point. This raises a further consideration, namely that the Sky point posture is generally maintained for longer periods than activities such as Solo bow, Copulation, or Mutual greeting. Thus the readings showing reactions to Sky pointing birds represent a longer period of time than other activities. If observations of each Sky point had been restricted to a period, equivalent to the duration of a Solo bow or Copulation, the recorded number of aggressive responses towards Sky pointing birds

TABLE 3  
AGGRESSIVE RESPONSES BY NEIGHBOURS TOWARDS BIRDS PERFORMING  
VARIOUS ACTIVITIES

<i>Behaviour</i>	<i>Percentage of neighbours reactions which are aggressive</i>	<i>Number of observations</i>
Running gauntlet ..	90,0	50
Sky point .. ..	35,2	79
Solo bow .. ..	25,8	81
Copulation .. ..	24,8	56
Mutual greeting ..	20,2	74
Rotary-wing flap ..	1,5	63
Rotary-feather shake	0,0	56
Wing stretch .. ..	0,0	22

TABLE 4  
THE AVERAGE INCIDENCE OF EACH BEHAVIOUR PATTERN AMONG 250 BIRDS  
DURING 5 MINUTE FREQUENCY COUNTS ON 16 DIFFERENT DAYS.

*Behaviours – Average Incidence per 5 min. count*

<i>Date</i>	<i>Threat</i>	<i>Fight</i>	<i>Sky point</i>	<i>Sky point and groan</i>	<i>Solo bow</i>	<i>Mutual greeting</i>	<i>Rotary wing-flap</i>	<i>Rotary feather-shake</i>	<i>Landing</i>	<i>Leaving</i>	<i>Number of counts averaged</i>
5.10.67 ..	11,6	1,4	10,1	4,2	23,2	7,4	15,4	22,1	2,5	2,0	60
11.10.67 ..	10,6	1,4	10,4	5,0	21,8	9,2	18,5	21,5	2,5	1,5	60
19.10.67 ..	10,0	0,8	8,6	4,6	20,9	15,6	19,3	25,7	1,9	2,3	55
26.10.67 ..	8,0	0,9	7,6	7,0	19,4	4,5	16,2	17,7	2,3	1,4	60
31.10.67 ..	6,9	1,1	7,0	5,6	20,3	4,2	19,2	24,2	2,4	2,6	65
2.11.67 ..	7,0	0,7	5,9	4,4	21,1	4,0	15,7	20,5	2,2	2,2	80
14.11.67 ..	8,5	0,6	6,6	4,0	22,0	2,8	16,3	23,2	1,7	1,3	70
15.11.67 ..	12,4	1,0	8,4	4,3	19,5	4,8	17,6	23,3	1,9	1,2	45
25.11.67 ..	11,6	0,6	6,8	4,3	16,7	4,4	19,2	24,3	1,5	1,7	65
29.11.67 ..	8,9	0,6	6,4	3,7	19,9	1,5	16,4	36,8	1,1	0,7	50
13.12.67 ..	7,0	0,5	5,7	3,0	15,6	1,4	13,7	31,3	0,7	0,3	60
21.12.67 ..	4,5	0,2	1,6	1,3	10,0	0,8	12,4	27,2	0,6	0,3	45
9.1.68 ..	6,3	0,2	3,6	3,7	17,6	0,9	16,4	27,5	0,8	0,5	65
11.1.68 ..	6,6	0,2	3,4	3,7	22,9	2,5	13,8	21,7	0,8	0,5	40
23.1.68 ..	6,5	0,4	3,2	4,5	18,9	1,7	15,6	19,6	1,2	0,7	70
25.1.68 ..	6,9	0,5	4,1	3,9	24,7	1,7	14,5	21,7	0,7	0,9	60
Totals ..	133,3	11,1	99,4	67,2	314,5	67,4	260,2	388,3	24,8	20,1	950
Means ..	8,3	0,7	6,2	4,2	19,7	4,2	16,3	24,3	1,6	1,3	

would almost certainly have been much lower.

It does seem that Sky point is, after all, likely to act as an "aggression reducing posture". This possibility seems even more probable when birds are watched leaving the colony without showing Sky point behaviour. Such birds, Running the gauntlet, are pecked by all and sundry, irrespective of sex. In fact most birds leave the colony by Running the gauntlet, but generally they precede this with a period of gradual movement away from the nest, in a Sky point posture. This initial Sky pointing probably enables the bird to gain a vantage point from which it feels better able to dash for the edge. The advantage of dashing is probably that it is very much quicker and the birds

are impatient to leave the colony after a long nest attendance.

*Analysis method C.*

This third method of observation involved counting the frequency of each major behaviour. Each count was for 5 minutes and included all activities seen to occur simultaneously in a group of 250 birds. The counts were initially spoken into a tape recorder. On most days five counts were made every hour of daylight. The 950 counts included in the analysis were taken on 16 days and to facilitate analysis the readings for each day were averaged (Table 4). It was surprisingly easy to watch 250 birds simultaneously provided the observer was situated on an elevated area and the birds were enclosed within an area that was clearly marked by some stationary objects. This task was also facilitated by the fact that at any one time most of the birds were impassive and were not performing any definite behaviour pattern.

The results were analysed by standard statistical procedures to establish correlation co-efficients between the incidences of various activities. The comparison of Sky point and Threat resulted in a very strong positive correlation ( $P=>0,001$ ). This correlation suggests that these two activities are motivationally linked in some way. Three possible reasons for this correlation come to mind, namely:—

1. That birds performing Sky point are in an aggressive state and are drawing aggression from neighbours.
2. That these birds are performing an appeasement posture in response to the aggression of neighbours.
3. That some other seasonal or environmental factor has the effect of increasing the incidence of both Threat and Sky point, even though these two behaviours may not be directly related either motivationally or functionally.

The third possibility seems very unlikely since the only factors likely to stimulate Threat are ones causing irritation or annoyance to the birds. It seems improbable that such irritations would activate one bird to Threaten and another bird to Sky point, unless these activities are, after all, related in some way. If they are related then the first or second possibilities are probable.

## DISCUSSION

Many of the observations outlined in this paper, have suggested that Sky pointing was an activity that tended to reduce the chance of a bird being pecked by a neighbour. A Sky pointing bird would also seem more likely to be in an appeasing state of motivation than an aggressive one since aggression is generally associated with a nest site and Sky pointing birds are usually away from the nest. In South African gannets the defended area consists of little more than the nest site. Nesting birds are often so close together that they can peck each other without leaving the nest. It therefore seems very probable that the correct explanation for the strong positive correlation between frequency counts of Threat and Sky point, is also that Sky point is being used as an appeasement posture. Thus when neighbours are for some reason in a very aggressive state the incidence of the appeasing Sky point will be higher.

This view of the Sky point posture is in harmony with suggestions made by Fisher and Lockley (1954) and Tinbergen (1959). However, Nelson (1965) believes that Sky point in *Sula bassana* was unlikely to function as an appeasing posture. He analysed some contexts where it was performed and concluded that the posture did not effectively prevent attack and was not adopted when attack was likely. It is possible that the appeasing function of Sky point is less developed in *S. bassana* than in *S. capensis*. In Jarvis (1971) it was shown that the Sky point posture is performed more frequently in *S. capensis* than in *S. bassana*. It may also be significant that the conspicuous black naked skin on the throat of gannets is considerably longer in *S. capensis* than in *S. bassana*. This black marking appears to accentuate the head position that is characteristic of Sky point. Its greater length in *S. capensis* may be an indication that Sky point is relatively more important in this species.

However, even if the Sky point witnessed in *S. bassana* has less of an appeasing function than in *S. capensis*, the reasons given by Nelson (1965) for not considering the posture to be appeasing, are not entirely convincing. He notes that in 78 cases of Sky pointing, 60% elicited a menace from previously quiescent neighbours. This he compared with the effect on neighbours of other movements considered to be roughly of similar magnitude. Thus 33 out of 432 Rotary head shakes (8%) and none of 36 Bows drew menaces.

These reasons may be misleading since Sky point is generally performed off the nest site while Solo bow is performed on the nest. The other activity compared, namely Rotary head-shake, is a bad choice since observations on *S. capensis* (Jarvis 1971) have shown that this activity rarely draws aggressive responses in any context. It can best be regarded as a comfort movement.

Since it has been concluded that in *S. capensis* the Sky point is probably used as an appeasement behaviour (at least in some contexts), it may be worth defining the meaning given in this paper to the term 'appeasement posture'. It is a posture that tends to reduce the level of aggression by neighbours towards the bird with the posture, in contexts where it is disadvantageous for the bird with this posture to either return the aggression or to flee from it.

#### CONCLUSION

Throughout this paper the activities used to illustrate the three methods of investigation and analysis, have included Sky point. It is clear that all three methods suggested that Sky pointing is used as an appeasement posture. None of the methods could actually prove this contention but in each case it was a likely explanation of the facts. Since the three methods of analysis seem to support each other, this suggests that these methods are valid and useful.

#### ACKNOWLEDGEMENTS

I am indebted to Professor G.J. Broekhuysen of the Zoology Department, University of Cape Town, for supervising my study of the ethology and ecology of the South African gannet. Professor Broekhuysen received a C.S.I.R. grant to finance the project.

I am grateful to Mr. C.S. Bosman, Director of the government guano islands, for permission to



work on Bird Island, Lambert's Bay. Various people on Lambert's Bay were helpful, especially Mr. B. Grib and the harbour master, Mr. Groenewald.

#### REFERENCES

- BISHOP, O.N. 1966. *Statistics for Biology*. London: Longmans.
- FISHER, J. and LOCKLEY, R.M. 1954. *Sea Birds*. London: Collins.
- JARVIS, M.J.F. 1971. Ethology and Ecology of the South African Gannet, *Sula capensis*. Ph.D. Thesis, University of Cape Town.
- NELSON, J.B. 1965. The Behaviour of the Gannet. *British Birds*, 58 (7 and 8): 233-288 and 313-336.
- TINBERGEN, N. 1959. Comparative Studies of Behaviour of Gulls (Laridae) a progress report. *Behaviour*, 15 : 1-70.