Effect of human disturbance on the breeding behaviour of jackass penguins *Spheniscus demersus*

P.A.R. Hockey and J. Hallinan
FitzPatrick Institute, University of Cape Town, Rondebosch

The effects of human passage through low-density colonies of breeding jackass peguins *Spheniscus demersus*, and of human approach to high-density colonies were assessed. Passage disturbance led to egg loss through predation by kelp gulls *Larus dominicanus* and invariably frightened nest-prospecting penguins away from the colony after the third or fourth intrusion, regardless of the interval between intrusions. Birds were disturbed and occasionally left the colony when an observer was less than 30 m from the edge of a high-density colony. Adult birds reacted most to a slow, direct approach and chicks to a staggered approach. The exodus rate of birds was higher at coastal than inland colonies, where no exodus was recorded. Results are discussed in relation to the conservation of the jackass penguin.

S. Afr. J. Wildl. Res. 1981, 11: 59 – 62

Die uitwerking van menslike deurgang deur kolonies van broeiende Kaapse pikkewyne *Spheniscus demersus* met 'n lae digtheid en van menslike nadering tot kolonies met 'n hoë digtheid is ondersoek. Deurgang-steuring het gelei tot verlies van eiers as gevolg van interspesie-roof deur swartrug-meeue *Larus dominicanus* en het sonder uitsondering pikkewyne wat nessoek ná die derde of vierde indringing van die kolonie verjaag — ongeag die tydsverloop tussen indringings. Voëls is gesteur en het soms die kolonie verlaat as 'n waarnemer minder as 30 m van die rand van die hoë-digtheidskolonie weg was. Volwasse voëls het die sterkste gereageer op 'n stadige, direkte nadering, en kuikens op 'n trapsgewyse nadering. Die uittogkoers van voëls was hoër by kus as by binnelandse kolonies, waar geen uittog aangeteken is nie. Die resultate word bespreek met betrekking tot die bewaring van die Kaapse pikkewyn.

S.-Afr. Tydskr. Natuurnav. 1981, 11: 59 – 62

This paper constitutes part of the commemoration of the 21st anniversary of the establishment of the Percy Fitzpatrick Institute of African Ornithology.

P.A.R. Hockey* and J. Hallinan
FitzPatrick Institute, University of Cape Town,
Rondebosch 7700, South Africa
*To whom all correspondence should be addressed

Received 13 January 1981; accepted 27 January 1981

Introduction

Several studies have highlighted the dangers of human disturbance to colonially breeding seabirds (Ainley 1974, Anderson & Keith 1980, Ellison & Cleary 1978, Erwin 1980, Gillett, Hayward & Stout 1975, Hand 1980, Hunt 1972, Kury & Gochfeld 1975, Robert & Ralph 1975, Taylor 1962, Thomson 1977). The jackass penguin, *Spheniscus demersus* and a number of other colonially breeding seabirds whose conservation status is vulnerable,breed at islands off the coast of southern Africa (Frost, Siegfried & Cooper 1976a, Siegfried, Frost, Cooper & Kemp 1975). The need for an effective management plan for conserving the jackass penguin in particular was recognized by Frost *et al.* (1976a) who identified long-term disturbance of breeding colonies by humans, and especially guano collectors, as one factor contributing to the species' decline. Repeated human disturbance of Adélie penguins, *Pygoscelis adeliae*, adversely affected their breeding success and led to a population decline (Ainley 1974, Taylor 1962, Thomson 1977). Exploitation and long-term disturbance of jackass penguin colonies has a similar effect (Frost *et al.* 1976a). This paper reports on preliminary experiments designed to determine the behavioural responses of jackass penguins to repeated disturbance by humans.

Methods

The study was carried out at Jutten Island (33° 05′S 17° 58′E), in Saldanha Bay, during June 1980. Approximately 25 000 jackass penguins breed at Jutten Island (J. Cooper pers. comm. 1980). Most of the birds nest among boulders along the shore of the island but, in addition, a few small colonies occur inland in well vegetated areas. The effects of two different types of disturbance to breeding jackass penguins were assessed: passage by a human through a low-density colony (nests 4 m apart), and approach by a human to a high-density colony (nests 1 m apart).

A 200 × 10-m transect was set up through each of three low-density colonies. A rangefinder was used to determine transect limits to minimize disturbance prior to the experiment. One transect was walked daily, at the same time, for seven days, one transect was walked every two hours between 08h30 and 16h30 on two consecutive days, and the third transect once every hour on two consecutive days between 09h00 and 17h00. Four categories

of birds were recognized in the transects: adults at nests containing eggs or chicks; adults within the colony not at nests; pairs prospecting nest sites; and chicks, including those having attained their first contour feathers.

Two different types of approach to a colony were adopted, one 'gradual' and the other 'direct'. The gradual approach comprised five stages. The observer spent ten minutes at each stage and recorded the behaviour of the birds using the instantaneous group-scan technique (Altmann 1974) at intervals of two minutes. Stages were positioned, using a rangefinder, at distances of 60 (control), 40, 30, 20 and 10 m from the edge of the colony. Movements between stages were made at a slow walk and gradual approaches were made to one coastal and one inland colony. Three direct approaches were made to different coastal colonies. A series of control observations was made at 60 m from the colony edge and the observer then walked to 30, 20 or 10 m from the colony. Six behavioural categories were recognized: standing at the nest; standing away from the nest; incubating; lying down; preening; and agitated behaviour, such as the Alternate Stare (Eggleton & Siegfried 1979). Two age classes were recognized: birds in adult plumage, and chicks.

Results

Passage disturbance

When birds were disturbed at hourly intervals the only difference between days was a greater number of individuals standing away from the nest on day 1 (χ^2 = 4,10: $P < 0,05$) (Table 1). The number of prospecting adults declined significantly following the fourth transect of each day; the decline was most rapid on day 1 (Day 1, χ^2 = 17,51: P = < 0,001. Day 2, χ^2 = 14,61: P = < 0,001). On both days there was a significant decline in the number of adults standing away from nests following the first transect (Day 1, χ^2 = 25,27: P = < 0,001. Day 2, χ^2 = 6,79: P = < 0,01). This accords with the morning exodus described by Frost, Siegfried & Burger (1976b).

When disturbed at two hourly intervals only the number of adults standing away from nests differed between the days (χ^2 = 6,88: P = < 0,01) (Table 2); a reverse trend to the results of the first experiment. The numbers of prospecting adults fell significantly following the third transect of day 1 (χ^2 = 10,08: P = < 0,001). Although the number of prospecting birds declined throughout the day on day 2 the decline was not significant.

The most striking and significant change that occurred in colony structure following daily disturbance was the absence of nest-prospecting adults after the fourth day (χ^2 = 16,44: P = < 0,001) (Table 3). At this stage the number of adults at nests with eggs or chicks also declined (χ^2 = 4,08: P = < 0,05). Incubating birds close to the transect line sometimes left their eggs and these were depredated by kelp gulls *Larus dominicanus*. No other significant changes in colony structure occurred after the fourth day.

Table 1 Hourly variation in the numbers of jackass penguins in transects through a breeding colony subjected to human passage disturbance

	Adults at nests with eggs or chicks		Adults within colony but not at nests		Prospecting adults at nest sites		Chicks	
Time	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2
09h00	38	32	21	11	6	8	13	12
10h00	39	29	9	5	4	4	19	12
11h00	34	34	6	4	2	4	14	11
12h00	27	29	6	7	2	4	11	13
13h00	30	33	7	4	0	0	14	18
14h00	30	30	3	2	0	2	9	18
15h00	28	30	4	8	0	0	11	16
16h00	25	28	6	1	0	0	17	14
17h00	28	32	8	6	0	2	13	16

Table 2 Two-hourly variation in the numbers of jackass penguins in transects through a breeding colony subjected to human passage disturbance

	Adults at nests with eggs or chicks		Adults within colony but not at nests		Prospecting adults at nest sites		Chicks	
Time	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2
08h30	43	43	14	13	8	10	16	11
10h30	30	39	9	18	10	8	6	10
12h30	31	34	6	7	10	8	9	5
14h30	39	28	11	13	4	8	9	5
16h30	37	29	3	20	0	6	14	10

Table 3 Daily variation in the numbers of jackass penguins in transects through a breeding colony subjected to human passage disturbance

Day	Adults at nests with eggs or chicks	Adults within colony but not at nests	Prospecting adults at nest sites	Chicks
1	24	24	4	32
2	37	30	6	28
3	32	21	6	28
4	33	31	6	20
5	27	25	0	23
6	21	30	0	32
7	22	36	0	21

Approach disturbance

As the observer gradually approached either a coastal or inland colony there was a steady decline in the number of adults lying down (Table 4), and no chicks were lying down once the observer had approached to 10 m. At the inland colony there was a steady movement of chicks away from the nest until the observer reached 10 m when 90% of the birds returned to their nests. There was no exodus from the inland colony at any stage. A direct approach to 30 m did not disturb the coastal birds and there was no exodus from the colony (Table 5). During the gradual approach to the coastal colony there was a 12% exodus of adults at 20 m and a further 9% exodus at 10 m. No chicks left the colony until the observer was at 10 m when there was a 91% exodus. All preening ceased at 20 m.

In contrast, a direct approach to 20 m from a coastal colony caused no exodus and almost no change in the behaviour of adults. However, many previously prone chicks stood up, and an increase occurred in chick preening activity ($\chi^2 = 21{,}38$: $P = < 0{,}001$) (Table 5). A direct approach to 10 m from a coastal colony had a marked effect: all adult preening activity ceased; adults that had been lying down, stood erect and there was a large exodus of adults (54%) and chicks (54%) from the colony.

There was a greater exodus of adults during a direct approach to 10 m, whereas chicks reacted more strongly to a gradual approach. Disturbance effects were observed at 20 m during both gradual and direct approaches.

Table 4 Changes in activity of jackass penguins in coastal (C) and inland (I) colonies in response to gradual approaches from 60 m to 10 m from the edge of the colony. Figures are percentages of the population involved in each activity

Distance of observer from edge of colony (m)	Age class	Standing at nest		Standing away from nest		Incubating		Lying down		Preening		Agitated behaviour		Sample size	
		C	I	C	I	C	I	C	I	C	I	C	I	C	I
60	Adults	3,7	13,5	24,8	0,0	24,8	35,5	33,1	43,3	13,8	7,7	0,0	0,0	109	90
	Chicks	0,0	20,0	6,2	0,0	–	–	75,0	80,0	18,8	0,0	0,0	0,0	30	20
40	Adults	9,0	18,0	20,4	23,6	25,6	34,8	32,6	23,6	12,4	0,0	0,0	0,0	113	89
	Chicks	6,5	15,0	9,7	0,0	–	–	48,4	85,0	35,4	0,0	0,0	0,0	31	20
30	Adults	16,9	22,2	32,3	30,0	17,8	33,3	25,0	13,3	8,0	1,1	0,0	0,0	124	90
	Chicks	0,0	0,0	23,3	0,0	–	–	60,0	100,0	16,7	0,0	0,0	0,0	30	20
20	Adults	13,8	11,1	48,6	33,3	21,1	44,5	16,5	11,1	0,0	0,0	0,0	0,0	109	90
	Chicks	0,0	0,0	3,3	0,0	–	–	93,4	100,0	0,0	0,0	3,3	0,0	30	20
10	Adults	12,1	19,5	54,6	40,2	30,3	32,0	2,0	0,0	0,0	3,1	1,0	5,2	99	97
	Chicks	0,0	90,0	100,0	0,0	–	–	0,0	0,0	0,0	0,0	0,0	9,1	3	22

Table 5 Changes in activity of jackass penguins in high-density coastal colonies during direct approaches from 60 m (control) to 30, 20 and 10 m. Figures are percentages of the population involved in each activity

Distance from colony edge	Age class	Standing at nests	Standing away from nests	Incubating	Lying down	Preening	Agitated	Sample size
60 m to 30 m	Adults	7,0	38,0	21,0	23,0	11,0	0,0	143
	Chicks	0,0	33,3	–	0,0	66,7	0,0	9
	Adults	15,1	37,2	15,1	23,5	9,1	0,0	159
	Chicks	0,0	0,0	–	0,0	100,0	0,0	10
60 m to 20 m	Adults	4,5	57,5	10,6	15,2	12,2	0,0	132
	Chicks	4,7	48,5	–	42,1	4,7	0,0	64
	Adults	4,5	59,5	13,2	15,4	7,4	0,0	136
	Chicks	3,2	26,2	–	16,7	45,8	0,0	61
60 m to 10 m	Adults	13,5	56,5	6,5	4,0	19,5	0,0	184
	Chicks	4,2	33,3	–	16,7	45,8	0,0	24
	Adults	17,6	77,6	4,8	0,0	0,0	0,0	85
	Chicks	27,3	18,2	–	54,5	0,0	0,0	11

Discussion

The immediate responses of jackass penguins to disturbance, investigated here, provide several pointers to their effective management. The physical nature of the colonies at Jutten Island is such that it was not possible to set up a directly comparable control for the passage disturbance experiments, which precludes rigorous interpretation of the results. Frost *et al.* (1976b) found that numbers in a jackass penguin colony at Dassen Island (33°25'S 18°05'E) declined in the two hours after dawn and remained constant until early afternoon when birds returned. The time at which birds return is variable and may be after dark (R. Wilson pers. comm. 1980). We found that regular passage disturbance, regardless of the interval between intrusions and independent of the time of day, invariably frightened and prevented birds prospecting for nest sites. The consistency of the results between varying experimental constraints emphasizes their validity, and it is clear that repeated passage disturbance would have a detrimental effect on the productivity of the population. Effects could be minimized if the interval between disturbances was long (7 – 10 days), as the number of prospecting adults dropped significantly only after the third or fourth disturbance. However, any disturbance of surface nesting birds should be avoided, as not only are prospecting birds frightened but effects are amplified by interspecific egg predation. Our findings refer to low-density colonies, and effects will be compounded in high-density colonies where a chain panic reaction sets in as adults run through the colony to escape and incubating birds join the exodus. We suggest that the least damaging way of observing jackass penguin colonies is by using a direct approach to a single colony and by not approaching closer than 30 m from the edge of the colony.

Acknowledgements

We are grateful to the Sea Fisheries Institute for allowing us to work at Jutten Island, and for providing transport to the island. Financial assistance was provided by the University of Cape Town, the National Geographic Society, and the South African Nature Foundation.

References

AINLEY, D.G. 1974. The comfort behaviour of Adélie and other penguins. *Behaviour* 50: 16 – 51.

ANDERSON, D.W. & KEITH, J.O. 1980. The human influence on seabird nesting success. *Biol. Conserv.* 18: 65 – 80.

ALTMANN, JEANNE. 1974. Observational study of behaviour: sampling methods. *Behaviour* 49: 227 – 265.

EGGLETON, PATRICIA & SIEGFRIED, W.R. 1979. Displays of the jackass penguin. *Ostrich* 50: 139 – 167.

ELLISON, L.N. & CLEARY, L. 1978. Effect of human disturbance on breeding of double-crested cormorants. *Auk* 95: 510 – 517.

ERWIN, R.M. 1980. Breeding habitat use by colonially nesting waterbirds in two mid-Atlantic U.S. regions under different regimes of human disturbance. *Biol. Conserv.* 18: 39 – 52.

FROST, P.G.H., SIEGFRIED, W.R. & COOPER, J. 1976a. Conservation of the jackass penguin (*Spheniscus demersus* (L)). *Biol. Conserv.* 9: 79 – 99.

FROST, P.G.H., SIEGFRIED, W.R. & BURGER, A.E. 1976b. Behavioural adaptations of the jackass penguin *Spheniscus demersus* to a hot arid environment. *J. Zool. Lond.* 179: 165 – 187.

GILLETT, W.H., HAYWARD, J.L. Jnr. & STOUT, J.F. 1975. Effects of human activity on egg and chick mortality in a Glaucous-winged gull colony. *Condor* 77: 492 – 495.

HAND, JUDITH, L. 1980. Human disturbance in western gull *Larus occidentalis* colonies and possible amplification by intra-specific predation. *Biol. Conserv.* 18: 59 – 64.

HUNT, G.L. 1972. Influence of food distribution and human disturbance on the reproductive success of herring gulls. *Ecology* 53: 1051 – 1061.

KURY, C.R. & GOCHFELD, M. 1975. Human interference and gull predation in cormorant colonies. *Biol. Conserv.* 8: 23 – 34.

ROBERT, H.C. & RALPH, C.J. 1975. Effect of human disturbance on the breeding success of gulls. *Condor* 77: 495 – 499.

SIEGFRIED, W.R., FROST, P.G.H., COOPER, J. & KEMP, A.C. 1975. South African Red Data Book: Aves. *S. Afr. Nat. Sci.* Progr. Rep. 7. CSIR, Pretoria, R.S.A.

TAYLOR, R.H. 1962. The Adélie penguin *Pygoscelis adeliae* at Cape Royds. *Ibis* 104: 176 – 204.

THOMSON, R.B. 1977. Effects of human disturbance on an Adélie penguin rookery and measures of control. In: Adaptations within Antarctic ecosystems. (Ed.) Llano, G.A. Proc. Third SCAR. Symp. Ant. Biol. 1177 – 1180.