

**SOME PHYSICAL PARAMETERS OF BEARDED VULTURE  
*GYPAETUS BARBATUS* NEST SITES IN SOUTHERN AFRICA**

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**SUMMARY**

Brown, C.J., Brown, S.E. & Guy, J.J. 1988. Some physical parameters of Bearded Vulture *Gypaetus barbatus* nest sites in southern Africa. *Proc. VI Pan-Afr. orn. Congr.* 139-152.

Data on Bearded Vulture *Gypaetus barbatus* nest sites were collected throughout the species' range in southern Africa. All nests (n = 74) were on cliffs of basalt (84 per cent) or cave sandstone (16 per cent), built mainly in potholes (89 per cent) but occasionally on ledges. All ledge nests were at low altitudes (below 2300 m a.s.l.) where snowfalls are seldom severe. Eighty nine per cent of nests had overhangs or concave cliffs above them. Most pairs had three nests (mean 3.1; range 2-5) which they used in rotation, possibly for nest hygiene and to avoid parasites. Distances between the nests belonging to one pair ranged from 2-2000 m (mean 230 m), being closer in pairs nesting in sandstone than those in basalt (52 m and 304 m respectively). Nests in exposed sites faced mainly between east and south (79 per cent). This was correlated with berg winds which blow mainly from July to September from the west. The altitude of nests ranged from 1850-3201 m a.s.l. The height of nesting cliffs varied from 24-732 m (mean 212 m) and on average nests were positioned at 72 per cent of the cliff height from the base; nests were relatively higher on high cliffs (over 250 m) than on lower ones (81 per cent and 60 per cent respectively). The mean inter-nest distance between pairs on the Natal Drakensberg escarpment, the Lesotho highlands and the northeastern Cape was 6.3 km, 13 km and 19 km respectively. On the Natal Drakensberg escarpment the number of nest sites judged suitable for Bearded Vultures were sufficient to support a pair per 1.5 km. Nest sites are not considered a limiting factor to the size of the Bearded Vulture population.

**INTRODUCTION**

Bearded Vulture *Gypaetus barbatus* are solitary, cliff-nesting scavengers (Hiraldo *et al.* 1979, Cramp & Simmons 1980, Steyn 1982). Over 200 pairs survive in the highlands of Lesotho and the adjacent regions of Natal, Orange Free State, Qwa Qwa, Transkei and the northeastern Cape (Brown in prep.). Prior to this study few Bearded Vulture nest sites had been located in southern Africa. This paper forms part of a study of the biology of the species in southern Africa and considers some physical aspects of its nest sites.

**METHODS**

Between 1980 and 1983 a concerted effort was made to locate Bearded Vulture nest sites throughout the species' range in southern Africa (a) by direct observation, both from the ground and the air, (b) from reports by nature conservation and forestry staff and other interested people and (c) from a mail questionnaire survey to about 6000 farmers. In areas where nest densities were being determined (e.g. Giant's Castle Game Reserve, 29:26S, 29:28E) consecutive sections of cliffs were watched during the breeding season, from first to last light, for up to three consecutive days or until a nest was discovered. Nests are usually out of sight in potholes and the rock face below nests are not heavily 'whitewashed' with droppings (*cf.* Cape Vulture *Gyps coprotheres*). For these reasons the presence of a nest

could be found usually only by observations of birds 'swapping over', i.e. an adult diving down and entering a pothole, followed a few seconds later by the rapid departure of another adult. Nests were located wherever possible while traversing sections of the Drakensberg escarpment, and while driving through Bearded Vulture nesting habitat.

TABLE 1. Some Physical Parameters of Bearded Vulture Nest Sites

Character	Sandstone sites	Basalt sites	Combined
No. of pairs	4	20	24
No. of nests	12	62	74
Mean no. of nests/pair	3.0	3.1	3.1
(Range)	(2-4)	(2-5)	(2-5)
Nest types: pothole	10	56	66
ledge	0	4	4
pothole/ledge	2	2	4
Overhang or concave cliff			
above nest: present	11	57	68
absent	1	5	6
Mean distance between			
alternate nests (m)	52	304	230
(Range)	(2-400)	(20-2000)	(2-2000)
Mean altitude of nests			
(m above sea level)	1935	2814	2578
(Range)	(1850-2134)	(2149-3201)	(1850-3201)
Mean height of nesting			
cliffs (m)	79	257	212
(Range)	(46-104)	(24-732)	(24-734)
Position of nests on			
cliffs, from base (%)	60	76	72
(Range)	(50-87)	(21-91)	(21-91)

The following physical parameters of Bearded Vulture nesting sites were recorded: (a) cliff rock type, (b) cliff height (from the top of the scree), (c) distance from nest to top of cliff, (d) altitude, (e) aspect (of nest entrance), (f) nest type (pothole, pothole/ledge, ledge), (g) presence or absence of overhang above nest and extent of protection of the nest site and the nest entrance, (h) number of alternate nests, (i) distance between alternate nests, (j) other raptor species and large birds nesting/roosting nearby, and the distance to them, (k) vegetation type, (l) habitat description and land usage in area of nest. Estimates of the length of time that sunlight fell on nests and cliffs at nest entrance were made. When sufficient shade fell on the nest for a bird to be two-thirds out of the sun, the nest was judged to be in shade.

#### RESULTS

##### Nest sites

All nests found were on cliffs of either basalt or cave sandstone formation. As basalt overlies the sandstone, nests in sandstone were at lower altitudes than those in basalt. The breeding sites of four pairs of Bearded Vultures were found in cave sandstone cliffs and 20 pairs in basalt cliffs. Some of the information obtained from these sites is summarized in Table 1. While 23 other sites were located from afar (e.g. from a fixed-wing aircraft), detailed information was not obtained on them and they are not included in the following analysis.

Eighty-nine per cent of the nests were built in potholes (small caves) in the cliff face. In most of these cases the nest structure was invisible when viewed from any angle except horizontally into the pothole. In one notable exception the nest had outgrown the pothole and extended out of the entrance and up the side of the cliff for about 1 m in height. Four nests (three belonging to one pair of birds) were built on ledges, and four nests were classed as pothole/ledge nests, being built into shallow depressions on ledges. Eighty-nine per cent of nests had overhangs or concave cliffs above the nest entrance, varying from 0.5-15 m wide. These overhangs would prevent snow settling and blocking nest entrances, although since most were in potholes, the nests themselves would be sheltered. The ledge nests were at low altitude (2286 m) where snowfalls were neither frequent nor usually severe, and all had overhangs. All the pothole/ledge nests had large overhangs.

#### Number of alternate nests

The mean number of nests per pair of Bearded Vultures was 3.1 (range 2-5). Fig. 1 shows the distribution of numbers of nests per pair of birds. Three nests per pair was most common (50 per cent of pairs) followed by two nests per pair (29 per cent). In some cases only one nest was found (invariably the nest in current use), but this was normally when an incomplete search of the area was made. All well known breeding pairs of Bearded Vultures had two or more nests. For this reason the pairs for which only one nest was found were not included in the calculations resulting in the figures presented above. Thirteen breeding pairs of Bearded Vultures were closely

monitored, six over three years and seven over two years (= 32 nest years). With one exception, birds did not nest in the same nest in consecutive years. The exception was a two-nest pair which deserted their nest during the incubation period in 1980 because of human interference (a closed circuit television camera was placed near the nest). In 1981 and 1982 this pair bred successfully in their alternate nest, and were never seen to re-enter their deserted nest pothole, which was only some 80 m away. During the course of this three-year study, birds with three or more nests did not use the same nest twice. One pair monitored since 1972 (by JJG) had eight nests, four in reasonable repair and four very neglected. These birds used the four better-maintained nests and returned to the first used in the sequence in their fifth consecutive breeding year.

#### Spacing of alternate nests

Alternate nests belonging to one pair of birds were on average 230 m apart (range 2-2000 m) (Fig. 2). Nests in sandstone may be very close together because of the rock structure which often forms horizontal series of potholes 2-6 m apart. Caves in basalt tend to be single formations, fewer in number and randomly spaced on a cliff. The distance between the nests belonging to one pair of Bearded Vultures was therefore greater for those birds nesting

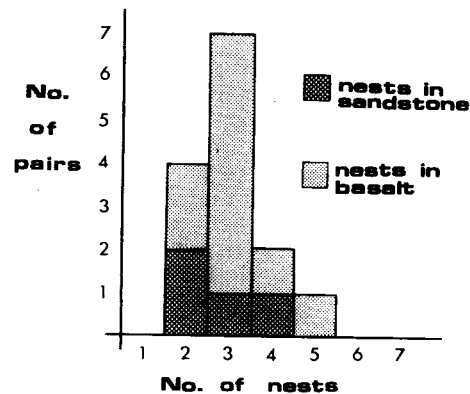


Fig. 1. Number of nests per pair of Bearded Vultures



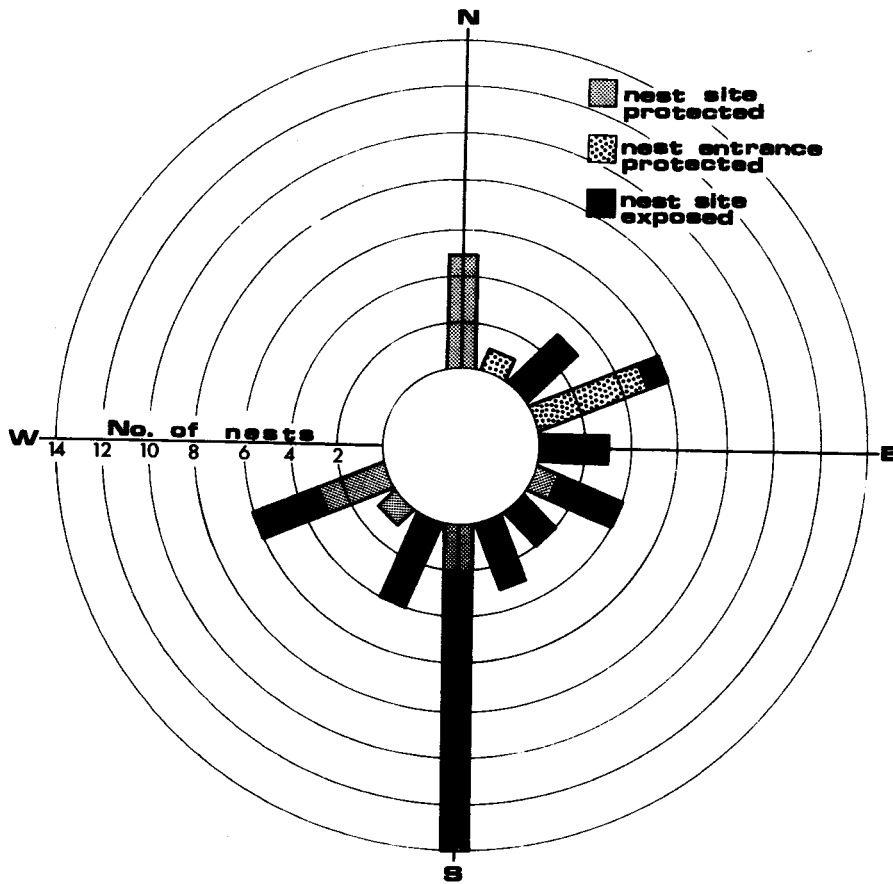


Fig. 3. Orientation of Bearded Vulture nests.

was 72 per cent of the cliff height (range 21-91 per cent). The minimum height was something of an exception, the next lowest height being halfway (50 per cent) up the cliff. The distribution of positions of nests on cliffs is shown in Fig. 6. In Fig. 7 the positions of nests on cliffs are plotted against the respective cliff heights. Nests on high cliffs (viz. above 250 m) were significantly ( $P < 0.001$ ) and more consistently higher on the cliffs (average of 81 per cent of cliff height) than were nests on lower cliffs (average of 60 per cent of cliff height).

*Habitat surrounding nest sites*

The habitat surrounding nests consisted mainly of subalpine and alpine grassland-fynbos and grassland-heath. The nests of two pairs had montane *Podocarpus* forests at the basis of the nesting cliffs and two pairs had nests directly above rivers. Only four pairs were found breeding in white-owned farmland areas (predominantly sheep farming), three of these pairs within easy foraging range of the Lesotho/Transkei borders. Twelve pairs were found on the high Drakensberg, bordering between the wilderness areas of the Natal Parks Board and Department of Forestry reserves on the east and pastoral Lesotho on the west. Three pairs were found on the borders of white-owned farms and African areas where primitive pastoral conditions prevail; two of the white-owned farms were stocked with sheep, the other,

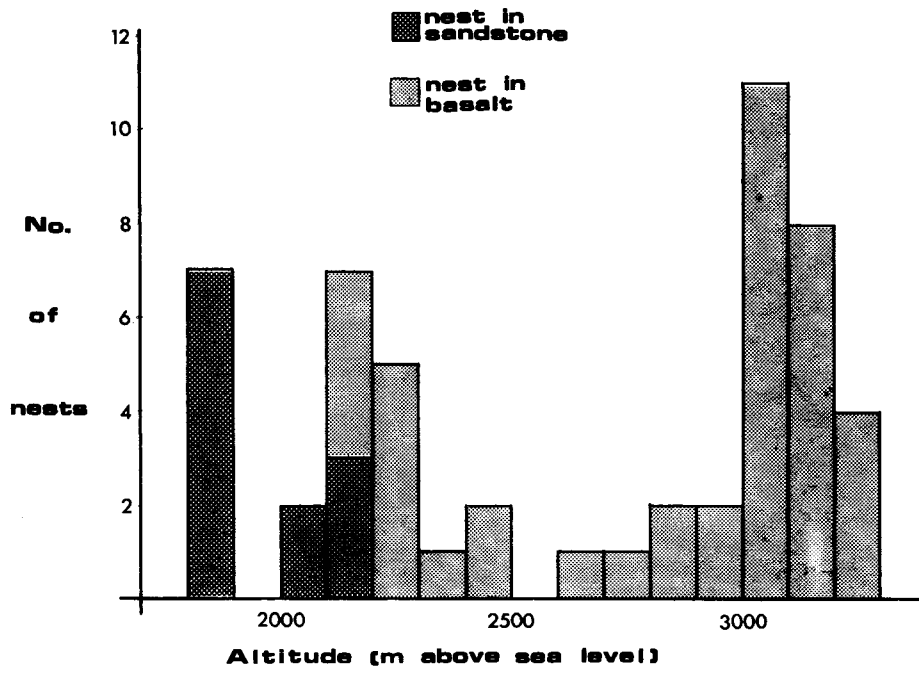


Fig. 4. Altitude of Bearded Vulture nests.

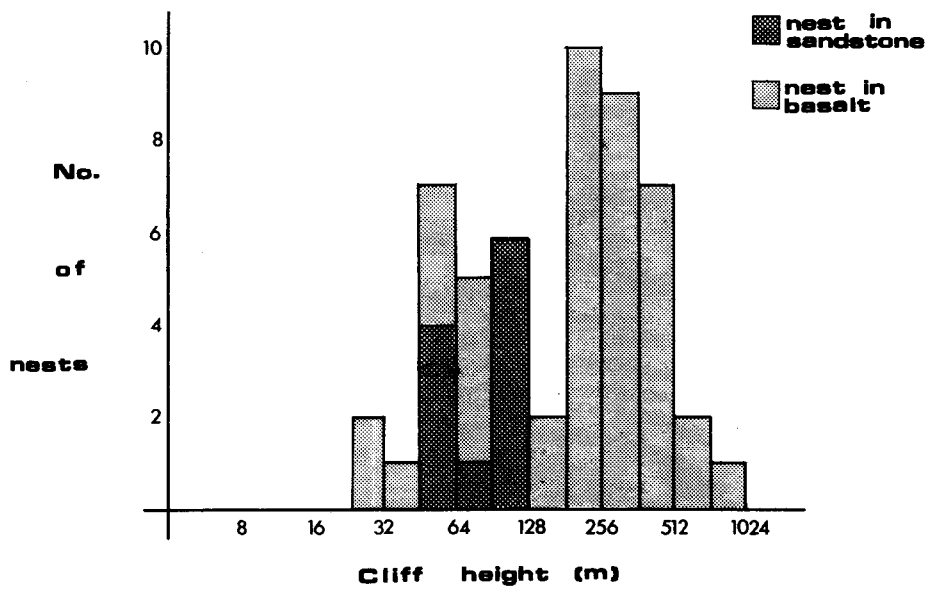


Fig. 5. Height of Bearded Vulture nesting cliffs. The x axis is logarithmic.

No. of Nests

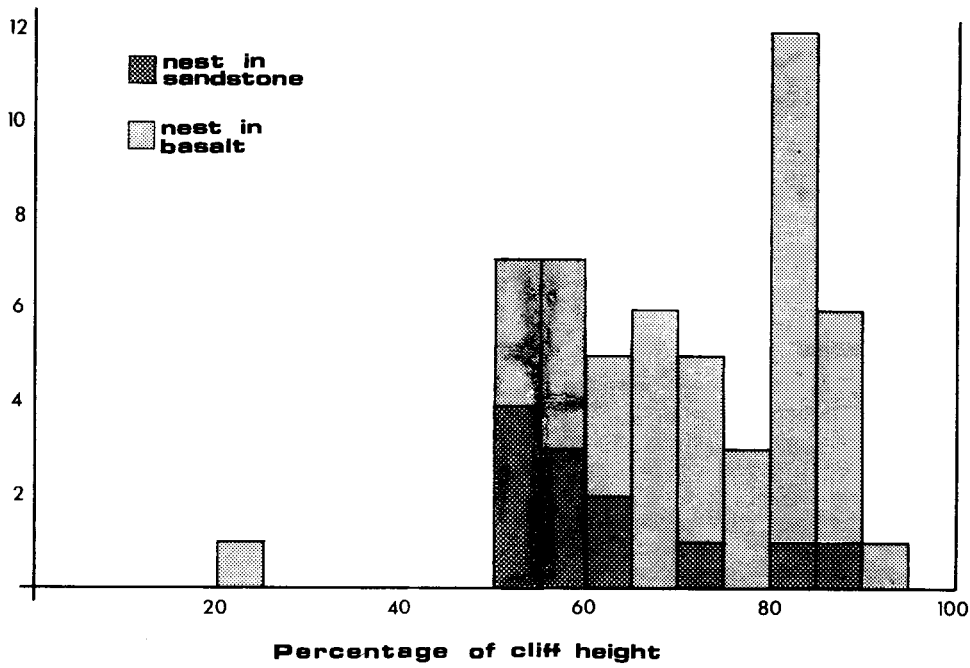


Fig. 6. Position of Bearded Vulture nests of cliffs, as a percentage of the cliff height from the base.

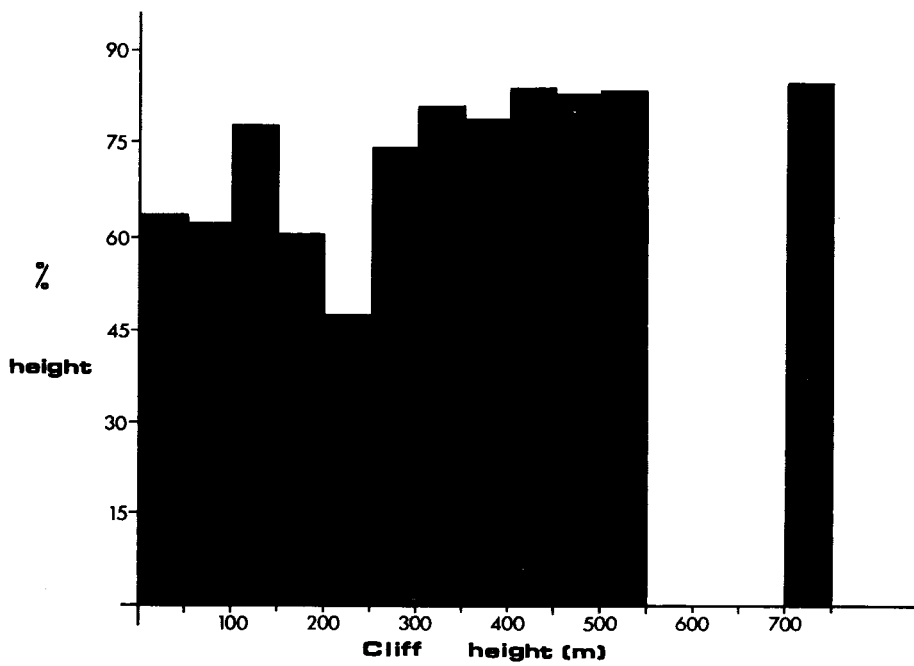


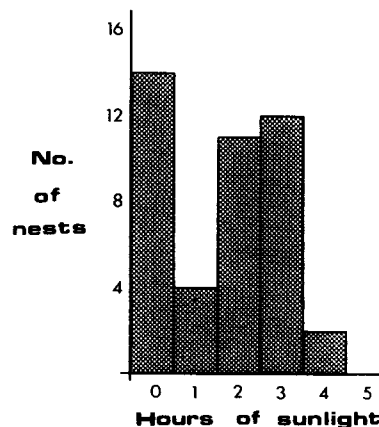
Fig. 7. The position of nests on cliffs plotted against the cliff height.

which was badly over-grazed, stocked sheep and cattle. Only three nests found in Lesotho were included in this analysis, although many more nesting sites were located, i.e. seen from a distance or from the air. These were not investigated more closely due to the inaccessibility of much of the area and to the tenuous political situation at the time. One nest in the Transkei was in an area of very similar primitive pastoral conditions to those in Lesotho. Finally, two nests were found in protected reserves. By far the greatest coverage was on white-owned farms where an attempt was made to reach every farmer with a farm in suitable habitat. Nonetheless, only eight farmers in the Cape Province reported Bearded Vultures nesting on their farms, four of which were confirmed; five nesting pairs were reported for Natal, one of which was confirmed and one highly probable; and one was reported for the Orange Free State, which was confirmed. Bearded Vultures nesting on white-owned farmlands are very rare, and there is only one case of a pair being any distance from primitive pastoral farming practices.

#### Sunlight on nests

Direct sunlight rarely fell for long periods on Bearded Vulture nests (Fig. 8). Only when the sun was approximately horizontal to the pothole entrance would the rays fall on the nest. In addition, 27 per cent of the nests were on due south-facing cliffs and received no sun at all. The longest recorded period of sun on a nest was 4 h and the mean (for those nests that received direct sunlight) was 2.6 h. Sun was recorded on nests only in the mornings, because of the predominantly south to east aspects of most nests. Figures for sun on cliffs at nest entrances ranged from 0-11.5 h.

Fig. 8. Number of hours of direct sunlight on nests per day.



#### Presence of other species nesting nearby

Bearded Vultures were found to be very tolerant of other birds nesting and roosting near their nest sites. Rock Pigeons *Columba guinea* perched within 0.5 m of nesting birds and Black Swifts *Apus barbatus* were seen roosting within 1 m of a Bearded Vulture nest entrance, evoking no response from the Bearded Vultures. Table 2 lists the larger species found nesting and roosting near nesting Bearded Vultures, and the distances involved. In the only incidence of two pairs of Bearded Vultures nesting on the same peak (about 700 m apart), no aggressive interactions between the pairs was seen. 'Off-duty' birds from the different pairs would soar together, and co-operative foraging occurred (Brown in prep.), with birds separating on their return and entering their respective nests.

Cape Vultures were commonly closely associated with Bearded Vultures on cliffs, colonies of up to 50 Cape Vultures existing within 100 m of a Bearded Vulture nest. The closest that a Cape Vulture was recorded roosting to a Bearded Vulture nest was 15 m. Once when a Cape Vulture attempted to land on the lip of a Bearded Vulture nesting pothole, the incubating bird aggressively rushed at the Cape Vulture which departed immediately. Cape Vultures were seen roosting on the edge of Bearded Vulture nests which were



Table 2. The distances between Bearded Vulture nests and other (larger) species nesting or roosting nearby

Species	Same or neighbouring cliff	Nest/ Roost	Number of records	Average distance (m)	Minimum distance (m)
Cape Vultures	same	R	11	140	15
<i>Gyps coprotheres</i>	neighbour	R	1	800	800
Black Eagle	same	N	1	120	120
<i>Aquila verreauxi</i>	neighbour	N	4	1025	600
Jackal Buzzard	same	N	2	220	150
<i>Buteo rufofuscus</i>					
Rock Kestrel	same	N	3	90	30
<i>Falco tinunculus</i>					
Lanner Falcon	same	N	2	115	9
<i>F. biarmicus</i>					
Peregrine Falcon	same	N	1	80	80
<i>F. peregrinus</i>					
Gymnogene	same*	N	1	120	120
<i>Polyborides typus</i>					
White-necked Raven	same	N	4	230	80
<i>Corvus albicollis</i>	neighbour	N	2	700	400
Bald Ibis	same	N	2	280	200
<i>Geronticus eremita</i>					
Black Stork	same	N	1	400	400
<i>Ciconia nigra</i>					

\*The Gymnogene was nesting in a tree growing out from the base of the cliff directly below a Bearded Vulture's nest.

not in use (i.e. in the non-breeding season or at alternate nests), evoking no response from Bearded Vultures.

Only one record of Black Eagles *Aquila verreauxi* nesting on the same peak as Bearded Vultures was obtained. The nests were 120 m apart on either side of a 90-degree corner and therefore out of sight of one another. Both species successfully reared young birds. In most cases the nearest Black Eagle was on another cliff or peak, the mean minimum distance being over 1 km. One incident of Bearded Vulture-Black Eagle nesting interaction was recorded in the Natal Little 'Berg during the Bearded Vulture's incubation period in late July 1981. The Black Eagles which had bred about 1500 m northwest of the Bearded Vulture's site in 1980 and had three alternate nests in good condition in that area, started nest building about 150 m from the Bearded Vulture's nest on a ledge facing their pothole entrance. Nest building was accompanied by aerial displays (diving, looping and rolling) in front of the Bearded Vulture's nest. Any flying Bearded Vulture was vigorously attacked by both eagles, one behind the other, the Bearded Vulture being hard pressed to avoid the combined onslaught. Even when perched on the cliff or in a pothole, the eagles would attack the Bearded Vulture, forcing it to take up a defensive position with talons extended, and in one case the Bearded Vulture tumbled out of a pothole

following a particularly close encounter. It then settled into a smaller, deeper pothole out of reach of the eagles, although they continued to display. Twice the situation was reversed, with the Bearded Vulture diving aggressively at a Black Eagle. The Black Eagles attempted to establish themselves for a further three days, after which their activities in that area decreased. The eagles did not breed that year and it is unlikely that they would have, as in the Natal Drakensberg they usually lay their eggs from April to June (Brown & Barnes 1984).

With the exception of the White-necked Raven *Corvus albicollis*, particularly towards the end of the Bearded Vultures' incubation and early nestling periods, the latter were very tolerant of other birds nesting in close proximity, with Jackal Buzzards *Buteo rufofuscus* nesting within 150 m, Peregrine Falcons *Falco peregrinus* within 80 m and one Lanner Falcon *Falco biarmicus* nest being only 9 m away.

#### *Bearded Vulture breeding density*

The breeding density of Bearded Vultures was determined for the Natal Drakensberg escarpment, for an area of the Lesotho highlands about the Mokhotlong village and for an area in the northeastern Cape in the Barkly East district. All three areas were considered to be of suitable habitat throughout. In some cases a number of adjacent nests were also found, but the areas about these were not systematically searched, and they are therefore not included in this analysis.

Eight nesting pairs of Bearded Vultures were found on the Natal Drakensberg escarpment between Sani Pass in the south and the Corner in Giant's Castle Game Reserve in the north, a distance of about 48 km. A 21-km sample section in the Cathedral Peak State Forest yielded three nesting pairs. An average breeding density for the Drakensberg escarpment was calculated as one pair of Bearded Vultures per 6.3 km.

In the Lesotho highlands all suitable nesting cliffs within an area of about 1250 km<sup>2</sup> were examined (both from the air and ground) and nine active nests found. Thus, for this area the breeding density was about one pair per 139 km<sup>2</sup> with a mean inter-nest distance of about 13 km.

In the northeastern Cape (on the Cape-Transkei/Lesotho borders) four nesting pairs were found in an area of just over 1000 km<sup>2</sup>, giving a nesting density of 290 km<sup>2</sup> per pair and a mean inter-nest distance of 19 km. The breeding density decreased dramatically further south from the Transkei/Lesotho borders.

## DISCUSSION

#### *Alternate nest sites*

Bearded Vulture nests are large and represent a large energy expenditure. The nature of their chosen sites, being dry, cold and in shadow, means that nesting material will remain in good condition for many years. Nests are unlikely to collapse (as do those of tree-nesting raptors) as potholes in cliffs are well protected and the substrate is stable. In addition, nests are placed in sites which are inaccessible to terrestrial predators. It is therefore surprising that alternate nest sites should be used and maintained.

Many birds of prey are more inclined to move to a new nest after an unsuccessful breeding attempt than after a successful one (Newton 1979). Bearded Vultures, however, almost invariably occupy a new site each year, and where possible, move on a rotational basis between nests and leave as long as possible between re-use of a site. With the large build-up and storage of carrion in the nest during the nestling period, nest hygiene and

nest parasites must be an important consideration. Because nests are so thickly lined with wool and other mammal hair (see e.g. Maclean 1985, this study) and because they are in such protected sites, parasites may survive far longer than in tree nests or nests in more exposed places where rain would wash through them and where they would be exposed to a far greater temperature range. In addition, in the nests of other species the nest lining is usually much thinner and is often trampled away by the end of the nestling period. It is possible then that Bearded Vultures use their nests on a rotational basis to starve out parasites that have accumulated in a nest before it is re-used. In addition, carrion flies are attracted to the food stored in the nest. These flies presumably lay their eggs in suitable dead material. The resulting larvae may pose a direct threat to the nestling, or more likely, the larvae may burrow into the woollen nest lining and pupate. Because of the generally cold temperatures, the pupae may remain dormant until warmed by the parent incubating the following year. Should the birds avoid that nest for a year or more, the chances of the pupae dying before hatching may be increased.

#### *Nest orientation*

Nest sites, particularly those at high altitudes (i.e. in basalt) and those in more exposed situations, tend to face between east and southwest. A similar situation was found for Cape Vultures in the Natal Drakensberg where 77 per cent of the birds and 84 per cent of their nests (totals of 1325 and over 215 respectively) faced from east to south (Brown in prep.). Most of the Cape Vulture colonies documented by Mundy (1982) faced south, but as he pointed out, the large north-facing Manoutsa colony in the eastern Transvaal was equally successful. In the Natal Drakensberg and the Lesotho highlands a most striking climatic feature is the berg wind, which blows from July to September and coincides with the incubation and early nestling periods of both the Cape and Bearded Vultures, when the latter are visiting their nests five or more times per day. Wind data, automatically recorded at Cathedral Peak State Forest (28:58S, 29:16E, 1860 m above sea level) were analysed for velocity, direction and duration. From Fig. 9 it is apparent that late winter and early spring are the most windy months. The wind direction, given here for the windiest month of August (Fig. 10) shows that winds above 20 km/h from the west-northwest to west-southwest were by far the most frequent, blowing for a monthly average of 77 h, with about 49 h of winds over 30 km/h and 23 h of over 40 km/h. While winds in excess of 75 km/h were not infrequent, the velocities of all these winds recorded at the Cathedral Peak weather station must have been considerably higher at the altitudes of the nests, as, on the exposed ridges in the Giant's Castle area it was often impossible for us to stay on our feet. It is suggested, therefore, that the orientation of nesting sites, both for the Bearded and Cape Vultures, are chosen on the lee sides of cliffs, so that birds arriving at nests are not exposed to tail winds, often in excess of 60 km/h.

#### *Nest altitude*

The mean altitude of Bearded Vulture nests in the basalt of the high Berg was 2835 m above sea level, with those nests on higher cliffs tending to be relatively higher up the cliff. As higher cliffs are usually also longer there is probably a bigger selection of suitable potholes than on lower cliffs. It seems likely that birds select higher sites where these are available, as this provides an energetic advantage for foraging, particularly in the early mornings before thermals have developed. In the Cape Vulture, a different situation appears to prevail. The mean altitude of nesting colonies on the Drakensberg escarpment was 2747 m above sea level,

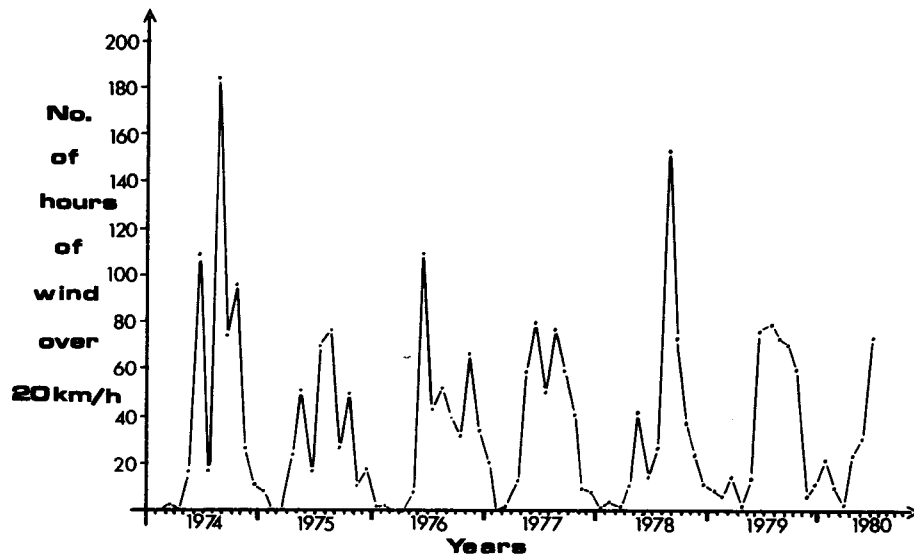


Fig. 9. The seasonality of wind over 20 km/h in the Cathedral Peak State Forest at 1860 m above sea level.

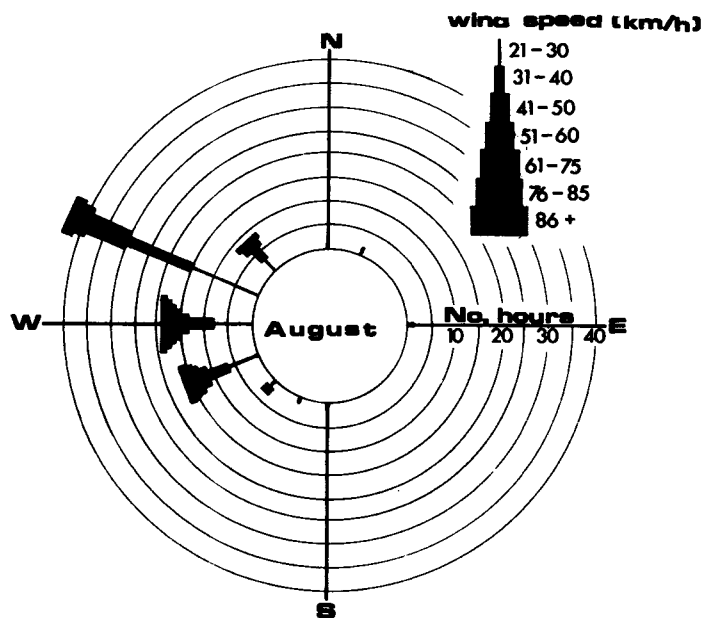


Fig. 10. The mean wind speed and duration, and the wind direction for the windiest month of August, analysed from 1972 to 1983 from data collected at the Cathedral Peak State Forest weather station.

approximately 100 m lower than Bearded Vultures' nests. Roosting colonies, however, were higher, averaging 2827 m. Cape Vultures nest mainly on open ledges and, while on the high Berg these are usually in cut-backs, they are nevertheless more exposed than are the Bearded Vultures' nests in potholes. Thus, while the advantage of height is a consideration, falls of snow in winter may dictate a lower altitude, as has been shown for Golden Eagles in Scotland (L.H. Brown 1976). It is interesting that the roosting cliffs, which can be left for lower ledges in bad weather, are at a very similar altitude to Bearded Vulture nests.

*Are nest sites a limiting factor?*

Newton (1979) states that, in any landscape, the upper limit to the number of established raptor pairs is set either by food or nest sites, whichever is in shorter supply. Nest sites as a limiting factor were investigated for a section of about 5 km of cliffs on the Natal Drakensberg escarpment. Cliffs were scanned through a 40x telescope, and the following criteria were applied: (a) only sheer or near sheer cliffs of over 50 m in height were considered; (b) sites had to be at least above halfway up the cliff; (c) sites had to face between east and south, or be in a protected position; (d) only potholes were considered, with entrance either circular or elliptical and about 0.8-2.0 m wide (although sometimes difficult to assess, sites that did not appear to be at least 1 m in depth were not considered); (e) sites had to have an overhang or a concave section of cliff above them; (f) sites had to be dry; (g) sites had to be unoccupied, or occupied by easily displaced species, and at least 1 km from a Black Eagle's nest.

In all, 11 sites were judged to be suitable. Assuming an average of three nests per pair of Bearded Vultures, a nesting density of about one pair per 1.5 km of Drakensberg escarpment would theoretically be possible. This is four times the current population. As Bearded Vultures do not actively defend large areas (adjacent pairs may nest only 700 m apart), though they may advertise their presence in an area by soaring, the constraints on the population are unlikely to be due to territory size either, but are probably a reflection of food availability. While this sort of exercise is limited in that we can apply only what we think are important criteria to the birds in selection of a nest site, and the observations are limited in their accuracy to what can be seen through a telescope from the ground, our strong impressions support the above results that within the range of the Bearded Vulture in southern Africa, nesting sites are not limiting to the size of the breeding population.

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