

# Long-term Population Fluctuations of Large Raptors in the Southern Kalahari

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The original purpose of this study was to determine the long-term population fluctuations of birds of prey of the Kalahari National Park. Similar work on rodent populations was initially intended to run concurrently.

It soon became apparent that bird of prey numbers fluctuated quite dramatically and somewhat irregularly from year to year. Initially, for the first ten years there seemed to be some correlation with populations and rainfall but as the study continued this relationship disappeared. There was no obvious pattern to the changes in numbers and there were no obvious trends. Even the number of breeding pairs of the resident species fluctuated with no obvious causes.

Thiollay (1978), discussing population influences of West African birds of prey, listed a number of biological reasons for changes. While most of these could be applied to the Kalahari it soon became obvious that the major influence for change in populations was rainfall. It took many years to realise that rainfall was not just the local effect but that heavy rains or drought occurring many hundreds of kilometres away was equally influential in determining the numbers of birds present.

## METHODS

The study area was within the Kalahari National Park, where two dry river beds provide the only lines of large trees in an otherwise undulating terrain of red sand dunes covered with sparse grass and shrubs with the occasional tree. This area is some 36,000 km<sup>2</sup> and adjoins a further 44,000 km<sup>2</sup> reserve in Botswana. Strip counts covering 11,141km over the period 1973 to 1992 (20 years) were carried out for 18 years by the same observer over the same routes and for the most part at the same times of day.

It is important to stress that the visibility is exceptionally good. The trees are fine-leaved and it is thus possible to see most larger birds with comparative ease. To standardise the results for visits of different duration covering different distances, the numbers of birds per 100km are presented. Identification was mainly through 10x binoculars or in cases of difficulties a telescope with 40x and 80x was used.

## RESULTS

The combined counts for the months January through to April are presented in Table 1. These are the late summer rainfall months for the area, when 80 % of the rainfall is recorded. This is the period when 80 % of the birds are to be recorded. The rainfall for the same period is also given in Table 1.

It must be realised that rainfall is irregular in semi-arid regions, and the lower the annual rainfall the less predictable it becomes. The Kalahari National Park has a mean annual rainfall at the southern camp Tweerivieren, of 225mm. This occurs mainly as summer storm rains which according to Leistner (1967) occur on average seven days each year. In the period 1984 to 1989 the number of rain storms varied from 3.3 to 9.3 days each year (Knight 1991).

In the semi-arid region of southern Africa, where the main rainfall occurs in the southern summer, there is a long term periodicity of ten continuous years of above average rainfall followed by ten continuous years of below average rainfall. This study was started in the middle of a so-called wet period and extended after five years into the dry period. Consequently the first ten years of results gave a very reasonable correlation of populations with rainfall. However, now that twenty years have passed and we are back in the wet period, the population correlation with rainfall has disappeared.

In preparation for this paper the rainfall for the same timespan for northern Namibia, northern Botswana and Skukuza in the Kruger National Park, was obtained. This was to see whether good rains in any one of those areas had provided favourable conditions that had prevented the migrants from proceeding further south to the study area. Generally speaking, the rainfall for the other areas followed a similar pattern to that of the Kalahari, so this was considered not to have affected the movements, although for some species at least there are indications of weather from other areas affecting the southern Kalahari populations.

There is no correlation between bird numbers and rainfall for any of the larger birds of prey in the southern Kalahari for the whole twenty-year study.

It must be appreciated that the strategy of the large migratory birds of prey in the southern arid regions of Africa differs a lot from the conventional concept of routine movement back and forth to the same areas. The birds are largely opportunist feeders that take advantage of the massive food resources that arise from good rains in semi-arid regions. Such sources as the flying stages of termites (alates), all stages of locusts, the mass breeding of queleas and the cycles of rodent populations are a constant source of enormous quantities of food. It is believed that the migrants are attracted to areas of heavy rainfall in their search for food and that it is this that determines where they are in their southern winter range.

It can be seen that there is no regular pattern of numbers in the southern Kalahari. Indeed the whole table is very confusing and not helpful in determining the cause and effect of the changes in numbers recorded. This statement not only concerns the migratory species from the north but other raptors as well, that apparently come from the southern areas. Perhaps it should be mentioned that several of the species have both small resident breeding populations as well as summer influxes of migratory individuals of the same species that are derived either from Africa or Europe. Indeed ringing birds in the area has shown that they have been recovered to the north, south, east and west. When some species are considered individually there is some understanding as regards movements.

Secretary Bird *Sagittarius serpentarius*. Changes in numbers are not understood. The general impression is that the numbers do not change very much from year to year. It may be that this species gathers socially in numbers up to 35 at certain water-holes at midday and the observations become distorted through these increased numbers.

White-backed Vulture *Gyps africanus*. It can be seen that the highest numbers are during the locally dry period. It is believed that success of breeding in South Africa has provided the additional birds.

Lappet-faced Vulture *Torgos tracheliotus*. Numbers are highest during the dry periods, this is possibly increased by both east and west populations of this species which at best occur in small numbers.

Black-shouldered Kite *Elanus caeruleus*. Wherever this species occurs the numbers fluctuate without apparent reason. However, a chance visit in late 1991 to the eastern Cape, 1000km from

Table 1. Number of birds observed per 100 kms for months of January to April each year.

|                                  | 1973  | 1974  | 1975  | 1976  | 1977  | 1978  | 1979  | 1980 | 1981  | 1982 | 1983 | 1984 | 1985 | 1986  | 1988  | 1989  | 1991  | 1992  |
|----------------------------------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|------|------|------|-------|-------|-------|-------|-------|
| <b>RESIDENT/REGULAR</b>          |       |       |       |       |       |       |       |      |       |      |      |      |      |       |       |       |       |       |
| <i>Sagittarius serpentarius</i>  | 2.3   | 9.4   | 10.6  | 4.1   | 0.7   | 1.6   | 4.1   | 4.2  | 8.1   | 4.3  | 2.9  | 10.9 | 5.0  | 3.6   | 1.1   | 14.0  | 5.6   | 3.9   |
| <i>Poliohierax semitorquatus</i> | 0.2   | 3.4   | 0.3   | 0.7   | 0.2   | 0.0   | 0.6   | 0.3  | 1.0   | 0.0  | 0.1  | 0.0  | 0.2  | 0.0   | 0.0   | 0.6   | 0.6   | 0.7   |
| <i>Polentaetus bellicosus</i>    | 0.5   | 0.2   | 0.5   | 0.0   | 1.3   | 0.3   | 2.1   | 0.8  | 0.3   | 0.6  | 0.5  | 0.0  | 0.0  | 0.0   | 0.2   | 0.0   | 0.5   | 0.3   |
| <i>Melierax canorus</i>          | 5.8   | 21.8  | 8.9   | 5.4   | 19.8  | 8.0   | 14.3  | 5.0  | 4.7   | 6.0  | 4.1  | 0.0  | 2.3  | 2.1   | 3.4   | 12.3  | 10.2  | 6.2   |
| <b>RESIDENT/IRREGULAR</b>        |       |       |       |       |       |       |       |      |       |      |      |      |      |       |       |       |       |       |
| <i>Gyps africanus</i>            | 1.2   | 1.1   | 2.2   | 10.3  | 42.7  | 2.6   | 20.9  | 5.8  | 13.8  | 26.0 | 16.9 | 82.4 | 64.9 | 0.0   | 6.4   | 12.9  | 4.6   | 41.6  |
| <i>Torgos tracheliotus</i>       | 0.9   | 0.7   | 0.9   | 3.1   | 11.7  | 0.0   | 1.2   | 0.0  | 2.5   | 1.8  | 4.5  | 6.7  | 7.5  | 0.7   | 0.6   | 0.0   | 0.2   | 2.1   |
| <i>Falco rupicoloides</i>        | 1.2   | 4.8   | 4.1   | 0.7   | 1.8   | 1.6   | 3.9   | 4.5  | 1.9   | 1.2  | 1.9  | 0.0  | 2.7  | 2.1   | 1.6   | 5.8   | 2.6   | 0.8   |
| <b>RESIDENT/MIGRANT</b>          |       |       |       |       |       |       |       |      |       |      |      |      |      |       |       |       |       |       |
| <i>Terathopius ecaudatus</i>     | 1.1   | 2.9   | 3.1   | 4.7   | 10.1  | 1.6   | 11.0  | 9.3  | 1.9   | 2.2  | 8.0  | 12.1 | 3.9  | 0.7   | 0.8   | 1.8   | 2.2   | 2.1   |
| <i>Aquila rapax</i>              | 1.6   | 0.9   | 2.5   | 11.3  | 12.4  | 1.3   | 9.2   | 8.1  | 4.9   | 2.4  | 2.9  | 12.7 | 7.7  | 0.7   | 0.4   | 3.5   | 1.4   | 4.4   |
| <i>Elanus caeruleus</i>          | 0.0   | 13.9  | 0.4   | 3.3   | 1.6   | 2.8   | 0.1   | 0.3  | 0.0   | 0.3  | 0.2  | 0.0  | 6.4  | 0.0   | 0.0   | 12.9  | 1.4   | 1.6   |
| <i>Circus pectoralis</i>         | 0.2   | 0.2   | 1.7   | 4.4   | 0.5   | 0.8   | 3.5   | 1.6  | 1.0   | 0.2  | 0.3  | 0.0  | 0.7  | 0.0   | 1.1   | 0.6   | 2.4   | 0.0   |
| <b>MIGRANTS</b>                  |       |       |       |       |       |       |       |      |       |      |      |      |      |       |       |       |       |       |
| <i>Falco biarmicus</i>           | 1.2   | 1.5   | 1.7   | 5.2   | 15.1  | 7.5   | 9.8   | 1.3  | 13.8  | 1.1  | 1.1  | 6.1  | 1.6  | 0.0   | 0.2   | 4.1   | 4.5   | 1.0   |
| <i>Falco rupicolus</i>           | 0.2   | 0.2   | 0.1   | 0.1   | 0.2   | 0.0   | 0.6   | 0.0  | 1.0   | 0.2  | 1.0  | 0.0  | 0.2  | 0.0   | 0.0   | 0.0   | 0.2   | 0.0   |
| <i>Circus cinereus</i>           | 0.0   | 0.0   | 0.7   | 4.0   | 1.6   | 1.0   | 0.1   | 0.3  | 0.5   | 0.1  | 0.1  | 0.0  | 0.0  | 0.0   | 0.0   | 0.6   | 1.4   | 0.7   |
| <i>Aquila nipalensis</i>         | 0.0   | 0.0   | 0.3   | 5.1   | 1.1   | 9.8   | 0.1   | 0.0  | 0.0   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0   | 0.3   | 0.0   | 0.0   | 0.0   |
| <b>RAINFALL</b>                  |       |       |       |       |       |       |       |      |       |      |      |      |      |       |       |       |       |       |
| January to April                 | 155.4 | 401.9 | 145.4 | 491.1 | 207.1 | 123.6 | 100.0 | 69.0 | 120.9 | 14.7 | 38.3 | 52.7 | 81.0 | 105.7 | 208.5 | 305.9 | 185.5 | 110.2 |

the Kalahari, where there was a severe drought, brought home the effect of negative rainfall on the local population. A well-known communal roost there was completely deserted and it is suggested that movements of this species are probably affected by drought to move away from such areas.

Tawny Eagle *Aquila rapax*. There is no doubt that the influx of migratory individuals affects the numbers. This year smallish numbers, mainly resident individuals, were seen. It was established that good rains had fallen in northern Botswana and many Tawny Eagles were seen there, so evidently they did not move as far south as normal. The resident breeding population varies from 0 to 10 pairs, whereas a "good" influx of migrants can exceed 100 birds.

Steppe Eagle *Aquila nipalensis*. In the twenty-year period this species occurred in numbers only in 1976 and 1978. These were exceptionally good years for termite eruptions. This species apparently migrates down the eastern side of Africa arriving in the Kruger Park when queleas start breeding; in good quelea breeding years, when there may be an estimated 15 million nests, the Steppe Eagle may stay in that area.

Martial Eagle *Polemaetus bellicosus*. The resident breeding population from 1988 to 1991 occupied from 2 to 9 nests (pers. comm. J.J. Herholdt). This is within the order of the different numbers seen in different years. These birds move enormous distances and this probably accounts for the variation in numbers. This species is persecuted more than most eagles by the sheep-farming community so that population trends are quite impossible to determine. But there is the belief that the numbers are slowly picking up again.

Brown Snake Eagle *Circaetus pectoralis*. This appears subject to cycles when it is present for a few years and then disappears for a few years. The area is on the perimeter of its distribution. The bird occurs only as a non-breeding migrant.

Black-breasted Snake Eagle *Circaetus pectoralis*. Numbers are reasonably constant for this resident breeding species.

Bateleur *Terathopius ecaudatus*. A small resident group of breeding birds fluctuates considerably. The numbers are dramatically increased by migrants, the majority of which are juvenile birds. It has been shown (Liversidge, in press) that these birds fly great distances each day and that probably the migratory birds come from central Africa. Brown (1970, 1976) has commented that birds disappear with rains and he regards the dry season as important to the species. It would appear from the numbers and rainfall figures that the Kalahari data support this.

Pale Chanting Goshawk *Melierax canorus*. This is a resident species, although a ringed nestling was recovered nearly 500km to the south-east. The reason for the nearly tenfold change in numbers is not clear.

Lanner *Falco biarmicus*. A ringing recovery from Malawi indicated that the birds come from a considerable distance. Since the study started there has been one breeding record. However, few birds are to be seen during the southern winter period. There is normally a big influx in February, but few birds occurred in 1992 so the migrants did not reach the Park. Again reports from northern Botswana indicated many birds in that area this 1992 season.

Rock Kestrel *Falco rupicolus*. This bird is mainly a local winter non-breeding visitor that occurs in small numbers. There are small variations, with years of absence, which may be a local phenomenon or the result of breeding success elsewhere.

Greater Kestrel *Falco rupicoloides*. A resident breeding species that is quite common in the dunes. Changes in numbers occur with possible cycles of four years but this is not regular. At this stage the causes of the variations in numbers are not understood.

Pygmy Falcon *Poliohierax semitorquatus*. Fairly constant numbers except for one year, 1974, when the numbers peaked. 1974 had heavy floods and this may have brought more birds into this comparatively dryer environment.

## CONCLUSIONS

Birds are obviously undertaking long-distance journeys and taking advantage of favourable local conditions over a wide area in their winter or non-breeding quarters. It is evident that the migratory raptors behave differently in the Kalahari or general southern semi-arid regions to those of the west African regions. One gets the impression from Thiollay (1978) that although the movements in West Africa are related to locust abundance they are relatively speaking more

regular than those of the Kalahari. In the southern semi-arid, the movements are more determined by locally abundant food resources that result from the unpredictable good rains (Brooke *et al* 1972).

It is shown that the changes that occur from year to year for most species are not related to local rainfall. However, some species are affected by rainfall elsewhere. In the past we have looked at good rains causing such changes but it is now realised that equally important is the effect of drought in distant areas.

It is interesting to me as a worker who knows only this variability in the environment to read Newton's book on population ecology (1979). He writes from a background of relatively stable conditions. Whilst some of his statements on breeding populations are not acceptable locally his basic conclusions about movements are. Thus under "movements" he states that movement patterns can be explained in terms of food supply and then goes on to discuss seasonality, regional variations, annual variations and cyclic prey abundance - all of which fit the Kalahari evidence very well.

It is important to accept that in semi-arid regions the larger birds of prey are dependent upon enormous areas which extend far beyond the boundaries of any nation in central and southern Africa.

It thus becomes imperative for conservation of these birds that international action should be taken and any single country attempting conservation cannot hope to be effective by its own actions.

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Bateleur *Terathopius ecaudatus*