Range Expansion of the Yellowbilled Oxpecker *Buphagus africanus* into the Kruger National Park, South Africa

A.J. HALL-MARTIN

Hall-Martin, A.J. 1987. Range expansion of the Yellowbilled Oxpecker *Buphagus africanus* into the Kruger National Park, South Africa. — *Koedoe* 30: 121 – 132. Pretoria. ISSN 0075 – 6458.

The Yellowbilled Oxpecker, long believed extinct as a breeding species in the Republic of South Africa has been recorded regularly in the Kruger National Park since 1979. The first definite indication of breeding was recorded in January 1984, and final confirmation of breeding was observed in December 1985. The recovery of the ungulate populations of the park, in particular buffalo, from overhunting and rinderpest during the long period of absolute protection stretching from 1902, has ensured a suitable habitat for the immigrant Yellowbilled Oxpeckers. Circumstantial evidence indicates that the birds have colonised in the park from the population of the Gonarezhou National Park in south-eastern Zimbabwe. The movement of the birds across the 50 km Sengwe area separating the two parks is explained by the cessation of cattle dipping and the movement of buffalo out of Gonarezhou from 1977 onwards. These events were a direct consequence of the hostilities in Zimbabwe at that time.

Key words: Yellowbilled Oxpecker, *Buphagus africanus*, Kruger National Park, range expansion.

A.J. Hall-Martin, Kruger National Park, Private Bag X402, Skukuza, 1350 Republic of South Africa.

Introduction

The historical range of the Yellowbilled Oxpecker *Buphagus africanus* Linnaeus, 1766 in South Africa was in the savanna biome (*sensu* Rutherford & Westfall 1986) from Pietermaritzburg in Natal through Zululand, and the eastern and northern Transvaal (Brooke 1984). Yellowbilled Oxpeckers feed chiefly on the 'bont' tick *Amblyomma hebraeum* and the brown ear tick *Rhipicephalus appendiculatus* (Stutterheim & Brooke 1981) when these occur on their preferred mammal symbionts the buffalo *Syncerus caffer* Sparrman, 1779, white rhinoceros *Cera-totherium simum* (Burchell, 1817), black rhinoceros *Diceros bicornis* (Linnaeus, 1758), eland *Taurotragus oryx* (Pallas, 1766) and cattle (Millais 1895; Attwell 1966; Buskirk 1975; Grobler & Charsley 1978; Stutterheim & Brooke 1981).

The extinction of the species in South Africa was reasonably explained by Stutterheim & Brooke (1981). The first phase of the birds' decline was due to increasing hunting pressure on their main mammal symbionts, and hosts of their main food source, toward the end of the last century. The second blow was the rinderpest epidemic of 1896 which virtually eliminated the remaining buffalo and had a disastrous effect on cattle populations. The final blow was the increasing use of arsenical compounds in cattle dip from 1902 onwards. Redbilled Oxpeckers *Buphagus erythrorhynchus* (Stanley, 1814) died within 48 hours of eating poisoned ticks, (Bezuidenhout & Stutterheim 1980) and it is suggested that the same holds for Yellowbilled Oxpeckers (Attwell 1966; Grobler 1979; Stutterheim & Brooke 1981). The Yellowbilled Oxpecker was widely regarded as extinct in South Africa as a breeding species by 1910 (Stutterheim & Brooke 1981; Brooke 1984; Kemp, Kemp & Tarboton 1985).

The factors which probably contributed to their extinction in the Kruger National Park area of the eastern Transvaal Lowveld, had largely been reversed by 1970. Conditions were favourable for the expansion of the range of the species from the south-eastern Zimbabwe nucleus into the Kruger National Park. A natural process of colonisation has occurred since at least 1979. This paper presents the recent records of the sightings of the Yellowbilled Oxpecker in the Kruger National Park and the first confirmed breeding records for the species in South Africa since 1906.

Methods

Records of Yellowbilled Oxpecker sightings

Regular observations by the writer have been made on birds throughout the Kruger National Park since April 1979 up to the time of writing (February 1986). Observations are made from a vehicle or on foot using Leitz 10 × 40 Roof Prism binoculars. Records of other observers' sightings of Yellowbilled Oxpeckers have been accepted only if verbally confirmed by the original observer. Photographs have also been accepted as confirmation of observations. Sightings are recorded and mapped.

Explanation of range expansion

This has been confined to a review of the internal records of the Kruger National Park to document the recovery of the populations of preferred mammal symbionts and a search for confirmation of recent historical events in south-eastern Zimbabwe which could shed light on the movement of Yellowbilled Oxpeckers into South Africa.

Results and Discussion

Distribution of Yellowbilled Oxpeckers in the Kruger National Park area before 1979

There is only one early record of Yellowbilled Oxpeckers close to, or possibly within the area which was proclaimed as the Kruger National Park in 1926. This is a

specimen collected by W.F. Francis near Komatipoort in 1896. It is specimen SAM 3993 in the collection of the South African Museum and there are no further details of its exact place of origin (McLachlan *pers. comm.*[1]). There have been numerous natural history notes and bird records from rangers, wardens, biologists and visitors over the years. None of these ever reported Yellowbilled Oxpeckers.

The formal reports on birds in the Kruger National Park prior to 1979 all refer to the Redbilled Oxpecker as the only species occurring in the park (Stevenson-Hamilton 1929, 1947; Rowland-Jones 1957; Pienaar & Prozesky 1961; Kemp 1974). C.J. Stutterheim worked on Redbilled Oxpeckers in the park for two years (March 1973 – December 1974) during which time no observations of Yellowbilled Oxpeckers were made despite systematic searches (Stutterheim & Brooke 1981).

There can thus be little doubt that the Yellowbilled Oxpecker disappeared from the Kruger National Park area sometime after 1896, and it had not returned by 1974.

Historical decline of favoured mammal symbionts in the Kruger National Park area

Up till about 1860 the eastern Transvaal had been little disturbed by hunters using firearms, only elephants *Loxodonta africana* (Blumenbach, 1797) and both species of rhino had been heavily hunted. In about 1845 a Portuguese trader and pioneer named João Albassini settled on the Sabie River near the present-day Hazyview Station. He organised a large force of hunters whom he armed with guns and employed to shoot elephants and rhinoceros. These hunters decimated the white rhino of the lowveld (Stevenson-Hamilton 1929). By 1870 the elephant and rhinoceros were scarce, but other game was still abundant, including buffalo, black rhinoceros, eland, kudu *Tragelaphus strepsiceros* (Pallas, 1766) and sable *Hippotragus niger* (Harris, 1838) (all of which were used by Yellowbilled Oxpeckers). By 1880 biltong hunters from the highveld were making annual dry season expeditions into the lowveld and shooting game in large numbers (Stevenson-Hamilton 1929). The Selati Railway construction, completed in 1893, well into the era of modern firearms, brought a new influx of hunters. The black rhinoceros was virtually eliminated during the 1890s (Stevenson-Hamilton 1929). Finally, the rinderpest epidemic of 1896/1897 killed large numbers of the remaining ungulates, in particular the buffalo. There were only "about a dozen" buffalo left in the park after the rinderpest (Stevenson-Hamilton 1929).

The decline in the ungulates favoured by the Yellowbilled Oxpeckers as key hosts (*vide* Grobler 1980), such as the buffalo, rhinoceros, eland, kudu and giraffe *Giraffa camelopardalis* (Linnaeus, 1758) appears to have been sufficient to cause the extinction of the birds which could not survive on alternative hosts. The loss of the key host (giraffe) of Redbilled Oxpeckers seems not to have affected this species to the same degree. It appears that the Redbilled Oxpeckers were able to survive on minor hosts such as impala *Aepyceros melampus* (Lichtenstein, 1812),

[1]McLachlan, G.R., *South African Museum, P.O. Box 61, Cape Town.*

sable, blue wildebeest *Connochaetes taurinus* (Burchell, 1823) and zebra *Equus burchellii* (Gray, 1824) (Grobler & Charsley 1978; Grobler 1980) which were not affected by the rinderpest. The survival of Redbilled Oxpeckers and the extinction of the Yellowbilled Oxpeckers may be indicative of a level of interspecific ecological competition during a period of limited food resources which has not yet been adequately elucidated.

Differential mortality among various species of ungulates during the rinderpest epidemic was noted by Stevenson-Hamilton (1929, 1957) who remarks that impala, sable, blue wildebeest, zebra, roan *Hippotragus equinus* (Desmarest, 1804) and some other species were hardly affected at all, while buffalo, eland and kudu were hard hit (Stevenson-Hamilton 1957).

Rehabilitation of Yellowbilled Oxpecker hosts and food sources

By 1925 most ungulate species including buffalo, giraffe and eland had recovered from the effects of heavy hunting and the rinderpest (Stevenson-Hamilton 1929) and numbers were increasing steadily. The white rhinoceros was, however, extinct and the few black rhinoceros to survive into the twentieth century did not recover, and were extinct by 1940 (Stevenson-Hamilton 1947). The numbers of buffalo increased to 10 514 by 1964 (Pienaar, Van Wyk & Fairall 1966) and reached a peak of 34 912 in 1981 (Joubert 1981) despite the imposition of culling to limit the population as early as 1967 (Pienaar 1969). White rhinoceros were re-introduced into the Kruger National Park between 1961 and 1969 when 141 animals were moved from Natal (Pienaar 1970) and a further 204 during the early 1970s (Hall-Martin 1984). The species has increased steadily to reach 1 200 by 1985 (Joubert 1985). Black rhino were re-introduced in 1970 and during the early 1980s and by 1986 had increased to at least 140 animals. While buffalo have been widespread throughout the Kruger National Park for many years, the two rhinoceros species are predominantly found south of the Sabie River, in the southern district of the park. The tick species *A. hebraeum* and *R. appendiculatus* are found throughout the park (Theiler 1962; Howell, Walker & Nevill 1978) and both species are commonly found on buffalo, black rhino and white rhino as well as on other hosts of Yellowbilled Oxpeckers such as eland, kudu, zebra and giraffe (Theiler 1962).

Some of the requirements for successful occupation of an area by Yellowbilled Oxpeckers, as listed by Grobler (1979) are:

(a) A fairly high density of the favoured host species, particularly buffalo.
(b) Suitable breeding sites.
(c) Suitable open country for location of hosts (by birds).
(d) A good food supply (in combination with the right hosts).

All these requirements could easily be met in the Kruger National Park, and in particular in the northern mopane *Colophospermum mopane* (Kirk ex Benth.) Kirk ex J. Leonard woodlands from the late 1960s onwards.

Yellowbilled Oxpeckers in neighbouring territories

The distribution of both species of oxpecker in Rhodesia (now Zimbabwe) in 1975 is given by Grobler (1979) and Irwin (1981). In the south-eastern lowveld of

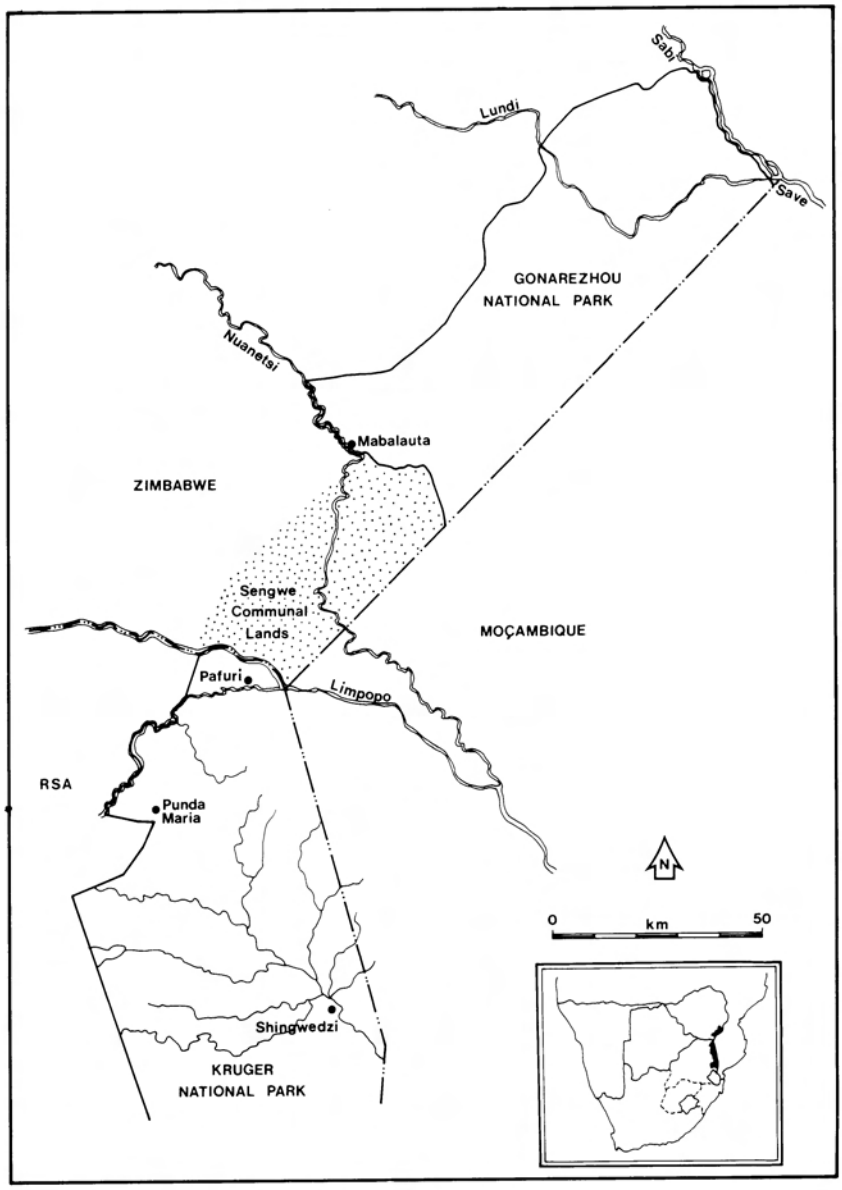

Fig. 1. Map of the RSA/Zimbabwe/Moçambique border region showing national parks and international boundaries relevant to the text. (Insert shows study area relative to southern Africa).

Zimbabwe (the topographical extension northwards of the eastern Transvaal lowveld), Yellowbilled Oxpeckers were virtually restricted to between Mabalauta and the Lundi River and principally within the area of the Gonarezhou National Park (Fig. 1). Here, buffalo, which had also been decimated by rinderpest in 1896 had recovered and were abundant (Child & Savory 1964; Smithers & Wilson 1979). The Gonarezhou National Park had a game fence along part of its southern boundary (Sherry 1975) while a section of the boundary along the Nuanetsi River was unfenced. Movements of several of the mammal hosts of Yellowbilled Oxpeckers between the Gonarezhou and the Limpopo rivers through the Sengwe Communal Lands (Fig. 1), a distance of ± 50 km was possible, though impeded to some extent by tribal settlement and hunting. Movements of a number of species such as buffalo, eland and cattle across the Limpopo River into the Kruger National Park were also well known (Nel *pers. comm.*[2]). A continuous distribution of suitable Yellowbilled Oxpecker hosts such as buffalo and eland and even small numbers of roan antelope between Gonarezhou and the Limpopo is shown by Smithers & Wilson (1979) and confirmed by Thomson (*pers. comm.*[3]) and Saunders (*pers. comm.*[4]). The occurrence of cattle in this area with attendant government sponsored dipping programmes must, however, have constituted an effective barrier to the spread of yellowbilled oxpeckers south of the Nuanetsi River in recent times. No direct evidence is available on the status of yellowbilled oxpeckers in Moçambique, near the borders of the Kruger National Park in recent years. Though their presence is implied by Mackworth-Praed & Grant (1963), it is stated by Clancey (1971) to be virtually absent from Moçambique south of the Zambesi River, and the nearest known population (Matusi) is far to the north-east of the present area.

Records of Yellowbilled Oxpeckers in the Kruger National Park

The first recent sighting of Yellowbilled Oxpeckers in the Kruger National Park was made on 13 August 1979 north of Shingwedzi by the writer as recorded by Stutterheim & Brooke (1981). A further 11 sightings by various observers were made in the next few years. All these records are listed in Table 1 and mapped in Fig. 2. All the sightings have been from areas where the vegetation is predominantly *C. mopane* woodland or tree savanna.

Records of breeding by Yellowbilled Oxpeckers in the Kruger National Park

The first sightings of immature birds was on 30 January 1984 at Eendrag Waterhole (Table 1 and Fig. 2). The two immature birds in this group still had dark-coloured bills. The locality of the sighting was 120 km south of the Limpopo River and 170 km south of Gonarezhou. Yellowbilled Oxpeckers are reported to be fairly sedentary birds (Grobler 1979; Irwin 1981) and it would appear unlikely that juveniles bred in Gonarezhou would be seen 170 km away so close to the end

[2]Nel, P.J., *Regional Ranger, Kruger National Park, Pr. Bag X402, Skukuza, 1350.*
[3]Thomson, W.R. *National Parks Board of Bophuthatswana, Pr. Bag X2078, Mafekeng, 8670.*
[4]Saunders, C.R. *Lowveld Lodge, Triangle, Zimbabwe*

ISSN 0075–6458

Table 1

Reported sightings of Yellowbilled Oxpeckers in the Kruger National Park 13 August 1979–2 January 1986. Sightings are mapped in Fig. 2.

Date	Place	Map Ref.	No of birds	Hosts	Observer	Notes
1979.08.13	Mphongolo R.	1	8	Kudu	A.J. Hall-Martin	Birds all adult
1979.09.24	Nkulumbeni R.	2	2	Buffalo	A.J. Hall-Martin C. Hall-Martin	Birds adult
1979.09	Luvuvhu R.	3	1	Hippo	P. Johnson	
1981.09	Klopperfontein	4	2	Buffalo	F. du Toit	Adults
1983.06.05	Mphongolo R.	5	2	Impala	J. Oelofse	Assoc. with redbilled oxpeckers
1984.01.30	Eendrag W'hole, Tsende River	6	6	Buffalo	A.J. Hall-Martin C. Hall-Martin	Four adult, two immature. Associated with redbilled oxpeckers
1984.03	Punda Maria/ Dzundwini	7	3	Buffalo	G. Cox	Same birds seen by several visitors
1984.05	Mphongolo R.	8	2	Kudu	D. Rusk	
1984.06	Boyela	9	1	Buffalo	A. Hall-Martin	Possibly more birds
1984.09	Klopperfontein	10	2	Buffalo	G. Lockwood	Possibly one adult and one subadult
1985.12.23	Punda Maria/ Gumbandevu	11	6	–	A. Wilson H. Wilson	Four adults at nest with two chicks. Seen by numerous other observers
1986.01.02	Punda Maria/ Mandadzidzi	12	6	Kudu	A. Hall-Martin C. Hall-Martin B. Pretorius	Probably same birds from nest 85.12.23. Distance ± 2 km from nest

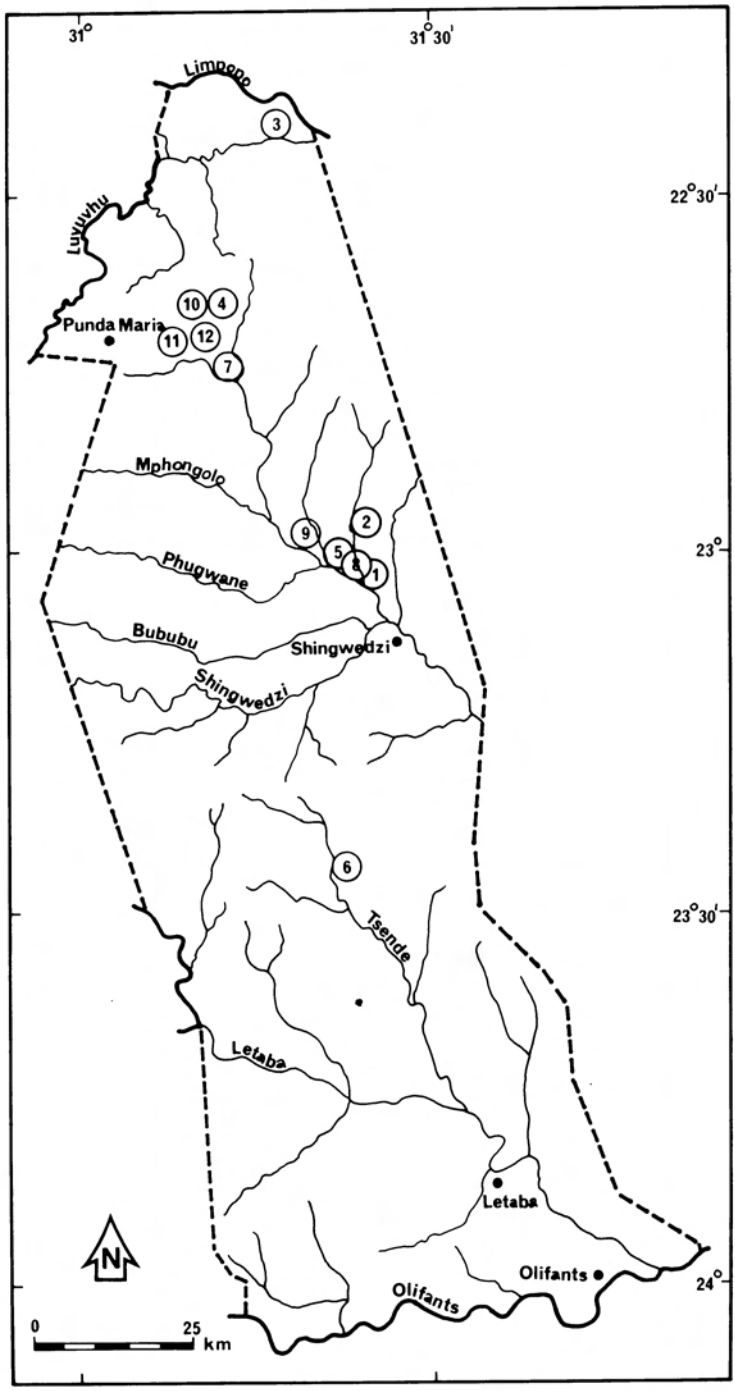

Fig. 2. The northern regions of the Kruger National Park showing localities of Yellowbilled Oxpecker sightings August 1979 – January 1986. (Numbers refer to entries in Table 1).

of the breeding season. It is reasonable to suppose, therefore, that they were hatched in the Kruger National Park. The observations of Alan and Heather Wilson (Table 1) were initially of chicks still in the nest in a hollow branch of a tall mopane tree. They also took the first photographs of Yellowbilled Oxpeckers in South Africa and these clearly show the juveniles in the nest (Hall-Martin 1986). These observations indicate that breeding in the Yellowbilled Oxpecker in the Kruger National Park takes place during December. This agrees with the records of Grobler (1979) from the Matobos and Hwange national parks which indicate a mid-summer breeding period.

Events facilitating the spread of Yellowbilled Oxpeckers into the Kruger National Park

In the absence of any evidence to suggest that the Yellowbilled Oxpecker population of the Kruger National Park was derived from Moçambique, it is concluded that the colonists originated from the known population in south-eastern Zimbabwe. From the records already cited it is clear that suitable mammal symbionts occurred in the Sengwe corridor. However, cattle which were regularly dipped also occurred and this may have formed the barrier to southwards dispersal of the birds before 1979. Many suggestions and reports of their sensitivity to poisoned ticks appear in the literature (Clancey 1964; Grobler 1979; Irwin 1981; Stutterheim & Brooke 1981).

During the Bush War in Rhodesia, the nationalist guerrillas operated out of Moçambique from 1976 (Moorcraft & McLaughlin 1982). Within a year the activities of the Department of Veterinary Services which was responsible for maintaining the game fences along the southern boundary of Gonarezhou and for cattle dipping in the Sengwe area were affected (Thomson *pers. comm.*[5]). Many breaks occurred in the fences and buffalo were able to move freely across them, and cattle dipping soon ceased. The Sengwe gap therefore carried buffalo, eland, kudu, roan antelope and undipped cattle. These factors presumably facilitated the dispersal of Yellowbilled Oxpeckers across the gap and into the Kruger National Park where they were reported for the first time in August 1979.

Maximum dispersal distances for oxpeckers

The minimum straight line distance between the southern boundary of the Gonarezhou National Park and the northern boundary of the Kruger National Park is 50 kilometres. The minimum distance between the estimated southern boundary of the range of Yellowbilled Oxpeckers in south eastern Zimbabwe as mapped by Grobler (1979) and the Limpopo River is only 16 kilometres. Yellow-billed Oxpeckers released into the Matobos National Park moved 15 km within about three months of their release (Grobler *pers. comm.*[6]). Redbilled Oxpeckers

[5]Thomson, J.W., *Dept. of Veterinary Services, Harare, Zimbabwe.*
[6]Grobler, J.H. *Natal Parks Board, P.O. Box 662, Pietermaritzburg, 3200.*

released in the same area were sighted 20 km and 30 km from the release area within a few months. There does not, therefore, appear to be any reason to suppose that Yellowbilled Oxpeckers could not disperse across the 16 km – 50 km gap between Gonarezhou and the Kruger National Park in the absence of poisoned ticks. The maximum distance between sightings within the Kruger National Park is 110 km, indicating that the species could spread at least over that distance in a few years.

Subspecific status of the Kruger National Park Yellowbilled Oxpecker

The Yellowbilled Oxpecker in the Kruger National Park can be regarded as being of the subspecies *B. a. haematophagus* Clancey, 1980 as noted by Irwin (1981).

Selection of symbionts and Yellowbilled Oxpecker group size

The present data are insufficient for arriving at firm conclusions. However, the mammalian hosts recorded in 11 sightings (Table 1) of Yellowbilled Oxpeckers indicate a preference for association with buffalo (55% of sightings) and a second choice for kudu (27% of sightings). Sixteen birds were, however, recorded on each species. The mean group size on buffalo was 2,7 birds and on kudu it was 5,3 birds. The mean group size for 12 sightings was 3,4 birds which is much less than the mean group size of 4,0, 5,5 and 5,7 recorded annually by Grobler (1979) over a period of three years. The mean herd size of buffalo in the northern district of the Kruger National Park in 1985 was 298,4 animals (Joubert 1985). Such herds are generally well spread out with oxpeckers often also spread out and moving rapidly from one host to another. It is, therefore difficult to account for all birds associated with the herd.

Yellowbilled Oxpeckers are also adept at hiding by clinging to the sides of animals furthest away from a source of disturbance e.g. the observer. In the case of kudu herds, with a mean group size of 4,82 in 1985 (Mason 1986) it is much more likely that all associated oxpeckers were seen and counted. The mean oxpecker group size on kudu agrees well with the data of Grobler (1979).

Conclusions

Yellowbilled Oxpeckers returned to the Kruger National Park from neighbouring populations in south-eastern Zimbabwe sometime between 1976 and 1979. They subsequently spread southwards in the mopane woodland and forest communities of the north-western region of the park. Breeding is known to have occurred from 1984 onwards. The species is now poised to increase its numbers and range and will most likely spread throughout the Kruger National Park over the next few years where buffalo occur in woodland or tree savanna communities. The species can be regarded as a resident breeding species and no longer as a vagrant as suggested elsewhere (Brooke 1984; Kemp, Kemp & Tarboton 1985). There would appear to be no longer any justification for the artificial introduction of the species

into the Kruger National Park as was suggested by Stutterheim & Brooke (1981) and others.

Acknowledgements

I thank those colleagues and friends who provided me with records of Yellowbilled Oxpecker sightings, in particular Graham Cox, Alan Wilson and Heather Wilson. I also thank Ron Thomson, Dr. J.W. Thomson, Dr. Hans Grobler and Dr. Colin Saunders for their comments and suggestions.

References

ATTWELL, R.I.G. 1966. Oxpeckers, and their associations with mammals in Zambia. *Puku* 4: 17 – 48.

BEZUIDENHOUT, J.D. and C.J. STUTTERHEIM. 1980. A critical evaluation of the role played by the redbilled oxpecker *Buphagus erythrorhynchus* in the biological control of ticks. *Onderstepoort J. vet. Res.* 47: 51 – 75.

BROOKE, R.K. 1984. South African Red Data Book — Birds. *S. Afr. Nat. Sci. Progs. Report* No. 97.

BUSKIRK, W.H. 1975. Substrate choices of oxpeckers. *Auk.* 92(3): 604 – 606.

CHILD, G. and C.R. SAVORY. 1964. The distribution of large mammal species in Southern Rhodesia. *Arnoldia (Rhod.)* 1(14): 1 – 15.

CLANCEY, P.A. 1964. *The Birds of Natal and Zululand.* London: Oliver & Boyd.

CLANCEY, P.A. 1971. A handlist of the birds of southern Moçambique, Part 10 (Passeriformes). *Mems. Inst. Invest. Cient. Moçamb.* 11 Serie A: 1 – 167.

GROBLER, J.H. 1979. The re-introduction of oxpeckers *Buphagus africanus* and *B. erythrorhynchus* to the Rhodes Matopos National Park, Rhodesia. *Biol. Conserv.* 15: 151 – 158.

GROBLER, J.H. 1980. Host selection and species preference of the redbilled oxpecker *Buphagus erythrorhynchus* in the Kruger National Park. *Koedoe* 23: 89 – 97.

GROBLER, J.H. and G.W. CHARSLEY. 1978. Host preference of the yellowbilled oxpecker *Buphagus africanus* in the Rhodes Matopos National Park, Rhodesia. *S. Afr. J. Wildl. Res.* 8: 169 – 170.

HALL-MARTIN, A.J. 1984. The status of white rhino (*Ceratotherium simum simum*) in the Kruger National Park. Report to the National Parks Board. Unpubl.

HALL-MARTIN, A. 1986. Return of the Chimurenga bird. *Custos* 15(2): 32 – 34.

HOWELL, C.J., JANE B. WALKER and E.M. NEVILL. 1978. Ticks, mites and insects infesting domestic animals in South Africa. Part 1. Descriptions and biology. *Science Bulletin* No. 393, Dept. of Agricultural Technical Services, Pretoria.

IRWIN, M.P.S. 1981. *The Birds of Zimbabwe.* Salisbury: Quest Publishing.

JOUBERT, S.C.J. 1981. Census results for large herbivore species in the Kruger National Park. Report to the National Parks Board. Unpubl.

JOUBERT, S.C.J. 1985. Census results for large herbivore species in the Kruger National Park. Report to the National Parks Board. Unpubl.

KEMP, A.C. 1974. The distribution and status of the birds of the Kruger National Park. *Koedoe Monograph* 2: 1 – 341.

KEMP, M.I., A.C. KEMP and W.R. TARBOTON. 1985. A catalogue of the birds of the Transvaal. Transvaal Museum/Transvaal Nature Conservation Division. Cyclostyled manuscript.

MACKWORTH-PRAED, C.W. and C.H.B. GRANT. 1963. *Birds of the Southern Third of Africa. African Handbook of Birds.* Series II, Vol. II. London: Longmans.

MASON, D.R. 1986. Monitoring of ungulate population structure in the Kruger National Park — report on a survey during August, September and October 1985. Dept. of Research & Information, Kruger National Park, Skukuza. Unpubl.

MILLAIS, J.G. 1895. *A Breath from the Veldt*. London: Henry Sotheran.
MOORCRAFT, P.L. and P. MCLAUGHLIN. 1982. *Chimurenga! The War in Rhodesia 1965 – 1980*. Johannesburg: Sygma/Collins.
PIENAAR, U. DE V. 1969. Observations on developmental biology, growth and some aspects of the population ecology of African buffalo (*Syncerus caffer caffer* Sparrman). *Koedoe* 12: 29 – 52.
PIENAAR, U. DE V. 1970. The recolonisation history of the square-lipped (white) rhinoceros *Ceratotherium simum simum* (Burchell) in the Kruger National Park (October 1961 – November 1969). *Koedoe* 13: 157 – 170.
PIENAAR, U. DE V. and O.P.M. PROZESKY. 1961. An amended check list of the birds of the Kruger National Park. *Koedoe* 4: 117 – 140.
PIENAAR, U. DE V., P. VAN WYK and N. FAIRALL. 1966. An aerial census of elephant and buffalo in the Kruger National Park. *Koedoe* 9: 40 – 107.
ROWLAND-JONES, M. 1957. Birds of the Kruger National Park and their distribution. Report to the National Parks Board. Unpubl.
RUTHERFORD, M.C. and R.H. WESTFALL. 1986. Biomes of southern Africa — an objective categorization. *Mem. bot. Surv. S. Afr.* No. 54.
SHERRY, B.Y. 1975. Reproduction of elephant in Gonarezhou, south-eastern Rhodesia. *Arnoldia (Rhod.)* 7(29): 1 – 13.
SMITHERS, R.H.N. and V.J. WILSON. 1979. Check list and atlas of the mammals of Zimbabwe/Rhodesia. *Museum Memoir* No. 9. National Museums, Salisbury, Zimbabwe/ Rhodesia.
STEVENSON-HAMILTON, J. 1929. *The Low-Veld: Its Wild Life and its People*. London: Cassell.
STEVENSON-HAMILTON, J. 1947. *Wild Life in South Africa*. London: Cassell.
STEVENSON-HAMILTON, J. 1957. Tsetse fly and the rinderpest epidemic of 1896. *S. Afr. J. Sci.* 53: 216 – 218.
STUTTERHEIM, C.J. and R.K. BROOKE. 1981. Past and present ecological distribution of the yellowbilled oxpecker in South Africa. *S. Afr. J. Zool.* 16(1): 44 – 49.
THEILER, GERTRUD. 1962. The arthropod parasites of vertebrates in Africa South of the Sahara (Ethiopian Region). Report to the Director of Veterinary Services, Onderstepoort, Pretoria. Unpubl.