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POST-MORTEM FINDINGS IN EAST AFRICAN BIRDS OF PREY¹

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Abstract: The causes of mortality and other *post-mortem* findings from 31 free-living and 12 captive East African raptors of 20 species are reported. Seventeen (39.5%) died as a result of trauma and only 4 (9.3%) of infectious disease (acid-fast bacterial infection, aspergillosis, nocardiosis, coliform pneumonia and pancreatitis). Other conditions encountered were anaesthetic overdose, predation, starvation, dehydration, cloacal impaction, pulmonary congestion and osteodystrophy. The causes of mortality are compared with those reported in similar surveys from other parts of the world.

INTRODUCTION

There is increasing interest in the causes of mortality in both free-living and captive birds of prey. Such interest was prompted by the recent precipitous decline in numbers of wild raptors in Europe and North America.^{1a} While investigations have frequently emphasized pesticide analysis, work has also been carried out on infectious diseases and other causes of mortality in these species. Studies on captive birds of prey have also been intensified, such research being a result of increased interest in maintaining raptors in captivity for scientific research, for breeding of endangered species, and for exhibition and falconry.

There has been very little work on raptor diseases in East Africa despite the large number and variety of species in the region.¹ No specific clinical or *post-mortem* study has previously been carried out and the only available references to raptor disease in East Africa are isolated records in veterinary laboratory reports and a small number of scientific papers.^{7,9,11,21} Some information on diseases encountered in captive East African species is available in more general papers on raptor disease.^{4,15} In the last 5 years, however, interest in East African

raptor populations has increased, partly because fears were expressed that they too might be declining as a result of such factors as habitat destruction and extensive use of chlorinated hydrocarbon insecticides.

In January 1970 I commenced a clinical and *post-mortem* survey of diseases in East African birds of prey of the orders Falconiformes and Strigiformes. The *post-mortem* findings from that study up to June 1973 are presented here.

MATERIALS AND METHODS

The free-living birds examined in the survey were either collected personally, were submitted by members of the public, or were submitted as part of a survey for persistent pesticides.¹⁰ The captive birds examined were owned by the author or members of the public and in a number of cases received clinical treatment. A "captive" raptor is defined for this study as one that has been in captivity for 7 days or more. Carcasses were examined as soon as possible after death. A *post-mortem* examination was carried out and when possible all tissues were examined; this applied even in cases such as road casualties where the cause of

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death was known. In many instances the skin, or portions of the body were required for scientific study and the *post-mortem* examination was modified accordingly. Both ecto- and endo-parasites were collected and submitted to the British Museum (Natural History) for identification. Faecal or intestinal samples were examined for parasites on direct smears and by salt flotation techniques. Blood smears were made from all carcasses, stained with Giemsa and examined for blood parasites. Tissues for histological examination were fixed in 10% formol-saline prior to embedding and sectioning; as a routine they were stained with haematoxylin and eosin but other stains were used where applicable. Material for bacteriology was taken whenever indicated by *post-mortem* findings and specimens were submitted to the diagnosis section of this laboratory for routine culture and typing. Culture of faecal material was carried out routinely on all free-living individuals. Virus isolation was attempted in six cases by inoculation of fertile eggs by the allantoic cavity route. A small number of tissues were analysed for chlorinated hydrocarbons at this laboratory.

RESULTS AND DISCUSSION

The results of the survey are summarized in Table 1. No diagnosis was made in 3 (7%) of the cases, a figure which compares favourably with that found in similar reports by other workers.⁴

Four deaths were attributed to anaesthetic toxicity. Two of these deaths were in free-living augur buzzards and occurred under metomidate anaesthesia during a pectoral muscle biopsy for pesticide analysis. A captive white-backed vulture died under the same anaesthetic but in this case asphyxia was also involved; the long neck of the bird became twisted during handling. The death of the fourth case, a captive lizard buzzard, was due to inadvertent inoculation of the new steroid anaesthetic CT 1341 (Saffan: Glaxo Laboratories Ltd.) into an air sac and the details have been reported elsewhere.⁶

Trauma was the commonest cause of mortality in the survey, being responsible for 17 (39.5%) of the deaths. Road deaths are extremely common in East African raptors, especially among black kites which feed on carcasses on the road. It is of interest that in only one case was a bird shot. Fire-arms are strictly controlled in Kenya and as a result, comparatively few raptors are killed by shooting. This is in contradistinction to Europe and North America where many raptors are shot and some free-living individuals may carry lead shot in their tissues. Persecution of raptors does, nevertheless, take place in Kenya and large numbers of accipiters and augur buzzards are probably killed by local people. As Brown¹ points out, there is little natural animosity to birds of prey by Africans but as the country develops many more people keep livestock and are inclined to protect them against predators. For instance, the black sparrowhawk killed by trauma was the second of the species to be caught in a gin-trap at a local poultry farm; the first was seriously injured but survived and was released after treatment. Birds of prey are protected in Kenya by the Game Laws but these laws are often difficult to enforce and their efficacy is doubtful, since provision is made for land owners to kill raptors if their livestock or property is threatened. Other interesting examples of trauma encountered in this survey were a captive shikra which was killed by a child and a barn owl which was caught by a domestic cat. In South Africa electrocution of vultures on power lines has been reported and suggested as a significant cause of mortality,¹⁷ but no such cases have been reported in East Africa. A pale chanting goshawk had free blood in its air sacs and buccal cavity but no specific injuries could be found and the diagnosis of trauma was therefore tentative. "Apoplexy" was a possible alternative diagnosis, this condition having been recorded in a captive peregrine (E. Boughton, personal communication) and known to falconers for many years.¹⁸ It has also been reported in cage birds¹² but its aetiology has not been fully elucidated; possibly it is a manifestation of

TABLE 1. Causes of death of 43 East African Raptors

Cause of Death	Species ^①	Number Examined
Unknown	African goshawk	<i>Accipiter tachiro</i> 1
	Red-chested owlet	<i>Glaucidium tephronotum</i> 1 ^②
	Tawny eagle	<i>Aquila rapax</i> 1
Anaesthetic overdose	Augur buzzard	<i>Buteo rufofuscus</i> 2
	Lizard buzzard	<i>Kaupifalco monogrammicus</i> 1 ^②
	White-backed vulture	<i>Gyps africanus</i> 1 ^②
Destroyed	African wood owl	<i>Ciccaba woodfordi</i> 1
	White-backed vulture	<i>Gyps africanus</i> 2
	Lizard buzzard	<i>Kaupifalco monogrammicus</i> 1
Trauma	Barn owl	<i>Tyto alba</i> 2
	Black kite	<i>Milvus migrans</i> 6
	Shikra	<i>Accipiter badius</i> 1 ^②
	Secretary bird	<i>Sagittarius serpentarius</i> 1
	Bateleur eagle	<i>Terathopius ecaudatus</i> 1
	Augur buzzard	<i>Buteo rufofuscus</i> 1
	Pale chanting goshawk	<i>Melierax canorus</i> 1
	Black sparrowhawk	<i>Accipiter melanoleucus</i> 1
	Black-shouldered kite	<i>Elanus caeruleus</i> 1
	Verreaux's eagle owl	<i>Bubo lacteus</i> 1
	African hawk eagle	<i>Hieraetus fasciatus</i> 1
Predation	Lanner falcon	<i>Falco biarmicus</i> 1 ^②
Hypoglycaemia	African goshawk	<i>Accipiter tachiro</i> 1 ^②
	Pale chanting goshawk	<i>Melierax canorus</i> 1
Shock/Stress	Black kite	<i>Milvus migrans</i> 2 ^③
Starvation/Dehydration	Black kite	<i>Milvus migrans</i> 1
	African Fish eagle	<i>Haliaeetus vocifer</i> 1 ^②
Over-feeding	Barn owl	<i>Tyto alba</i> 1
Osteodystrophy	Augur buzzard	<i>Buteo rufofuscus</i> 1 ^②
Cloacal impaction	African fish eagle	<i>Haliaeetus vocifer</i> 1
Pulmonary congestion	African barn owl	<i>Tyto alba</i> 1 ^②
Nocardiosis	African fish eagle	<i>Haliaeetus vocifer</i> 1
Aspergillosis and Acid-fast infection	African fish eagle	<i>Haliaeetus vocifer</i> 1 ^②
Pancreatitis	Secretary bird	<i>Sagittarius serpentarius</i> 1 ^②
Pneumonia	Dark chanting goshawk	<i>Melierax metabates</i> 1 ^②

① Authorities for scientific names Brown and Amadon (1968) and Brown (1970)

② Captive for at least 7 days

③ One captive for at least 7 days and one free-living

terminal haemorrhage or of haemorrhage associated with shock, as described by Fiennes.⁸

One captive lanner falcon was killed by safari ants (*Dorylus* sp.) (Fig. 1); these ants are voracious carnivores and hunt in large numbers at night. The bird is assumed to have descended to the ground in its cage in the dark and being unable to regain its perch, was eaten alive. This incident should serve as a warning to those who keep hawks in captivity in the tropics; safari ants will quickly attack and kill fowl and other captive birds. It is also conceivable that they could kill free-living birds, especially if the latter are roosting near the ground.

Chronic stress was diagnosed in a black kite which had been in captivity for some time and which had a chronic, ul-

cerated, wing injury. At *post-mortem* examination the bird was thin and showed adrenal enlargement macroscopically and hypertrophy histologically. Another black kite which had a fractured wing was considered to have died of haemorrhagic "shock" on account of its severely dehydrated and anaemic appearance.

Two birds were diagnosed as dying of "hypoglycaemia" but this diagnosis must be tentative as no blood chemistry was carried out. In the case of the captive African goshawk, the clinical signs shown were of incoordination following a period of reduced food intake. This syndrome would be termed "fits" by falconers and is well recognized in their birds, especially accipiters. It has been postulated due to hypoglycaemia⁴ on account of the invariable history of a drop in



FIGURE 1. Foot of lanner falcon (*Falco biarmicus*) showing erosive lesion on plantar surface and attached safari ants (*Dorylus* sp.). The latter, which were the cause of death, produced little damage to this foot but elsewhere had eaten and removed large areas of soft tissue.

nutrient intake prior to development of clinical signs. The goshawk showed no significant histological changes and no bacteria could be isolated from the brain, liver or heart blood; these findings support the diagnosis. This goshawk also showed a cystic dilatation of the gizzard, apparently an anatomical abnormality and one that was recorded previously in an owl.⁹ The free-living chanting goshawk was found dead in its nest. It too, had not eaten for 2 days before death and yet was in good bodily condition. There were no significant histological findings and the only bacteria isolated were considered to be *post-mortem* invaders.

Two wild birds were considered to have died of starvation, a diagnosis based on their emaciated condition and the presence of a retained pellet or vegetation in an otherwise empty stomach. The black kite also had a small ulcer in its gizzard and was very dehydrated. (Another black kite also had vegetation in the gizzard and was in an emaciated condition but had died of trauma). Starvation is probably an extremely common cause of death in wild raptors. Workers in Europe and America have demonstrated a 60-80% mortality rate in birds of prey in their first year of life² and although the majority of these probably suffer from territorial competition, the ultimate cause of death is starvation. One of the starvation cases encountered in the present study was a fish eagle. This species shows very aggressive territorial behaviour which undoubtedly can result in the starvation of a large number of youngsters. One case of interest was a young free-living barn owl which was extremely dehydrated and in poor physical condition when collected. When received in captivity it was immediately force-fed with meat by a layman but it died within a few hours. At *post-mortem* examination the stomach was grossly dilated with meat; the latter was found to weight 50 g while the total weight of the bird was only 255 g. The case illustrates the importance of not overfeeding such birds but of treating the dehydration and supplying small quantities of food at regular intervals. The only other nutri-

tional disease seen was a severe case of osteodystrophy in a hand-reared augur buzzard. The bird was destroyed. This buzzard was fed only meat; the calcium-phosphorus imbalance of this diet resulted in severe bone abnormalities with spontaneous fractures, bowing of the limbs and locomotory disturbance. The condition is well known in captive birds and is discussed in some detail by Keymer¹⁵ and by Wallach and Flieg.²² It is of interest that the latter authors describe nervous signs following such osteodystrophy and attribute the condition of "fits" in falconers' birds to this disease but the only clinical signs shown in the augur buzzard were extreme weakness, anaemia and impacted crop and cloaca.

Foot lesions were found in a captive lanner falcon, a free-living black-shouldered kite and a free-living Verreaux's eagle owl, all of which died as a result of injuries. The foot lesions in the falcon (Fig. 1) were bilateral and were attributed to a poorly designed perch; this has been described as a predisposing cause of "bumblefoot" in falconers' birds.¹¹ The eagle owl is of interest since "bumblefoot" is exceedingly rare in captive owls and there is only one report of a foot condition in a free-living owl.²⁰ The lesion in the present case was healing and appeared to have been the result of a puncture wound from the bird's own talon. A free-living black kite showed a severe, but healing, leg injury which appeared to have been caused by fighting.

One white-backed vulture had chronic air sac lesions from which no bacteria nor mycoplasmas were isolated. The bird had been treated for sinusitis some months previously and it is possible that the air sacs had also been involved. An epizootic of sinusitis killed a number of species including seven birds of prey (five lizard buzzards and two black-shouldered kites) in a private bird collection on the coast of Kenya. Unfortunately none of these birds was received for *post-mortem* examination.

One fish eagle showed cloacal impaction and this was the probable cause of death. The discovery of this condition in a free-living bird is of interest; in an earlier survey of over 200 raptors, three

such cases were encountered but only one was in a free-living bird. Boughton (personal communication) records cases in a captive European sparrowhawk and a captive kestrel, and there are other reports of the condition in birds in zoological collections.

Only four birds died of infectious diseases. One fish eagle had lesions associated with an *Aspergillus* sp. and acid-fast organisms (not cultured). This is believed to be the first recorded case of an acid-fast bacterial infection in an East African raptor.¹⁴ Aspergillosis is a common cause of death in raptors^{4,15} and in addition to the fish eagle mentioned above, has been diagnosed from tissues of a martial eagle (*Polemaetus bellicosus*) sent to me from Ghana, West Africa. Another fish eagle died of nocardiosis, to my knowledge the first case of this disease in an East African wild bird. A captive secretary bird died of pancreatitis and *Escherichia coli* in pure culture was isolated from the affected organ. The fourth case of infectious disease was pneumonia in a dark chanting goshawk; again *E. coli* was isolated from the affected lungs. A barn owl showed severe pulmonary congestion but there was no pneumonia.

Despite the paucity of deaths due to infectious diseases, a number of interesting organisms were isolated. In the majority of cases faecal cultures yielded only *E. coli* and occasionally *Proteus* spp. and *Citrobacter freundii*. No *Salmonella* spp. were isolated in this survey but these were isolated from two species of raptor in the Sudan.¹⁶ An *Arizona* sp. (Serotype Pc 196/Minn 98) was cultured from the intestine of an African goshawk dying from unknown causes. This was an interesting finding in view of the known pathogenicity of this genus to poultry but in this case it did not appear to be associated with the goshawk's death. It is of interest that *Pasteurella* spp. have not been isolated from the tissues of any raptor in this survey despite a report of pasteurellosis in eagles in neighbouring Tanzania.²¹

In no case in the present study were parasites considered to be the cause of death, though Mallophaga, Nematoda

and Cestoda were present in a number of birds. Identification of these parasites is not yet complete. Mallophaga are common on raptors and their numbers were especially high on some of the birds which were in poor condition. A bird of particular interest was a black-shouldered kite killed by vehicle collision which showed a heavy Siphonaptera (*Echidnophaga gallinacea*) burden. Although this flea is common in East Africa³ and attacks many avian species¹⁹ this is the first occasion on which the author has found fleas on a raptor, other than as stragglers from prey in the nest. F. G. A. M. Smit of the British Museum (personal communication) suggests that in this case too the fleas had been acquired from prey shortly before death. No Hippoboscidae were found in this survey but it is assumed that any present had already left the host, since they have been found on both free-living and captive East African species. Nor were Acarina present on any of the carcasses. While ticks have been found on live East African raptors, mites have not. Blood parasites were found in only one of the 43 birds examined (though in some cases they may have been missed due to poor smears from dead material). This was a red-chested owlet and it is of interest that not only *Haemoproteus* and *Leucocytozoon* were present but also microfilariae.⁵ Coccidial oocysts were noted in only one bird, the red-chested owlet, in which the cause of death was not determined. No lesions suggestive of trichomoniasis were encountered and the author has not, to date, identified a *Trichomonas* sp. from either live or dead East African raptors.

There was no evidence of Newcastle disease virus in any of the specimens sampled. No other viral diseases were suspected. Results of toxicological analyses are not yet available.

CONCLUSIONS

This survey is the first of its kind to be carried out in East Africa. It indicates the relative significance of trauma and infectious disease in raptor mortality and indicates areas where further work might be warranted. The number of birds examined is small but the findings

agree in many respects with those of previous surveys elsewhere in the world.^{4,15} The importance of trauma has been discussed before¹⁵ and the present survey emphasises its significance in East Africa. Of the infectious diseases, aspergillosis and acid-fast infections are well recognised in raptors^{4,15} but nocardiosis and pancreatitis appear to be less common. The absence of any cases of trichomoniasis may be significant but this condition is possibly not so common as fal-

coners believe.⁴ Raptors play an important role in the East African ecosystem and it is vital that more research be carried out into their biology. A number of researchers have referred to the role of predators as "enemies" in the control of raptor numbers but little is known of the part played by disease. It is suggested that study of diseases and parasites should be carried out in conjunction with future research on the ecology and behaviour of East African birds of prey.

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