THE STATUS, ECOLOGY AND CONSERVATION OF THE MAURITIUS KESTREL

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ABSTRACT

This paper summarizes efforts made to conserve the Mauritius Kestrel since 1973. Restricted to a small remaining area of native evergreen forest, the total population is now estimated at only *c.* 15 individuals. The feeding ecology and breeding biology of the species are described, together with the causes of its decline. Various techniques employed in efforts to ensure its survival are discussed, chiefly habitat management and captive breeding.

INTRODUCTION

The Mauritius Kestrel (*Falco punctatus*) had been studied since early 1973 and its life history is now fairly well known. It is a distinctive island form, the males averaging 130–140g and the females 160–170g. There is no readily detectable difference between adults and immatures, as all have the female type plumage. The species has evolved in the evergreen sub-tropical forests of Mauritius and occupies a niche similar to that of an accipiter. In morphology and behaviour it also shows convergence with accipiters, with short rounded wings and a dashing hunting technique.

Considerable attention has been focused on this kestrel because of its extreme rarity and apparent impending extinction. In 1974 the world population was stated to be only six individuals, including two in captivity. Since then the kestrel is thought to have increased slightly in the wild, but it still remains critically endangered at fewer than 15 individuals.

DISTRIBUTION AND STATUS

Kestrels are now restricted to an area of no more than 50km^2 in the south-west of the island, an area of precipitous cliffs and steep ravines. They are not uniformly distributed in this area, since they frequent the best sections of native forest, including the Black River Gorges, Magenta Scarp and the Tamarin Gorge. McKelvey (1977a) gives their range as being less than five square miles (13km^2), but this is an underestimate. In the past the population was probably well distributed all over the island, but today it occurs mainly in areas classed as upland forest and this has probably always been the main habitat. The forest in its climax

is characterized by four well-stratified layers, with trees reaching 25m in the upper stratum. The canopy is open and may contain up to 12 species. The dominant trees belong to the Sapotaceae, and include *Sideroxylon major, Labourdonnaisia glauca* and *Sideroxylon puberulum*. The forest is dense and little light penetrates to the floor. A large proportion of the trees are endemic to Mauritius or the Mascarenes.

When the island was first colonized, a large portion of the upland was covered with a tropical evergreen montane forest, but by 1937 this upland climax had been reduced to only 18km^2. Since then, further denudation has been caused by cyclones and subsequent colonization of the disturbed areas by exotic vegetation. The kestrel is now mainly found in sub-climax forest where trees rise to about 15m. It is absent from areas that are heavily degraded and simplified by a few species of exotic plants.

Most accounts state that the kestrel is rare and localized; those published in the 1950s suggest that it was approaching extinction. By 1970 the population was thought to number between six and ten pairs (Temple 1977). In April 1973 only eight or nine individuals could be located, and two of these soon disappeared, believed shot. A pair was trapped at the end of the year for captive breeding. The female died and a replacement was caught in 1974, leaving only two known pairs in the wild (Temple 1977).

Since 1974 the population has probably increased, and at the end of 1976 McKelvey (1977a) estimated that there were eleven birds, five of which were raised that year. A year later the population was thought to consist of 14–15 birds, a number that has probably remained stable since (Jones 1980). Caution is needed with the data, because the kestrel is an elusive bird, living in rugged terrain difficult of access. The numbers since 1973 are also in some cases likely to be underestimates, since non-breeders are especially difficult to locate. Breeding pairs may occasionally have been overlooked, and probably not all attempted nestings were noted, especially those that failed at the early stage. During every breeding season from 1973/74 to 1981/82, 0–3 breeding pairs only have been located, with a mean production in the wild of 2.6 young per annum.

Since 1973 a pair have been seen frequently on Brise Fer Mountain at the mouth of the Black River Gorges. It has been suspected that this pair were tree-nesters, but the site was never found. In 1977, a pair in this area frequented a cliff site but did not breed (P. Trefry *in litt.* 1977; McKelvey 1977b).

FEEDING ECOLOGY

The kestrel is adapted to hunting in the sub-tropical montane forest, where it specializes on lizards. Temple (1977) records that it feeds on roughly equal numbers of lizards and birds, especially the Grey White-eye (*Zosterops borbonica*). Staub (1976) claims that the Grey White-eye is the favoured prey, while McKelvey (1977a) notes that *Phelsuma* geckos form more than 50 percent of the diet. These geckos comprise 94 percent of 218 identified food items delivered to a nest observed at the end of 1981. A range of other prey items are occasionally taken, including the House Shrew (*Suncus murinus*) (Meinertzhagen 1912; Jones & Owadally 1981) and several of the introduced reptiles and passerines (Staub 1976; Guérin 1940; Jones 1980; McKelvey 1977a, 1977b).

Several searching and hunting strategies are used by the kestrels. The frequencies of these are difficult to determine because most hunting is below the canopy, out of view of the observer. Still-hunting is the most commonly seen searching

technique, as the kestrels sit quietly in a tree or on a rocky vantage point watching for prey. Other methods include hovering and poising, but these are used less frequently than by other kestrels, such as *Falco tinnunculus*, that live in open habitats. Slow quartering above the forest has been described by Temple (1978); and Staub (1976) mentions that kestrels stalk *Phelsuma* geckos by hopping after them among the branches of a tree, often with great rapidity.

Prey are usually caught by direct flying or glide attacks. The victim may be snatched off a branch by surprise or caught after a brief pursuit. Alternatively, flying attacks at passerines may develop into tail chases (McKelvey 1977a). Prey that are relatively inactive, such as many insects, are captured by dropping from a vantage point or after a direct glide or flying attack. Active flying insects, such as dragonflies, are caught in a brief sally from a perch. Guérin (1940) saw one kestrel dive from quite high 'with the speed of an arrow' and seize a Madagascar Lovebird (*Agapornis cana*).

Direct competition for food with introduced birds and mammals is unlikely to be great, and there are no other resident birds filling a raptor niche. Other falcon species visit Mauritius in small numbers during the northern winter, including the Peregrine Falcon (*F. peregrinus*) (Staub 1976). Only the Eleonora's Falcon is an annual visitor. None competes directly.

BREEDING BIOLOGY

The breeding biology of the kestrel has been discussed by Jones (1980) and Jones & Owadally (1981). It does not appear to differ greatly from that of other falcons, although the young are believed to remain dependent for longer than is usual in temperate zone kestrels.

Courtship displays begin in September or October. Eggs are laid in October, November or possibly later, in a cliff hole. The usual clutch size is three, and records of larger clutches are probably incorrect. The eggs are incubated mainly by the female and hatch after about 30 days. The young stay in the nest until about five and a half weeks old. Upon fledging, they remain partly dependent on the parents for several months, although they start catching some prey items soon after leaving the nest. Kestrels which are assumed to be the young are seen in the territories of the adults until the following breeding season. Both sexes probably mature at one year old (Jones *et al.* 1981), but do not necessarily breed at that age.

CAUSES OF DECLINE AND RARITY

There has been a profound change in the biota of Mauritius in historic times, and half to two-thirds of the original avifauna has become extinct. Of the remaining eleven native species, eight can be classed as rare and seven are in the *Red Data Book* (King 1981). Three species—the Mauritius Kestrel, Echo Parakeet (*Psittacula echo*) and Pink Pigeon (*Nesoenas mayeri*)—are critically endangered, with a composite population of less than 50 individuals in the wild.

Habitat destruction

This is the primary reason for the extinction of so many species and the rarity of others, including the kestrel. After the island was colonized by the Dutch in 1638, the native forests were quickly destroyed. Between 1753 and today the forests have been reduced from nearly 16,500ha to 2388ha (*Table 1* and *Figure 1*). The

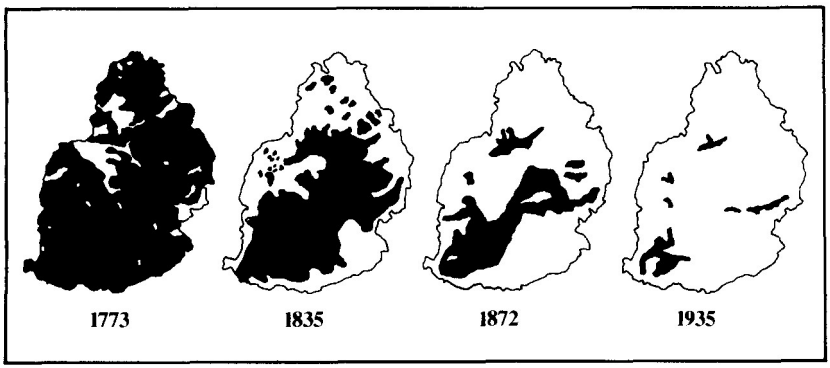

Figure 1: Areas (black) under indigenous unaltered forest cover (after Vaughan & Wiehe 1937).

Figure 1: Destruction of native forest in Mauritius since 1753.

	Native forest in		
Date	acres	hectares	Percentage intact
1753	406,137	164,359	99.9
1770	388,705	157,304	84.4
1804	313,000	126,667	67.9
1836	300,000	121,406	65.1
1846	142,000	57,466	30.8
1852	70,000	28,328	15.2
1880	16,000	6,475	3.5
1936	7,000	2,833	1.5
1980	5,900	2,388	1.3

Note: Modified from Vaughan & Wiehe 1937; Ah Kong 1980.

human population, which rose from under 19,000 in 1767 to over 926,500 in December 1980 (Ah Kong 1980), continues to put pressure upon remaining areas of native vegetation.

Forests were destroyed primarily to develop agriculture, but also for commercial forestry. Today thousands of hectares are under tea, sugar cane, pine and eucalyptus. Habitat destruction still continues; during the early 1970s about half (2800ha) of the *Sideroxylon-Helichrysum* scrub on Plaine Champagne, above the scarp of the Black River Gorges, was cleared for forestry plantations, resulting in drastic declines in the populations of Echo Parakeet, Pink Pigeon, Mauritius Olive White-eye (*Zosterops chloronothos*) and Mauritius Fody (*Foudia rubra*) and likely to have far-reaching effects on all the other endemic birds, including the kestrel which forages in this area.

Woodcutting for firewood has been assumed to be a major cause of forest destruction (Temple 1978) and in some areas, such as the east side of Trois Mamelles and along some river reserves, its impact is probably significant. However, when viewed in comparison to the progressive degeneration of the native plant communities by exotics, the impact of woodcutters is minor.

One of the most alarming features of Mauritian forests is their rapid and seemingly irreversible degeneration into exotic scrubs and thickets. As the older plants die or are destroyed by cyclones, they are increasingly being replaced by introduced species. Often the vigorous exotics outcompete and displace the natives, which have little competitive ability. Several exotic plants are involved in this degeneration. Two of the most important are the privet (*Ligustrum walkeri*) and the guava (*Psidium cattleianum*). On mountain slopes the privet is forming monotypic stands, and in upland areas the guava is a dominant plant. These exotics not only change the floristic composition of the forest but also radically alter its structure into a dense scrub layer. This affects the kestrel, because hunting beneath the canopy becomes increasingly difficult. Bird diversity is also dependent upon vegetation structure and the simplification of the forest's structure will be expected to result in a decline in the number of bird species.

Regeneration of native plant communities is further prevented by trampling and browse damage by the introduced deer (*Cervus timorensis*). Monkeys (*Macaca fascicularis*) and Black Rats (*Rattus rattus*) feed on young fruits of native trees. The monkeys are especially fond of fruits from trees of the family Sapotaceae and the rats the fruit of Bois d'Olive (*Eleodendron orientale*) (Owadally 1980; pers. obs.). In contrast the seeds of many exotic plants are spread by introduced animals, thereby increasing the colonizing ability of these plants.

Faunistic impoverishment and food availability

Coupled with the degradation of native plant communities, decline has occurred in the numbers of insects, geckos and passerines, all prey items of the kestrel. After cyclone 'Carol' in 1960, when the Macchabé Forest was badly damaged, exotic plants invaded and the numbers of insects declined (Vaughan 1968). Insect diversity has probably declined too, as this is related to floristic diversity. An average night's trapping for moths in one of the more degraded areas of Mauritius will result in about 90 percent of the catch being a few pan-tropical species and commensals.

The density of *Phelsuma* geckos in the native forest is largely dependent upon the density of native trees and shrubs. Discussing the density of *P. guimbeaui rosagularis*, a favourite food item of the kestrel, Vinson (1976) notes: 'The association of *guimbeaui rosagularis* with native vegetation is very close. There appears to be very frequently in a given biotope a direct relation between the density of the gecko population and the abundance of indigenous plants. In areas where the native vegetation is only represented by a few trees scattered among exotic species, *guimbeaui rosagularis* is either scarce or absent'.

The other species and sub-species of *Phelsuma* found on mainland Mauritius, *P. g. guimbeaui, P. o. ornata* and *P. c. cepediana*, are unable to maintain populations in areas heavily degraded by privet and can only be found at most in very small numbers in areas degraded by guava (J. M. Vinson, pers. comm. 1981). These three species are found in areas of exotic forest largely unsuitable for kestrels.

The density of passerines is very low in the native forest and is lower than on other Indian Ocean islands that have similar species and less degraded forests. On Réunion, the Merle (*Hypsipetes borbonica*), Paradise Flycatcher (*Terpsiphone bourbonnensis*) and Olive White-eye (*Zosterops chlorinothos*) are found at higher densities than are their equivalents on Mauritius. The most successful of Mauritius' native birds, the Grey White-eye, is an ecologically generalized species and is less common in the remaining forests than in disturbed areas of mixed vegetation, such as lowland scrub.

The kestrel population may be limited by low food availability. If so, the instability of the population and the recent increase appear incongruous, since raptor populations are often stable. Long-term studies on several species with broad diets have shown that their breeding populations fluctuate by less than 15 percent (Newton 1979). These long-term studies were conducted in habitats with abundant food and where the upper limit on the number of breeding pairs was, in most cases, the availability of nesting territories. In poor habitats, populations are likely to fluctuate more. During years of food abundance, normally poor quality marginal territories may be used as well as good ones, while in years of food shortage only good territories may be used.

The territories occupied by kestrels seem to be in great demand. A breeding site occupied every year since at least 1976 is often frequented by non-breeding adults, and we have seen these extra adults during courtship, incubation and the rearing of the young. In July 1978, when the breeding pair was trapped from this site for captive breeding, it was soon replaced by another pair that successfully bred in the succeeding months (Jones *et al.* 1981).

It seems therefore that the numbers of kestrel pairs breeding on Mauritius may be limited by the number of potential territories which hold enough food. Stated thus, the disappearance of the native forest is the main cause of decline. Several other possible causes of the kestrel's rarity have been proposed, but these are probably secondary, as discussed below.

Monkey predation

Predation by the introduced Crab-eating Macaque has previously been assumed to be a major cause of the kestrel's decline and rarity. Temple (1978) suggests that in some years the monkeys may destroy all the kestrel nests, although he offers no direct evidence. As early as 1801 Grant stated that 'the birds much diminish in the woods, as monkeys, which are in great numbers, devour eggs'. If, as these references suggest, monkey predation is high, it would seem unlikely that the kestrel should have survived until today. Also, many of the nest sites are in cliffs inaccessible to monkeys.

Extensive predation on the native birds by monkeys has been doubted by primatologists working on Mauritius (R. W. Sussman, I. Tattersall and R. W. Jamieson, pers. comm. 1980). A study on the macaques in an area of lowland exotic forest and savannah revealed that they were almost entirely vegetarian, and in two years of study no evidence of nest predation was detected. About 93 percent of their feeding time was spent on fruits, stems, leaves and flowers, 5 percent on invertebrates and the remaining 2 percent was undetermined (Sussman & Tattersall 1980). A comparable study has yet to be done in the native forest, where the endangered birds occur. Eye-witness accounts of monkey predation on the eggs and young of native birds have been recorded by McKelvey (1976) and Temple (1978). From a large body of circumstantial evidence, monkeys may be limiting the population of the endemic Pink Pigeon. Predation on the eggs and young of kestrels has yet to be shown. In the closely related Japanese Macaque (*Macaca fuscata*), egg-eating has been shown to result from a feeding tradition found in some populations and not in others (Miyadi 1965, 1967).

Human persecution

Locally the kestrel is known as 'mangeur de poules' (chicken-eater) because of its believed depredations on domestic poultry. This has led to unnecessary persecution in the past (Guérin 1940) and may be a reason for its disappearance from some of its former range. In 1971 and 1973 pairs of kestrels are believed to have

been shot (Temple 1977, 1978). More recently, persecution of the kestrel has been rare or non-existent, perhaps due to conservation education on the island.

Pesticide contamination

This could be another reason for the kestrel's extreme rarity. In the past organochlorines were used extensively on Mauritius for agricultural purposes and malaria control. A single egg produced by the captive female kestrel in 1974 contained several toxic chemicals, but below the level normally associated with reproductive disfunction in raptors (Temple 1978). Infertile eggs laid by a captive female in 1978 did, however, contain appreciable levels of DDE and DDT (Cooper *et al.* 1981).

MANAGING THE SURVIVAL OF THE MAURITIUS KESTREL

The prospects theoretically appear to be good. In recent years there has been growing interest in raptor management. Techniques have become sophisticated and literature has expanded.

Double clutching

Manipulation of the nesting biology of falcons and other raptors has been successful in the U.S. If first clutches are removed, the bird will usually lay a second clutch. 'Double clutching' has few disadvantages, and work with captive American Kestrels (*Falco sparverius*) has shown that young from second clutches do not differ in size or survival from those of first clutches (Bird 1978; Bird & Rehder 1981).

During the 1981/82 breeding season, we removed first clutches of eggs from wild kestrels for artificial incubation. A new pair, discovered before they had started laying, were watched daily. After the female had incubated for six days we removed the eggs. All three were fertile and hatched, and subsequently we hand-reared two young; the third was a runt and died at 15 days. Meanwhile the pair re-laid on the same cliff but at a different site. We watched the nest daily and all three eggs of the second clutch hatched but were not reared beyond one day. Possibly this pair failed due to inexperience.

A clutch was also taken from the only other located pair of kestrels. It was late during incubation and there is no evidence that the pair relaid. Two of the three eggs were fertile and hatched. One kestrel, a male, was reared; the second, a female, died at 26 days.

Translocation

The translocation of wild or preferably captive-bred kestrels to Réunion Island has been suggested by Cheke (1975, 1978) and Temple (1976, 1981). Réunion has larger areas of less degraded forest than Mauritius and once supported a native kestrel known from an early account and from sub-fossil remains (Cowles, in press). Unfortunately, however, hunting pressure on birds on Réunion is very high and the island has lost more of its original avifauna than Mauritius. The movement of kestrels to another part of Mauritius is similarly inadvisable because suitable habitat does not exist away from the south-west corner.

Habitat management

Whole habitat conservation is the only way we can realistically hope to save all the fauna and flora of complex tropical ecosystems, such as rainforests (Myers 1979).

Setting aside land and leaving it may be adequate in some parts of the world, but in others passive management achieves little.

On Mauritius 2.4 percent of the island is national nature reserve. These reserves are the last remaining areas where much of the native fauna and flora are to be found, but they are being steadily degraded by exotic plants, which can only be stopped by removal. Weeding has been proposed, but is practically impossible at present. The small 1.27ha reserve of Perrier on the upland plateau has been selectively weeded since 1969, and this provides work for two full-time labourers.

It is doubtful whether the remaining plant communities can be preserved intact. There is, perhaps, more hope for the birds, since some Mascarene birds are now found in exotic forests. Mascarene Paradise Flycatchers and Grey White-eyes are common in the plantations of *Araucaria cunninghamii*, mango (*Cassia fistula*) and other species in the north of Mauritius. On Rodrigues, the warbler *Bebrornis rodericana* is found in dense jamrosa (*Syzygum jambos*) thickets at the heads of certain valleys, and the Rodrigues Fody (*Foudia flavicans*) is common in some hardwood plantations. These examples illustrate that the potential for this type of management exists and may be combined with forestry or fruit-growing.

For many species of birds, provided we have sound data on their ecology, we can design habitats for them. It is straightforward to manage those such as game birds that live in simple habitats. The same approach could probably be applied to more diversified habitats, although we will never be able to recreate the bird communities in the most complex rainforests.

Habitat management has long-term potential for the kestrel. The optimum habitat is probably upland climax forest, though the bird is also found in the simpler lowland forests. Today kestrels are sometimes seen in exotic forest at the mouth of the Black River Gorges, indicating that the species is not limited to highly specific types of forest. This exotic forest is about 60ha and is managed as coppice with standards. The dominant tree is the gum *Eucalyptus tereticornis* with trees at all stages of maturity. Mixed in with these are *Terminalia belerica, T. arjuna*, mahogany (*Swietenia mahagoni*), *S. macrophila*, teak (*Tectona grandis*) and Yatis (*Litsea polyantha*). Smaller numbers of other exotic trees are also found, including mango, Badamier (*Terminalia catappa*) and some old *Araucaria cunninghamii*. The understorey is kept clear by forestry workers and flood action. Kestrels seen in this area have been observed feeding on geckos, house shrews, agama lizard (*Calotes versicolor*) and passerines.

The quality of this forest could be improved for kestrels, and also for the geckos on which they depend, if the number of gum trees was reduced. Dense populations of the day gecko (*Phelsuma g. guimbeaui*) can be found in some areas of totally exotic vegetation. This gecko, probably one of the most important food sources for the kestrel, has quite precise habitat requirements. The densest populations that we know of are in mature stands of trees along rivers and streams. Suitable trees must have crevices, holes and loose bark for egg-laying and shelter, and may support populations of 20 or more geckos per tree representing all age classes. Favoured trees include Badamier, *T. arjuna*, Mango, Pongam (*Pongamia pinnata*) and Coconut (*Cocos nucifera*).

Captive breeding

Cade and Dague (1980) have suggested that techniques of raptor management applied to Peregrines and other species need to be applied to the Mauritius Kestrel. In fact most of the management techniques applied to these other raptors are of limited use with the Mauritius Kestrel because its rarity is due largely to unmanageable factors. One of the most realistic possibilities of preventing its extinction is to harvest eggs and young from the wild for captive breeding and to

Table 2: Captive Mauritius Kestrel breeding results.

Year	Females ref.	No. of clutches	No. of eggs	No. of fertile eggs	No. of eggs hatched	No. of young reared
1973/74	A	0	0	0	0	0
1974/75	B	1	3	2	1	0
1975/76	B	2	6	5	0	0
1976/77	B	1	1	0	0	0
1977/78	B	0	0	0	0	0
1978/79	Yellow/blue	4	12	0	0	0
1978/79	Silver	2	5	3+?	1	1

Note: Modified from Cooper *et al.* 1981.

maintain captive populations on Mauritius and elsewhere. Attempts to establish Mauritius Kestrels in captivity have so far failed (Jones *et al.* 1981) for several reasons, summarized below.

Between 1973 and 1978 a total of four males and four females were taken from the wild; five were captured as adults and three as nestlings. Three of the females were taken as adults and may have been at the end of their reproductive lives. The other female taken from the nest in December 1977 was two to three weeks old and unfortunately imprinted on humans (Jones 1980; Jones *et al.* 1981). Some 27 eggs were laid in captivity by productive females; at least 10 were fertile yet only one young kestrel was successfully reared (*Table 2*).

Unfortunately the last of these nine captive adults died in January 1979. The oldest died after five years, but seven birds survived for only two years or less. The Mauritius Kestrel appears to be susceptible to disease and several different causes of death, which in some cases were multifactorial, were isolated at post-mortem (*Table 3*). Island forms, because they have evolved in an insular environment with

Table 3: Register of adult Mauritius Kestrels.

Number	Reference	Sex	Date trapped/hatched	Date of death	Pathological findings
A		F	Trapped May 1973	8.3.74	Oviduct infection
B		F	Trapped December 1973	26.1.78	Oviduct neoplasm
1	Old Male	M	Trapped May 1973	18.9.78	'Bacterial enteritis' Hepatic lesions
2	Yellow/Blue	F	Taken from nest 13.12.77	2.12.79	Egg peritonitis, Sinusitis, Pesticides
3	Yellow	M	Taken from nest 22.12.77	1.1.80	Sinusitis, Pesticides
4	Green	M		26.9.79	'Pericarditis, Sinusitis' Respiratory infection
5	Blue	M	Trapped 22.7.78	25.11.79	Peritonitis, Sinusitis, Pesticides
6	Silver	F		4.1.80	Sinusitis, Pesticides
7	Red	M	Hatched 23.10.78 (parents 5 + 6)	13.1.80	Sinusitis, Unidentified Mycoplasma
8	Pink	M	Hatched 11.11.81, egg taken from wild	Still alive	—
9	Lt. Green	M	Hatched 21.11.81, egg taken from wild	Still alive	—
10	Orange	M	Hatched 22.11.81, egg taken from wild	Still alive	—

Notes: 1. Pathological findings noted in inverted commas were diagnosed on Mauritius but could not be confirmed by histological examination at the Royal College of Surgeons of England, London.
2. Modified and expanded from Cooper *et al.* 1981.

little exposure to disease, are particularly susceptible to alien pathogens (Warner 1968).

Four of the males (green, yellow, blue, red) and two of the females (silver, yellow/blue) had an infection of the sinuses. One male had hepatic lesions (old male); another had a respiratory infection (green) and an unidentified mycoplasm was isolated from the third (red). Small amounts of DDE (a metabolite of DDT) were isolated from the four kestrels (two males and two females) that were analysed for pesticides.

Three of the four female kestrels died of oviduct conditions. One (A) that was trapped in December 1973 died after only 11 weeks in captivity with an oviduct infection. A replacement female (B) trapped in May 1974 laid fertile eggs for two seasons, a single infertile egg in her third year in captivity and died in 1978 from an oviduct neoplasm (Cooper 1979). The female (yellow/blue) taken from a nest in 1977 laid 12 infertile eggs in 1978. She died in late 1979, while laying the first egg of the season, from egg peritonitis.

The poor reproductive success shown by the captive kestrels is of particular interest, since Brown & Amadon (1968) attributed the decline of this species to 'genetic deterioration'. Cooper (1979) and Temple (1978) also suggest that the reproductive conditions that they have been suffering from may be under genetic control.

It is unfortunate that the captive breeding project has been besieged by a considerable number of problems. One of the greatest has been a lack of long-term planning and little or no continuity between successive project managers. When the first author took over the running of the project in early 1979, he was the sixth manager in six years.

Despite all of the problems that have been encountered with the captive kestrels, we believe that it is a suitable bird for captive breeding. It adapts well to captivity and all of the kestrels that have been kept, if they have lived long enough, have shown reproductive behaviour.

In conclusion, we believe the kestrel can and will breed successfully in captivity in large numbers if it does not show 'genetic diminution of reproductive vitality'. The results of our efforts so far do show that the kestrel *may* be suffering from 'genetic deterioration', but this is no justification for us to halt the captive breeding programme.

In future years we shall continue to:

- Pursue the study of the kestrel in the wild to try and verify the causes of its decline and low population.
- Take for captive breeding, whenever possible, first clutches of eggs and/or young until the kestrel is established in captivity.
- Maintain the captive kestrels at the Government Aviary on Mauritius and feed them on disease-free whole animal diets, such as laboratory mice and quail.
- Regularly screen all captive kestrels for pathogens.
- Keep close contact with the veterinary advisor so that health problems can be promptly dealt with.
- If the captive breeding of this species proves successful we propose to distribute captive-bred birds to responsible captive breeding centres elsewhere.

ACKNOWLEDGEMENTS

We would like to express our thanks to John E. Cooper, Wendy Strahm, Lee M.

Durrell and Gerald Durrell for reading an early draft of this paper and making many valuable suggestions. Harriet Rathborn kindly typed the drafts. The first author is supported in his work on the endangered wildlife of Mauritius by the International Council for Bird Preservation and the World Wildlife Fund International.

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