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Veterinary support for *in situ* avian conservation programmes

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Summary

Avian veterinarians have much expertise which can be usefully applied to *in situ* avian conservation programmes. Their knowledge can assist conservation biologists in many of the manipulations which they are currently applying to endangered wild birds in their natural range. Possibilities are outlined and illustrated by examples from various field programmes.

Introduction

In situ conservation may be defined as that which takes place within the natural range of the species involved, as opposed to *ex situ* efforts, usually involving captive breeding, which may be far removed from that area, often in a different country. The majority of current *in situ* programmes are taking place in less developed countries, particularly islands, which are home to the majority of severely threatened bird species (Collar *et al.* 1994).

Conservation biologists managing endangered species need to attack both the ultimate and proximate factors which threaten extinction by reducing survivorship and/or fecundity. Ultimate causes of species decline include such factors as competition, pollution or habitat loss, which may take years of work and political effort to correct. In the meantime, extinction may be brought about by proximate factors such as reduction in food supply, reproductive failure, or disease. The science of "clinical ornithology" has developed to help to reduce the impact of these proximate factors in order to buy time for the correction of major underlying problems (Temple 1978). A whole range of manipulative techniques for wild birds is in increasing use for this purpose, including nest site management, reduction of competitors, predators and parasites, supplementary feeding, and intervention in breeding biology. In the face of uncontrollable proximate threats, birds may be removed from their habitat altogether to attempt captive breeding, either until the habitat can be restored or as an insurance adjunct to the wild population (Temple 1978). Manipulative procedures and captive breeding may need to be applied for a long time, often into the foreseeable future, to await the return of a sustainable natural habitat.

This paper indicates and suggests a number of ways in which avian veterinarians can assist and support such interventions, using examples from the literature as well as the author's experience in Mauritius and the Caribbean islands. These fall under five headings:

1 Assisting field manipulations.
2 Combating disease as a proximate cause of decline.
3 Investigating the general background of wildlife disease.
4 Applying avicultural medicine to captive breeding.
5 Screening birds to be used for reintroduction/restocking.

Assisting field manipulations

Nest-site limitations are a major problem for many secondary hole-nesting species, particularly many psittacines, due to destruction, intra- or inter-species competition or parasitism of nestlings by free-living arthropods (Snyder 1978, Snyder *et al.* 1987). Responses include the repair of existing nest holes, erection of nest-boxes and attempts to control arthropods. Veterinarians are well aware of the risks to parrots from chewable materials and can advise about the use of such materials as galvanized wire, roofing felt and treated wood. Arthropods which attack nestling birds include dermestid beetles (Order, Coleoptera), ticks (Order, Metastigmata), chicken bugs *Haematosiphon inodorus* and the tropical nest fly *Passeromyia heterochaeta* (Jackson 1978). The latter has been a particular problem for the Echo Parakeet *Psittacula eques* on Mauritius, leading to the loss of nestlings in the past (Jones and Duffy 1993). The simple addition of 5% carbaryl dust to the nest substrate at the beginning of the season, and its frequent renewal, has led to the control of this problem and, we hope, may also help to prevent invasion by bees (Lovegrove 1995). Carbaryl dust is also being used in artificial nest-baskets for the Mauritius Pink Pigeon *Columba mayeri* to control hippoboscid flies *Ornithoctora plicata*, which may cause anaemia and transmit disease among squabs. Other ectoparasite repellants, such as those used for the protection of horses, or even pest-strips, may be of value if they can be protected from direct access by the birds.

Food supply has been recognized as a limiting factor for a number of endangered birds, often due to habitat degradation by introduced plant species. Supplementary feeding is now a widely used management practice to support both existing populations and reintroduced birds (Archibald 1978, Jones *et al.* 1992, Powlesland and Lloyd 1994). As well as the need to ensure that the food supplied is of appropriate nutritional composition, possible problems associated with food deterioration such as aflatoxicosis need to be considered, with appropriate monitoring as necessary. A more important veterinary problem relates to the "bird-table effect", whereby the establishment of feeding stations for the target species inevitably leads to the concentration of individuals in a small area (Archibald 1978) as well as the attraction of other species and predators (Jones *et al.* 1992). Supplementary feeding is a high priority for the Pink Pigeon (Seal and Bruford 1991) and the provision of water has proved necessary for one released population on Ile aux Aigrettes. The attraction of the Madagascar Turtle Dove *Streptopelia picturata* and the Barred Ground Dove *Geopelia striata* to these sources has lead to an outbreak of trichomoniasis in the nestlings of released Pink Pigeons, which will need to be controlled. Despite the wide knowledge of the risks of passage of trichomoniasis between pigeon species (Conti and Forrester 1981), there appears to be no information on possible control methods and attempts are being made to limit transmission of the parasite by drug use, water treatment and hopper design. Other bird and vermin species may deposit infected faeces at feeding sites, posing severe risks of viral, bacterial and parasitic diseases if these are not hygienically maintained. The spread of salmonellosis among wild birds concentrated at garden feeding tables is well recognized (Wilson and Macdonald 1967).

Manipulation of birds' reproductive cycles in the field may involve the cross-fostering of eggs or young within or between species, either because of poor parental performance, to increase productivity or even to change migration routes (Cade 1978). The increased potential for spread of vertically transmitted disease, particularly parrot viruses, will be clear and is further considered under captive breeding.

Combating disease in endangered birds

The role of pathogens in threatened bird populations has been thoroughly reviewed (Cooper 1989). It is now generally accepted that disease plays an important part in regulating animal populations, and the possibility that it may play a crucial role in the final extinction of small populations has been highlighted (Van Riper *et al.* 1986). There is a truism that the spread and effect of pathogens, such as viruses, is dependent on high population density and, therefore, that they become less important as population size falls, when the deleterious effects of inbreeding are more relevant. This idea is unlikely to hold true, however, if the pathogen has alternative hosts, such as avian malaria, when species are crowded into small reserves, or when the population is stressed for some reason (May 1995). We can add to these caveats that of vertically transmitted disease, such as Psittacine Beak and Feather Disease (PBFD) and polyomavirus infection, particularly when such infections are chronic and slow to be clinically expressed, when they chiefly infect young birds and when they influence infant survival. Trichomoniasis (see above) would fit all these criteria. It is also widely reported that inbreeding in small populations causes deleterious effects, one of which may be increased susceptibility to disease (O'Brien and Roelke 1985, Lacy *et al.* 1993, Munson 1993). However, observation of these effects seems to be limited to captive mammals and then primarily to an increase in juvenile mortality (Shields 1993). Even the proposed disease susceptibility of the genetically impoverished cheetah *Acinonyx jubatus* (O'Brien and Roelke 1985) seems limited to feline infectious peritonitis and may just be a species effect (Miller-Edge and Worley 1992).

The clinical consequence of all this is that avian veterinarians need to be looking very carefully at endangered birds which are within recovery programmes for evidence of known diseases which we might expect to lower their survival and productivity in the wild, or become magnified in a captive breeding effort. Thus, with the Echo Parakeet, we have been able to collect samples of faeces at feeding stations, blood and ectoparasites from chicks and even from adults trapped on the nest, and to test these for PBFD, herpesvirus, polyomavirus and endoparasites. The advent of DNA probe technology has greatly advanced such possibilities, not least because of the stability of the material and small amounts needed. It has also allowed us to go back to look for evidence of disease in archive material (Cooper and Jones 1986), collected before the advent of the tests. Veterinarians should always be alert to the possibilities that effects ascribed by biologists to inbreeding depression may be due to these types of vertically transmitted infections, whose incidence is likely to be emphasized by inbreeding just as are deleterious genes.

Application of avicultural medicine in the wild is possible: trichomoniasis in Pink Pigeons is being controlled by drug administration, one advantage of the "bird table effect". The finding that infection by *Leucocytozoon marchouxi*, known from other Mascarene columbids (Peirce *et al.* 1977), is now a cause of death of Pink Pigeons in the Mauritius aviaries, leads to the possibility that it may be a limiting factor in one of the wild groups which, living in an ideal area for a culicine vector, is apparently failing to thrive. This can easily be investigated by trapping the birds at feeding stations and collecting blood smears, and possibly controlled by attacking the vector.

Investigating background wildlife disease

Correctly deduced concerns about the risks of introducing disease into the wild by restocking with captive-bred birds need to be set against the background of disease in the existing population. If a disease is present in the target population, or even closely related wild species sharing the same environment, we may not need to be so concerned. Equally, we need to be aware of disease transmissible to the target species from other common birds, such as *Leucocytozoon* infection. Surveys of disease within the environment, and even the knowledge of possibilities gleaned from surveys elsewhere (Joyner *et al.* 1992, Gilardi *et al.* 1995), are extremely important and should, if possible, be carried out before a recovery programme begins. On small islands, where the overall number of species is often low, fairly comprehensive information can be gathered. Prior detection of an *Atoxoplasma* sp. in introduced small passerines in Mauritius (Peirce *et al.* 1977) warns us of possible risks to a proposed *in situ* captive breeding programme for the Mauritius Fody *Foudia rubra* if, indeed, this is not already a cause of its decline. The presence of positive serological titres to psittacine herpesvirus in the captive group of St Vincent Amazon Parrots *Amazona guildingii* maintained on the island probably indicates that the disease exists in the healthy wild population, although it is impossible to be certain that the group has not encountered other species of captive parrots. A survey among the wild population is clearly required to advance future management of the species.

Applying avicultural medicine to captive breeding

Avian veterinarians have standard techniques and protocols for the prevention and investigation of disease in avicultural collections (Clipsham 1989). These can be readily applied to *in situ* captive breeding programmes and should include investigation of housing, food and water storage and delivery (Clipsham 1990), carrier status of the birds, disease risks from surrounding feral or domestic species, vector control, and so on. Many captive breeding facilities are located at some distance from the wild habitat and nearer to centres of population for logistical reasons. This naturally tends to expose the birds to diseases of domestic birds and even to disease vectors not present in their habitat. Kollias (1989), in his veterinary protocol for the Puerto Rican Amazon Parrot *Amazona vittata*, had to make a plea for the removal of a neighbouring poultry farm! The literature contains many examples of disease outbreaks in *ex situ* programmes which can be attributed to spread from other species, such that some authors have been prompted to consider this factor a major limitation to the whole concept (Derrickson and Snyder 1992).

Avicultural techniques for manipulation of breeding biology, whether carried out in the wild or in captivity, introduce serious disease risks. Fostering birds, especially between species, has led to serious losses, such as those in Pink Pigeons exposed to pigeon herpesvirus (Snyder *et al.* 1985). Very careful and thorough screening of potential foster birds is required and, preferably, they should originate locally. The finding of polyomavirus antibodies in captive Rose-ringed Parakeets *Psittacula krameri* used to foster wild and captive-bred Echo Parakeets caused considerable problems. However, the lack of evidence of polyomavirus disease in reared offspring (as determined by histology and DNA probe analysis of tissue) and the need to perfect rearing techniques led to a decision to continue, and a subsequent serological survey of fostered birds gave negative findings two years later. It is likely that some of the foster Rose-ringed Parakeets were not, as originally thought, captured from the feral population present on Mauritius but may have been imported. Such problems reinforce the need to maintain captive breeding programmes in the species natural range (Derrickson and Snyder 1992) and, as far as possible, not to introduce other imported birds without thorough investigation.

Developmental abnormalities are quite often reported in captive-bred endangered birds which may be attributed to inbreeding (Cooper *et al.* 1988). Some of these are actually commonly seen in general avicultural practice (tarsometatarsal rotation, sternal and spinal kinks, choanal atresia) and are more likely to be nutritional or infective in origin, or result from faulty artificial incubation. Investigations of the diets of adult birds and chicks, and of incubation and rearing techniques, are crucial to understanding and prevention. Failure may lead to managers breaking up viable breeding pairs because they fear genetic problems. It must be remembered that one of the major disadvantages of *in situ* captive breeding is frequently the lack of adequate or reliable infrastructure, which may make the conditions for artificial rearing less than ideal.

Screening birds for reintroduction

Veterinarians have a major role in reintroduction or restocking programmes, to ensure that genetic or infectious diseases are not introduced to the wild (Bush *et al.* 1992). The former would be particularly important if "soft release" allowed defective individuals to survive and breed beyond their expected capabilities. For infectious disease, the disease status of existing wild populations must be known for sensible decisions to be made. Whether the birds were bred *in situ* or *ex situ*, thorough clinical screening and review of health and breeding records are required. Further monitoring of the birds after release should be carried out, which is clearly made easier by close management and supplementary feeding, and it is essential to monitor the survival of the next generation, in case young birds are more susceptible to some diseases than adults.

There have been numerous reports of major disease problems in captive groups of birds which might render them unfit for release, including atoxoplasmosis in Bali Mynahs *Leucospar rothschildi* (Partington *et al.* 1989) and tuberculosis in waterfowl (Cromie *et al.* 1991), and avian veterinarians can think of many more alarming possibilities (proventricular dilatation disease for example) which may occur. It is noteworthy, however, that the majority of these reports are from *ex situ* facilities where birds are in close proximity to many other wild and captive species. Nevertheless, screening of *in situ* produced birds must be equally rigorous and has tended to be ignored, probably because it has been assumed that there are no diseases to be acquired which are not already present in the wild. A recent outbreak of poxvirus infection in the *in situ* captive Mauritius Pink Pigeon group, which has not been seen in the wild and whose origin is as yet unknown, suggests this is untrue. Certainly all restocking of Mauritian birds has, since 1984, been preceded by disease screening, which has become more intensive as better techniques have become available.

Conclusion

Veterinary supervision of *in situ* avian conservation programmes, if they involve any manipulation of the birds whatsoever, is clearly necessary. Kollias (1989) has outlined a suitable protocol which includes the need for a supervising veterinarian with extensive experience in the field, primary care veterinarians who may be local or co-opted on short-term contracts or carrying out more specific research projects, back-up pathologists, and specialist diagnosticians. Much of the necessary on-site care and collection of material can be carried out by properly trained biologists or aviculturists if this is overseen. The supervising consultant needs to devise the programmes throughout, respond to problems as they crop up, keep the programme up to date with new veterinary information, and review records and findings from associated laboratories.

The major difficulty in implementation of these ideas is funding. Acceptance of veterinary involvement by biologists is no longer the problem it used to be, although many managers still see it as useful solely for the solution of short-term problems. Very few projects have a continuing veterinary component written into their budget, or any preventive programme as part of their protocol. The general view is probably that veterinary involvement, unless it is voluntary, is too expensive. The principle of outside bodies funding or seconding veterinary expertise for avian conservation programmes needs to be pursued.

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