

How was the cause of illness ascertained (p. 554)? What are the common malarial parasites in poultry in that region?

Unfortunately, the lack of coherence between the ecology of avian malaria and information about decline in vulture population does not allow one to establish whether or not the results¹ indeed highlight an additional cause for the 99.9% decline of Oriental White-backed vulture populations. However, importantly, the authors endorse earlier findings that diclofenac is the main reason for such declines.

Response:

In our communication we had provided evidence to the best of our satisfaction that malaria could also cause a decline in vulture population in those regions where diclofenac is not used. We have provided evidence to this effect and are convinced with the study. Nevertheless, Farah Ishtiaq has raised several questions about the presence of a specific malarial parasite and its pathogenicity in the vultures in Central India. We totally agree with her that haemoprotozoan parasites are common and widespread in several avian species. It is also entirely possible that the *Plasmodium* spp. LaC1 reported by us in vultures, or AP70 in mountain thornbill, and the three other identical lineages reported by Ishtiaq *et al.* in three different bird species in Myanmar, indicate that the particular lineage in question is present in several avian hosts. But screening of all other probable avian hosts in the region was not the focus of our study. Following microscopic detection of malarial parasites in the blood smears of the affected vultures, the aim was to identify the particular species infecting vultures. Evolution, phylogenetic relationships with hosts and distribution were never within the scope of our communication.

The first step after microscopic examination was to ascertain through DNA analysis, whether the particular haemoprotozoan was a *Plasmodium* or *Haemoproteus* sp. To do this a small fragment of the mitochondrial rRNA genes is sufficient. Here again we reiterate that this is not a study on evolutionary relationships or phylogeny, but rather a simple identification of the genus of the infective organism. This DNA-based identification was further supported by microscopic identification of the parasite and by the treatment of two live, sick birds with anti-malarial drugs.

Visceral gout in birds, including vultures, is not an exclusive symptom of only diclofenac poisoning, but can be brought about by several causes. Like fever, gout is seen in several conditions and one of the simplest but most potent cause for this condition in flesh-eating birds is starvation/dehydration. A carnivorous bird going off-feed due to illness or lack of food can rapidly develop gout, and it need not be a chronic/debilitating condition leading to loss of body mass or

any other external symptom. We have also mentioned that the presence of a large number of mosquitoes around the birds during the nesting season from October to March, led to the investigation for the presence of blood parasites (p. 557). Ishtiaq's observation that this opportunistic infection is due to a compromise of the immune system to allow for reproduction is extremely plausible.

Sixteen vulture tissue samples from the north and northwestern states which were positive for diclofenac residues were not screened for malarial parasites. Due to several constraints discussed by us, we could not screen more than three vulture samples from Gadchiroli which were positive for malaria, for the presence of diclofenac. But we ruled out the possibility of exposure to diclofenac poisoning by several circumstantial evidences.

There are a couple of points towards the end of the correspondence by Ishtiaq which we fail to understand. For example, the statement about treating sick birds with no controls. This would require injecting normal healthy vultures or sick birds only with the vehicle (water). We do not see any reason for injecting water to normal vultures. Also, we had only one sick bird at a time, which we wanted to save rather than experiment upon. Ours was a sincere attempt to treat and save birds of this highly endangered species, with efforts to understand the underlying causes for their decline. Also what we meant by saying, 'Whether these recoveries were due to the anti-malarial drugs or simply due to the availability of sufficient food and water is debatable' (p. 557), is that there is a good chance that the availability of food and water revived the bird sufficiently to fight off the infection on its own, with or without the drugs support. The fact that the infection was there in the first place is not debatable. Again, irrespective of the other malarial parasites present in the other bird species/poultry, this particular lineage (*Plasmodium* spp. LaC1/AP70) was definitely present in the White-backed vultures of Gadchiroli.

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