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Research article

Poisoned baits pose a threat to vultures in Nepal

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Abstract

Poisoning is the greatest threat to vultures globally. Asia's vultures were driven to near extinction through poisoning by the veterinary non-steroidal anti-inflammatory drug (NSAID) diclofenac. Since the ban on the veterinary use of diclofenac in Nepal in 2006, there has been a partial recovery of vulture populations in the country. However, other threats are emerging, including other vulture-toxic NSAIDs, as well as other forms of unintentional poisoning. The use of poison baits, whereby animal carcasses are laced with poison to target carnivores, often results in the collateral deaths of vultures. Here, we summarize the data on the number of such poisoning incidents, and the number of vultures killed, between 2011 and 2023. A total of 224 vultures of seven species were found dead at 22 poisoning incidents across the country. Himalayan griffons accounted for over half of the fatalities (n = 108), along with 93 White-rumped vultures and small numbers of four other species. We recommend that conservationists raise the awareness of this issue with local stakeholders, and try to devise mitigation measures to reduce threat of poisoning to vulture population.

Keywords: Collateral deaths; Diclofenac; Endangered birds; Himalayan griffon; NSAIDs

1 | Introduction

The African-Eurasian vultures are at a very high risk of extinction in the wild through poisoning, both intentional and otherwise (Botha et al. 2017). Poisoning is the primary cause of anthropogenic vulture mortality globally (Hernández & Margalida 2009; Parvanov et al. 2018). Poisoning does not only pose a threat to vultures, it is also affecting other wild and domestic animals, as well as human health.

In Asia, vulture populations collapsed from the mid-1990s onwards through unintentional secondary poisoning by the non-steroidal anti-inflammatory drug (NSAID) diclofenac (Oaks et al. 2004; Shultz et al. 2004; Green et al. 2004). Diclofenac was commonly used to treat livestock throughout South Asia, including India and Nepal, during the 1990s and 2000s. As a result, four species, White-rumped vulture *Gyps bengalensis*, Slender-billed vulture *Gyps tenuirostris*, Indian vulture *Gyps indicus*, and Red-headed vulture *Sarcogyps calvus* have undergone catastrophic declines (Prakash et al. 2012), and are now classified as Critically Endangered (IUCN 2015). Similarly, the Egyptian vulture *Neophron percnopterus* is classified as Endangered.

Although the veterinary use of diclofenac was banned by the governments of India, Pakistan and Nepal in 2006, followed by Bangladesh in 2010 (Prakash et al. 2012; Sarowar et al. 2016), there are several other vulture-toxic NSAIDs freely available (Galligan et al. 2020). These include aceclofenac (Galligan et al. 2016, Chandramohan et al. 2022), ketoprofen (Naidoo et al. 2010) and nimesulide (Galligan et al. 2022). However, there are alternative NSAIDs that are known to be safe for vultures, i.e., meloxicam (Swan et al. 2006; Swarup et al. 2007) and tolfenamic acid (Chandramohan et al. 2022).

To focus conservation actions, including ensuring that diclofenac was not sold in pharmacies, and promoting safe drugs as alternatives, in Nepal, Vulture Safe Zones (VSZ) were created by partnerships of local communities, veterinarians, conservation organizations, and government agencies (Bhusal 2018). The world's first genuinely safe VSZ was declared in Nepal in 2021 (SAVE 2021). The Vulture Safe Zone is an integrated approach, which involves advocacy, education, monitoring, research, supplementary feeding, and site protection. Some populations of *Gyps* vultures in Nepal seem to be recovering as a result of these actions (Galligan et al. 2019; Bhusal et al. 2021; McClure et al. 2022; Bhusal et al. 2023).

In addition to the ongoing threat of vulture-toxic NSAIDs, vultures are exposed to other forms of poisoning, including the use of poison baits. Vultures are killed when feeding on carcasses laced with poison, which have been set to target mammalian predators as a result of human-wildlife conflict, or for the control of feral dogs. Such poisoning results in the death of a large number of vultures yearly in Nepal (Chaudhary et al. 2019), thus could pose a major threat to vulture populations. However, details of poisoning incidents, the number of vulture deaths, and conservation responses to such incidents have not been documented. Therefore, we summarize data from all known vulture poisoning incidents in Nepal between March 2011 to March 2023, and describe the responses and mitigation measures to these incidents.

2 | Materials and methods

2.1 | Study area

We have collected the poisoning incidents data from all over Nepal. Nepal comprises 147,516 km^2 (26°22′ to 30°27′ N and 80°04′ to 88°12′ E) and is bordered by China to the north and India to the south, east, and west. The elevation ranges from 60 to 8848.86 m above sea level constituting the tropical, subtropical, temperate, subalpine and alpine climates. Varied climatic zones of Nepal support the occurrence of more than 17,097 faunal species, including 886 bird species, of which nine are vulture species (GoN 2018).

2.2 | Data collection

All the data presented in this work were collected from March 2011 to March 2023. Most poisoning incidents were reported by local communities or local authorities. However, in recent years, Bird Conservation Nepal field biologists and veterinary doctors have responded to the incidents by following the Wildlife Poisoning Crime Scene Protocol 2020 (NARREC & Humanelabs 2020), which is widely applied in Africa. The aim of the protocol is to investigate the poisoning site and gather witness statements to identify the perpetrators; collect samples from the carcasses of vultures and other dead animals to identify the cause of death, and the source of the poison; and to rescue any vultures that are still alive for rehabilitation. The laboratory analysis of the samples is also carried out to confirmed the poisoning case.

In poisoning cases, there is often mass mortality associated with at least one baited carcass. Feeding by vultures on the baited carcass was confirmed by

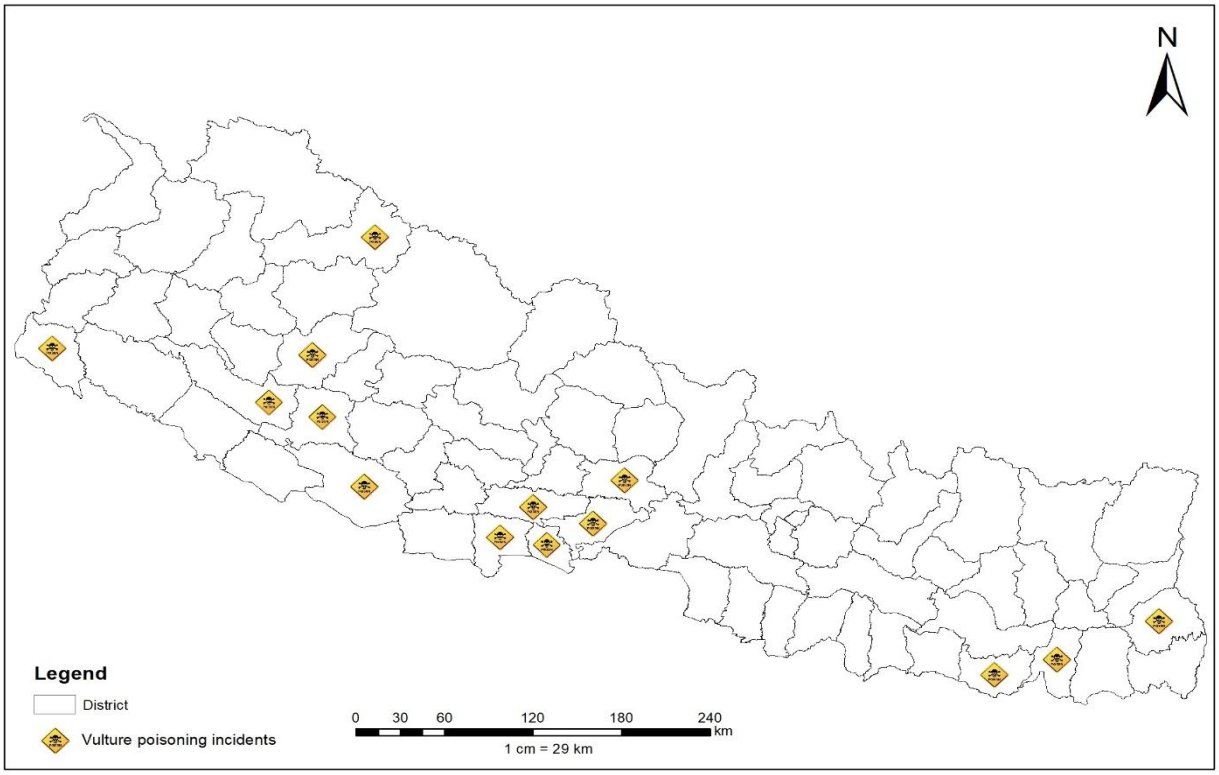

Figure 1. Map of Nepal showing the vulture poisoning incidents districts.

footprints around the carcass. During post-mortem, food remains are usually observed throughout the esophagus, as well as the fully filled crop of dead vultures. If there are sick and grounded vultures, these often show the symptoms of nervous disorders such as ataxia and drooping of their necks. Sick vultures are also usually approachable, as they cannot fly.

2.3 | Response to poisoning incident

The condition at the poisoning site is usually very harrowing. The main focus should be to rescue any live vultures to prevent them from succumbing to poisoning. The search of the incident site was thoroughly done to find more sick and affected vultures. The rescued vultures were provided with good veterinary care. In some mild cases of poisoning, sick vultures can be successfully treated, and the birds returned to the wild. In addition to this, the search operation was also focused on collecting all dead vultures as they may act as a source for further poisoning. All dead vultures were subsequently buried to prevent further contamination.

2.4 | Rescue and treatment of vultures

Protective gloves and masks were compulsory to handlers in every case of poisoning, to prevent the poison entering the body through skin abrasions, inhalation or sometimes ingestion. All the secretions like feces, feathers, vomitus etc. were handled cautiously.

Treatment varied depending on the active compound of the poison. Administration of a specific antidote can save the lives of sick vultures. In general, the poisoning compound cannot be identified on site. So, a holistic treatment approach should be practiced. Initially, the affected vultures were allowed to vomit by any means.

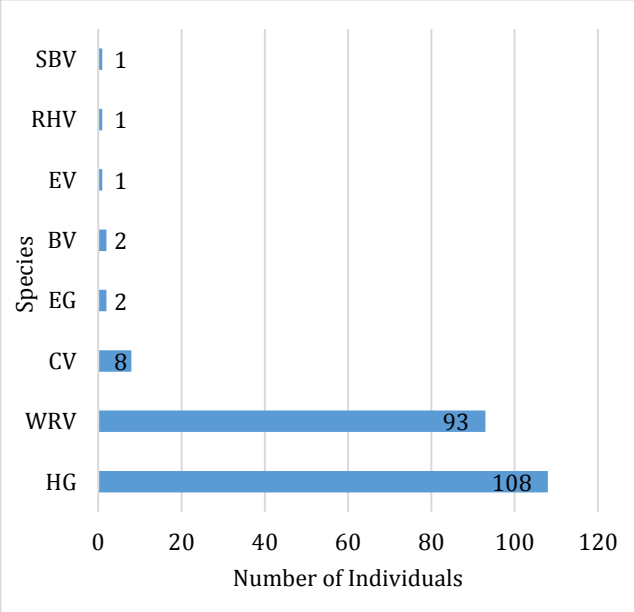

Figure 2. Number of individuals of each species death by the poisoning incidents (HG-Himalayan griffon, WRV-White-rumped vulture, CV-Cinereous vulture, EG- Eurasian griffon, BV-Bearded vulture, EV- Egyptian vulture, RHV-Red-headed vulture and SBV-Slender-billed vulture

Vomiting helps to expel the toxic food from the digestive tract and prevents further absorption of the poison. Secondly, the fluid restoration via parenteral route was done which was very much beneficial. Oral fluid therapy was avoided. Fluid therapy helped to maintain the blood volume reduced from the shock. Oxygen supplementation may be required. After treatment, the vultures were kept in a calm environment.

2.5 | Postmortem examination of dead vultures

The post mortem examination of dead vultures was done after collection of all the dead birds at the site. The samples collected during the performance of post-mortem were preserved below 4°C and in 10% formalin. Samples collected included the crop content, stomach content and intestinal content in order to identify the poison. Samples taken from the liver, spleen and intestine were collected to observe the toxic effects of the poison. The active compound of the poison may remain unabsorbed by the body and those compounds can be detected at the toxicological laboratory. For this, the body of the vultures should be fresh. The toxic compounds present in the ingesta might undergo chemical reaction and form another compound resulting in the negative result in aged or degenerated carcass. The collected samples were tested in the National Forensic Science Laboratory by Gas Chromatography -Mass Spectrometry (GC-MS) at Kathmandu, Nepal.

3 | Results

A total of 22 bait poisoning incidents occurred from 2011 to 2023 in Nepal resulting in the deaths of 224 individuals of seven vulture species, an annual average of 17.23±19.11. Of the 224 individuals, 95 were from species classified as Critically Endangered, i.e., 93 white-rumped vulture, and single red-headed and slender-billed vultures (Fig. 2).

There were also 108 Himalayan griffon *Gyps himalayansis*, eight cinereous vulture *Aegypius monachus*, two Eurasian griffon *G. fulvus*, two bearded vulture *Gypaetus barbatus* and a single Egyptian vulture (Fig. 2). The number of dead vultures per incident ranged from 1-71 individuals and averaged 10.66 ± 14.29.

The poisoning incidents were reported from 14 different districts of Nepal. The highest numbers of incidents were reported from Dang district followed by Parasi, Kanchanpur, Nawalpur and Mugu district respectively. The highest number of vulture deaths was found in East Nawalparasi District (n=91) followed by Kanchanpur (37), Dang (33) and Nawalpur (16) districts (Fig. 3).

A total of 27 sick individuals were found alive and subsequently rescued and treated. Of these, 18 birds were recovered and were released back into the wild; however, nine individuals did not respond to treatment and subsequently died (Fig. 4).

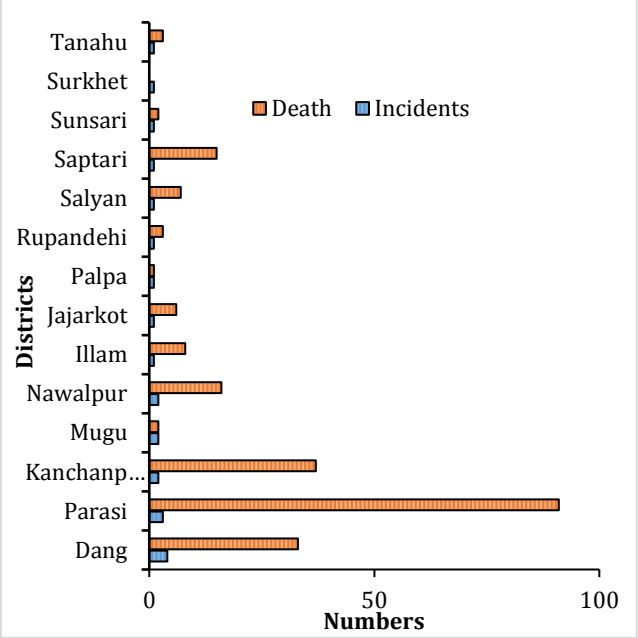

Figure 3. District wise poisoning incidents and number of vulture death

4 | Discussion

Poisoning, including the use of poison baits, is the biggest threat to vultures globally (Botha et al. 2017), and is a major cause of population declines throughout Africa (Ogada et al. 2016). Here we reported the deaths of several vultures annually in Nepal, caused by unintentional poisoning with poison baits, which were collateral deaths as a result of human-wildlife conflict. There was the limitation of missing such incidents record that may happened in the remote areas of the country. Almost half of the deaths were from species classified as Critically Endangered, and which have only recently begun to show a partial recovery from the catastrophic declines caused by diclofenac. Although diclofenac and other toxic NSAIDs remain the main threat to vultures in South Asia (Galligan et al. 2020), the use of poison baits is the cause of the most recorded vulture deaths in Nepal (Chaudhary et al. 2019), and should therefore be treated as a serious emerging threat to vulture populations.

Although, globally, the use of poison baits is a serious threat to vultures (Botha et al. 2017), in Asia, the only country where it is the main threat to vulture populations is Cambodia (Loveridge et al. 2018). However, it is also a local issue in Assam in North-east India, where around a hundred vultures a year die from such poisoning incidents (e.g., VCF 2022). Other areas have also recently experienced similar events, e.g., Bangladesh (SAVE 2023). The results published here show that the use of poison baits is an issue facing Nepal's vultures, too, with several birds dying annually. This included a major incident in 2021, when 69 vultures died (SAVE 2021). The average number of birds killed per incident was a little more than ten individuals. This is higher than in some studies (Margalida et al. 2008; Parvanov et al. 2018), but will vary with species and the exact circumstances of each incident. For instance, there have been recent cases in Africa of several hundred birds being killed in a single incident, albeit in cases of deliberate poisoning of vultures (e.g., BBC 2019). In Nepal, multiple deaths in each incident are likely due to cases occurring in areas with high vulture densities, including close to nesting colonies. This could further exacerbate the conservation implications, resulting in a reduction in breeding success if one or both members of a breeding pair are killed.

Although unintentional poisoning is responsible for a number of deaths every year, it appears not to be having a marked effect as of toxic NSAIDs on populations of vultures in Nepal. Wild White-rumped vultures that had been fitted with GPS transmitters have been found to have high annual survival rates, with no birds having been found to have died of poisoning while being monitored

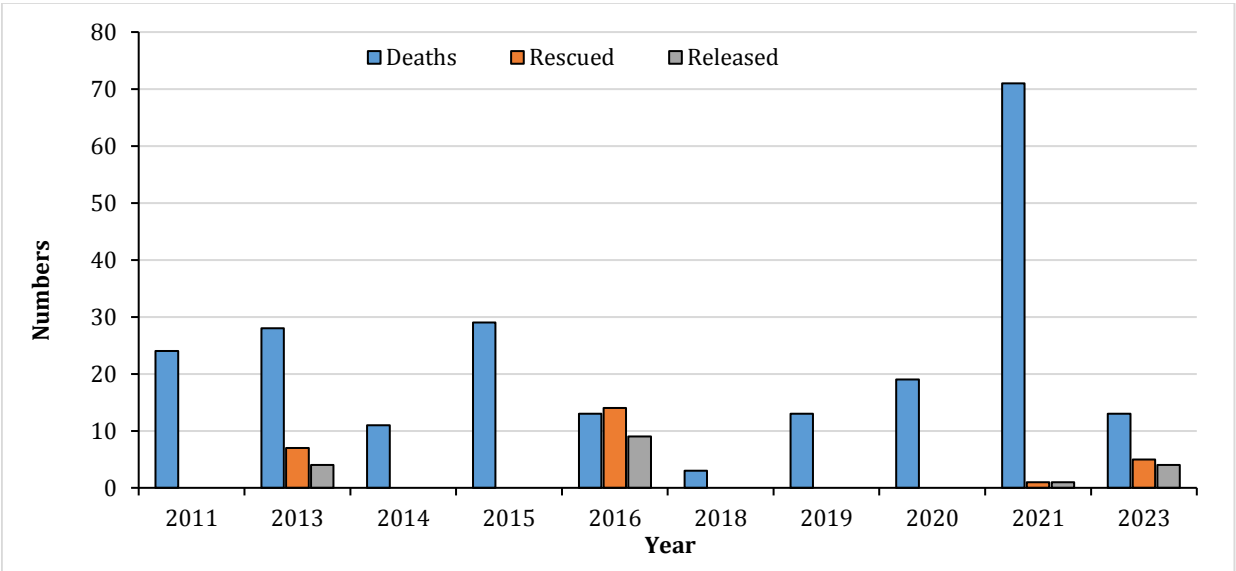

Figure 4. The detail number of dead, rescued and recovered vultures in the different years.

(BCN, unpublished data). Furthermore, unlike in most regions of the world, there is evidence of a partial recovery of vulture populations in Nepal (Galligan et al. 2019). Currently, incidents of poisoning appear to be at a sufficiently low level to allow population growth; however, one should not be complacent, and actions to counter the problem should be incorporated into VSZ conservation advocacy.

Identification of poisons used was not always possible due to a lack of laboratory facilities. Doing so will improve the chances of controlling poisoning incidents in the future. Most incidents of vulture poisoning, in Asia especially, is unintentional and a result of human-wildlife conflict (Ogada et al. 2016). The poisons used in such incidents are most commonly freely and legally available pesticides (Botha et al. 2015). Therefore, understanding the causes of human-wildlife conflicts in areas around vulture colonies, and to devise potential mitigation measures, will help to reduce the frequency of vulture poisoning. Advocacy and education regarding poisoning, targeted at local stakeholders, should form part of the awareness programs already conducted by local conservationists as part of their Vulture Save Zone work. This will greatly benefit the conservation of vultures in Nepal. Municipal Dumping Sites are the congregate foraging site of vultures especially Egyptian vulture but we are unknown about the potential toxicity to the bird. In Nepal dumps all type of organic and inorganic garbage even including poisoned killed rodents at the same place so the detail study is needed.

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Authors' contributions

KPB, IPC, DBR, DCT and ABJ collected the data, BK lead the postmortem, sample collection and rescue. DCT wrote manuscript draft, KPB and JWM improved and finalized the manuscript. All authors contributed critically to the final version of manuscript and gave final approval for publication.

Conflicts of interest

Authors declare no conflict of interest.

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