POPULATION DECLINE OF VULTURES AND THEIR CONSERVATION: SCENARIO IN INDIA AND HIMACHAL PRADESH

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ABSTRACT
World list of living species of Vultures stands at 23, comprising of seven species of New World and 16 Old World species. They are found on every continent except Antarctica, Australia and Oceania. They are scavenging birds, feeding mostly on the carcasses of dead animals. Vulture stomach acid is exceptionally corrosive, allowing them to safely digest putrid carcasses infected with Botulinum toxin, hog cholera, and anthrax bacteria that would be lethal to other scavengers. Six, out of nine species of vultures found in India have been facing problem of existence and therefore declared as threatened. The veterinary use of the non-steroidal anti-inflammatory drug (NSAID)-diclofenac-in livestock is the main, and perhaps the only, cause of the population declines Likewise, due to this chemical, vultures suffer from a disease called gout. Only a few studies have been conducted on the ecological aspects of these vultures which are crucially important in the ecosystem as efficient scavengers. Recent studies conducted with the financial help from Department of Science and Technology, New Delhi revealed the presence of 8 species of vultures from different areas of Himachal Pradesh. A total of 22 nesting colonies of Indian White-backed Vulture, supporting 77 nests have been reported from different areas of Himachal Pradesh during breeding season (October to March/April) in 2010-2011. A single nesting colony of Slender-billed Vulture Gyps tenuirostris has been recorded in Baroh area of Kangra with 2 nests. A total of 14 nesting colonies, supporting 64 breeding pairs of Himalayan Griffon (Gyps himalayensis) have been reported from Himachal Pradesh. No conservation measure could be efficient in protecting these threatened species from extinction if we do not have any reliable information on the current status, species richness, habitat-use pattern and ecology of these vultures. Identification and monitoring of the locations and number of remaining individuals of Vultures in the wild would be effective measure for conservation.

KEYWORDS: Vultures, Causes of Population Decline, Rate of Decline, Conservation Measures

INTRODUCTION
Vultures are classified into two groups: Old World vultures and New World vultures. World list of living species of Vultures stand at 23, comprising of seven species of New World and 16 Old World species (Tables 1, 2). The similarities between the two different groups are due to convergent evolution. The Old World vultures found in Africa, Asia, and Europe belong to the family Accipitridae, which also includes eagles, kites, buzzards, and hawks. Old World vultures find carcasses exclusively by sight. The New World vultures and condors found in warm and temperate areas of the Americas are not closely related to the superficially similar Accipitridae, but belong in the family Cathartidae, which was once considered to be related to the storks. However, recent DNA evidence suggests that they should be included among the Accipitriformes, along with other birds of prey. However, they are still not directly related to the other vultures. Several species have a good sense of smell, unusual for raptors, and are able to smell the dead they focus upon from great heights, up to a mile away (BirdLife International, 2011; Wikipedia, 2011). They are scavenging birds, feeding mostly on the carcasses of dead animals. They are found on every continent except Antarctica, Australia and Oceania. Vultures do not use their feet to kill their prey (the definition of a Raptor) and so have gone back and forth between being classified as a raptor or a non-raptor, and have gone through extensive DNA testing to test the relationships. A particular characteristic of many vultures is a bald head, devoid of feathers. This helps to keep the head clean when feeding. Research has shown that the bare skin may play an important role in thermoregulation (Ward et al., 2008). Vultures seldom attack healthy animals, but may kill the wounded or sick. When a carcass has too thick a hide for its beak to open, it waits for a larger scavenger to eat first. Vast numbers have been seen upon battlefields. They gorge themselves when prey is abundant, till their crop bulges, and

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sit, sleepy or half torpid, to digest their food. They do not carry food to their young in their claws, but disgorge it from the crop. These birds are of great value as scavengers, especially in hot regions. Vulture stomach acid is exceptionally corrosive, allowing them to safely digest putrid carcasses infected with *Botulinum* toxin, hog cholera, and anthrax bacteria that would be lethal to other scavengers. This also enables them to use their reeking, corrosive vomit as a defensive projectile when threatened. Vultures urinate straight down their legs; the uric acid kills bacteria accumulated from walking through carcasses, and also acts as evaporative cooling (Wikipedia, 2011). The digestive acids are not the sole factor present that benefits vulture’s carrion-eating lifestyle. Vultures must also have an ability to destroy toxins produced by bacteria that may be present long after the bacteria have been killed. Some potent toxins may well be absorbed by the oesophageal (food-pipe) epithelium before ever reaching the stomach. *Clostridium botulinum*, the causative agent of Botulism, produces five different toxins (named toxins A through F). Toxins A & E are principally found connected with human illness, and toxin C with animal illness. It is perhaps for this reason that Vultures have very high titres (amounts) of antibodies against this toxin, and also antibodies against the other Botulinum toxins. This is also observable in Coyotes and Crows who also have remarkable ways of preventing poisoning. The adaptive mechanism for life as carrion eaters may therefore be the presence of a substantial immune system, which may have a partly genetic basis, but also ‘immune training’ from the parent (i.e. in mammals-from breast milk) and from encountering microorganisms/toxins themselves (Ohishi *et al.*, 1979). It is for the above reasons that the digestive system of vultures’ has been the topic of research. The ability to disinfect rodent carcasses carrying Hantavirus is currently being tested and could prove to be of great significance to human medical research. There may also be vital information to be discovered for use in the event of biological warfare, acts of terrorism, or world-wide epidemics (Shriner, 1998).

Vultures are believed to have evolved in parallel with large herds of migratory ungulates, feeding on the remains of sick, injured and depredated individuals (Mundy *et al.*, 1992). With the disappearance of these herds from most of the world range of vultures, the food supply formerly provided by wild ungulates was replaced by domesticated animals (Pain *et al.*, 2008). *Gyps* vultures have large areas of bare skin on their body, and by changing their posture they can vary the extent to which these are covered by feathers. They have varying amounts of bare skin exposed and adopted in cold and hot conditions. Postural change can cause the proportion of body surface composed of bare skin areas to change from 32% to 7%, and in cold conditions these changes are sufficient to account for a 52% saving in heat loss from the body. These bare skin areas in *Gyps* vultures play an important role in thermoregulation (Ward *et al.*, 2008).

**ECOLOGICAL ROLE OF VULTURES**

The ecological, social and cultural significance of vultures in India may be summed up as: scavenging on animal carcasses of animals and thereby helping keep the environment clean; and the disposal of dead bodies as per the religious practices of the Parsi community. Vultures are the primary removers of carrion in India and Africa. Removal of a major scavenger from the ecosystem will affect the equilibrium between...
populations of other scavenging species and/or result in increase in putrefying carcasses. In the absence of carcass disposing mechanisms, vulture declines may lead to an increase in the number of putrefying animal carcasses in the country side. In some areas the population of feral dogs, being the main scavenging species in the absence of vultures, has been observed to have increased. Both increases in putrefying carcasses and changes in the scavenger populations have associated disease risks for wildlife, livestock and humans. In the absence of any alternative mode of disposal of animal carcasses, they continue to be disposed off in the open and with increasing numbers of feral dogs, there is increased risk of spread of rabies, and livestock borne diseases like anthrax (Prakash et al., 2003).

**POPULATION DECLINE**

Although *Gyps* vulture populations were probably declining slowly in many parts of the world during the 20th century, a very different situation existed in India, Nepal and Pakistan. Here, large populations of Indian White-backed Vulture and Long-billed Vulture remained until the 1990s. Large numbers of Slender-billed Vulture, which was not distinguished as a separate species from Long-billed Vulture until recently (Rasmussen and Parry, 2001), were also found in the northeastern parts of the subcontinent (Ali and Ripley, 1983; Prakash et al., 2007). Indeed, during the 1980s Indian White-backed Vulture was thought likely to be the commonest large bird of prey in the world (Houston, 1985). In India, *Gyps* vulture densities were so high in some areas that they were considered a hazard to aircraft (Grubh et al., 1990). This abundance was undoubtedly due to a plentiful food supply, in the form of the carcasses of domesticated ungulates (Pain et al., 2008). The era of abundant *Gyps* vultures in the Indian subcontinent came to a sudden end in the 1990s. This was firstly documented in Keoladeo National Park, Bharatpur in eastern Rajasthan (Prakash, 1999; Prakash et al., 2003). Subsequently, this population crash was documented throughout the Indian subcontinent (Samant et al., 1995; Prakash et al., 2003, 2005 a & b, 2007; Gilbert et al., 2004, 2006; Green et al., 2004; AVPP, 2007; Pain et al., 2008).

Of the nine species of vultures recorded from India, five belong to the genus *Gyps*. Three *Gyps* vultures viz., Indian White-backed Vulture (*Gyps bengalensis*), Long-billed Vulture (*Gyps indicus*) and Slender-billed Vulture (*Gyps tenuirostris*) are residents, and the remaining two, the Eurasian Griffon (*Gyps fulvus*) and Himalayan Griffon (*Gyps himalayensis*) are largely wintering species (Prakash, 1999; Prakash et al., 2003, 2007). In addition, Lammergeier (*Gypaetus barbatus*), Egyptian Vulture (*Neophron percnopterus*) and Red-headed Vulture (*Sarcogyps calvus*) are residents and Cinereous Vulture (*Aegypius monachus*) is wintering species (Grimmett et al., 1999).

Six, out of nine species of vultures found in India have been facing problem of existence and therefore declared as threatened. Of these, three species endemic to South Asia, the Indian White-backed Vulture *Gyps bengalensis*, Long-billed Vulture *Gyps indicus* and Slender-billed Vulture *Gyps tenuirostris* are at high risk of global extinction and are listed as critically endangered because of rapid population declines within the last decade in the Indian subcontinent. Further, Red-headed Vulture *Sarcogyps calvus* has been recently upgraded to critical category. Moreover, Egyptian Vulture *Neophron percnopterus* has been categorised as endangered and Cinereous Vulture *Aegypius monachus* has been placed under near threatened category (Prakash et al., 2003; Green et al., 2004; IUCN, 2007).

The minimum decline in White-backed vulture numbers in India during the period 1992-2003 was 99.7% and 97.4% for Long-billed/Slender-billed. This corresponds with a minimum estimated rate of decline of 34% per year for White-backed Vultures and 27% per year for the Long-billed/Slender-billed group. In the most recent census, there is evidence that the rate of declines may be increasing with a measured 81% decline between 2002 and 2003 in White-backed vultures, a 59% decline in Long-billed vultures, and a 47% decline for Slender-billed vultures (MoEF, 2006).
CAUSES OF DECLINE AND REMEDIAL MEASURES
The veterinary use of the non-steroidal anti-inflammatory drug (NSAID)-diclofenac-in livestock is the main, and perhaps the only, cause of the population declines (Oaks et al., 2004; Shultz et al., 2004; Green et al., 2004, 2007). Vultures are exposed to toxic levels of diclofenac when they feed on carcasses of livestock which have died within a few days of treatment, and which contain residues of the drug (Oaks et al., 2004). Vultures that consume sufficient tissue from such carcasses die from the effects of diclofenac induced kidney failure. Shultz et al. (2004) found that a high proportion of Indian White-backed Vulture and Long-billed Vultures found dead in the wild had severe visceral gout, consistent with diclofenac poisoning being the main or sole cause of the population declines. Simulation modeling has indicated that less than 1% of the livestock carcasses available to vultures need to contain levels of diclofenac lethal to vultures to cause the recorded rates of decline across the country (Green et al., 2004).

Likewise, due to this chemical, vultures suffer from a disease called gout. Besides this, environmental changes have also produced adverse effects on the population of vultures as well. Food shortage, caused by the burial or burning of carcasses to reduce the nuisance and health risks have also contributed to their decline. Other reasons for the decline are anthropogenic (related with human population) like loss of nesting habitat, decreased breeding efficiency, infectious diseases, general environmental pollution etc. (Galushin, 2001; Virani et al., 2001; Pain et al., 2003; Prakash, 2004; Arun and Azeez, 2004; Oaks et al., 2004; Shultz et al., 2004; Green et al., 2004, 2006, 2007; Baral et al., 2005; Johnson et al., 2006; Prakash et al., 2007).

Diclofenac originated from Ciba-Geigy (now Novartis) in 1973. Diclofenac is marketed under many trade names like Anuva, Diclac, Dicloflex, Diclogem, Diclowin Plus, Diclton, Modifenac, Morbidic, Oflen, Naklofen, Rhumalgan, Sandoz, Topac, Voltafam, Voveran etc. It is a non-steroidal anti-inflammatory drug (NSAID) taken to reduce inflammation and as an analgesic reducing pain in conditions such as arthritis or acute injury. It can also be used to reduce menstrual pain, dysmenorrhea. The name is derived from its chemical name: 2-(2, 6-dichloroanilino) phenylacetic acid. In the United Kingdom, India, Brazil and the United States, it may be supplied as either the sodium or potassium salt, in China most often as the sodium salt, while in some other countries only as the potassium salt. Diclofenac is available as a generic drug in a number of formulations. Over the counter (OTC) use is approved in some countries for minor aches and pains and fever associated with common infections (http://www.novartis.com; Salmann, 1986).

The exact mechanism of action is not entirely known, but it is thought that the primary mechanism responsible for its anti-inflammatory, antipyretic, and analgesic action is inhibition of prostaglandin synthesis by inhibition of cyclooxygenase (COX), and it appears to inhibit DNA synthesis (Dutta et al., 2000). NSAIDs are associated with adverse renal [kidney] effects caused by the reduction in synthesis of renal prostaglandins in sensitive persons or animal species, and potentially during long term use in non-sensitive persons if resistance to side effects decreases with age. Unfortunately this side effect can't be avoided merely by using a COX-2 selective inhibitor because, "Both isoforms of COX, COX-1 and COX-2, are expressed in the kidney. Consequently, the same precautions regarding renal risk that are followed for nonselective NSAIDs should be used when selective COX-2 inhibitors are administered. However, diclofenac appears to have a different mechanism of renal toxicity (Brater, 2002; Naidoo and Swan, 2008).
applications that allow diclofenac to be present in carcasses of domestic livestock available as food for vultures; establishment of IUCN South Asian Task Force under the auspices of the IUCN; Range countries to develop and implement national vulture recovery plans, including conservation breeding and release”. Recently, Government of India on May 11, 2006, through Drugs Controller General (F.No. 18-03/2006-DC) with approval of Health Ministry decided to withdraw all the licenses granted to manufacture diclofenac formulations for veterinary use and marketing of such formulations.

Currently, three captive breeding centers for Vultures, one in Haryana, second in West Bengal and third in Assam have been setup in India. Four more breeding centers are planned, in an attempt to create reservoirs of birds to be re-introduced once the environment is clear of diclofenac. The recovery programme in India is a joint project involving the Royal Society for Protection of Birds (RSPB), the Zoological Society of London, and the Bombay Natural History Society (BNHS, BirdLife in India), supported by Indian state and central governments. Also participating are Bird Conservation Nepal (BirdLife in Nepal), The Peregrine Fund, National Birds of Prey Trust and the Ornithological Society of Pakistan (BirdLife in Pakistan) (BirdLife International, 2008).

SCENARIO IN INDIA AND HIMACHAL PRADESH
The ecology and population dynamics of the Indian White-backed Vulture are poorly known, except a doctoral thesis (Grubh, 1974) and a few related publications reported from the Gir forest, Gujarat (Grubh, 1978 a & b, 1986). A few studies have been conducted on the ecological aspects of these vultures which are crucially important in the ecosystem as efficient scavengers. Most of this information is in the form of small articles. Many of such articles discuss various ecological and behavioral aspects of the different species such as feeding (Fox, 1913; Smith, 1915; Ezra, 1918; Gough, 1936; Livesey, 1937; Grubh, 1973), breeding (Jones, 1916; Gill, 1921; Sharma, 1970; Bhat, 1992; Kanoje, 1996) and inter-specific interactions (Grubh, 1978 a & b; Arun and Azeez, 2004).

In the recent years this group of scavenging birds has received the attention of the scientific community and various governments due to sharp decline in their population throughout their distributional range in the Indian subcontinent. Therefore, many programmes, including the captive breeding are being implemented for the betterment of Vultures in India. Recently, Chhangani (2002, 2003, 2004, 2005, 2007) has made some studies on the different aspects of vultures in Rajasthan, India. Comprehensive studies on the status, abundance, population, etc. of vultures were conducted in Himachal Pradesh. Most of the literature available on the vulture life in the State was in the form of occasional short notes based upon opportunistic observations. A few sightings (Pandey, 1989; Mahabal and Sharma, 1992, 1993; Gaston et al., 1993; Mahabal, 1996, 2000, 2005; Thakur et al., 2002, 2003, 2010; Mattu and Thakur, 2006; Thakur, 2008) merely threw some light on the presence of different species of vultures in some small areas.

Recent studies (October 2009 onwards) conducted with the financial help from Ministry of Science and Technology (Department of Science and Technology), New Delhi under FAST Track Scheme for young scientists revealed the presence of 8 species of vultures from different areas of Himachal Pradesh. A small breeding population of critically threatened Indian White-backed and Slender-billed Vultures has been found in very small patches in different areas explored. Indian White-backed Vulture *Gyps bengalensis* has been distributed in small patches in Bilaspur, Chamba, Hamirpur and Kangra. A total of 22 nesting colonies of this species, supporting 77 nests have been reported from these areas during breeding season (October to March/April) in 2010-2011. A single nesting colony of Slender-billed
Vulture *Gyps tenuirostris* has been recorded in Baroh area of Kangra with 2 nests. In addition, individuals of this species have been sighted feeding on carcasses at three sites i.e. one bird at Tarkhankad in Kangra, two birds with a juvenile at Sirmani in Kangra and three birds at Thulol near Sihunta in Chamba. A total of 14 nesting colonies, supporting 64 breeding pairs of Himalayan Griffon (*Gyps himalayensis*) have been reported from Himachal Pradesh.

Information on socio-cultural practices of disposal of carcasses and accessibility of Diclofenac to the vultures revealed that only 5% of the chemists in surroundings of nesting sites indicated towards the use of human diclofenac to the cattle, inspite of the fact that they were well aware about the story of vultures and diclofenac. Practice of removal of the skin and leaving the carcass for vulture consumption by locals has been a tradition of gone days in Himachal Pradesh. In the absence of this practice, dead bodies of domestic animals are usually buried. However, this social custom in Kangra valley is being practiced by some migrants from Punjab who unknowingly have been supporting a small breeding population of critically threatened Indian White-backed, Slender-billed and Red-headed Vultures. In addition, these immigrants were knowledgeable persons regarding the placement of carcass for vulture consumption as according to them vultures thoroughly clear the bones than other scavengers. Hides and bones of dead cattle have been an excellent source of money for them.

**CONSERVATION STRATEGIES**

No conservation measure could be efficient in protecting these threatened species from extinction if we do not have any reliable information on the current status, species richness, habitat-use pattern and ecology of these vultures. Recently the state of Himachal Pradesh has come under a strong threshold of development. As a result, several animal species are under tremendous stress because of increasing human population, deforestation, pollution, construction of river valley projects, etc. Many natural habitats have been over-exploited, degraded and even destroyed. Most of large animals in the area are highly endangered and are protected under the Indian Wildlife (Protection) Act, 1972. Conservation of already depleted biological resources is perhaps the only option left to overcome this situation.

Identification and monitoring of the locations and number of remaining individuals of Vultures in the wild would be effective measure for conservation. Some of the parameters like terrain type, altitude, relief etc.; height, type, density and status of vegetation; nearby human settlements, source of water and food, mortality rate of cattle in nearby villages, socio-cultural practices of disposal of carcasses; vulture species type and richness, population dynamics, habitat-use pattern, breeding ecology and breeding success; human/animal interference in the light of some previous studies like Stendell (1967), US Fish and Wildlife Service (1980) and Hays *et al.* (1981) could be beneficial. Breeding colonies of vultures should be continuously monitored for any changes in the population size. These records, in the long run would help in the formulation of area/locality based, viable vulture conservation strategies. In addition, public awareness and public support programmes are the most important aspects of any effective conservation and management plan. Therefore, local people should be engaged in the whole process of conservation and management.
### TABLE 1: New World Vultures and their Conservation Status (Family: Cathartidae)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Species</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Turkey Vulture <em>Cathartes aura</em> (Linnaeus, 1758)</td>
<td>LC</td>
</tr>
<tr>
<td>2.</td>
<td>Lesser Yellow-headed Vulture <em>Cathartes burrovianus</em> Cassin, 1845</td>
<td>LC</td>
</tr>
<tr>
<td>3.</td>
<td>Greater Yellow-headed Vulture <em>Cathartes melambrotus</em> Wetmore, 1964</td>
<td>LC</td>
</tr>
<tr>
<td>4.</td>
<td>Black Vulture <em>Coragyps atratus</em> (Buchstein, 1783)</td>
<td>LC</td>
</tr>
<tr>
<td>5.</td>
<td>King Vulture <em>Sarcoramphus papa</em> (Linnaeus, 1758)</td>
<td>LC</td>
</tr>
<tr>
<td>6.</td>
<td>California Condor <em>Gymnogyps californianus</em> (Shaw, 1797)</td>
<td>CR</td>
</tr>
<tr>
<td>7.</td>
<td>Andean Condor <em>Vultur gryphus</em> Linnaeus, 1758</td>
<td>NT</td>
</tr>
</tbody>
</table>

LC= Least Concern  
CR= Critical  
NT= Near Threatened  
(Source: BirdLife International, 2011)

### TABLE 2: Old World Vultures and their Conservation Status (Family: Accipitridae)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Species</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Palm-nut Vulture <em>Gypohierax angolensis</em> (Gmelin, 1788)</td>
<td>LC</td>
</tr>
<tr>
<td>2.</td>
<td>Lammergeier <em>Gypaetus barbatus</em> (Linnaeus, 1758)</td>
<td>LC</td>
</tr>
<tr>
<td>3.</td>
<td>Egyptian Vulture <em>Neophron percnopterus</em> (Linnaeus, 1758)</td>
<td>EN</td>
</tr>
<tr>
<td>4.</td>
<td>Hooded Vulture <em>Necrosyrtes monachus</em> (Temminck, 1823)</td>
<td>EN</td>
</tr>
<tr>
<td>5.</td>
<td>White-backed Vulture <em>Gyps africanus</em> Salvadori, 1865</td>
<td>NT</td>
</tr>
<tr>
<td>6.</td>
<td>White-rumped Vulture <em>Gyps bengalensis</em> (Gmelin, 1788)</td>
<td>CR</td>
</tr>
<tr>
<td>7.</td>
<td>Indian Vulture <em>Gyps indicus</em> (Scopoli, 1786)</td>
<td>CR</td>
</tr>
<tr>
<td>8.</td>
<td>Slender-billed Vulture <em>Gyps tenuirostris</em> Gray, 1844</td>
<td>CR</td>
</tr>
<tr>
<td>9.</td>
<td>Rueppell's Vulture <em>Gyps rueppellii</em> (Brehm, 1852)</td>
<td>NT</td>
</tr>
<tr>
<td>10.</td>
<td>Himalayan Vulture <em>Gyps himalayensis</em> Hume, 1869</td>
<td>LC</td>
</tr>
<tr>
<td>11.</td>
<td>Griffon Vulture <em>Gyps fulvus</em> (Hablizl, 1783)</td>
<td>LC</td>
</tr>
<tr>
<td>12.</td>
<td>Cape Vulture <em>Gyps coprotheres</em> (Forster, 1798)</td>
<td>VU</td>
</tr>
<tr>
<td>13.</td>
<td>Red-headed Vulture <em>Sarcogyps calvus</em> (Scopoli, 1786)</td>
<td>CR</td>
</tr>
<tr>
<td>14.</td>
<td>White-headed Vulture <em>Trigonoceps occipitalis</em> (Burchell, 1824)</td>
<td>VU</td>
</tr>
<tr>
<td>15.</td>
<td>Cinereous Vulture <em>Aegypius monachus</em> (Linnaeus, 1766)</td>
<td>NT</td>
</tr>
<tr>
<td>16.</td>
<td>Lappet-faced Vulture <em>Torgos tracheliotos</em> (Forster, 1791)</td>
<td>VU</td>
</tr>
</tbody>
</table>

LC= Least Concern  
EN= Endangered  
CR= Critical  
NT= Near Threatened  
VU= Vulnerable  
(Source: BirdLife International, 2011)

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Decline of vultures and their conservation


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