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Vulture: Distribution, Feeding, Habitation, Breeding and Population Dynamics

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I. Introduction

Birds are not only part of our natural heritage but also important components of our cultural history from the antiquity until recently. Vultures are always present in Greek legends and traditions. Vulture names differ from place to place. Egyptian Vultures, named "Cuckoo's horses", which carry migrating Cuckoos on their backs. Vultures' arrival is linked with children's couplets and magic actions for health, fortune, marriage and success in dairy products. In other places Egyptian Vulture is called "cheese maker". Moreover, the bird's body is used in folk medicine. Griffon Vultures are present in every day sayings, characterizing lazy, boorish or gluttonous people. Fairy tales personalize Vultures and eagles as shepherds, while in local traditions sheep are transformed to Griffon Vultures due to the supernatural punishments of shepherd's inhospitable behavior.

Vultures ate unburied people killed in wars and legends mentions that heroes were eaten by eagles. Instruments of pastoral music tradition are also associated with Vultures. Children used to collect flight feathers and sell them to local lute players and flutes were frequently constructed from the ulna bone of the wing of Griffon Vultures or Golden Eagles. Nevertheless, those bones had to remain 40 Sundays in church before use, to be purified. Lastly, many place names refer to Vultures, but after their population decline, people rarely associate those toponyms with these birds. In holybook, Ramayana there are descriptions about Vulture like bird Jatau which fight with Ravan till death to protect Sita Devi.

Folk history and legend remain for longer time than birds themselves, but if we want to involve local people in nature conservation it is crucial to involve local people in nature conservation to create an environment for endangered species apart from making them aware of legends and folk history associated with Vultures (Stara et al., 2005). From ecological point of view Vultures are important components of ecosystem for cleaning the dead carcasses and provide healthy environment to other living beings. Vultures are nature's most successful scavengers and they provide an array of ecological, economic and cultural services. As the only known obligate scavengers, vultures are uniquely adapted to a scavenging lifestyle. Vultures' unique adaptations include soaring flight, keen eyesight and extremely low pH levels in their stomachs (Balmford, 2013). In the present review we critically analyzed distribution, feeding, habitation, breeding and population dynamics of vulture.

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II. Taxonomic Status and Distribution

Presently 14 of 23 (61%) vulture species worldwide are threatened with extinction and the most rapid declines have occurred in the vulture-rich regions of Asia and Africa (Ogada et al., 2012). Vultures are classified in two categories i.e. new world Vulture and old world Vulture. New world Vulture belongs to family Vulturidae, which consists of seven living species, and old world Vulture belongs to family Accepitridae which consists of 16 living species. Both old world and new world Vultures are scavengers in nature and feed mostly on carcasses of dead animals. Similarities between two groups of Vultures are due to convergent evolution. Fossils record of the family Vulturidae indicate that this family was diverse and probably originated in Europe or Asia (Olson, 1978) and no fossils record of Vulturids younger than early Miocene (25 million year ago) are known in the old world (Craft and Rich, 1972). The family has become restricted to the new world Vulture, where the earliest record is from the late Oligocene.

Backer (1986) stated that Condors were large size distinct Vultures where ever they probably originated. Extinct species include the Andean Condor (Vulture grythus), California Condor (Gymnogyps callifornianus) and King Vulture (Sacroramphus papa) is intermediate in character between the Condor and the smaller vulturids (Cathartes, Coragyps) (Fisher, 1946). Recently two discoveries gave detail about fossils' histories and evolution of Vulture, the first was a partial skeleton of early Condor closely related to California Condor (Gymnnogyps callifornianus) from the early

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Pleistocene of Florida and the second is single complete torso metatarsus bone from the middle Miocene of California. This specimen has character of typical Vulturidae, including a mordantly developed inter cotylar prominence, rectangular hypo tarsus without a bony canal, deep and long ante (Cracraft and Rich, 1972).

Globally, there are 23 species of vultures, of which the majority occur in the Old World and within the family Accipitridae. Accipitridae is a diverse avian family, comprising up to 14 sub - families, 65 genera and 231 species. Some species in family Acciptridae are most threatened by anthropogenic factors belongs to 4 eagles subfamilies (Orrcaetinae, Haliaeetinae, Aqualinae and Hariinae and old world Vulture subfamilies Gypatinae and Aegypiinae). All Accipitridae species are protected under the Convention on International Trade in Endangered Species (CITES). In general Vultures do not kill their prey but have occupied a special ecological niche by feeding on carrion. The remaining seven species comprise the New World Cathartidae family. Most species occupy a range within one continent comprised of two or more countries. Four species, the Griffon vulture (Gyps fulvus), Bearded vulture (Gypaetus barbatus), Egyptian vulture (Neophron percnopterus), and Cinereous vulture (Aegypius monachus), have or historically had large ranges that span three continents. Two species, Turkey (Cathartes aura) and Black vultures (Coragyps atratus), range widely within both North and South America. Cape vultures (G. coprotheres) in southern Africa and California condors (Gymnogyps californianus) in North America have historically small ranges, though fossil evidence suggests that California condors were once found throughout the United States, southern Canada, and northern Mexico. Vulture-rich regions include Central and South America, South Asia, and Africa.

III. Food and Feeding Pattern in Vulture

It was observed that old world Vultures are thought to partition or compete for several types of resources. In Africa, where Vulture species diversity is highest, there is evidence that they compete for food (Hertel, 1994). Co-existence of two ecologically similar species within a habitat is achieved by the evolution of some degree of difference in resource use. By feeding on different foods, at different sites, or with different foraging behaviors, species can avoid competitive exclusion. Avian scavengers which feed upon an unpredictable and ephemeral resource may finely divide their food resource along one or more resource axes in order to survive. Wallace and Temple (1987) demonstrated that scavengers presented with very large carcasses in open habitat showed interference competition by establishing a dominance hierarchy among species locating the resource.

The guild of New World avian scavengers formed a dominance hierarchy with Andean Condors (Vulture gryphus) on top, followed by King Vultures (Sarcorumphus papa), Crested Caracaras (Polyborus plancus), Turkey Vultures (Cathnrtes aura), and Black Vultures (Corugyps utratus), in that order. Lemon (1991) studied about feeding pattern in Vulture and observed that feeding at large carcasses in open areas that were frequented by all the species of scavengers in the guild. The largest carcasses were opened to make them available to small scavengers and larger scavengers at the same time. More than half of the carcasses provided were burros (Equus asinus). In the forested areas of the tropics, this type of resource is unavailable.

Houston (1984) studied about searching and feeding pattern in Vultures and showed that most of the biomass available to Vultures on Barro Colorado Island, Panama, came from animals with masses less than 3 kg. Differences in foraging behavior and sensory physiology may make carrion in forest habitats less available to some species of scavengers than to others. Niche overlap may be quite different for avian scavengers feeding on small carcasses.

Vultures feed on an unpredictable and ephemeral resource. Vultures have sharp vision and good olfactory cues which play an important role in searching of food. Most of their foraging energy is spent searching for carrion, and when they find carrion, they are observed by other Vultures which quickly follow them to the food source. The carcasses they feed upon are usually not large enough to allow all Vultures to feed without some intra-specific or inter specific competition. The carcasses decompose rapidly and are only available to the Vultures during a brief time period. As a result, many Vultures are forced to feed upon a limited resource at essentially the same time. Cathartid Vultures in the lowland tropical rain forest of Costa Rica partition their feeding behavior spatially and temporally. A similar guild structure has been seen in Accipitrid Vultures in East Africa (Krunk, 1967).

The method that Vultures use to locate carrion also affects the temporal segregation of feeding. The species that feeds on a carcass first should be the species that detects it first. Turkey Vultures probably use olfactory cues to locate food while Black Vultures rely on vision (Smith and Paselk, 1986).

Stewart (1978) studied about arrival of Vultures on carcasses into different location i.e. at one place carcass placed in open area while another carcass placed under forest canopy and suggested that Black Vultures seem to follow Turkey Vultures to carrion. Black Vultures arrived first at carcasses in the open where they were highly visible, but arrived second at carcasses under the forest canopy where olfactory cues may have been more important. It appears that the species that

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was most proficient at detecting carrion in each habitat arrived first. The less proficient species had to rely on cues from the other species to provide information about the location of food. Carrion placed in the open gap habitat was located quickly because more species were proficient at detecting it. All Cathartid Vultures have acute eyesight and are able to find carcasses that are visible from above. Carcasses that were on the forest floor were harder to detect. Only those species that have the ability to detect carrion by using non-visual cues could locate it. As a result, feeding began later on carrion in primary and secondary rain forest than it did in the gap habitat.

Little is known about the foraging behavior or physiology of King Vultures and Lesser Yellow-Headed Vultures. Houston (1984) suggested that King Vultures were unable to detect carrion by the use of olfactory cues. Lemon (1991) studied about feeding behaviour of Vulture at different carcasses position and stated that the composition and behavior of feeding aggregations were different, depending upon where the food was located. When carrion was placed in the open gap habitat, either Turkey Vultures or Black Vultures were the first species to arrive and feed. Feeding aggregations in the gap habitat could be very large with three or four species represented, but no inter-specific aggression or even casual displacement was observed. Intra-specific aggression was common only among Black Vultures.

In the secondary forest, perhaps due to limited visibility and open ground, Black Vultures and Turkey Vultures foraged and fed individually or in small single species and mixed species groups. No inter-specific aggressive encounters or displacements were seen. Under the primary forest canopy, where carcasses were obscured from view of birds above the canopy, Turkey Vultures or Ring Vultures were the first species to arrive. Ring Vultures were frequently the first birds to locate a carcass and would feed upon it before Turkey Vultures arrived. On one occasion, Turkey Vultures located a carcass 15 meter away from the edge of a gap in the primary rain forest and approached the carcass from downwind, flying back and forth perpendicular to the wind direction. As they were approaching and descending toward the carcass, a large group of Black Vultures from a nearby roost tree joined them. The Turkey Vultures began feeding first, and the Black Vultures began feeding moment’s later.

Sidiropoulos et al., (2005) studied about the utilization of an Artificial Feeding Site (AFS) by carrion eating birds in Pinovo, a mountain chain near the northern Greek borders, which is one of the most important areas for Raptor conservation in the Balkans and observed seasonal variation among different species of Raptors. Of the 31 species of birds of prey recorded in the area, including all four species of European Vultures were observed feeding, along with corvids. Raven was the most regularly observed species, followed by the Golden Eagle, especially in winter. The Egyptian Vulture was the most regular Vulture species in the AFS during spring and summer months, while Griffon Vultures were abundant in autumn. Especially in autumn Griffon Vultures concentrated and some remain in the area up until late November, because of the continued supplementing of the AFS. The Bearded Vulture seems to use the AFS mainly from late winter to early spring, coinciding with its regular presence in the area. Common Ravens may appear in large concentrations all year-round.

Rebnold (1987) studied about searching behaviour of food in Black Vultures and observed that adults arrived at baited sites earlier than young adults and juveniles. During natural roost departures, adults were as likely to depart at the head of departing groups as at the rear, while young were concentrated in the rear. Birds removed experimentally from the population long enough to be naive about the location of food followed others from the roost when reintroduced. Control adults (birds caught and handled but not restrained for long) were not concentrated in the rear of roost-departing groups, as were experimental adults. Juveniles tended to follow regardless of recent experience.

Krik et al., (1995) investigated the role of social dominance in habitat use by flocking migrant and resident Turkey Vultures (Cathartes aura meridionalis and Cathartes aura ruficollis). Migrants foraged primarily in savanna habitats while residents foraged almost exclusively in gallery forest. In the gallery forest residents discovered carrion first significantly more often than migrants, despite there being equal densities of residents and migrants foraging over this habitat. Because residents fed in smaller groups than migrants at carcasses they had higher feeding rates. There was also a negative relationship between group sizes of residents and migrants. The feeding rate of residents declined in response to increased group size of migrants, but group size of residents had no effect. Migrant group size also had a greater effect on resident feeding rates than King Vulture presence or absence.

The effect of migrant and resident group size on feeding rates in migrants was compared, the most significant factor was migrant group size. A second analysis showed that both resident group size and presence or absence of king Vultures had a significant effect on feeding rates in migrants. Rates of agonistic encounters in migrant and resident Turkey Vultures increased weakly in relation to group size. However, there was an increase in residents' encounter rate with migrants in relation to increased migrant group size. Migrants dominated residents in almost all agonistic interactions over carcasses and suggested that savanna habitats were less attractive to residents for foraging because they held larger groups of migrants.

Animal carcasses appear with a variable spatio-temporal predictability (Ostfeld and Keesing, 2000) and affect ecosystem diversity and functioning. They provide the primary food resource for guilds of scavengers composed not only of specialist but also of facultative carnivore and avian scavengers (Wilmers et al., 2003). These aggregations of facultative scavengers, which are also important predators, can increase predatory pressure in the area surrounding carcasses having profound impacts on prey species (Avizanda et al., 2009).

A particular case are the so-called 'Vulture restaurants' (places with a constant carcass supply) which are increasingly considered key management tools in the worldwide conservation of endangered scavenger populations (Koenig, 2006). However, this management action can trigger local scale processes associated with the attractiveness of Vulture restaurants for facultative scavengers (Piper, 2006).

Carcasses can play an important role in ecosystem diversity and community structure (Devault et al., 2003). Fresh carcasses in the form of scattered and concentrated at predictable sites such as Vulture restaurants, can increase nest predation risk in their immediate surroundings due to the aggregation of scavengers which are also facultative predators. The area with a relatively simple vertebrate community, should be taken into account when considering other regions where much more complex assemblages of carrion-eaters with broad trophic niches are present (Travaini et al., 1998).

The Vulture restaurant is a special case of a carcass site where facultative scavengers concentrate permanently because of a constant food supply. There, the probability of predation risk could be persistent over time, having a stronger effect on the population dynamics of prey species. Previous studies by Kristan and Boarman; 2003 and Avizanda et al., 2009 support this possibility.

Bertan et al., (2004) studied about inter-species interaction and suggested that aggressive interactions between Bearded Vultures and Ravens are the result of the coexistence between one species whose feeding habits facilitate kleptoparasitism and another species that is highly opportunistic and constitutes a potential predator. The aggressive behaviour of Bearded Vultures towards Ravens appears to be directly associated with the defense of the nests and its intensity is related to the age of the chicks and supported by the fact that most attacks (92%) were initiated from the nests or adjacent sites. Aggressive behaviour frequently much high during hatching period and the first month of the chick's life when vulnerability to predation is higher. It was not found that pairs which received a higher frequency of attacks in their nesting areas displayed a higher defensive in-both the difference in the size of the two species and the type of food manipulated by the Bearded Vulture affect the Raven's parasitic efficiency.

The negative effects of coexisting with the Common Raven for the Bearded Vulture appear to be more closely associated with the costs derived from nest defense and nesting space. However, although the frequency of intrusions by the Raven in the nests might be considered low, the Bearded Vulture's defensive behaviour suggests there are real predation risks during the initial phases of the breeding period when the chicks (due to their size)may be more vulnerable.

IV. Nesting and Roosting Pattern in Vulture

Snow and Pernis (1998) studied about nesting and roosting pattern in three species of Vulture i.e. Himalayan Griffon, Eurasian Griffon and Lammergeier Vulture and estimated that all three species probably nest at the same time on the Tibetan plateau. Egg-laying by Lammergeiers on the Tibetan plateau occurs in late February or early March. For Himalayan Griffon, if the duration of the breeding cycle is similar to that of Eurasian Griffons in Europe, then initiation of nesting on the Tibetan plateau should occur in about early March (Snow and Perrins, 1998). Saker Falcon chicks have been observed in nests on the plateau in June and in nearby low land central Asia their chicks fledge in early July.

Due to low nest site availability these birds may have been forced to nest in closer proximity to each other than usual. Third, in nearly all other areas where Lammergeier and Eurasian or Himalayan Griffons coexist, they share resources with a third species of Vulture. Because these two species are the only large Vultures in this region (Cinereous Vultures are uncommon in this part of Qinghai), inter-specific competition may be less than in other places where they co-exist. Eurasian Griffon colony size and level of aggression by Lammergeiers have been shown to be positively correlated (Bertran and Margalida, 2002). Himalayan Griffons, because of their semi- or non-colonial nesting, may provoke less response from Lammergeiers.

Katzner (2004) stated that Saker Falcon Falco cherrug at the cliff exhibiting apparently territorial behaviour. When approached the cliff, the bird flew repeatedly from a roost circled above the area calling extensively, and returned to the cliff face. Although by this way unable to determine the age of this bird or to locate a nest, this bird's behaviour was consistent with that observed at Saker Falcon nests with chicks in other locations in the region.

Lambertucci et al., (2008) states that new world Vulture Andean Condors use cliffs with shelves as communal roosts in northwestern Patagonia, Argentina. There was a strong seasonal pattern in roost use and use also varied among roosts, possibly due to differences in their environmental characteristics, size, and room available for roosting, as well as proximity to nest sites and stage of the breeding season. Differential use of roosts among age classes, spatial segregation seems probable and concludes that intensive censuses of communal roosts can provide useful information about the size, status, and dynamics of local populations.

To determine Vultures nest properties and nest trees characteristic study was carried out in Europe. Nest structure was detected and nest-tree characteristics evaluated in the Türkmenbaba Mountain, Eskisehir (northwestern Turkey), where the largest Aegypius monachus colony in the country exists. Individual nest and nest trees preferences were identified. The diameter axis of nest, diameter axis of nest cup and nest thickness as nest properties and tree species, height of nest tree, diameter at breast height (DBH), aspect of tree, trunk shape, nest-tree branches, the conditions of nest tree and crown class of nest tree as nest tree characteristics were examined. The nest structure measurements indicated that the mean nest diameter was 176.9 ± 42.63 cm, nest thickness was 37.13 ± 15.05 cm. and cup diameter was 62.11 ± 10.49 cm.

Aegypius monachus invariably nests on flat-topped Pinus nigra trees with a height of 11.47 ± 3.87 m. (mean ± SE) and DBH of 42.91 ± 7.36 cm. Aegypius monachus showed a preference for building their nest on trees containing <20 branches per trunk and intermediate or upper level of canopy. Aegypius monachus prefers older and mature Pinus nigra trees in Türkmenbaba Mountain. Therefore, the preservation of these kind of trees is essential for the survival of the species and should be incorporated into management plans (Yamac et al., 2005).

In Spain, the study about age determination of chicks in nest was carried out by attaching transmitters. It is often very useful to know the age of chicks in the nest. For instance, if activities such as ringing or attaching transmitters are to be carried out correctly, it is essential to know the age of the pulli before accessing the nest. If chicks are tagged at the wrong age there is the risk of unnecessary disturbance or even serious problems. The monitoring of a Black Vulture colony comprises relatively few visits to the colony, so it is not being possible to accurately determine the laying or hatching dates for most of the clutches. With this information and knowledge of the average incubation period for the species, it would be possible to accurately estimate the age of pulli in the nest that can be seen well through a telescope. Twelve development stages of the pullus, specifically 10-day periods, from birth until fledging approximately 120 days later, digiscoped photographs taken weekly at four nests of black Vultures, where the precise hatching date of the chick was known. On the basis of different stages of development of pulli, the age of chick was determined. Additionally, several hundred digital photographs, taken at the time of ringing of about 65 chicks of known age, have been used. The information used within this study was gathered during monitoring carried out at the Black Vulture colony at Rascafría (Madrid, Spain) in years 2004 and 2005 knowledge of breeding phenology of both pair and colony as a whole is important for their management and conservation (Puente et al., 2005).

In northern Spain, density and nest-site selection in the Egyptian Vulture was investigated. The breeding density is positively correlated with the availability of cliffs and independent of trophic resources and human activities. The positive or negative selection of a particular cliff for nesting seems to be determined by intraspecific competition (Ceballos et al., 1989).

Parker et al. (1995) suggested that Black Vultures, Coragyps atratus, spend each night in a communal roost, and individuals sleep at several different roosts over time. They feed in large aggregations at carcasses and engage in apparently cooperative behaviour within coalitions of individuals that co-occur predictably at both roosts and carcasses. Roost census data and DNA fingerprinting results were used to investigate whether Black Vultures tend to roost in the company of genetic relatives. A positive correlation emerged between indices of the genetic similarity of individuals and their tendency to use the same roost on the same night. The results provide evidence of long-term associations between some closely related breeding adults, associations that appear not to be simply a consequence of natal philopatry but reflect the daily reassembly of coalitions at communal roosting sites. This social organization could facilitate the evolutionary stability of cooperation among communally roosting black Vultures.

Avizanda et al. (2009) studied about nest predation of Bearded Vulture and suggested that the eggs were extracted, broken and eaten in the immediate vicinity of the nest and, when available, the structure of the nests was completely destroyed. On many occasions common Ravens predating on nests in this fashion. Lines with carcass presence showed higher predation rates (8–92%) than their respective paired lines where carcasses were absent (0–12%). The probability of nest predation increased with carcass availability and raven abundance but decreased with vegetation cover.

The Bearded Vulture, like most Raptors, is territorial and strongly defends its nesting space from potential competitors through aerial attacks (Bertran and Margalida, 2002). Aggressive interactions between Bearded Vultures and Common Ravens Corvus corax are relatively common; observations of several pairs in the Pyrenees revealed that 26% of the territorial attacks were directed against Ravens. Aggressive interactions between both species have been reported in the areas where the two coexist (Margalida et al., 2001).

Territoriality frequently involves protecting offspring and food. Another risk of predation exposure for eggs and chicks can occur occasionally when certain factors i.e. Human disturbance, looking for and preparing food lead the birds to temporarily abandon their nests, and it was observed in other large Raptors. Aggressive encounters initiated by Ravens tended to be more frequent in the middle of the chick-rearing period. This coincides with the stage when the Bearded Vulture pairs are more active, moving around and preparing the remains in the ossuaries (Margalida and Bertran, 2001). The Raven is a species that exploits a great variety of food sources, which includes the soft parts attached to the bones of the carcasses (Hiraldo et al., 1991).

Ravens are agile flyers with strong talons, in this case the difference in size between Ravens and Bearded Vulture does not favour robbing food in flight. There was a high attack rate (75%) directed against Bearded Vultures in flight, more commonly when they entered or left their nests. Unlike other scavengers, the Bearded Vulture (depending on the size of the conspicuous shape) carries its prey in its talons or bill (Margalida and Bertran, 2000). Other species such as the Eurasian Griffon Vulture Gyps fulvus, which carries semi-digested food to the nest in its crop, have not been observed interacting with Ravens. This appears to indicate that Ravens carry out routine attacks when they notice the presence of potential hosts in the vicinity of the nests. One possible advantage of this behaviour is that Ravens, through harassment, can force the Bearded Vulture to land on the ground.

V. Reproductive Biology of Vulture

In Europe, Eurasian Griffon Vulture Gyps fulvus compete extensively with Lammergeier Vulture Gypaetus barbatus for nest sites (Bertran and Margalida, 2002). Evidence of inter specific aggression at nest sites also has been observed between Eurasian Griffon and Cinereous Vultures Aegypius monachus and between Eurasian Griffon and Egyptian Vultures Neophron percnopterus, and between Cinereous Vulture and Bearded Vultures (Aykurt and Kiraç, 2001). Nest-based inter specific aggression between Vulture species or between Vultures and other Raptors is frequently strong enough to have negative reproductive consequences (Matus, 2002). Lammergeiers are solitary breeders, often occupying nests high on cliffs in mountains or river valleys (Snow and Perrins 1998).Their nests are often, but not always, well-spaced from conspecifics and other Vultures. Himalayan Griffon is one of the world's least-known Vultures. Some reports suggest that they are not colonial breeders while others suggest that they are semi-colonial (Bertran and Margalida, 2002).

The study about Egyptian Vulture population trend between1988–2005, and the number of breeding pairs and reproductive performance were carried out in Castellon province of eastern Spain by Ripolles et al., 2006 and suggested that the number of breeding pairs increased from one pair in 1989 to 12 in 2005, probably due to the absence of poisoning and direct persecution in the Castellón province. From 2003–2005, 34 breeding attempts at 23 different breeding sites observed and mean chicks fledged per occupied territory was 0.91 ± 0.08, mean chicks fledged per successful pair was 1.20 ± 0.09, and mean breeding success was 0.76 ± 0.07 successful pairs per breeding pair in a tropical forest than it is for those same scavengers feeding in a coastal desert. In a tropical rain forest, competition for a dispersed, ephemeral resource may depend upon differential exploitation rather than interference.

The mean age of first breeding (egg-laying) in the captive population of Bearded Vultures was 7.7 years for females and 8.9 for males. The first offspring was raised on average by 8.3-year-old females and 9.7-year-old males. In wild Bearded Vultures, first-time-paired and territorial individuals were recorded when they were 6.5 years old, on average. The mean age of first breeding was 8.1 years, whereas the mean age of first successful breeding was 11.4. Paired females were recorded at the age of 6.5 years and breeding at 6, whereas the youngest recorded paired males were 6.4 years old and breeding at age of 7 year. Pyrenean Bearded Vultures are characterized by delayed reproduction, with the first breeding attempt taking place well after the acquisition of full adult plumage.

Gilbert et al., (2002) investigated the breeding success and pattern of mortality in two Vulture colonies Dholewala and Changa Manga area within Punjab Province, Pakistan between December 2002 and June 2000.Breeding success was found to be 62% in Dholewala and 59% in Changa Manga area. A total of 668 sick and dead Vultures were collected of which 591 were less than one month post mortem. No significant variation was found in the weekly mortality rate of adult and sub-adult Vultures during the study period spanning winter through summer. A peak in mortality rate was observed during late April and early May that corresponded to mortality of newly fledged juveniles. Minimum annual mortality rate in the adult breeding population was calculated to be 11.4% and 18.6%in Dholewala and Changa Manga respectively. In a subsample of dead Vultures (n = 185) visceral gout was found in 80%of adults, 63% of subadults, 19% of juveniles and, 13% of nestlings. These mortality rates were consistent with a rapid population decline. Results imply that the mortality factor responsible for the decline in Gyps Vultures described in India is also present in Pakistan and will potentially lead to a population decline of a comparable magnitude.

In birds laying a particular number of egg in generally believed to be in part genetically determined and consequently subject to natural selection, but in many species clutch size is known to be strongly influenced by ontogenic and environment factor. Species with variable clutch size most biologists would conclude that upper limit to clutch size is ultimately determined by natural selection. The clutch size of each species of birds has been adapted by natural selection to correspond with the larger number of young for which the parents can on an average provide food. Cody (1971) suggested that nine different factors known to influence the clutch size, age of parent, time of breeding food supply, population density, latitude, longitude, elevation, habitat and nest site.

Avian growth pattern are diverse and have evidently differentiated in response to a variety of social and environmental variable, including most prominently the mode of parental care and the predictability and the stability of food supply for the young. The intrinsic rate of post natal growth appears to have been maximized through selection, so that seasonal or geographical difference are absent or small except in obvious cases of malnutrition.

VI. Flight Development in Vulture

Donazari et al., (1996) stated that in Northern Spain the first flights of fledgling Egyptian Vultures Neophron percnopterus took place between at the age of 68-80 days. The post-fledging period ended when the young migrated (at the age of 89-113 days). The length of the post-fledging period was between 9-34 days and correlated negatively with the date of first flight. The number of flights carried out per day, the flight duration, the time spent flying, the time spent soaring and the size of the home range increased with age. Older fledglings in broods of two were more precocious and active in flight than their siblings. The young followed their parents during their visits to feeding places; this behavior is unusual among Raptors and may be related with maturation of social foraging strategies.

Information on the length of post-fledging and the development of behavioural patterns for old world Vulture is very limited. After attaining flight, young Vultures should be capable of searching for carcasses and feeding by themselves, rapidly becoming independent and there is prolonged parental care due to the need to obtain a scarce and unpredictable food resource

VII. Population Genetics of Vulture

Chromosome studies in 4 families of Falconiformes i.e. Cathartidae, Falconidae, Sagittariidae and Accipitridae showed that the karyological variety in this order is much wider than in any other avian order, which underlines the heterogeneous character of the group. Of the 4 families only the Cathartidae show karyological similarities with other avian groups (Gruiformes, Ciconiiformes), while the karyotypes of the Accipitridae are most uncommon among birds, because of the presence of only 8 microchromosomes (Boer, 2006).

Gautschi et al. (2003) suggested that captive population to be genetically more variable than the largest natural population in Europe, both in terms of mean number of alleles per locus and mean observed and expected heterozygosity. Allelic diversity of the captive population was higher and mean heterozygosity measurements were comparable with the ones found in two large, extinct populations from Sardinia and the Alps represented by museum specimens.

The amount of genetic variability were still high in the captive population of Bearded Vulture in the year 2000, mainly because the carriers of rare alleles were still alive. However, the decline in expected heterozygosity and the loss of alleles over generations in captivity was significant. Point estimates of effective population size, based on pedigree data and estimates of effective number of breeders, based on allele frequency changes, ranged from 20 to 30 % and were significantly smaller than the census size. The results demonstrate that the amount of genetic variability in the captive Bearded Vulture population is comparable or even larger than the amount present in natural populations. However, the population is in danger to lose genetic variability over time because of genetic drift. Management strategies should therefore aim at preserving genetic variability by minimising kinship, and at increasing effective population size by recruiting additional founders and enhancing gene flow between the released, the captive and natural populations.

Manuel et al., (2007) suggested that the toll-like receptor (TLR) family is an ancient pattern of recognition for Raptor family and conserved from insects to mammals. Members of the TLR family are vital to immune function through the sensing of pathogenic agents and initiation of an appropriate immune response. The toll-like receptors complementary DNA encoding for a Gyps fulvus is orthologue of mammalian TLR1 (CD281). The predicted 650 amino acid sequence comprised an extracellular domain with five leucine-rich repeats (LRR) and an LRR-C-terminal (LRR-CT) motif, followed by a 23 amino acid transmembrane segment, and a 190 amino acid intracytoplasmic region containing the Toll/IL-1R (TIR) domain.

Vulture TLR1 and TIR domain showed 64% and 86% amino acid sequence similarity with chicken sequences. The tissue and cell expression pattern of Vulture TLR1 were analysed by real time-PCR (RT-PCR) and correlated with the ability to respond to various pathogenic challenges. Despite the similarities in the overall structure and expression pattern of Vulture TLR1 with other vertebrate TLRs, the length of the Vulture TLR

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ectodomain, number and position of LRRs and N-glycosylation sites suggest structural differences that may have functional implications.

Nanda et al. (2006) suggested that most of Acciriptids including Hawks, Eagles, Kites and old world Vulture (Falconiformes) show a sharp contrast to basic avain karyotype. Most of Acciriptids exhibit stingingly few micro-chromosome and appear to have been drastically restructured during evolution. Chromosome paints specific to the chicken(GGA)macro chromosomes 1-10 were hybridized to metaphase spreads of three species of Vultures (Gyps rueppelli, Gypaetus barbatus and Gyps fulvus).

Paints of GGA chromosomes 6-10 hybridize only to single chromosome or large chromosome segments, illustrating the existence of high chromosome homology. In contrast, paints of the large macrochromosome 1-5 show split hybridization signals on the chromosomes of the accipitrids, disclosing excessive chromosome rearrangements which is in clear contrast to the high degree of chromosome conservation substantiated from comparative chromosome painting in other birds. Furthermore, the GGA chromosome paints hybridization pattern reveal remarkable interchromosomal conservation among the two species Gyps rueppelli and Gypaetus barbatus of the genus Gyps.

VIII. Population Dynamics of Vulture

Satheesan and Shamshad, (2005) suggested that, Katerniaghat Wildlife Sanctuary in Uttar Pradesh continued to be paradise for wild life fauna. This protected area spread over 400 sq. km harbours the Tiger, One-horned Rhinoceros, Elephant, and Leopard in India and bordering Nepal, as well as Crocodile, Gharial, and the Gangetic Dolphin in the Gerua river. In this Forest Division in Bahraich District 28o 24'- 27o 4'N to 81 o 65'- 81 o 3'E covering 551.64 sq. km, 575 Vultures of five species (Long-billed and Eurasian Griffons, and White-backed, King, and Egyptian Vultures) and 31 nests of the Oriental White-backed Vulture Pseudogyps bengalensis were sighted in February 2002. But their actual population may be much more because of the proximity to Nepal and the Himalayas. The reduced population of White-backs observed here resembles similar trends in population decline observed during the rains elsewhere. Moreover, Vultures return to Katerniaghat to breed year after year, further confirmed by the vestiges of nesting materials detected on, and wing primaries found below Semal and Haldu trees. Factors responsible for Vulture decline here, including man-animal and animal-animal conflicts and other threats. Vultures here need immediate and total protection so that they can continue to "fire-wall" tigers on the prawl in sugarcane fields, crocodiles lurking in lotus ponds and other species against deadly pathogens and maintain the health of ecosystems network.

The current state of Griffon Vulture local population in the Gorge Uvac and its geographical position (located in northeast direction some 168 km far away) offer opportunities for spontaneous recolonisation of previously abandoned habitats in Herzegovina in Europe. This is supported by the fact that during winter months young birds from Serbia migrate through Herzegovina. On the other hand, during this phase of their life cycle, they are facing risk to be poisoned. Presented results could be used as a basis for planning protection and reintroduction of Griffon Vulture in Herzegovina. Successful protection and reintroduction achievements of Vulture species in Spain and France confirmed that it is possible to return these species on locations from which they have already vanished. By launching the Action Plan for Vulture protection in the Balkans, Bosnia and Herzegovina got the opportunity to be included in reintroduction programmes of endangered Vulture species. A long term study (1980-1991) has been performed, using census of nest and nesting couples. During this period, 61 nests, 83 nesting couples and 252 cases of nesting have been observed in four colonies of Griffon Vulture. During this period, 6 nests and 10 cases of nesting have been observed for the Egyptian Vulture. One pair of Bearded Vulture has been observed; however, the nest was not found (Marinkovic et al., 2005).

One of the most threatened bird species in Cyprus is the Griffon Vulture, which thirty years ago used to be a fairly common species on the island. The protection and conservation of rare Raptor species such as the Griffon Vulture can be significantly supported by artificial reproduction. Eggs normally are lost by parental neglect, predation, extreme environmental conditions, pathogen infection and other calamities. Vultures lay a second clutch to replace eggs that are removed for artificial incubation and through this achieved double reproduction since Vultures lay only one egg every year. For the conservation of the Griffon Vulture in Cyprus, many management measures and activities were implemented in order to contribute towards conserving the indigenous Vulture population. Among these measures, a cage with the proper specifications was constructed to encourage breeding in captivity in the cage. An attempt was made successfully in 2004 for artificial reproduction of a Vulture under laboratory conditions. The egg was removed from a pair in captivity and after it was incubated artificially it was placed in a nursery for a certain period and then in an artificial nest until the age of 4 months old. Then it was transferred back to the cage where its natural parents were found when it was ready to survive by itself without any human support (Iezekiel et al., 2005).

White-rumped Vulture Gyps bengalensis was once abundant in South-East Asia and in the Indian subcontinent. Vultures have declined from many parts of their former ranges due to food shortages and loss of habitat (Pain et al., 2003). Eight species of Vultures have been recorded from Nepal, of which six are resident and two are migratory. White-rumped Vulture is reported up to 3100 meter, although it is most common up to about 1000 meter. In Nepal Koshi Tappu Wildlife Reserve (KTWR), Royal Suklaphanta Wildlife Reserve (RSWR) and the unprotected Rampur Valley are still strongholds for the species Gyps bengalensis.

Vulture population declines may have not noticed for many years simply because they were so abundant. The monitoring of colonies indicates that Gyps Vulture populations have been declining throughout their range in Nepal (Virani et al., 2001). Gyps bengalensis, once distributed throughout the lowlands of Nepal, now patchily distributed, being rarer in the east (Inskipp and Inskipp, 2001; Virani et al., 2001 and Baral and Gautam, 2002). During 2001–2002, 45 White-rumped Vultures were found dead in eastern Nepal, compared to only five in western Nepal (Virani et al., 2001). This suggests that mortality factors were less prevalent in the west or it may reflect lower survey effort in the east.

Baral et al., (2005) conducted a survey of the critically endangered White-Rumped Vulture Gyps bengalensis in lowland Nepal from October 2002 to May 2003. Direct observations were made at roosting and nesting sites to assess the population size, breeding success and nest-tree availability. A questionnaire survey was conducted to assess carcass disposal methods, threats from persecution and conservation attitudes. Six Vulture colonies were found, which supported 72–102 birds during the breeding season, and 123 birds following the breeding season. Breeding success at 70 occupied nests was 0.5 young per nest. Most nests were in kapok Bombax ceiba trees, and nesting habitat may be a limiting factor because these trees are logged for commercial purposes. A total of 33 dead Vultures was found, of which 30 were adults.

The carcasses of domestic livestock appear to be the main source of food for Vultures because there are few alternative wildlife prey species in the surrounding habitats. The abundance of carcasses observed suggests there is no shortage of food. Local people have favourable conservation attitudes, and their carcass disposal method is beneficial to Vultures.

IX. Seasonal Fluctuation in Vulture

Vultures show large level of seasonal fluctuation in their number to fulfill their requirement such as food availability, nesting and roosting site availability. Monitoring of bird population is often difficult as most species are territorial and sparsely distributed over sizeable area. Birds density exhibits local seasonal fluctuation and their activity may vary throughtout year. Usually Raptor censuses are restricted in breeding season when rapid changes in their detectibilty take place. In case of polonial and flocking Raptors census work is facilated by tracing the birds in localized area such as their colonies and communal roost.

The Vulture of genus Gyps are large gregarious species that breed colonially in cliffs, forming large nesting groups. Improved monitoring technique consist of counting birds at their breeding and roosting sites early in the morning and late in the evening before or after their foraging trips (Robertson and Boshchoff, 1986).

The behaviour of communal roosting is well documented among old and new world Vultures as well as in some flocking eagles. Seasonal fluctuations in roost size are typical for the migratory Egyptian Vulture Neophron percnopterus and for small cathartid Vultures (i.e. Cathartes aura, Coragyps atratus), which gather year round at persistent communal roosts. The temporal variation in the use of communal roosts is produced by different ecological pressures such as roost type, levels of human disturbance, climatic conditions and food availability. Some species are restricted to big dead trees which can support many birds and have easy access. While others select trees with thick foliage where favorable microclimatic conditions occur (Wright, 1986).

Xirouchakis (2007) suggested that morning and evening counts in Griffon Vulture Gyps fulvus colonies and communal roosts revealed that their numbers fluctuated by season and time of the day. In the colonies the Vultures built up high numbers during the pre-breeding and incubation periods (November–February) with maxima in December–January and dropped during the fledging and dependence periods (July–October) with minima in June–July. On the contrary griffons started to use communal roosts during the chick-rearing period (March June) while their numbers peaked when the young fledged (June–August). Daily use of colonies exhibited a bimodal pattern that was most pronounced in the pre-breeding period. Population size should be assessed by conducting morning counts starting at dawn in all active colonies and communal roosts during November–February.

X. Vulture and Human Interaction

Vulture is shy in nature and does not directly interact with human being but in indirect manner Vulture and human interact with each other. The traffic load near large cities may show dramatic cyclical changes induced by weekend tourism, and this could induce cyclical changes in the activity patterns of wildlife. Bautista et al., (2004) studied a 19-km-long section of a road that crossed a high-use Raptor area near a large city in Spain and observed 18 Raptor species along this segment of the road, including some threatened species, such as the Spanish Imperial Eagle (Aquila adalberti). The number of cars increased dramatically on Saturdays and Sundays and assessed the effect of varying traffic loads on Raptor behavior by recording all birds of prey as close or distant to the road during working days and weekend days.

On weekends, the occurrence of Spanish Imperial Eagles and Vultures decreased near the road. The occurrence of other species did not change between working days and weekend days. The activity decrease on weekends by Imperial Eagles and other large Raptors suggests that there are weekly cycles in Raptor activity and these weekly cycles in wildlife caused by human.

Arroyo et al. (2006) evaluated the effect of human activities on the behaviour and breeding success of Bearded Vultures breeding in the French Pyrenees. Human activities influenced Bearded Vulture behaviour (primarily through a decrease in nest attendance), but this effect varied in relation to the type of activities and the distance to the nest. Very noisy activities and hunting most frequently provoked nest unattendance even when occurring far (>1.5 km) from the nest. People on foot or cars and planes only affected Bearded Vulture behaviour if close (<500–700 meter) to the nest and also find a significant relationship between human activities and Vulture breeding success. The probability of failure increased with the frequency of human activities. There was a significant relationship between the probability of failure and the frequency of very noisy activities.

Houston (2008) states that Carcasses were provided at a gallery forest site in Venezuela to compare the feeding methods of four different Vulture species. Turkey Vultures or Lesser Yellow-headed Vultures were always the first species to arrive. Black Vultures were most likely to arrive at large carcasses or those in open situations and were the only species to form large feeding groups. King Vultures were equally likely to arrive at small or large carcasses. There were marked differences in feeding technique, food selection, rate of feeding and bill morphology between Turkey, Black and King Vultures, and the level of aggression between species was low compared to intra-specific aggression.

XI. Vulture Conservation Programme

Surveys on the population status of Vultures suggested that in the last decade there has been drastic crash in Vulture population observed. To save its population it is necessary to run various Vulture conservation programmes. Piper (2006) stated that, three forms of supplementary feeding schemes have been used in Vulture conservation; pure supplementary feeding, predator simulation and Vulture restaurants. Supplementary food will only contribute to the conservation of a species if food is the crucial limiting factor. If the population is limited by poison then the provision of clean food will only contribute if it can be ensured that the Vultures will not consume any poisoned food. In some cases, if the poison is lethal, diffused throughout the carcass and not biodegradable (in either the carcass or the Vulture) then there need only be one poisoned carcass in about 250 for the entire population to be extirpated.

The provision of supplementary food must be accompanied by a well though out action plan that simultaneously deals with the other important population threats. Supplementary feeding programmes must be implemented with a careful understanding of the demography of the species and its social structure. For instance, the regular provision of small quantities of food at a few fixed sites in the Negev Desert was of greater benefit to adult birds while the provision, randomly in space and time, of a few large carcasses was of much greater benefit to immature and subdominant individuals.

Conservation actions and reintroduction programmes have been carried out to restore viable populations of Griffon Vulture in the South of France. Demographic and genetic studies were run to assess and understand the success of these programmes. By using micro-satellite markers, investigated genetic diversity and structure of three native colonies that were spatially fragmented around the Mediterranean basin. Assessment of the genetic characteristics of four founder groups of reintroduction programs, and two settled reintroduced colonies in France were carried out and found that all studied populations of Griffon Vulture form only one genetically diverse unit, in which restricted gene flows between some colonies could lead to genetic differentiation. All Griffon Vulture colonies should be managed as one unit, optimising connections between them and random sampling of individuals among remnant populations of Griffon Vultures permits us to constitute highly diverse founding groups. Genetic diversity is preserved in the reintroduced colonies, probably because of high immigration rates of Pyrenean or Spanish individuals. Vulture genetic diversity reintroduction has been a success from the genetic point of view.

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