

Food consumption by captive Indian White-backed Vultures *Gyps bengalensis* under different feeding conditions

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Summary

A series of experiments were conducted in the aviary to study the extent of food consumption of Indian White-backed Vultures *Gyps bengalensis* individually and in groups under varying feeding conditions. Twenty-four Indian White-backed Vultures were caught, ringed and some were housed individually and some in different-sized groups in cages (1.5 x 1.5 x 2 m) and in an aviary (27 x 45 m). The birds were provided with known quantities of fresh meat daily and at intervals of two, three, four and five days. It was found that the average consumption rate of individual and grouped birds at one, two, three, four and five days intervals was 300 g, 516 g, 585 g, 634 g and 659 g individually and 293 g, 547 g, 592 g, 699 g and 713 g in groups, respectively. The average consumption rate of putrefied meat of two, four and six days old by vultures that were starved for four, six and eight days was 408 g, 283 g and 161 g, respectively. This paper discusses consumption of meat by captive Indian White-backed Vultures under varying feeding conditions.

Introduction

The Indian White-backed Vulture *Gyps bengalensis*, presently a critically endangered species, was formerly widely distributed in India, from the Himalayas west to Srinagar, east to Arunachal Pradesh, Assam and the north-east hill states, south to the southern Western Ghats in Kerala and Tamil Nadu (Islam & Rahmani 2002). The survival of this species is now at stake since vultures have to go without food for prolonged periods, which in turn may affect their immunity and organisms that inhabit the gastrointestinal tract and can cause disease if activated (Singh & Sherikar 1999). This species has suffered an extremely rapid

population decline, particularly across the Indian subcontinent, probably as a result of disease compounded by poisoning, pesticide and change in the pollution procedure for processing dead livestock (Islam & Rahmani 2002). The diclofenac drug has also been implicated in its population decline (Sridhar & Chakravarthy 2004).

Feeding trials were conducted to determine the food requirements of vultures subjected to different lengths of starvation time under in situ conditions. Experiments were conducted between 1986 and 1989 under "Bird Menace to Aircraft" project, sponsored by Aeronautics Research and Development Board (A.R.D.B.), Ministry of

Defence, Government of India, through the Bombay Natural History Society (B.N.H.S.), Mumbai, to get an idea of the amount of artificial food required to draw birds away from airports.

Material and methods

An aviary was constructed at Kora Kendra, a carcass processing plant, at Bapane, Vasai Taluka, Thane District, about 60 km from Mumbai on the National Highway-8. This aviary was also subdivided into individual cages (see Figures 1 & 2).

Twenty-four adult Indian White-backed Vultures were caught with the help of a specially constructed and manually operated net set up before dawn (05h00) and before the arrival of vultures at carcasses in the Gir forest, Gujarat State, after obtaining permission from the government authorities. The birds were transported in a four-wheel-drive vehicle to Kora Kendra.

In the first set of experiments, observations on the consumption of fresh meat were made. Twelve randomly-selected adult vultures were each housed in separate 1.5 x 1.5 x 2.0 m (l x b x h) wire mesh cages. The birds in individual cages were provided with fresh drinking water in plastic pans of 0.45 x 0.60 m and a perching site in the form of a horizontal wooden pole of length 1.5 m. Similarly a group of 12 marked birds (colour metallic bands on legs) were housed in an aviary (27 x 45 m). In the aviary the birds were provided with fresh drinking water in

a concrete tank (1.5 x 3 m) and horizontally fitted 3.6 m long bamboo poles at 2 m for perching. Weighed quantities (5 kg) of fresh meat of cattle and buffalo were provided to the vultures at intervals of one, two, three, four and five days. Vultures for one-day starvation interval were subjected to 30 treatments, for two days starvation interval to 16 treatments, for three days starvation interval to ten treatments, for four days (starvation) interval to six treatments and for five days (starvation) interval to four treatments, respectively. The amount of food consumed by each bird was determined by weighing the leftover meat. These experiments were run for eight months.

In the second set of experiments, observations on the consumption of putrefying meat (left at room temperatures of 25–30°C from 2–6 days) were conducted on the same birds inside the aviary after an interval of 28 days. Three birds together were housed in one cage and two such cages of six vultures formed one set. There were three such sets of vultures which were subjected to three different experiments: (a) one set of six vultures was offered a weighed quantity of two-day-old putrefied meat at an interval of four days starvation, (b) the second set of six vultures was offered four-day-old putrefied meat at an interval of six days starvation and (c) the third set of six vultures was fed six-day-old putrefied meat at eight days starvation interval. Fresh drinking water was provided daily.



Figure 1. Full view of the aviary and part of the carcass processing plant at Kora Kendra.



Figure 2. Vultures in the cages inside the aviary at Kora Kendra.

Results

Individual consumption of fresh meat

The average consumption rate of known quantity of unlimited fresh meat by vultures when offered at one-day intervals (i.e. daily) varied from 101 to 517 g/day. Among the 12 birds (with 30 replications) the average minimum consumption rate of an individual was 214 g/day and the average maximum was 377 g/day. The consumption rate of meat by vultures varied widely. It was found that on some days the birds hardly consumed the meat. The data further revealed considerable variation in the quantity of meat eaten by individual vultures. For instance the same bird consumed from 30 to 690 g per day and another from 0 to 660 g/day. Among the 12 individuals, average consumption rate of one bird was nearly 300g/day (Table 1).

It was found that at two-day intervals, the average daily consumption rate of vultures varied between 209 to 697 g. The average quantity of fresh meat consumed by a bird (with 16 replications) varied from 471 to 599 g with an average of nearly 516 g. When vultures were offered meat at three-day intervals, the average daily consumption varied from 493 to 653 g. Among the 12 birds the average consumption with ten replications was 501 to 644 g with an average of 585 g. At four-day interval, the average daily consumption varied between 578 and 711 g. Among the 12 birds, the average consumption rate with six replications was between 568 and 742 g, with an average of 634 g. At five-day intervals, the average daily consumption by vultures varied between 640

and 680 g. Among the 12 vultures (with four replications) the rate was 550 to 725 g, with an average of 659 g (Table 1).

The analysis of variance revealed that there were highly significant differences in food consumption at different starvation intervals ($P < 0.01$). Comparison of mean food consumption at different starvation intervals indicated that food consumption in case of daily feeding was significantly lower as compared to two, three, four and five days starvation intervals. Food consumption for two days of starvation was significantly less compared to starvation intervals of four and five days. However, there were no significant differences (Table 1, $P < 0.01$) between two and three and between four and five day starvation intervals

Group consumption of fresh meat

To simulate the natural feeding conditions of vultures, a common feeding experiment was also conducted in the aviary on a group of 12 randomly selected vultures for one-day starvation and 15 vultures each for 2-, 3-, 4-, and 5-day starvation intervals. The birds were allowed to move freely and perform daily activities. The average consumption rate of these vultures was also observed as with the individual experimental birds, i.e. 1-, 2-, 3-, 4- and 5-day intervals. It was found that when vultures were given food at one-day intervals and subjected to 30 treatments, the consumption rate varied between 0 to 638 g/day with an average of 293 g/day (Table 2). At two-day intervals and with 12 replicates the rate varied between 400 and 776 g/day

with an average of 547 g/day. When the meat was offered at three-day intervals the consumption rate (with ten replicates) varied from 330 to 726 g/day with an average of 592 g/day. When the time interval between two meals was four days, the consumption

rate (with six replicates) varied between 467 to 867 g/day with an average of 699 g/day. The consumption rate with four replications was 588 to 900 g/day, with an average of 713 g/day when offered at an interval of five days (Table 2).

Table 1. Food consumption by individual Indian White-backed Vultures at different starvation intervals

Treatments	Starvation Intervals				
	One day n=12	Two days n=12	Three days n=12	Four days n=12	Five days n=12
1	244	209	580	661	671
2	296	416	653	580	644
3	440	420	620	629	680
4	393	410	556	711	640
5	410	630	558	578	
6	370	480	582	643	
7	177	475	610		
8	431	580	493		
9	176	585	579		
10	337	660	621		
11	310	534			
12	381	564			
13	280	697			
14	166	642			
15	360	456			
16	517	504			
17	134				
18	200				
19	379				
20	196				
21	470				
22	278				
23	250				
24	265				
25	292				
26	215				
28	373				
29	204				
30	101				
Mean	300	516	585	634	659
SE	19.39	30.63	14.09	20.5	95.88

n = No. of birds

Experiment on consumption of putrefied meat

It was found that when the meat was putrefied for two, four and six days and the

birds were starved for four, six and eight days, the average consumption rate was 408 g, 283 g and 161 g, respectively (Table 3).

Table 2. Food consumption by a group of Indian White-backed Vultures at different starvation intervals.

Treatments	Starvation Intervals				
	One day n=12	Two days n=15	Three days n=15	Four days n=15	Five days n=15
1	285	530	333	867	900
2	275	553	666	753	745
3	443	446	598	807	618
4	371	560	646	467	588
5	449	608	600	600	
6	375	673	433	700	
7	208	660	726		
8	477	776	676		
9	137	474	640		
10	379	426	604		
11	250	400			
12	609	460			
13	321				
14	025				
15	638				
16	559				
17	000				
18	000				
19	360				
20	000				
21	570				
22	270				
23	000				
24	347				
25	395				
26	177				
27	316				
28	377				
29	170				
30	000				
Mean	293	547	592	699	713
SE	35.48	34.68	25.9	54.99	41.67

n = No. of birds

Table 3. Consumption rate of putrefied meat by Indian White-backed Vultures when offered at different intervals (one set = six vultures).

Sets	Putrefaction period (days)	Starvation intervals (days)	Average consumption (g)
First set	2	4	408
Second set	4	6	283
Third set	6	8	161

Discussion

In the present study vultures consumed an average of 300 g fresh meat/day. Grubh (1974) observed that the quantity of fresh meat of cattle and buffalo consumed by the Indian White-backed Vultures in Gir forest, Gujarat, was 318 g. Both the above studies were made with captive vultures and the average meat consumption was almost the same. To know the consumption rate of vultures at different starvation intervals, vultures were offered fresh meat at 2-, 3-, 4- and 5-day intervals and the same were compared amongst themselves to note the significance. It was found that average consumption rate by a vulture at 2-, 3-, 4- and 5-day starvation intervals was 516, 585, 634 and 659 g/day respectively (Table 1). From the above results, it is clear that the consumption rate of fresh meat by vultures when compared with daily food consumption was statistically significant ($P < 0.01$). However, when compared with birds of two-day starvation intervals feeding regime, the four- and five-day intervals consumption rate was significant. Three-, four-, and five-day interval feeding regimes compared among themselves were not significant. These results indicate that with the increase in the

length of time between the provisions of food, the consumption rate of fresh meat by vultures increased significantly.

When the feeding experiment was conducted on a group of birds to simulate the natural feeding conditions of vultures, it was found that the average consumption rate at 1-, 2-, 3-, 4- and 5-day intervals was 293, 547, 592, 699 and 713 g/day, respectively. Pennycuik (1969) calculated that an African White-backed Vulture *Gyps africanus* could carry a load of up to about 20% of its fat free weight. Houston (1973) speculated that the maximum load might determine the quantity of meat that can be swallowed and the capacity of the crop. The findings of the present study agree with the findings of earlier workers. From the results obtained (Tables 1 & 2) it was clear that the captive birds never ate more than 1,000 g/day, even when starved for periods of 1–5 days. Agarwal *et al.* (1983) also reported that vultures could consume up to 1,000 g per day. According to Grubh (1974) one of his experimental vultures once ate 2,000 g meat, which was about 48% of the bird's body weight. In the present study, we did not record a captive bird consuming in excess of the estimated maximum load.

In the present study the data on group feeding were similar to those on individuals feeding. Under both conditions vultures consumed about the same quantity of food if the quality of food was fresh and there was no peripheral disturbance.

In nature, various factors may influence the feeding patterns of vultures, such as other carrion feeders (e.g. crows, dogs etc.) and interventions by humans, age and sex of the vultures (Ali & Ripley 1968), efficiency of rendering agencies in removing carcasses for processing (Andrews 1952), inter- and intra-specific competition (Petridges 1959, Atwell 1963, Houston 1974, 1975, 1986, 1988, Anderson & Horwitz 1979), sense of smell (Houston 1984) and the suitability of the site for feeding (Jackson 1975). In the captive vultures, the extraneous factors may not play a significant role in determining the consumption and feeding patterns.

In Table 3 it is clear that the average consumption rate of putrefied meat by vultures was 408, 283 and 161 g, when it was putrefied for two, four and six days and the starvation interval was four, six and eight days, respectively.

Conclusion

The feeding potential of Indian White-

backed Vultures at different starvation intervals was observed with captive birds individually and in groups. It was found that the average consumption rate of fresh meat in both the cases increased substantially along with the starvation period. From the different feeding trials it was observed that there was similarity in the food consumption individually and in groups, providing that the quality of food was the same and there was no external disturbance. When the experiment was conducted with putrefied meat, it was found that the consumption rate decreased with the increase of putrefication and hunger. It is concluded that there is a significant relationship between the quality, quantity of food and the hunger of Indian White-backed Vultures. These findings will be crucial for developing strategies for vulture management under varying feeding and environmental conditions.

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References

- Agarwal, R.A, Bhatnagar, R.K., Chakravarthy, A.K., Singh, D. & Singh, R.B. 1983. Investigation on control of vultures, Pariah kites and other birds hazardous to aviation, page 14. Project report for the period 1982 – 1983 submitted to A.R.D.B., Ministry of Defence, Government of India.
- Ali, S. & Ripley, S.D. 1968. Handbook of the Bird of India and Pakistan. Vol. 1, Oxford

- University Press, Mumbai.
- Anderson, D.J. & Horwitz, R.J. 1979. Competitive interactions among vultures and their avian competitors. *Ibis* 121: 505–509.
- Andrews, A. 1952. The ugly scavengers. *The Cattleman*. February: 149–152.
- Atwell, R.I.G. 1963, some observation on feeding habits, behaviour and inter relationship of Northern Rhodesian Vultures. *Ostrich* 34: 235–247.
- Grubb, R.B. 1974. The ecology and behavior of vultures in Gir forest. Ph.D. thesis, University of Bombay.
- Houston, D.C. 1973. The ecology of Serengeti vultures. Ph.D. thesis, University of Oxford.
- Houston, D.C. 1974. The role of griffon vultures, *Gyps africanus* and *Gyps rueppellii* as scavengers. *Proc. Zool. Soc. Lond.* 172: 35–46.
- Houston, D.C. 1975. Ecological isolation of African scavenging birds. *Ardea* 60: 55–64.
- Houston, D.C. 1984. Does the King Vulture *Sarcoramphus papa* use a sense of a smell to locate food? *Ibis* 126: 67–69.
- Houston, D.C. 1986. Scavenging efficiency of turkey vultures in tropical forest. *The Condor* 88: 318–323.
- Houston, D.C. 1988. Competition for food between Neotropical vultures in forests. *Ibis* 130: 402–417.
- Islam, M. Z. & Rahmani, A.R. 2002. Threatened Birds of India. *Buceros* Vol. 7, No. 1 & 2, 2002. Compiled from Threatened Birds of Asia. BirdLife International Red Data Book (2001). BirdLife International, Cambridge, U.K.
- Jackson, J.A. 1975. Regurgitative feeding of young black vulture in December. *Auk* 92: 802–803
- Pennycuik, C.J. 1969. The mechanics of bird migration. *Ibis* 111: 525–556.
- Petridges, J.A. 1959. Competition of food between five species of East African vultures. *Auk* 76: 104–106.
- Singh, R.B. & Sherikar, A.A. 1999. An experimental study on the normal gut micro flora and the survival of known pathogens through the intestinal tract of Indian White-backed Vulture *Gyps bengalensis*. *Vulture News* 40: 20–25.
- Sridhar, S. & Chakravarthy, A.K. 2004. Vexed vultures and their captive breeding programme in India. *Newsletter for Birdwatchers* 44: 90–94.

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