References

Abdulali, H. (1962). An ornithological trip to the Gulf of Kutch. *Journal of the Bambay Natural History Society*. 59: 655-658.

Ali, S. (1941). *The Book of Indian Birds*. Bombay Natural History Society, Oxford University Press, Mumbai. 12th revised edition, 72pp.

Ali, S. & S.D. Ripley (1968). *Handbook of The Birds of India and Pakistan* - Vol 1. Oxford University Press, Bombay, 66-68pp.

Arendt, W.J. & A.I. Arendt (1988). Aspects of the breeding biology of the Cattle Egret (*Bubulcus ibis*) in Montserrat, West Indies, and its impact on nest vegetation. *Colonial Water Birds* 11(1): 72-84.

Bhatnagar, S.P., S.K. Shukla & M.S. Bhaum (2004). Studies on the distribution of the heronries in and around Ajmer city ecosystem. *Newsletter for Birdwatchers* 44(3): 46-47.

Brown, L.H., E.K. Urban & K. Newman (1982). *The Birds of Africa* Volume I. Academic Press, London, 145-149pp.

Burger, J. (1978). Competition between Cattle Egrets and native North American herons, egrets, and ibises. *Condor* 80: 15-23.

Datta, S. (1996). Bird watching at Dibru-Saikhowa Wildlife Sanctuary. *Newsletter for Birdwatchers* 36: 51-53.

Godfrey, W.E. (1966). *The Birds of Canada* - National Museum of Canada, Bulletin No. 203, Biological Series No. 73, Ottawa, 38-39pp.

Gopal, G., A.K. Mathur & H.R. Choudhary (2004). Study on breeding performance of Cattle Egret, *Bubulcus ibis* in Kota division of Rajasthan. International Conference on Bird and Environment. Haridwar, India (Unpublished).

Grimmett, R., C. Inskipp & T. Inskipp (2000). *Pocket Guide to The Birds of The Indian Subcontinent*. Oxford University Press, Mumbai.

Hoyt, D.F. (1979). Practical methods of estimating volume and fresh egg weight of bird eggs. *Auk* 96: 73-77.

Iyer, M.K. (2004). Nesting of Phalacrocoracidae, Threskiornithidae and Ardeidae at Ahmedabad Zoo. *Newsletter for Birdwatchers* 44(3): 43-44.

Lowe-McConnell, R.K. (1967). Biology of the immigrant Cattle Egret *Ardeola ibis* in Guyana, South America. *Ibis* 109: 168-179.

Maccarone, A.D. & K.C. Parsons (1988). Differences in flight patterns among nesting ibises and egrets. *Colonial Water Birds* 11(1): 67-71.

Mahabal, A. (1990). Heronries in Raigad district, Maharashtra - a preliminary survey. *Journal of the Bombay Natural History Society* 87: 137-138.

Mathew, K.L. & I.R. Gadvi (2004). Distribution pattern and the size of Cattle Egret *Bubulcus ibis* heronries in Saurashtra region of Gujarat, India. International Conference on Bird and Environment. Haridwar, India (Unpublished).

Pande, S.A. & P.G. Mestri (2002). Heronries of the raigad district, Maharashtra. *Newsletter for Birdwatchers* 42(2): 19-20.

Rao, V.V. (2004). Egrets and their role in environment. International Conference on Bird and Environment. Haridwar, India (Unpublished).

Siegfried, W.R. (1971). The nest of Cattle Egret. *Ostrich* 42: 193-197.

Singh N. & N.S. Sodhi (1985). Heronries and the breeding population density of the cattle egret *Bubulcus ibis coromandus* (Boddaert) during 1985, in tehsil Kharar of the Ropar district (Punjab). *Pavo* 23(1/2): 77-84.

Skead, C.J. (1956). The Cattle Egret in South Africa. *Audubon Magazine* 58: 206-209.

Snoddy, J. (1969). Feeding behaviour of cattle egret *Bubulcus ibis*. *Condor* 70: 137-143.

Subramanya, S. (1996). Distribution, status and conservation of Indian heronries. *Journal of the Bombay Natural History Society* 93: 459-486.

Thomas, J., M. Chellappan & H. Bhaskar (2004). Role of insectivorous birds in rice pest management. International Conference on Bird and Environment. Haridwar, India (Unpublished).

Vyas, R. (2006). Spatial and temporal distribution of nests in a heronry. *Zoos' Print Journal* 21(8): 2339-2342.

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CASE REPORT **ZOOS' PRINT JOURNAL 22(11): 2888-2890**

DIURNAL RHYTHM AND MOVEMENT PATTERN OF PEREGRINE FALCON *FALCO PEREGRINUS* IN CAPTIVITY IN UNITED ARAB EMIRATES

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Abstract

Diurnal rhythm and activity pattern of Peregrine Falcon *Falco peregrinus* was studied in UAE from 2001 to 2003 in large enclosures, wherein they showed regular movement and the median distance travelled in a day was 50-75m. They preferred to forage in the morning than in the evening. The daily activity (68%) started from 0530-0630hr and they roosted between 1730-1830hr (47%). The major part of their daily activity involved in foraging followed by resting. The males were parochial about roosting sites and during the breeding season they made a variety of calls, which attracted and stimulated the females for courtship display preceded by mating. The vocalizations also helped them maintain territories.

Keywords

Falco peregrinus, foraging, roosting, United Arab Emirates

According to Ali (1977) the Peregrine Falcon's *Falco peregrinus* body is a marvel of nature's engineering; wings are long and pointed, legs are strong, toes are long and claws are hooked and powerful. The species is extremely accomplished and swift fliers, generally killing their prey on the wings (Ali & Ripley, 1983). They take great delight in bathing and the birds wintering in England took bath daily, despite the chill and choose running water of few inches depth where the stream bottom matched the colour of their plumage (Baker, 1967). The birds have devised various means of energy conservation in every aspect of their life and their metabolism is the highest in the animal kingdom (Remple & Gross, 1993). The Peregrine

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Table 1. Awakening and roosting behavior of Peregrine Falcons in UAE during 2001 to 2003 (n=126 days)

Time Periods (hrs)	Awakening	Exit from Roost	Activity pattern and number of days * First-feeding	Final-feeding	Roosting	Sleeping
0500– 0529	18 (14)	2 (2)	-	-	-	-
0530 – 0629	85 (68)	90 (71)	81 (64)	-	-	-
0630– 0705	23 (18)	34 (27)	45 (35)	-	-	-
1700– 1729	-	-	-	28 (22)	16 (13)	-
1730– 1829	-	-	-	96 (76)	59 (47)	39 (31)
1830– 1930	-	-	-	2 (2)	51 (40)	87 (69)

Percentages in parenthesis

Falcon spend considerable part of their time for gathering food and feeding in order to meet the high rate of metabolism. The species begins the daily activity cycle at daybreak, as the day winds down, a Falcon heads for its nighttime shelter. In this paper diurnal rhythm and activity pattern of Peregrine Falcon in captivity is reported. Jenkins & Benn (1998) reported from South Africa that the male occupied larger home ranges than females. Females were more sedentary, spending 50% of their time in the nest. The home ranges of neighbouring birds overlapped by about 20%, but neighbours tended not to forage in the same area on the same day. Since falcons don't build real nests, the falconers who host the falcons construct nesting boxes for the falcon pairs. These nests are complete with small gravel used to cushion eggs, protective edges to prevent eggs and young birds from falling out of the nest, and perching bars from which the falcons watch their prey (Rowe, 2002). Only few reports are available on this aspect from the UAE.

In most of the Peregrine Falcon, males are larger than females. Small males are better protectors of their nests than are large females (Andersson & Wilkund, 1987) and the large females are better protectors of their nests than small females (Storer, 1966). Peregrine Falcon is a migratory bird from their breeding grounds to the wintering grounds and back. Not much information is available on the diurnal activity pattern of falcons in captivity.

Methods

Various aspects of diurnal rhythm, activity pattern of Peregrine Falcon were studied in sophisticated enclosures (6.5m length x 6.5m width x 4m height) similar to their natural habitat for three years from 2001 to 2003 in the United Arab Emirates. The study was based on visual observations. Each day was divided into 3- to 5-hour periods starting from 0500-1000hr, 1000-1500hr, 1500-2000hr and observations were made on alternate periods for two days in each month for a whole day. A pair of Peregrine Falcons was observed in detail from morning to evening to study the movement patterns and roosting habits. The observer reached the roost in the early morning before the birds woke up and moving out of the roosts. The timing of the activities such as awakening, first and last feeding, roosting and sleeping were recorded. A grid map of the area was used to record the positions and movement of the pair from 0500-1930hr. The distance between the roost and the point of first feeding and the number of points on which the Falcon perched after moving out of the roost before the initial feeding was also recorded. The approximate distance between the point of last feeding and the evening roost, the number of points perched on the way to the roost after the final feeding were also recorded.

Observations and Results

Activity Pattern: The Peregrine Falcon woke up between 0549 and 0641hr and started wandering from 0600-0650hr. They started foraging in the morning between 0530-0705hr and less often during the next half hour (64% & 35% respectively). During the entire period of observation, the Peregrine Falcon stopped foraging from 1700-17.30hr (22%), 1730-1830hr (76%) and 1830-1930hr (2%). They entered the roost at 1730-1930hr (47% & 40%) and became silent between 1830-1930hr (69%) (Table 1). Even though there was a tendency to roost in the same nest, a change in the roosting was observed 11 times (n=126). The species is not specific in its perch location during daytime but at night it was specific. The pair awoke (N=119), flew out of the roost (N=87) and started foraging (N=76) before sunrise. In the evening they stopped foraging (N=112) and entered the roost (N=79) before sunset. The members of a pair drift apart slowly as wandering progresses, but keep in touch with each other through contact calls. They did not roost at mid-day and foraged vigorously from 1740-1830hr. Thereafter, the tempo of feeding slowed down between 1745-1835hr and they proceeded to their night roosts after perching on several places on the way.

Awakening: The Peregrine Falcon pair awakened in the morning between 0500-0705hr during different seasons. Sixty-eight percent of awakening took place between 0530 and 0630hr and 14% during 0500-0530hr and 18% during 0630-0705hr (Table 1). Generally the falcon pair roosted together, even outside the breeding season and siblings roosted close to one another for a month after leaving the nest. They generally moved out of the roost between 0530-0705hr and started foraging immediately. Seventy one percent of the roost leaving was between 0530 and 0630hr, 27% during 0630-0705hr and 2% during 0500-0530hr.

Movement: Monthly variation in the daily distance traveled by a pair of Peregrine Falcon is shown in Table 2. The pair traveled a mean distance of 850m per day. The rate of movement was lowest during 0500-0600hr, thereafter the pair moved faster up to 1500hr and then the rate was further increased up to 1800hr. But the rate slowed down again during the evening hours. The maximum distance was covered in December and the minimum in September. The pair performed a quarter of the movement before 1000hr and half within 1400hr. Thus on an average, it took about five hours to cover quarter part of the day's movement, four hours for the second

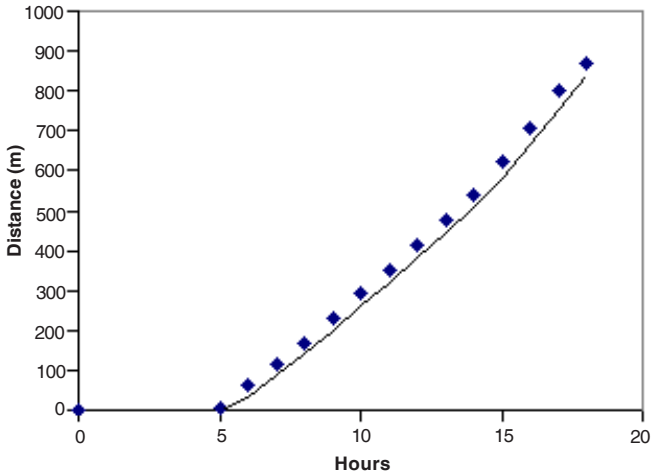

Figure 1. Cumulative distance travelled by Peregrine Falcons during the day

Table 2. Mean distance traveled by a pair of Peregrine Falcons in captivity in a day

Time (hours)	Mean distance (m)	Cumulative Mean distance (m)
0500-0559	3.8	3.8
0600-0659	59.3	63.1
0700-0759	51.8	114.9
0800-0859	53	167.9
0900-0959	62.1	230
1000-1059	62.6	292.6
1100-1159	56	348.6
1200-1259	48.3	413.2
1300-1359	64.6	477.8
1400-1459	61	538.8
1500-1559	85	623.8
1600-1659	81.8	705.6
1700-1759	98	803.6
1800-1900	67.1	870.7
Total	**854.4**	**5654.4**

Table 3. Frequency of progression rates

Progression rate (metre)	Time of the progression	Frequency	Percentage
0-25	5.00-7.00	10	6.02
26-50	7.01-10.00	51	36.74
51-75	10.01-11.30	50	66.86
76-100	11.31-14.00	30	84.93
101-125	14.01-15.30	13	92.76
126-150	15.31-17.00	7	96.98
151-175	17.01-18.00	3	98.79
175-200	18.01-19.00	2	99.99

quarter, three hours for the third quarter and two hours for the last quarter (Table 2 & Fig. 1). Mean distance traveled by a pair of Peregrine Falcon in class intervals of 25m is given in Table 3. It was observed that 85% birds travelled up to 100m within seven hours, starting from 0500hr. After 1400hr the birds' movement slowed down (Table 3).

The male bird searched for food when the female was breeding and they exhibited high accuracy in identifying own roosts. They defended their cages, when other individuals tried to intrude and sometimes ended up in fighting. A hungry Peregrine Falcon attacked even other Falcons in the aviary for food and after feeding; they did not attack or kill stray birds, which intruded into the aviary even though they were very close.

When Peregrine Falcon in captivity are fed properly and not left hungry, they exhibited high adaptiveness and adjusted with other species of birds.

Conclusion

The foraging behaviour allows the birds to avoid competition for food with other birds of prey. The Peregrine Falcons are highly adaptive to take maximum advantage of their prey and also capable of protecting themselves from predators. The slow and stealthy movement between the roost and the foraging areas and the habit of changing the roost from time to time are also meant to achieve this. They made morning calls and move out of their roosts, preened their feathers, moved from one perch to another and then glided down to initiate foraging. Sometime they drank water especially after food. The birds awakened in the early hours and continued their activities until evening. Foraging was the main activity during day. The pairs travelled a mean distance of 850m per day. The activity and movement pattern of Falcon's is similar to other species of birds.

References

Ali, S. (1977). *The Book of Indian Birds*. Bombay Natural History Society, Mumbai, 204pp.

Ali, S. & D. Ripley (1983). *A Pictorial Guide to the Birds of the Indian Subcontinent*. Bombay Natural History Society, Oxford University Press, Bombay, 345pp.

Andersson, S. & C.G. Wilkund (1987). Sex role partitioning during offspring protection in the Rough-legged Buzzard *Buteo lagopus*. *Ibis* 129(1): 103-107.

Baker, J.A. (1967). *The Peregrine*. Harper & Row. New York, 167pp.

Jenkins, A.R. & G.A. Benn (1998). Home range size and habitat requirements of peregrine falcons on Cape Peninsula South Africa. *Journal of Raptor Research*. 32(2): 90-97.

Remple, D. & C. Gross (1993). Falconry and birds of prey in Gulf. *The Condor* 102(4): 814-822.

Rowe, M. (2002). Behaviour of peregrine falcon. *Journal of Experimental Biology* 202(14): 3564-3756.

Storer, R.W. (1966). Sexual dimorphism and food habits in three North American Accipiters. Street, Manchester, London. *The Auk* 104(3): 635-639.

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