VI. SUMMARY

A study was made on the breeding ecology of Brahminy Kite, *Haliastur indus*, in a 125 Km$^2$ portion of Cauvery Delta in the Nagai-Quaid-e-Milleth District, Tamil Nadu, India from 1986 to 1994. A brief account on the flora, fauna, climatic variations and Cauvery river water discharge of the study area has been given.

Variation in the breeding Brahminy Kite populations was observed in the two study locations (Mayiladuthurai and Poompuhar), each enclosing 25 Km$^2$ area. Maximum number of nests were recorded at Mayiladuthurai (N=17) during 1986-87 and at Poompuhar (N = 19) in 1986-88 breeding seasons. Density of breeding pairs in Mayiladuthurai area had been ranging from 0.36 pair/Km$^2$ in 1988-89 to 0.68 pair/Km$^2$ in 1986-87, while at Poompuhar area the density was greater (Range : 0.64 pair/Km$^2$ in 1988-89 to 0.76 pair/Km$^2$ in 1987-88 season). The spacing of nests at Mayiladuthurai was ranging from 5 m to 1.5 Km and at Poompuhar the distance between nests varied from 50 m to 850 m.

Reuse of old nests of previous years was observed in all the breeding pairs of both study areas from year old nests (25.84% pairs) to 7 year old nests (0.56% pair). Greater proportion of new nests were built in 1989 (52%) while lesser proportion of new nests were observed in 1987 (25%). In Cauvery Delta, Brahminy Kites began nesting early during 1986-87 and 1990-91 breeding seasons (I week of December) and late nesting was observed during 1986-87 (III week of January). Incubation started early (IV week of December) during 1986-87, 1990-91 and 1991-92 seasons but kites
incubated even in the late seasons (III week of February) in 1987-88, 1988-89 and 1989-90. Egg laying reached its peak during January II week in most of the breeding seasons. Patterns of fledgling dispersal varied among years (early dispersal: I week of March during 1986-87 and 1987-88 seasons; late dispersal: I week of May in the last 3 consecutive years of study). Maximum number of young fledged during April I week of the entire study period. The possible reasons for such fluctuations have been discussed.

Proportions of 1 and 2 egg clutches fluctuated during 1986-87 (1-egg clutch n = 3, 2-egg clutch n = 33) and 1988-89 (1-egg clutch n = 6, 2-egg clutch n = 19) breeding seasons. Out of 296 nesting attempts, 178 were successful (60.14%) during the entire study period. In a total 344 eggs laid, 320 eggs were successfully hatched (93.02%) during the study. Hatching success was maximum (98.11%) during 1989-90 and minimum (88.41%) in 1986-87 season. Hatching success was higher (94.69%) in the human habitations than in the agricultural habitats (91.88%). Fledging success was also appreciable (87.5%) during the entire study period. Maximum fledging success was observed (96.23%) during 1989-1990 and the minimum success (79.71%) in 1986-1987. Riverine habitat showed more fledging success (91.69%) but in the agricultural habitats it was low (86.88%). There was no significant difference in the fledging success in between the two study locations and among breeding seasons.

Clutch size manipulation experiment showed that clutch size fixation appeared to occur at 4 egg clutch in the early breeding season, at 3 egg clutch during middle of the season and 1 or 2 eggs during the late season. Kites were non-responsive to enlarged clutches. Fledging success was
reduced (70.52%) in enlarged clutches and in the enlarged broods (74.0%). The pattern of food consumption by young in one-, two- and three-chick broods differed significantly ($X^2 = 11.31, P > 0.05$). The one chick brood young one consumed more food than the others.

The nesting ecology of Brahminy Kite was also studied at Mayiladuthurai and Poompuhar study locations. In Mayiladuthurai area kites preferred human habitations (52.63%) and in Poompuhar, agricultural dry lands (30.28%) for nesting. The most dominant tree species at the nest sites of Mayiladuthurai, in decreasing order of mean Importance Value, were the coconut tree (97.66), Tamarind tree (64.27) Neem tree (40.42), Palm tree (34.22), Banyan tree (14.42), Mango tree (10.10) and Rain tree (8.59). Poompuhar study area differed in the most dominant tree species at the nest sites from that of Mayiladuthurai area. Remarkable variations were also found in the principal tree species composition at the control sites and nest sites ($X^2 = 15.0, P > 0.05$). Most of the nests (69.23%) were located within 100m from the permanent water source, 76.92% nests were near the seasonal water bodies and 61.53% nests were within 100m from agricultural lands at Mayiladuthurai area. Out of the total nest studied at Poompuhar area 78.57% of nests were located within agricultural lands. Test of Central Place Foraging Hypothesis revealed that among male Brahminy Kites, there was more significant relationship between mean prey transportation distance and mean prey weights (Spearman rank correlation $r_s = ±0.604, n = 35$), than the female kites ($r_s = ±0.449, n = 31$).

A relative similarity was observed in the extent of breeding territories among 12 pairs of Brahminy Kites ($X^2 = 8.69, P < 0.05$).
of the territory had been shrinking as the growth of the nestling progresses. The proximity to human activities did not appear to influence choice of nest site by Brahminy Kites (100% nests < 100m from path or foot trail; 84.6% nests < 100m from trunk roads) at Mayiladuthurai and at Poompuhar (85.71% nests < 100m from path or foot trail; 53.57% nests from traffic roads and human habitations). The importance of habitat features in the light of earlier findings had been discussed.

At Mayiladuthurai area 3 principal components accounted for 93.63% of the variations in the habitat variables. The 1st principal component explained 55.45% of the variations, representing the proximity to hunting sites. In Poompuhar, the first 3 components explained 91.85% of the total variance, out of which the 1st component had significant correlation with the feeding sites (54.65%).

Coconut tree was frequently used by the kites for nesting, both at Mayiladuthurai (46.43%) and Poompuhar (42.86%). There was no significant difference in the average height of the nest trees and neighbouring trees at Mayiladuthurai (t=2.72, P<0.05) and Poompuhar (t=2.14, P<0.05) areas. Significant deviations were observed between the expected values and observed values of the expected number of the trees in each distance category tested for aggregation of trees near nest sites.

The overall comparison of Reproductive Effort of male and female Brahminy Kites revealed that males loaded a higher proportion of the nest sticks than the females (79.61 ± SD 2.75%). Significant difference was observed in the mean nest stick loading bout length among the sexes. The mean number of incubation shifts per day were ranging from 4.83 ± SE 0.11
to $5.42 \pm SE 0.15$ for female kites and $3.08 \pm SE 0.33$ to $3.36 \pm SE 0.13$ for male kites. Overall, females incubated for a higher proportion of the day ($75.32 \pm SE 0.96\%$) than the males ($16.65 \pm SE 0.37\%$). The eggs were unattended by the parents for $8.0 \pm SE 2.05\%$ of the total incubation period. The average amount of time spent for incubation by the female kite was longer than the male. Female kites brooded the young most of the day time ($70.43 \pm SD 5.36\%$) and entire night hours. The frequency of unattended brooding shift/day was lesser ($4.75 \pm SE 0.13$) during nestling rearing phase and increased during the late fledgling phase ($6.54 \pm SE 0.14$).

Patrolling frequency and patrolling bout length per day for male kites were higher than that of the female kites. Males did more chasing during territorial defense ($82.48 \pm SD 12.62\%$) and had higher risk scores ($79.06 \pm SD 11.21\%$) than the females.

Males delivered relatively more prey to the young ones ($51.5 \pm SD 5.72\%$) during nestling rearing stage. During incubation stage, all prey deliveries were by males only. The mean number of prey deliveries per day increased with the growth of the nestlings. The possible reasons for such variations have been discussed.

Out of the major reproductive effort correlates such as patrolling, nest building, incubation, brooding, prey delivery and nest defense, there were only a few significant relationships between the expended efforts and future efforts. Negative correlations were also found for certain behaviours. The results of the above attributes were discussed.

Significant differences in the average Daily Energy Expenditure (DEE) between sexes were observed during the entire breeding cycle. Males
expended more DEE for patrolling territory. But female spent more DEE for incubation, nestling brooding and fledgling brooding. The possible reasons of such differences in energy expenditure were discussed. Management recommendations have been made with the view of implementing intelligent management programs on which conservationists may concentrate their efforts to protect this top carnivore of the agricultural wet land ecosystem of Cauvery Delta.