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Sizes, shapes and flight behaviour of egret flocks enroute to roosts near Sirsi, Karnataka, India

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Egrets are long legged, lanky, gregarious birds with slender flexible necks. They generally feed on small fishes and insects in marshy places, cultivated wetlands and waterbodies. There are four species of egrets in India - Cattle Egret (*Bubulcus ibis*), Little Egret (*Egretta garzetta*), Median Egret (*Egretta intermedia*) and Large Egret (*Ardea alba*) (Ali & Ripley 1987). They are diurnal birds and colonial roosters. In many areas, on many evenings, they can be seen flying in flocks of various sizes and shapes back for roosting.

It is believed that majority of egret flocks fly in an inverted 'V' shape, with one bird leading at the front breaking wind pressure such that the birds following get an aerodynamic advantage. However, detailed studies on flock shapes *vis-a-vis* flock size, sunset time and such other information are scanty. Here, we report the results of our study aimed at answering the following questions :

(a) What are the different sizes and shapes of flocks and flight behaviour of egrets?

(b) Is a flock lead by different individual birds by turn?

(c) What are the factors affecting these parameters?

The study was conducted in the precincts of Sirsi (14°36' N, 74°54' E; 619 m aMSL), Uttara Kannada district, Karnataka, for about three months (September to December 1996). Sirsi, situated in the Sahyadri (Western Ghats), receives about 2500-2800 mm annual rainfall. The roosting sites of the birds were within the Sirsi town.

Birds in flight were observed from elevated places at three different sites during evening hours (17.30-18.30 h). Binoculars were used. The flock size, shape and sunset time were noted. Flocks were classified in two ways: (1) Based on their geometric shapes, (a) strict geometric (arrow headed, lambda headed, inverted 'V' shape, 'M' shape, rod shape, dot shape), (b) curved, (c) irregular; (2) Based on the positions of flock extremities into the following patterns: (a) both ends forward, (b) both ends backwards, (c) one end forward and the other backwards.

During analyses, the cluster size of the median bird and the mean cluster size of flocks were determined. The mean sizes of flocks flying before and after sunset were compared through Mann-Whitney U Test; the distributions of flock sizes and number of birds in these two time periods were subjected to Kolmogorov-Smirnov Test (Siegel 1956).

During the study, 302 flocks totalling 2566 egrets were observed, majority being Little Egrets. However, for analyses, all egret species were considered one group. The frequency distribution (%) of different flock sizes and the proportion (%) of birds in each of these size classes are shown in Fig. 1. The smallest flock was of single bird and the largest, of 119. Although 23.2% flocks were of single birds, they contained only 2.7% of the total

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birds observed. Further, though smaller sized flocks were frequent (Fig. 1a), the total population was well distributed across the various flock sizes (Fig. 1b).

The mean flock size was 8.5 ± 15.7 (Mean ± S.D.); however, the cluster size of the median individual (1283rd bird) was 22. The former measure describes the flocks from the "observer centred" view, giving equal weightage to groups of all sizes. The latter has been proposed to be a more (biologically) meaningful index of group size from the "animal centred" view. It describes the size of the group that the median bird finds itself in, unlike the mechanical measure such as mean cluster size (Barrette 1991).

Majority of the birds (77.1%) flew in "both ends backward" pattern suggesting a specific aerodynamic advantage in it. The proportions of flocks in strict geometric, curved, and irregular shapes were 80.1%, 5.2% and 14.2% and those of birds, 38.8%, 9.7% and 52.3% respectively. This means more birds (not flocks) flew in a few irregularly shaped flocks which seem to have been formed as follows- birds take off individually in small strict geometric shaped clusters. As they fly, they join and/or are joined by more such flocks, eventually leading to increasingly larger and irregular flocks. Hence, large irregular flocks nevertheless seem to be made up of smaller strict geometrically shaped flocks which may still confer an aerodynamic advantage.

Most of the flocks had a leader flying in front. Different individuals lead the flock in turns. The observation suggests that breaking the wind force

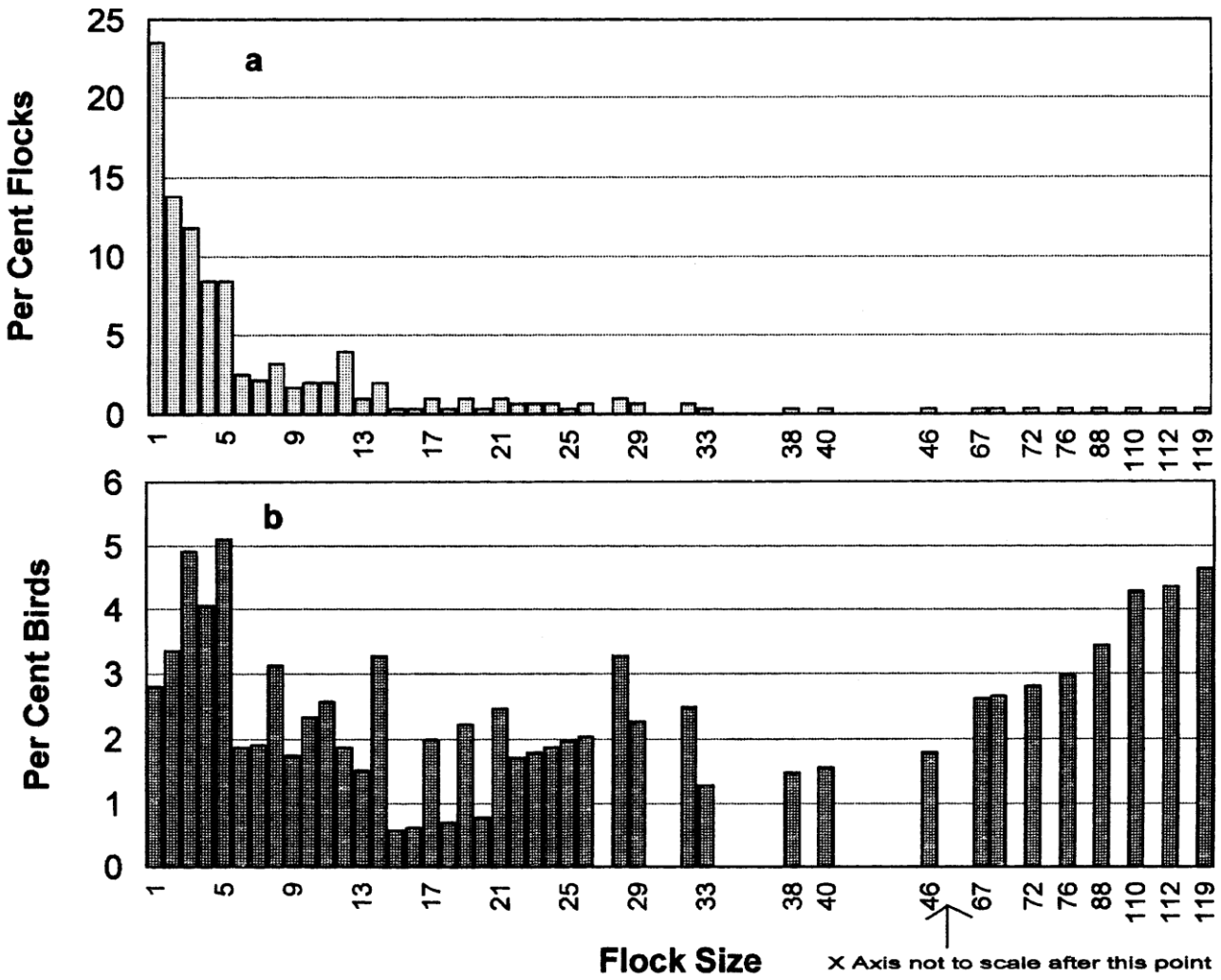

Fig. 1. The proportion (%) of - (a) different flock sizes of egrets observed near Sirsi (n = 302); (b) egret population (totally 2566 egrets) occurring in different flock sizes near Sirsi.

might require substantial energy and one bird cannot lead for a long distance. However, the exact sequence and time of leader-change-over was difficult to study because the same flock could not be observed over a long distance. Interestingly, a similar slipstreaming and leader-change-over are said to be followed by cyclists in "Tour de France Cycle Racing", especially above speeds 15 km h^{-1}.

The number of flocks and birds in flight relative to the sunset time are shown in Fig. 2. While 56.9% of the birds flew after sunset, 43% flew before. Within ten minutes before and after sunset, majority of the flocks/birds were found flying back to the roosts. The distributions were not symmetrical about sunset, but skewed to the right. The cluster size of the median individual was 20 before and 23 after sunset, suggesting that an individual bird finds itself in a larger flock after sunset than before. However, the significance of difference between these two 'median individual' cluster sizes could not be tested statistically. Hence, we compared the 'mean' cluster sizes through Mann-Whitney U Test. The flocks flying after sunset were significantly larger than those flying before (Mean ± SD: 9.4 ± 14 v/s 7.6 ± 17.4 respectively; Mann-Whitney U Test, U = 9664.5, P<0.01). The distribution of flock sizes and the number of birds $flock^{-1}$ also differed significantly between the two time periods (K.S. Test; D_{max} = 0.14, P<0.1 for flock size and D_{max} = 0.3086, P<0.01 for number of birds $flock^{-1}$). Medium sized flocks (15-40) were more

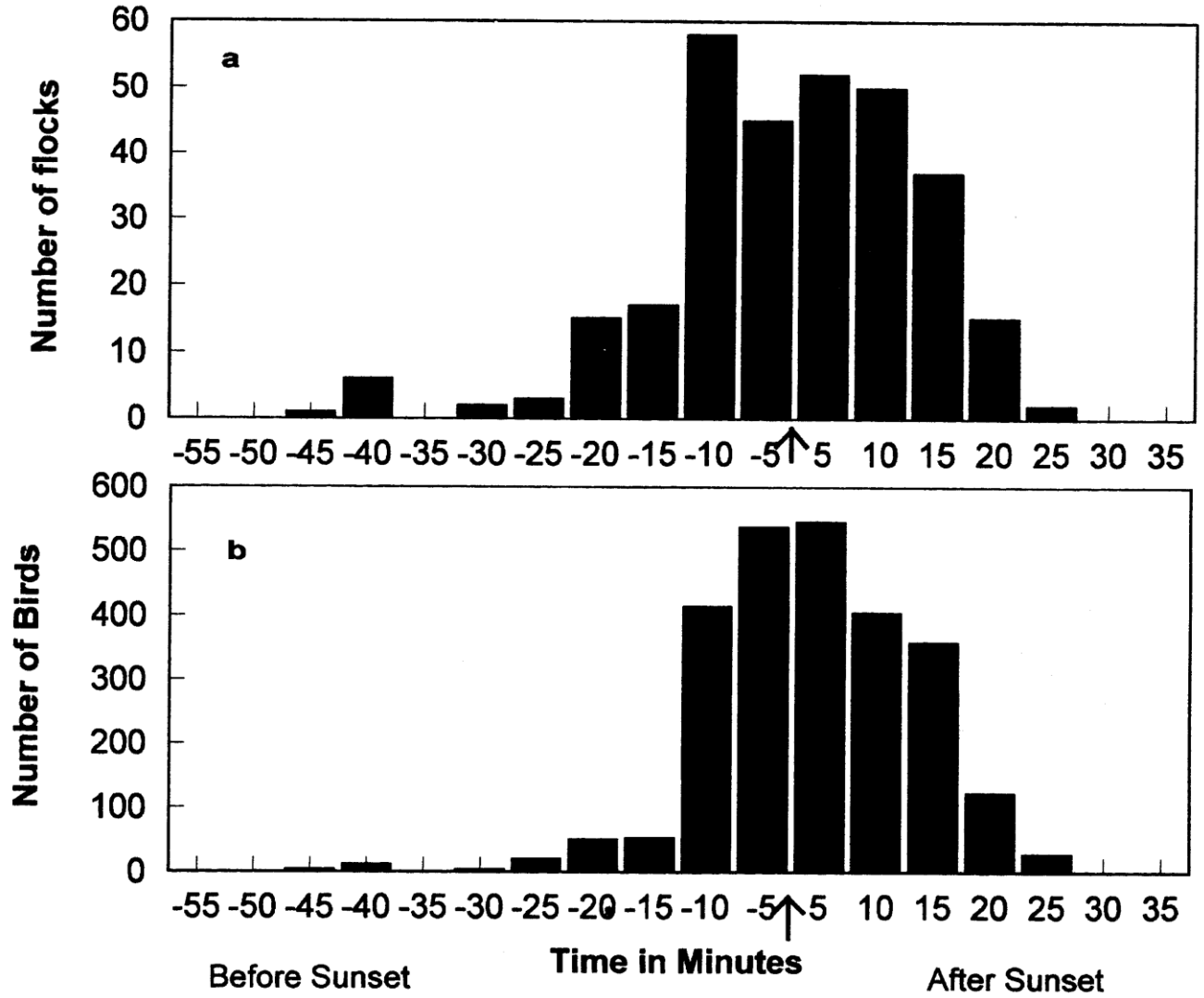

Fig. 2. Frequency distribution of number of (a) flocks, and (b) egrets relative to sunset time near Sirsi. The arrow marks ( ) in this figure point to the sunset time.

frequent after sunset than before. Further, the flocks flying before sunset tended to be more geometrically shaped than those later. The proportions of flocks with strict geometric, curved and irregular shapes were 87.26%, 5.7%, 7.0% before sunset and 77.9%, 6.2% and 15.9% after sunset respectively. It is likely that the larger irregular flocks are the eventual in-flight congregations of smaller flocks which foraged at a place farther from the roost. It would be interesting to study the dynamics of flock size and shape with respect to sunset time. Further, availability of food, maximisation of foraging time, competition for roosting sites, experience of individual birds (and hence age) could also determine the departure time of birds to their roosts.

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