

Analysis of Montagu's Harrier *Circus pygargus* Aerial Display during Courtship

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INTRODUCTION

The purposes of the present work are to analyse the Montagu's Harrier aerial display patterns during courtship, and to evaluate the intensity and frequency of their daily variations in differing weather conditions.

From this analysis it could also be evaluated which of the aerial displays observed are actually determinant for pair formation, and thus for mating.

MATERIALS AND METHODS

The survey was carried out in the 1988, 1989 and 1990 breeding seasons for a total of 358 hours of observation. Of these, 110h were devoted to the courtship period, with a daily average of 3.5h.

8 x 30 binoculars were used from a roofless fixed observation post, situated at a mean distance of 150-200m. For elaborating the data, entered on appropriate cards, various statistical tests were used: the chi-square test for evaluating significance, Roper's (1984) method for quantifying the intensity of aerial display by means of the local rate (No. of occurrences per type of display observed), and Markov's analysis for establishing whether a sequence was casual or temporal.

RESULTS AND DISCUSSION

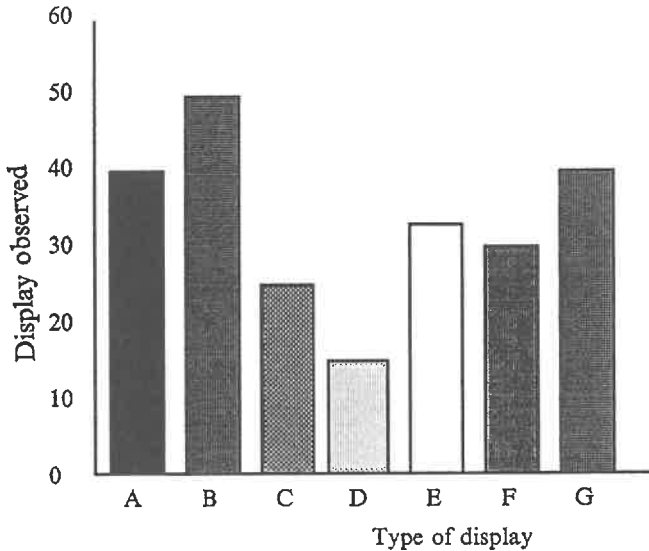
Evaluation of aerial display intensity

In central Italy, courtship lasts on average five weeks, from the 5th or 8th of April until the 10th or 15th of May. Eight different types of Montagu's Harrier aerial display are observable in this period, of which seven can be considered to be courting activity (Buxton 1946) (Fig. 1), whereas Flight-drifting (low-level reconnaissance over the nest site) is carried out by single individuals for not more than 7 to 10 days following arrival in the nesting area (Richmond 1959). Since the effective courtship displays are: Sky-dance, Mutual gliding, and Mutual High-circling, the frequency of these was analysed in the various weeks of courtship (Fig. 2).

An increasing trend of activity was evidenced up to the period of mating. The local rate increases continuously up to oviposition and the beginning of incubation (Fig. 3). Subsequently, the "courting" activities and aerial displays in general undergo a sudden reduction, due both to the ending of the period (cf. Hesse in Cramp & Simmons 1980; Delamain 1932), and to the fact that

the pair are engaged in autonomous and differentiated activities (the female in incubation, and the male in hunting and food supply). Evidently, once the young are fledged, the aerial display local rate increases with play and training activities, and with the increase in the number of individuals at the site. Only in this period does the local rate assume values analogous with those of the fifth week of courtship (Fig. 4).

Figure 1. Displays observed during courtship.



A = Sky dance; B = Flight play C = Mutual gliding
D = Mutual high circling E = Communal soaring
F = Food pass G = Defence of territory

Analysis of pre-mating courtship displays

From the Markov matrices analysis of display sequences, the basic courtship displays for pair formation were identified, being those prevalently carried out prior to mating: Sky-dance, Flight-play and Food-pass. In 41% of the cases Sky-dance preceded Food-pass, followed by mating, whereas in 15% Sky-dance preceded Flight-play, which led on to the act of mating. In 20%, instead, mating followed directly on from Flight-play, without being preceded by other displays (Delamain 1932).

Sky-dance is a flight display carried out from the first week of courtship and performed at an almost constant rate. Where Sky-dance differs during courtship is in the way it is performed (Table 1). In the first weeks, it is mainly carried out without prey (N = 21; 71%), while after pair formation it occurs more frequently with prey (N = 14; 87%). Generally, the display is performed by the male, although there are also cases when it is done by the female (N = 49; 8%) (Table 2).

Flight-play begins from the first week, but reaches its peak only around the fourth or fifth week of courtship. This is mainly performed by the male on the female (N = 37; 79%).

The Food-pass can be observed from the first week; in these early phases it mainly takes place on the ground (Table 3), whereas subsequently it occurs almost exclusively in flight (Pandolfi & Pino d'Astore 1988). The fundamental role of the Food-pass and, as well, of Flight-play, which is a ritualized form of it (Buxton 1946; Studinka 1942; Glutz *et al.* 1976; Pandolfi & Pino d'Astore 1988), is to reduce aggressivity with the approach of fecundation.

Daily aerial displays in relation to weather conditions

The frequency pattern of aerial displays during the various times of day was found to be identical with that reported by Studinka (1942), the maximum frequency being observed in the middle of the day with a peak at around 1 p.m. (Fig. 5). This pattern is accentuated in fine weather

Figure 2. Quantitative variations in displays during courtship.

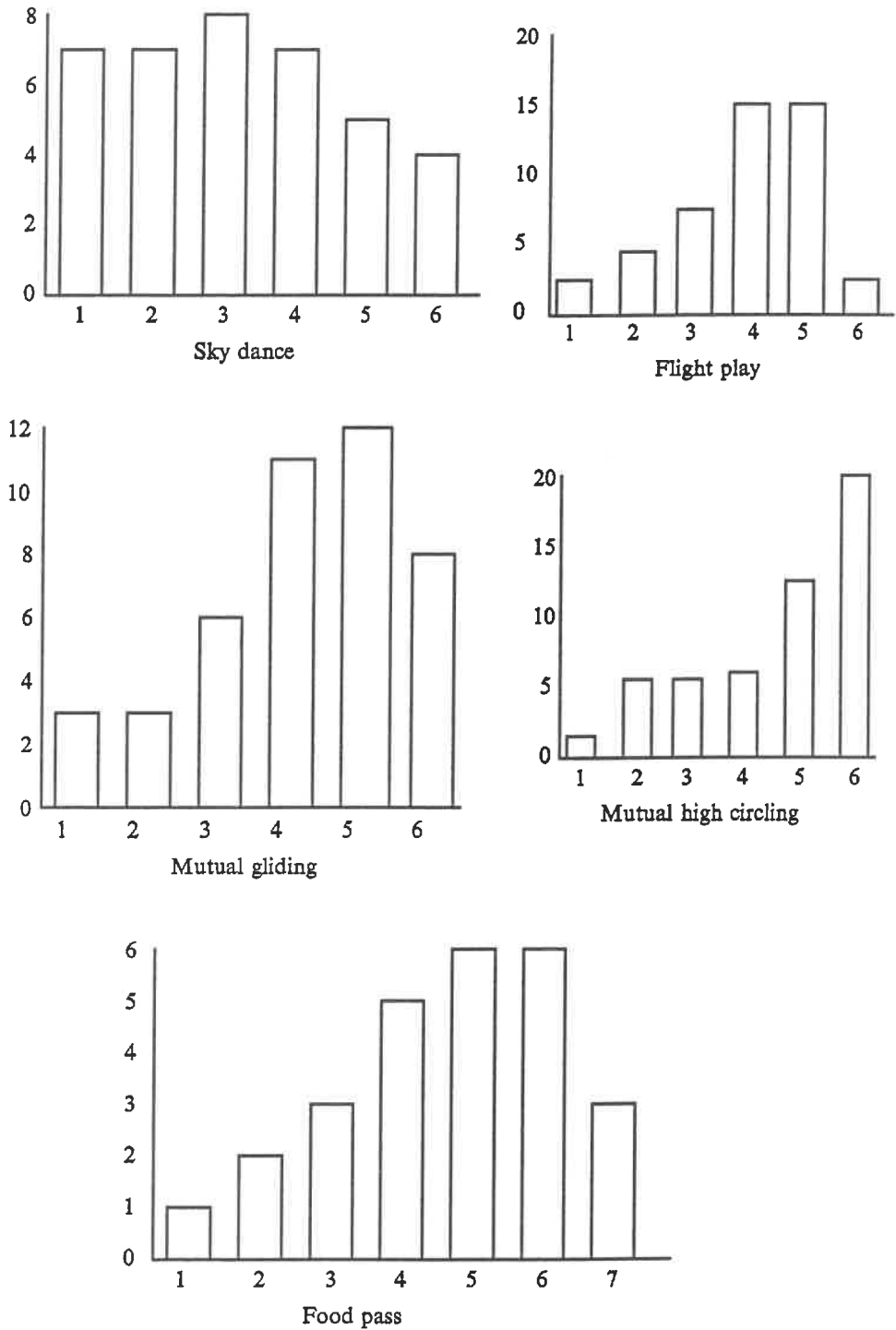


Figure 3. Local rate of the various phases of reproductive cycle.

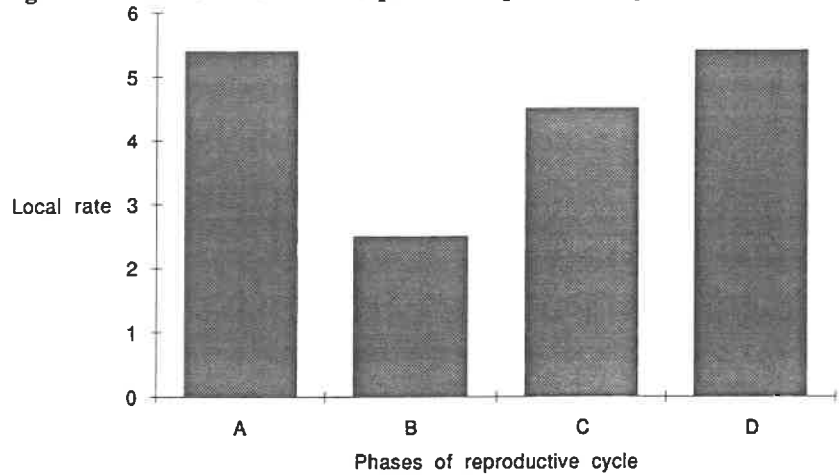


Figure 4. Local rate in the weeks of courtship.

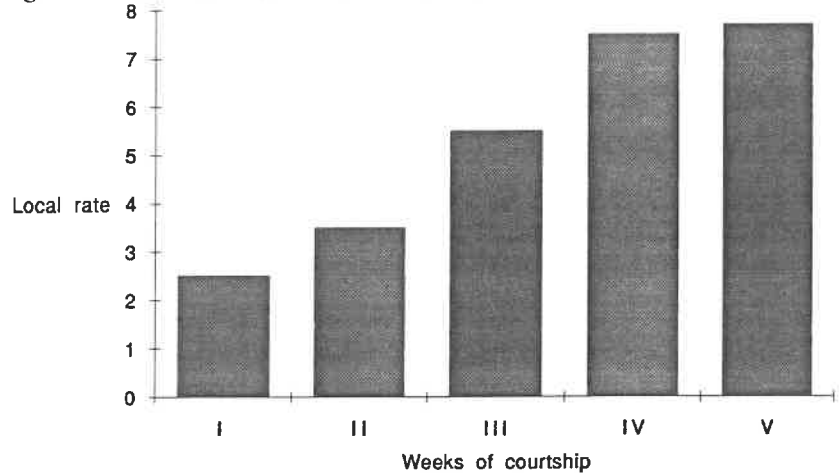


Figure 5. Daily frequency pattern of the various displays during courtship with good weather (-----) and bad weather (—).

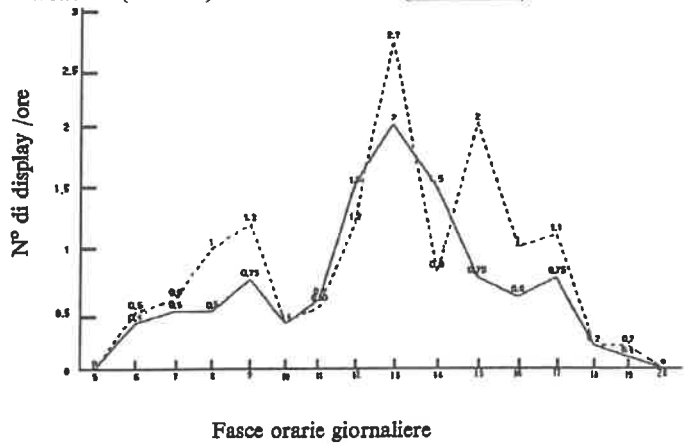


Table 1. Sky-dance distribution in the weeks of courtship (April-May), with distinction between displays with and without prey.

	with	without prey	prey
I		2	5
II		2	5
III		5	6
IV		5	2
V		5	-
V		I4	-

Table 2. Sky-dance observed during courtship (April-May).

Sky-dance	with prey	without prey
male	18	19
female	0	4
total	18	23

Table 3. Food-pass during courtship (April-May).

weeks	Ground Food pass	Aerial Food pass
I	3	0
II	4	2
III	4	2
IV	3	4
V	6	7

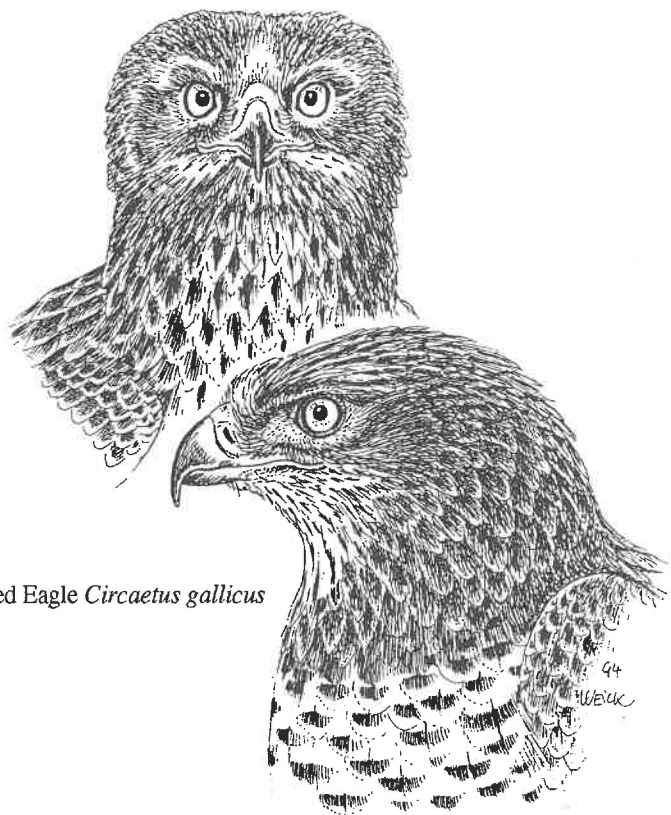
conditions, whereas in bad weather and with absence of sun, it decreases. This aspect, already noted by Studinka (1942), was analysed here in greater depth, the decrease in the various displays being significantly brought out by the chi-square test. Studinka's observations, several times reiterated (Robinson 1950; Richmond 1959), that aerial activity in general decreases in bad weather can be confirmed by comparing the individual displays in periods of clear and of overcast sky. From this analysis it is seen that not all the decreases occurring in bad weather conditions are significant; only for Mutual Gliding (chi-square = 5.76; d.f. = 1; $p < 0.01$) is there any significant reduction. This can be explained by the fact that these displays require strong warm-air currents, which are more intense in good and sunny conditions. Thus, it is not that Montagu's Harriers fly less in bad weather conditions, but that they reduce only those particular displays that cannot be carried out because of the weather.

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Short-toed Eagle *Circaetus gallicus*