

Hourly patterns of incubating Kentish plovers (*Charadrius alexandrinus*) in the Llobregat Delta, NE Spain

Spartina. Butlletí naturalista del delta del Llobregat • Número 3. Anys 1997-98

Rebut: 07.11.97
Acceptat: 12.12.97

Ignasi Torre* and Tomás Ballesteros**

* Museu de Granollers. Ciències Naturals.

Francesc Macià, 51. 08400 Granollers.

**Associació per a l'estudi de l'ecologia i el medi ambient. ECOIMA.

Pere Vergés, 1. 08020 Barcelona.

Keywords: Breeding etology, Kentish plover (*Charadrius alexandrinus*), Llobregat Delta, NE Spain

Abstract: Observations of incubating Kentish plovers (*Charadrius alexandrinus*) were carried out throughout the 1993 breeding season in the Llobregat Delta (NE Spain) to establish hourly sexual patterns of incubation. Our results confirm that females are the main incubating sex during the day (70.1% of the adults observed), whilst males are the main incubating sex at night (73.4%). However, oscillations occur. Females reach maximums in the early morning (7-10 hrs., 94.4-100%) and evening (16-19 hrs., 64.7-80%), whilst males do so in the afternoon (13-16 hrs., 40-42.8%) and at night (20-1 hrs., 62.5-83.3%).

Paraules clau: Etologia reproductiva, *Charadrius alexandrinus*, delta del Llobregat, NE d'Espanya

Resum: Pautes horàries d'incubació del corriol camanegre (*Charadrius alexandrinus*) al delta del Llobregat.

Al llarg de la temporada reproductora de l'any 1993 hom va dur a terme observacions de corriols camanegres (*Charadrius alexandrinus*) en el període d'incubació dels seus nius al delta del Llobregat per tal d'establir els patrons horaris d'incubació. Els resultats confirmen que les femelles van incubar principalment durant el dia (70,1% dels adults observats) i els mascles durant la nit (73,4%), però mostrant oscil·lacions. Les femelles van presentar els seus màxims a primera hora del matí (7-10 h, 94,4-100%) i a la tarda (16-19 h, 64,7-80%), i els mascles van presentar els màxims al migdia (13-16 h, 40-42,8%) i a la nit (20-1 h., 62,5-83,3%).

Palabras clave: Etología reproductiva, *Charadrius alexandrinus*, delta del Llobregat, NE de España

Resumen: Pautas horarias de incubación del chorlitejo patinegro (*Charadrius alexandrinus*) en el delta del Llobregat.

A lo largo de la temporada reproductora del año 1993 se realizaron observaciones de chorlitejos patinegros (*Charadrius alexandrinus*) que incubaban sus nidos en el delta del Llobregat (NE España) para establecer los patrones horarios de incubación. Nuestros resultados confirmaron que las hembras incubaron principalmente durante el día (70,1% de los adultos observados) y los machos durante la noche (73,4%), pero mostrando oscilaciones. Las hembras presentaron máximos a primera hora de la mañana (7-10 hrs., 94.4-100%) y por la tarde (16-19 hrs., 64,7-80%), y los machos los presentaron al mediodía (13-16 hrs., 40-42.8%) y por la noche (20-1 hrs., 62,5-83,3%).

INTRODUCTION

Some aspects of the breeding biology of Kentish plovers (*Charadrius alexandrinus*) such as the sharing of incubation by the

sexes, were studied many years ago (i.e. Niethammer 1937 in Walters 1954). Patterns of incubation were established after observa-

tions conducted by day (Cramp & Simmons 1983), whilst nighttime patterns were inferred on the basis of suggestions (Walters 1954; Nakazawa 1979; Warriner et al. 1986). Most authors have made no attempt to quantify night incubation behavior (Paton 1995; but see Fraga & Amat 1996), and data on nighttime incubation are lacking for all plovers (Bergstrom 1986). A variety of breeding systems have been described in the Kentish plover (see Fraga & Amat 1996) and investigation into the share of incubation by the sexes may provide some information about the breeding strategies of Kentish plover populations.

Spain holds one of the most important populations of Kentish plovers in Europe (Tucker & Heath 1994). Nevertheless, the species was not studied in this country until the early 1990s, most studies being carried out in the Llobregat Delta (Ballesteros & Santaefemia 1990; Santaefemia et al. 1990; Ballesteros & Torre 1993; Torre & Ballesteros 1994), the second most important breeding area in Catalonia (Santaefemia et al. 1990). A general study concerning most aspects of the breeding biology of this species at Fuentedepiedra (Málaga) has recently been published (Fraga & Amat 1996).

The aim of this paper is to study the share of incubation time by both sexes in the Kentish plover throughout the day, nighttime and the breeding season, and to compare our results with those obtained in the rest of its range.

MATERIAL AND METHODS

The study was carried out in the Llobregat Delta (Barcelona, NE Spain), where a small population of 15 pairs of Kentish plovers breeding on a beach was monitored from late March to late June 1993. We used a very simple non-continuous method of sampling differing from those used by most authors when studying patterns of incubation in

plovers (Bergstrom 1986; Warriner et al. 1986; Székely et al. 1994). Under the null hypotheses that males and females incubate for equal amounts of time, we can expect that the probability of finding a male or a female incubating at any particular time of day will be the same. Our study is not designed to quantify the time invested by each sex in incubation, rather our aim is to ascertain patterns of variation in incubation related to sex, time of day and incubation periods.

Observations were made twice a week (see Paton 1995 for a similar approach) from a parked car on a road near the breeding area. Nests were monitored each hour (see Purdue 1976 for a similar approach) and the sex of the incubating adults was determined by using binoculars (10x50) and telescope (20x-60x). Nighttime records were made using a powerful portable spotlight.

Observations covered all daylight hours and half of the night hours and were made from 5 a.m. to 1 a.m. (GMT, 20 hours in total). We considered daytime to be between 6 a.m. and 8 p.m., and nighttime between 8 p.m. and 6 a.m. Observations were also recorded in relation to the time since the

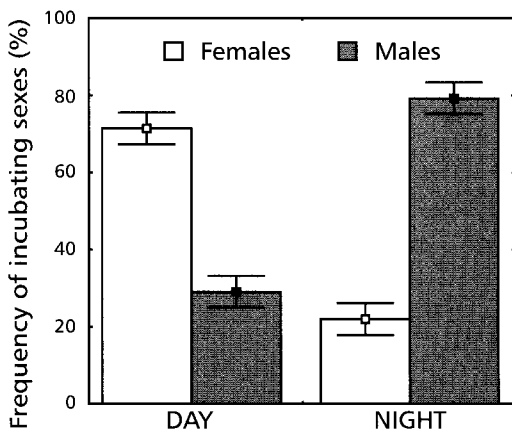


Figure 1. Observed frequencies (\pm standard error) of male and female incubating Kentish plovers throughout the day and night in the Llobregat Delta ($\chi^2 = 39.04$, d.f. = 1, $p < 0.0001$, Yates corrected Chi-square).

initiation of incubation to ascertain sexual patterns of incubation. Laying dates were established by direct observation, either by finding incomplete clutches or hatched young. Otherwise, laying dates were estimated using the egg flotation method (Hays & Lecroy 1971; Székely et al. 1994).

X²-tests were performed to verify sexual differences between day and night in the observation frequencies, and incubation was divided into three periods of nine days each (incubation lasts about 27 days, pers. obs.) to test possible sexual differences in incubation duties throughout the incubation period. We considered that a nest was attended when the adult remained more than 50% of the observation time on the nest (Purdue 1976).

RESULTS

Throughout the breeding season we made 301 observations of incubating Kentish plovers, most of which were during daytime

(78.7%, $n = 237$); nighttime observations were less frequent (21.2%, $n = 64$). The average percentage of incubating sexes during the observation times (twenty hours) was 61.6% females and 38.2% males, females being observed more frequently than expected ($X^2 = 7.12$, d.f. = 1, $p = 0.007$, Yates corrected Chi-square). During the day females did the bulk of incubation (70.1% of the adults observed, $n = 167$), while males averaged 29.2% ($n = 70$). At night, patterns were completely opposite and males were observed more frequently than females (73.4% males, $n = 47$, versus 26.5% females, $n = 17$). Females were the main incubating sex during the day and males during the night ($x^2 = 39.04$, d.f. = 1, $p < 0.0001$, Yates corrected Chi-square, Figure 1), although there were some variations. In the early morning (7-8 a.m.) males did not incubate, and the percentage of male observations increased from 7 a.m. (0%) to 3 p.m. (42.8%) ($x^2 = 11.82$, d.f. = 2, $p < 0.01$). The patterns of

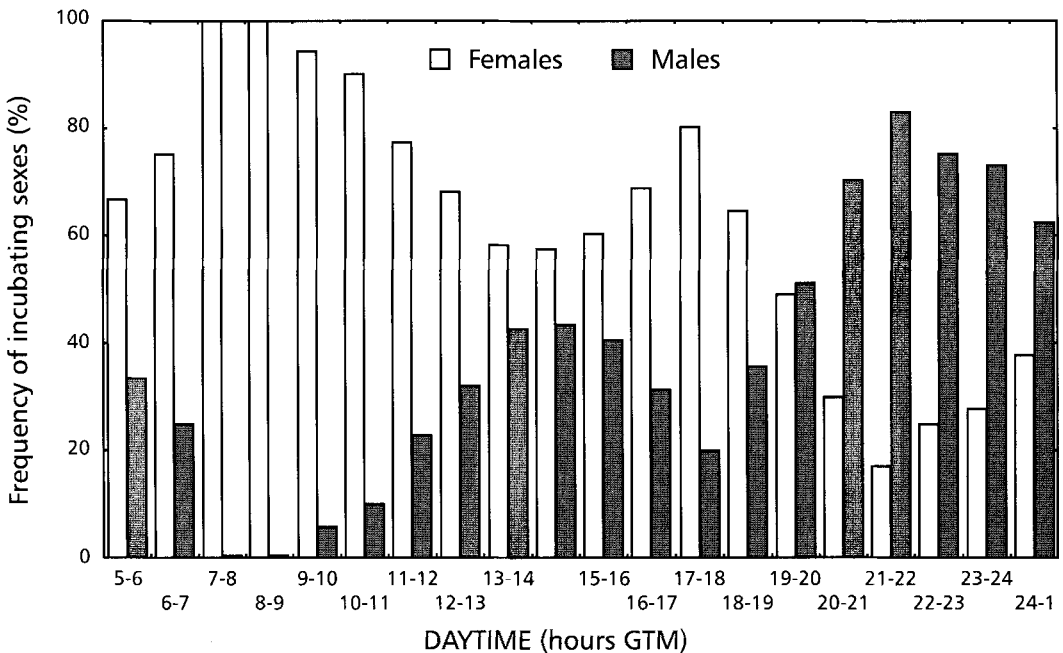


Figure 2. Observed frequencies of male and female incubating Kentish plovers throughout the day in the Llobregat Delta at one hour intervals (20 hours, observations are lacking from 1 to 5 a.m.).

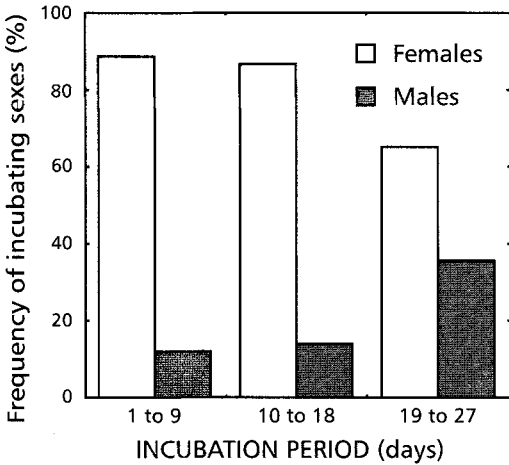


Figure 3. Observed frequencies of male and female incubating Kentish plovers throughout the day in relation to the time since the initiation of incubation ($X^2 = 9.03$, $d.f. = 2$, $p = 0.01$).

incubation seemed to fit a bimodal distribution (Figure 2), with males mainly incubating between 13-16 (40-42.8%) and 20-1 hours (62.5-83.3%) and females between 7-10 (94.4-100%) and 16-19 hours (64.7-80%).

During the day, the percentage of incubating males increased from early to late in the incubation period ($x^2 = 9.03$, $d.f. = 2$, $p = 0.01$): from 11.7% of males observed between the first and ninth day of incubation to 35.1% of males observed between the 19th and 27th day of incubation (Figure 3).

An absence of incubating birds was recorded only twice (0.66%), and a very important value of nest attendance (99.33%) was obtained.

DISCUSSION

During the study period in the Llobregat Delta female Kentish plovers were observed more frequently than males at nests. However, we have fewer nighttime observations (gap between 1 to 5 a.m.), which would influence the total percentage of incubating males (about 40% of individuals observed). According to the pattern in Figure 2, we

should expect males to be the main incubating sex between 1 to 5 a.m., and in this case our results would be in agreement with the general pattern of incubation found in the species: male and female incubate in roughly equal amounts (Glutz et al. 1975 in Cramp & Simmons 1983), as has been reported in monogamous birds (Trivers 1972 in Bergstrom 1986). The percentage of incubating females during the day (70.1%) was similar to that observed by Rittinghaus (1961) in a monogamous population in Germany (66%), but lower than that observed by Nakazawa (1979) in Japan (84%) and Warriner et al. (1986) in California (79.7%), and included in the range of variation reported by Székely et al. (1994) in Hungary ($67.7\% \pm 17.7$). In spite of pseudo-replication of our observations, the hourly patterns of incubation recorded are very similar to those reported by Fraga & Amat (1996) in Málaga, with males mainly incubating at night and females mainly during the day. We also detected the male incubation peak around midday, which could be a consequence of the female heat stress in relation to the rise in temperatures at this time of the day or to a greater involvement by males in diurnal incubation as the season advances (Fraga & Amat 1996).

The significant increase in males incubating during the final stages of the incubation period is consistent with the observations made by Nakazawa (1979) concerning male nest attendance increasing up to hatching. We found a surprisingly high value of nest attendance throughout the study period, but this should be taken with care since the non-continuous method of sampling used by us is not suitable for testing for such behaviour.

ACKNOWLEDGMENTS

J.A. Amat and J.L. Tella kindly revised a preliminary version of the paper and provided most of the literature cited. The final version

was revised and improved by comments of J. Figuerola and G. Llorente.

LITERATURE

BALLESTEROS, T. i SANTAUEFEMIA, F.J. 1990. *Notas sobre las recapturas de Chorlitejo patinegro Charadrius alexandrinus en el delta del Llobregat (Barcelona, NE Spain)*. Butll. G.C.A. 7: 43-44.

BALLESTEROS, T. i TORRE, I. 1993. *Incidencia de la predación sobre el fracaso de las puestas de Chorlitejo patinegro (Charadrius alexandrinus) en el delta del Lobregat*. Butll. GCA10: 59-61.

CRAMP, S. and SIMMONS, K.E.L. 1983. *The birds of the Western Palearctic*. Vol. III. Oxford University press.

FRAGA, R.M. and AMAT, J.A. 1996. *Breeding biology of a Kentish Plover (Charadrius alexandrinus) population in an inland saline lake*. Ardeola 43(1): 69-85.

HAYS, H., and LECROY, M. 1971. *Field criteria for determining incubation stage in eggs of the Common tern*. Wilson Bull. 83: 425-429.

NAKAZAWA, R. 1979. *Incubation behaviour of the Kentish plover (Charadrius alexandrinus), with special reference to the share of the sexes and the effect of ground surface temperature*. Misc. Rep. Yamashina inst. for Ornithol. 11: 54-63.

PATON, P.W.C. 1995. *Breeding biology of Snowy Plovers at Great Salt Lake, Utah*. Wilson Bull. 107: 275-288.

PURDUE, J.R. 1976. *Thermal environment of the nest and related parental behavior in Snowy plovers, (Charadrius alexandrinus)*. Condor 78: 180-185.