

Off-nest behaviour of the Little Tern *Sterna albifrons* during incubation

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Abstract - The off-nest behaviour of the Little Tern *Sterna albifrons* was studied in the Axios Delta, a Macedonian wetland. The time taken up by the following components of this behaviour was measured during incubation in four nests and during different parts of the day: Away from nest, Shift during incubation, Chase of intruders, Throwing Sideways, Around nest, Wake Up and fly, Courtship Feeding and Human Disturbance. Data were analysed by Repeated-Measures ANOVA. There were significant effects of nest, day and part of the day on a number of these components of off-nest behaviour. The birds from one of the nests spent very different proportions of time on the various activities than those at the other nests. The effects of the part of the day were clear and some activities exhibited trends: time spent on Away and Shift typically decreased from the beginning to the end of the day, Human Disturbance was diminished in the third part of the day and Wake Up and Throwing Sideways were greater in the middle of the day. Despite clear day effects on many variables there was no regular pattern to these. There was also an interaction of day and part of the day on Away, Throwing Sideways, Human Disturbance and Wake Up denoting that these activities were affected by unpredictable events.

Introduction

Behavioural aspects of the Little Terns *Sterna albifrons* and of the related New World species *S. browni*, *S. athalassos* and *S. antillarum* have been described in varying degrees (Massey 1974, Wolk 1974, Moseley 1979, Davies 1981). Courtship and/or chick feeding behaviour was quantified by McLannahan in Cramp (1985), Davies (1981) and Taylor (1982). Fasola and Saino (in press) quantified the parental behaviour of Little Terns at nest. Despite a considerable amount of descriptive information on the subject, various components of Little Tern behaviour have rarely been quantified.

The time larvae spend away from their nests may have important ecological consequences such as predation risk (Hunter and Morris 1976, Burger and Lesser 1978) and overheating of nest contents due to exposure to the sunlight (Jehl and Mahoney 1987). However, Little Terns leave their eggs uncovered for a variety of reasons. Additionally, some aspects of the behaviour of Little Terns seem to change in intensity during the season and even during a particular day (see

literature mentioned above). This study aimed in quantifying various components of the off-nest behaviour of Little Terns throughout the incubation period and the differences among nests and parts of day.

Methods

The study area was the Axios river estuary (40° 30' N, 22° 43' E) a Macedonian wetland near the city of Thessaloniki, Greece. The study colony was located on a sandy beach of the Delta and in 1989 had 93 nests of Little Terns and some nests of Common Terns *Sterna hirundo* and Kentish Plovers *Charadrius alexandrinus*.

Initially a group of eight nests were observed from a hide placed at the edge of the colony. The eggs from four of the nests disappeared early in the study so the data presented here refer to the other four. Observations were made recording with a stopwatch the time incubating parents spent off-nest. Various components of this behaviour (see below) were

recorded separately. The role of sexes was not differentiated. Clutches in all nests were complete at the start of observation and all nest owners were incubating. To ensure that our data referred to nests with eggs, data from only the first six observation days were used for statistical analysis i. e. 17, 18, 21, 22, 25 and 26 June making a total of 214 nest hours. Three three-hour observation periods (hereafter "period") were defined to sample different parts of the day: period A: 0715-1015; period B: 1335-1635 and period C: 1735-2035 (except on 17 June when the mid-day observation period was 1335-1600). The terminology used in this paper relating to the behaviour of Little Terns studied is the following:

At nest: one of the adults was incubating or (rarely) standing over the eggs.

Off nest: eggs were left uncovered. It was classified into the following activities:

Away: both parents left out of sight for no apparent reason;

Shift: incubating parent moved from the nest during a changeover in incubation duties;

Chase: adults left nest unguarded to chase-off an intruder such as a gull;

Throwing sideways: incubating bird moved from the nest, throwing small objects such as pebbles and shells backwards (see Cramp 1985);

Around: parent(s) near nest, standing without exhibiting any other behaviour;

Wake-up: incubating bird rose up suddenly and spontaneously flew away out of sight due to unknown reasons. Eggs remained uncovered for variable time;

Courtship feeding: incubating parent left nest to be fed by its partner;

Human disturbance: incubating bird left nest and flew away due to human presence in the vicinity of the colony.

The records were found to be non-normally distributed, and so the data were transformed using the logit transformation. The first variable modelled was the logit transform of the proportion of total time at nest:

$$\log \frac{\text{time At Nest}}{\text{time Off Nest}}$$

This gives an overall indication of time spent by parents at the nest. Similarly, for all components of off-nest time, logit transformations relative to the total off-nest time were used. To allow for zeros each of the transformed variables was of the form:

$$\log \frac{\text{time (a component of the off-nest behaviour)} + 0.5}{\text{total time Off Nest} - \text{time (a component of the off-nest behaviour)}}$$

To examine the effect of nest and time on the components of behaviour studied the data were subjected to an univariate Repeated-Measures ANOVA using the same three basic factors in each case: Nest (a random effect), Day and Period (both fixed effects). The interaction of day and period was also examined for each component of behaviour. Calculations were performed using MINITAB at the Department of Statistics of the University of Glasgow, U.K.

Results

Overall time (from all nests, days and periods combined) spent off nest was 8.1% and time at nest was 91.9% of the total. The differences among nests and time of day are in Table 1. Of the time spent off nest almost half was time spent on Away, followed by that spent on Human Disturbance, Around, Wake Up and on the remaining activities (Table 1). The results for each component of behaviour are described separately below.

At Nest: there were highly significant effects related to Nest and Day. This behaviour varied greatly among

Table 1. Effect of nest and time on the off nest components of behaviour in Little Terns. Values indicated are F-values from repeated measures ANOVA. ***: $P \leq 0.001$; **: $P \leq 0.01$; *: $P \leq 0.05$.

	Proportion of time off nest	Nest	Day	Period	Day-Period
At nest	see text	64.34 ***	5.43 ***	0.69	1.63
Away	44.7	4.76 **	8.04 ***	6.55 **	3.62 ***
Shift	2.3	28.48 ***	2.51 *	4.78 **	1.21
Chase	2.4	5.57 **	2.01	2.28	0.73
Throwing Sideways	4.5	1.28	0.61	10.76 ***	2.67 **
Around	12.1	12.57 ***	1.17	0.29	1.57
Human Disturbance	16.5	9.48 ***	2.43 ***	26.59 ***	7.48 ***
Wake Up	11.7	11.96 ***	52.07 ***	6.82 **	2.94 **
Courtship Feeding	5.9	3.10 *	2.09	11.39 ***	1.68

days. The order of observation days by average time At Nest was day 5>4>2>6>1>3. Notably, the birds of one of the nests (thereafter Nest 1) spent a much smaller proportion of time at their nest than the birds of the other nests.

Away: the effects of all parameters were significant. Nests ordered by average Away time were 1>2>3>4. In day 1 there was unusually high Away and in day 6 unusually low Away. Periods ordered by average Away time were A>B>C.

Shift: there were significant main effects of all parameters but no significant interaction between Day and Period. Days ordered by average Shift time were 5>6>4>2>1>3. Periods, ordered by average Shift time were of the sequence A>B>C. The birds at Nest 1 spent a much smaller proportion of time on Shift than those at the other nests.

Chase: the only significant effect was that of Nest probably because the birds at Nest 1 spent a much smaller proportion of time off-nest on Chase.

Throwing Sideways: there was a significant effect of Period and a significant interaction between Day and Period. Periods ordered by average Throwing Sideways were B>A>C.

Around: the only significant effect was that of Nest. The owners of Nest 1 spent a much greater proportion of time off nest on Around than the other nests did.

Human Disturbance: there were significant effects of all parameters related to Human Disturbance. On days 1, 4 and 5 there was relatively little time off due to Human Disturbance. On average, in period C there was less time off due to Human Disturbance. The birds at Nest 1 spent a much smaller proportion of time off nest on Human Disturbance.

Wake Up: the effects of all parameters on this behaviour were significant. On day 1 there was less Wake Up than other Days. Periods ordered by average Wake Up were: B>C>A. At Nest 1 birds spent a much smaller proportion of time off nest on Wake Up than the birds at other nests did.

Courtship Feeding: there were significant effects of Nest and Period on this behaviour. The birds at one of the nests spent a much smaller proportion of time off nest on Courtship Feeding than other nesters. In period C time spent in Courtship Feeding was much less than other periods.

Discussion

Lack of quantification of the off-nest components of behaviour of Little Terns make comparison with other studies difficult. Davis (1968) found that in ten nests of Least Terns studied, parents spent on average 91%

of their time near nest and 9% far from it. This is very similar to our results.

The proportion of time off nest that was spent on activities Away and Shift typically decreased from the beginning to the end of the day. This pattern may suggest that, in the middle of the day and in the afternoon, birds spent less time on these activities to better protect their eggs from exposure to sunlight. Additionally, the fact that time spent off nest due to Human Disturbance decreased and minimized in period C (afternoon) was a consequence of most visitors such as fishermen leaving during the third part of the day.

Although during Away eggs were at a high risk of predation it was not clear why such considerable time was spent on this activity. Davis (1968) noted a behaviour which looks like the Away described in this paper. He noted (p. 28) that while the male was absent the female without any apparent disturbance flew from the nest towards the sea -and returned three minutes later. This type of behaviour of Little Terns needs further research.

Of the nests studied, the behaviour of the parents at Nest 1 was quite different from that at the other nests. These birds spent overall a much greater proportion of time off nest and, in most components of off-nest behaviour, differences were also distinct: more time was spent on Away and Around and much less on Shift, Chase, Human Disturbance and Wake Up. In combination with the fact that there was only one egg in this nest it seems probable that this was a pair of young nesting birds. Clutch size and breeding behaviour and performance of young breeding Least Terns *S. browni* and other larids is different from older and more experienced individuals (Coulson 1963, Coulson and Horobin 1976, Massey and Atwood 1981).

Generally, although there were clear day effects on many of the components of off-nest behaviour of Little Terns (Table 1), there was no regular pattern to these. Interactions of Day-Period occurred for Away, Throwing Sideways, Human Disturbance and Wake Up and this suggests that the proportion of time off nest that was spent on these activities was very much affected by unpredictable events. Such events could be weather conditions, distance covered for food, etc. It is suggested that these should be taken into consideration for future studies.

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Riassunto - In periodo di incubazione si è quantificato il tempo speso fuori dal nido da 4 coppie di Fraticelli nel delta dell'Axios (Macedonia). Sono stati presi in considerazione i seguenti comportamenti: Allontanamento dal nido, Cambio per l'incubazione, Attacco ad intrusi, Postura di lato al nido, Attività intorno al nido, Alzarsi e involarsi, alimentazione nel corteggiamento e Allontanamento per disturbo umano. Si sono individuate correlazioni significative di questi comportamenti con: il tipo di nido, il giorno di osservazione e la parte del giorno. Si è osservata una alta variabilità intrapopolazionale, ma è chiaro un andamento giornaliero preciso per alcune di queste attività. Per altre correlazioni si sono solo individuate tendenze; ad esempio Allontanamento e Cambio per l'incubazione decrescono col passare del giorno. L'Allontanamento per disturbo umano diminuisce nell'ultima parte della giornata mentre Alzarsi e Postura di lato al nido sono più intensi a metà giornata. Sono descritte altre correlazioni, ma pare evidente che molti di questi comportamenti sono legati ad eventi imprevedibili.

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