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Breeding biology of the House Martin *Delichon urbica* in Algeria

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Abstract. Dates of egg laying, clutch size, the numbers of hatchlings and fledglings, and egg dimensions were studied in Annaba, Algeria in 2004–2005. The onset of laying is related to the end of the wet period and shows some inter-year variation. 38–45% of breeding pairs produce two broods per year. Mean clutch size declines with the progress of the breeding season. Mean values vary between the first (4.7 eggs) and second clutch (3.5 eggs) but not between years. Hatching and fledging success is relatively low in comparison with other Western Palearctic populations, probably because of environmental constraints operating at the southern edge of the House Martin breeding area. The relatively small size of Algerian House Martin eggs fits the general geographic pattern of variation.

Key words: House Martin, *Delichon urbica*, reproduction, timing, clutch size, geographic range, North Africa

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INTRODUCTION

In much of the species Eurasian and North African breeding range, the House Martin is common and numerous (Cramp 1988, Turner & Rose 1989, Snow & Perrins 1998, Seriot & Alves 2002). In spite of this, very little is known about its breeding biology in the southern part of the geographical area (Møller 1984). Most detailed studies on different aspects of the breeding biology of House Martins were conducted in Britain (Bryant 1975, 1978a, 1978b) central part of Europe (Hund & Prinzinger 1979, Rheinwald 1979, Pikula & Beklova 1987) and North-East Europe (Lind 1960, Lyuleeva 1974). Most southerly situated populations have been studied in Extremadura, Spain (Pajuelo et al. 1992, de Lope et al. 1993) but there is a complete lack of basic breeding data from European Mediterranean region or from North Africa (Etchecopar & Hue 1964, Seriot & Alves 2002). North African populations of House Martins seem especially interesting because they live at the southern edge of the species breeding range and, as a consequence, different environmental factors influencing life histories may be expected to reach their extreme values (Garcia & Arroyo 2001).

Having analysed the reproductive ecology of an North African population of the Barn Swallow *Hirundo rustica* Sakraoui et al. (2005) found that the breeding strategy differ in many respects from theoretical predictions concerning the geographical pattern (Lack 1947, Ashmole 1963, Møller 1984). Especially, clutch sizes proved to be larger and the number of clutches per year smaller than expected. It seemed probable that similar special features would be revealed in House Martins, as this species is also an air insect feeder, undergoing similar environmental constraint. Consequently, its breeding performance would be expected to be dependent on the productivity of aerial insects, which is sensitive to weather conditions (Bryant 1973, 1975). The hot and dry period of the breeding season typical of North Africa is a heavily limiting factor for the timing of breeding (Blondel & Aronson 1999). Because the weather differs to

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some extent between years, the period of sufficient abundance of food supporting breeding may also differ.

In this paper we describe and analyse the timing of House Martin breeding, clutch size, brood size and egg traits in the southernmost population studied so far.

MATERIAL AND METHODS

The study of House Martins was carried out in Annaba, Algeria, North Africa (37°N, 8°E) in 2004–2005. The climate of Annaba is the sub-wet version of the Mediterranean-type climate, with one hot and dry season between May and September and with a mild and wet season from October to April. The rainfall ranges from 650 to 1000 mm per year. The study area included extensive suburbia of Annaba, with many blocks of apartments, factories and garages, south of the city centre. The province of Annaba covers ca. 1400 km^2, with population about 550 000 people.

Nesting places were observed for signs of breeding activity by pairs of House Martins in spring. Active nests were checked at least once a week to monitor the course of breeding and to record basic reproductive variables. Especially, we established the date of the start of laying eggs in individual clutches, clutch size and brood size at the stage of hatching and fledging. Measurements of egg length (L) and breadth (B) were taken with sliding calipers to the nearest 0.1 mm. Egg volume (V) in cubic centimeters was calculated according to Manning's (1979) formula: $V = 0.00051 * L * B^2$. Per-clutch mean values of egg characters were calculated and used in analyses as unit records to avoid the non-independence of individual eggs within clutches (Bańbura & Zieliński 1990, 1998a).

Standard statistical methods were applied (Sokal & Rohlf 1995). Calculations were performed using MS Excel and STATISTICA 6 (StatSoft, Inc 2003).

All data on the weather were downloaded from the web, www.tutiempo.net/en/.

RESULTS

Broods and timing of breeding in relation to weather

Over the two-year study period, we monitored 101 first brood nests, 51 and 50 in 2004 and 2005, respectively. Nesting in this population is not supported by nest boxes. Less than the half of breeding pairs produced also second broods, 45% and 38% in the consecutive years, respectively, with the difference in the proportion being non-significant (Fisher's exact test: $p = 0.071$).

The onset of egg laying was extensively distributed in time, with the breeding season 2004 being longer than 2005 (Fig. 1). In 2004, egg laying

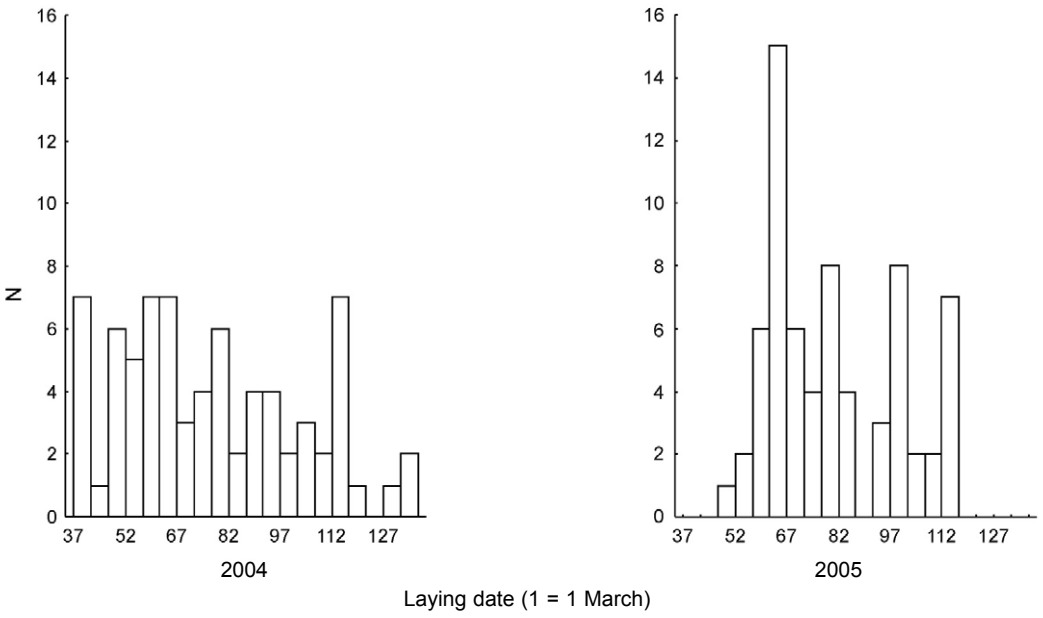


Fig. 1. The frequency distribution of laying dates (expressed as the number of days after 1 March, with 1 = 1 March) in the Annaba population.

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Table 1. Dates of the onset of egg laying in the first and second broods of House Martins in Annaba in 2004–2005. One-way ANOVAs testing for year effects are given. Sample size in parentheses.

Brood	Means ± SD		Year effect	p
	2004	2005		
First	2 May ± 15.8 (51)	11 May ± 12.6 (50)	$F_{1,99} = 10.27$	0.0018
Second	16 June ± 15.7 (23)	14 June ± 9.2 (19)	$F_{1,39} = 0.26$	0.61

started as early as on 6 April as compared with 18 April in 2005. This resulted in a significant difference in the mean onset dates of the first but not the second brood (Table 1).

The analysis of graphs showing egg laying and two characteristics of weather, mean daily temperature and rainfall, suggests that House Martins in Annaba start laying eggs just after a series of rainy days when the temperature reaches around 15°C (Fig. 2). A similar pattern occurred in both the years of the study.

Breeding performance

A consistent pattern of variation in clutch size in relation to year and brood appeared (Table 2). There was a significant difference between the first and second broods, with first clutches being larger than second, while neither the effect of year nor the effect of year-brood interaction occurred.

Very similar patterns of variation and significance of differences exist for corresponding performance characteristics, the per-brood mean number of hatchlings and fledglings (Table 2).

Clutch size clearly declines with the course of the breeding season (2004: $r = -0.62$, $n = 74$, $p < 0.0001$; 2005: $r = -0.51$, $n = 68$, $p < 0.0001$ (Fig. 3).

In both years of the study, hatching success in the first brood was very similar, c. 70%. This means that hatching failure was as high as 30%. Hatchability of the eggs in second broods was even lower, 57–58%. The percentage of hatchlings

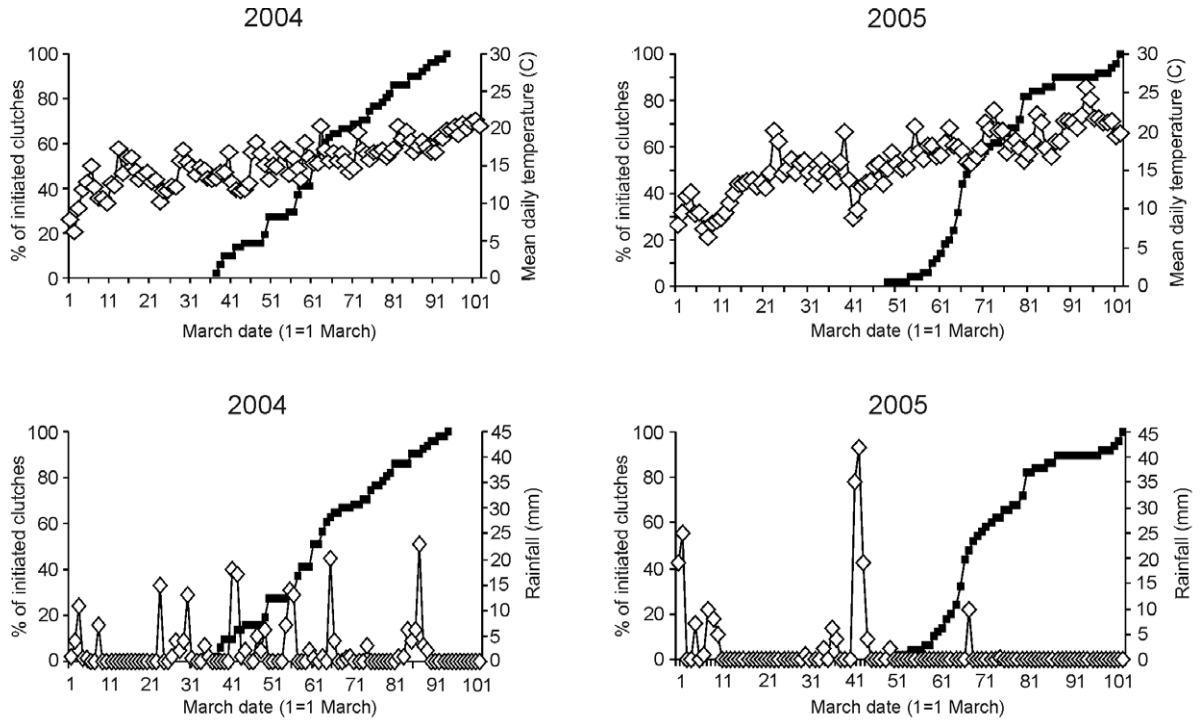


Fig. 2. Relation between two weather characteristics (mean daily temperature and daily sum of rainfall), -◇-, and cumulative percentage of the laying dates of initiated first clutches (expressed as the number of days after 1 March, with 1 = 1 March), -■-, in the Annaba population.

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Table 2. Clutch size, hatchling number and fledgling number in the first and second broods of House Martins in Annaba in 2004–2005 (mean ± SE). Year and brood effects were tested using two-factor ANOVAs. Sample size in parentheses.

Variable	Brood	Year		Effects	$F_{1,139}$	p
		2004	2005			
Clutch size	First	4.71 ± 0.12 (51)	4.70 ± 0.12 (50)	Year	0.08	0.78
	Second	3.43 ± 0.18 (23)	3.53 ± 0.19 (19)	Brood	61.5	< 0.0001
				Year*Brood	0.10	0.75
Hatchlings	First	3.35 ± 0.21 (51)	3.30 ± 0.21 (50)	Year	0.01	0.92
	Second	1.96 ± 0.31 (23)	2.05 ± 0.34 (19)	Brood	23.5	< 0.0001
				Year*Brood	0.07	0.79
Fledglings	First	2.33 ± 0.23 (51)	2.86 ± 0.23 (50)	Year	0.80	0.37
	Second	1.26 ± 0.34 (23)	1.26 ± 0.37 (19)	Brood	20.3	< 0.0001
				Year*Brood	0.78	0.38

that survived up to fledging was 69–86% for the first brood and 61–64% for the second brood. As a result, the percentage of eggs that produced fledglings, 50–61% for the first brood and ca. 36% for the second brood, constitutes a relatively low breeding success.

Egg traits

Egg length, breadth and volume did not differ between the first and second broods but breadth and volume turned out to significantly differ between the two years of the study (Table 3). Eggs were on average larger in 2005 than in 2004. These two variables were positively correlated with mean daily temperature occurring during five-day-long periods preceding the onset of laying a particular clutch by 5 days (egg breadth: $r = 0.30$, $n = 72$, $p = 0.009$; egg volume: $r = 0.32$, $n = 72$, $p = 0.007$). The weather conditions during the time of first brood egg formation were significantly different in the two years of the study, with the season 2005 being both warmer and less rainy than 2004 (Table 4).

DISCUSSION

In Algerian towns, House Martins nest very often on various external structures of blocks of flats as well as on other buildings, the habit being very similar to nesting behaviour shown in other parts of the species Mediterranean, and, as a matter of fact, Western Palearctic area (Cramp 1988, Snow & Perrins 1998). It is very characteristic that the blocks of apartments are also a site to nest for Barn Swallows, so that some overlap in nesting places can be observed in North African towns (Sakraoui et al. 2005). Both the species feed on the wing, exploiting, however, different groups of flying insects (Kozena 1983). The food of the House Martin as well as the space this species utilises is more similar to those typical of the Swift *Apus apus*

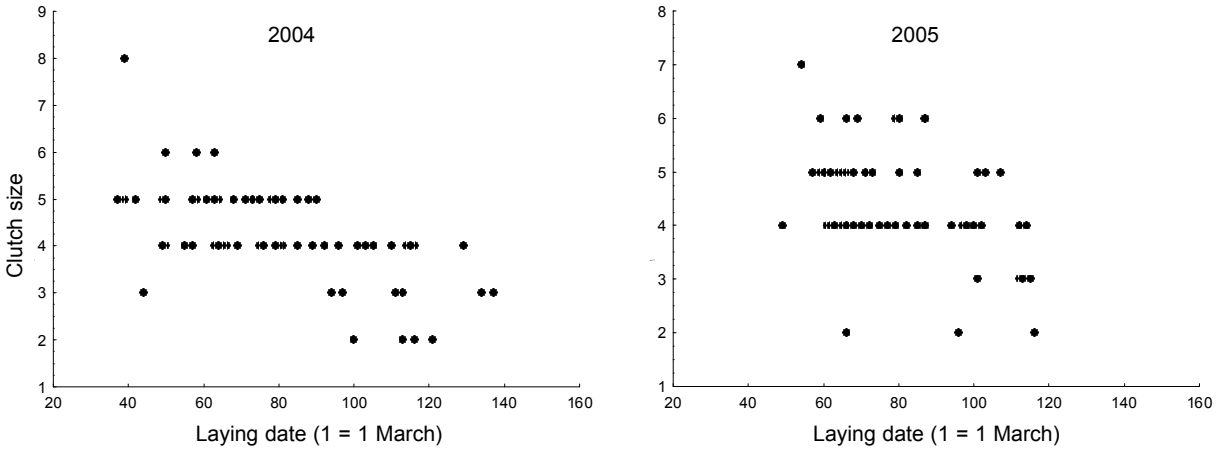


Fig. 3. Relationship between clutch size and laying dates (expressed as the number of days after 1 March, with 1 = 1 March) in the Annaba population.

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Table 3. Average values of egg length, breadth and volume in the first and second broods of House Martins in Annaba in 2004–2005 (mean ± SE). Per-clutch mean egg traits were used as observation units. Year and brood effects were tested using two-factor ANOVAs. Sample size in parentheses.

Egg trait	Brood	Year		Effects	$F_{1,139}$	p
		2004	2005			
Egg length (mm)	First	18.30 ± 0.11 (51)	18.50 ± 0.18 (21)	Year	0.57	0.45
	Second	18.44 ± 0.17 (23)	18.52 ± 0.26 (10)	Brood	0.20	0.66
				Year*Brood	0.12	0.73
Egg breadth (mm)	First	12.75 ± 0.05 (51)	12.98 ± 0.08 (21)	Year	4.7	< 0.04
	Second	12.75 ± 0.08 (23)	12.88 ± 0.11 (10)	Brood	0.45	0.50
				Year*Brood	0.41	0.52
Egg volume (cm3)	First	1.50 ± 0.02 (51)	1.57 ± 0.02 (21)	Year	4.31	< 0.05
	Second	1.51 ± 0.02 (23)	1.54 ± 0.03 (10)	Brood	0.08	0.78
				Year*Brood	0.44	0.51

(Lack 1973, Kozena 1975, 1983). A property common to all the species feeding on airborne insects, mostly the imagines of flying insects, is breeding later in the season than in the case of insectivorous birds feeding mainly on larvae (Baker 1938, Lack 1950). This obviously results from the timing of insect development and, consequently, availability of the adult stage to insectivorous birds. The abundance of insects in the air is directly and indirectly weather-dependent (Lack 1973, Bryant 1975, Elkins 1988). As a result, aerial insect feeders start breeding when enough amounts of insects appear, which happens after a threshold weather conditions occur with the progress of spring (Baker 1938, Lack 1950). This produces both geographical patterns and local year-specific differences in the timing of breeding.

During this study, laying of first eggs took place in the first half of April, but yearly mean laying dates for the first broods were in the first half of May. This is relatively early timing when compared with central and north Europe where laying starts in May–June (Lyuleeva 1974, Hund & Prinzinger 1979, Rheinwald 1979, Pikula & Beklova 1987, Cramp 1988, Kamiński & Wołosiuk 1995, Górska 2001). The breeding biology of the House Martin has hardly ever been studied in the southern part of the Western Palearctic but it seems that the breeding season starts even earlier in Extremadura, West Spain where the first eggs are laid in March (Pajuelo et al. 1992, de Lope et al. 1993). An inspection of climatological data concerning Annaba (Algeria) and Badajoz (Spain) shows that although both the towns are characterised by a similar seasonal distribution of temperature, they differ in rainfall. Annaba has a more pronounced wet season lasting from October to April and a dry season from May to September. The wet season is characterised by lower rainfall that gradually declines through January–February–March. The earlier breeding season in the Barn Swallow in Spain than in Algeria has analogously been reported (Sakraoui et al. 2005). This seasonal advantage is probably the reason for Spanish House Martins being capable of producing even three broods in some years (Pajuelo et al. 1992, de Lope et al. 1993), the phenomenon not having been reported for other areas including Algeria.

The inter-year difference in the onset of laying as well as in the length of the breeding season in Algerian House Martins seems to be best accounted for by temperature and rainfall distribution in early spring. Temperature clearly influences both the development and flying activity of insects, with temperature of 13°C consisting a threshold (Lack 1973, Bryant 1975, Elkins 1988). Thus, the fact that Algerian Martins initiate laying eggs when the mean daily temperature reaches around 15°C is reasonable but it is worth pointing out

Table 4. Mean (± SD) weather characteristics for the 5-day-long period preceding clutch laying by 5 days in 2004–2005. Only the first brood is included. Results of testing for inter-year differences by one-way ANOVAs are shown. ( ) — sample size.

Weather variable	Year		Year effect	
	2004	2005	$F_{1,99}$	p
Mean daily temperature (°C)	15.44 ± 1.74 (51)	18.23 ± 2.25 (50)	50.57	< 0.0001
Maximum daily temperature (°C)	20.99 ± 2.26 (51)	24.16 ± 2.94 (50)	37.02	< 0.0001
Minimum daily temperature (°C)	9.81 ± 1.71 (51)	13.05 ± 2.15 (50)	71.16	< 0.0001
Rainfall (mm)	22.20 ± 26.51 (51)	2.97 ± 14.27 (50)	20.50	< 0.0001

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that in this population the end of heavier rains associated with warm temperature seems to constitute an important condition triggering breeding. Similar year-related differences in the timing of breeding have been recorded for other populations (Lyuleeva 1974, Bryant 1975, Hund & Prinzinger 1979, Rheinwald 1979, Pikula & Beklova 1987). It is also clear that hot summer may be a critical period to rear nestlings in the Mediterranean Region, thus determining the end of the breeding season (Blondel & Aronson 1999). Inter-year differences in these two limits of the breeding season are likely to explain corresponding differences in proportions of pairs producing two broods within a season.

The average first clutch size of 4.7 found in this study is amongst the greatest reported in the literature (Bryant 1975, Hund & Prinzinger 1979, Rheinwald 1979, Pikula & Beklova 1987, Górska 2001). In a little more northerly localized House Martin population in Spain the average size of the first clutch has been reported to be ca. 4.6 (Pajuelo et al. 1992, de Lope et al. 1993). Mean clutch sizes in adequately studied central European populations are 4.2–4.7 (Hund & Prinzinger 1979, Rheinwald 1979). In all populations studied the second clutch is on average smaller, with the mean second clutch size in Annaba being within the reported range (Bryant 1975, Hund & Prinzinger 1979, Rheinwald 1979, Pikula & Beklova 1987, Cramp 1988, Pajuelo et al. 1992, de Lope et al. 1993). Typically for many passerines (Perrins 1970, Crick et al. 1993, Wiggins et al. 1994, Bań-bura & Zieliński 1998b, Antczak et al. 2004, Czeszczewik 2004), clutch size declines with the progress of the breeding season in different populations of the House Martin including the Algerian population reported in this paper.

Per-brood-mean numbers of hatchlings and nestlings, like clutch size to which they are strictly related, are higher for the first clutch than for the second clutch. They also show a decline with the time of the breeding season. Because of the relation with clutch size, the explanation of the pattern of variation is similar. The values of hatching success are much lower than those reported for other Hose Martin and Barn Swallow populations (Bryant 1975, Hund & Prinzinger 1979, Rheinwald 1979, Pikula & Beklova 1987, Pajuelo et al. 1992, de Lope et al. 1993, Bańbura & Zieliński 1998, Górska 2001, Sakraoui et al. 2005). In a geographically closest population out of different House Martin populations studied, that from Spanish Extremadura, there was also a difference in hatching success between the broods, with the second brood being worse (82%) than the first one (94%). However, the overall rates were much higher than in Annaba (de Lope et al. 1993).

Breeding success of 86% in the first brood and 72% in the second brood recorded by de Lope et al. (1993) is typical for the House Martin as a species nesting in relatively safe places, these values being much higher than in the present study population. We suppose that the very hot and dry breeding season of House Martins in Annaba may be the reason for low breeding success and its components. Such climatic conditions typical of the Mediterranean Region are very demanding for parents during incubation and feeding nestlings as well as for eggs and nestlings themselves because they result in overheating and fresh water deficit (Blondel et al. 1991, Bańbura et al. 1994, Zandt 1997, Blondel & Aronson 1999). Such limiting conditions tend to enhance with the progress of the season, which would explain why the breeding success in the second brood is clearly lower than in the first brood in this study as well as in de Lope et al.'s (1993) study.

Egg volume and linear dimensions in the Annaba population of House Martins fit to the pattern of geographic variation reported in the literature (Makatsch 1974, Bryant 1975, Hund & Prinzinger 1979, Cramp 1988). On average, eggs in the study population are slightly larger than in West Mediterranean populations (Makatsch 1974) but smaller than in central European and British populations (Makatsch 1974, Hund & Prinzinger 1979, Cramp 1988). By contrast with other published studies, in the Annaba population of the House Martin, no differences between the first and the second broods within years were found (cf. Bryant 1975, Hund & Prinzinger 1979, Cramp 1988). Eggs turned out to be slightly but significantly wider and larger in general in the second year of this study than in the first year, with the length being the same. Egg sizes as important components of reproductive strategy of birds are known to show some year differences (Makatsch 1974, Zieliński & Bańbura 1998, Pinowska et al. 2004).

Actually, the timing of reproduction, egg size and components of reproductive success are known to be weather-dependent to some extent in aerial feeders (Lack 1973, Bryant 1975, Saino et al. 2004). Because the forming of an egg takes a female five days (Perrins 1996), in order to find out potential differences in weather between the two seasons studied, which could influence the timing of reproduction and egg sizes, we analysed mean

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weather conditions in a five-days-long period preceding by five days the onset of egg laying in individual first clutches. Both temperature and rainfall conditions proved different, with the season 2005 being characteristically less rainy. Although we still do not know what is the causal link between weather conditions and the life history of the House Martin (via food and physiological condition), we think that the between-year difference in weather provides the most likely explanation for the difference in breeding performance of this species.

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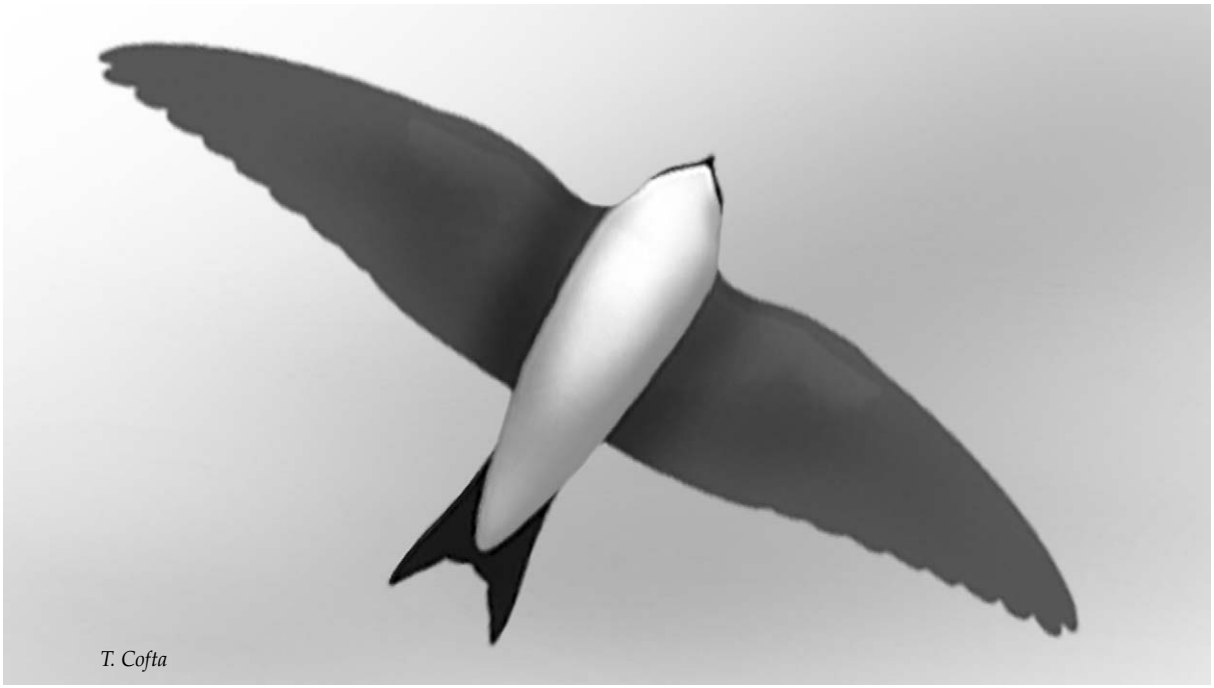
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STRESZCZENIE

[Biologia rozrodu oknówki w Algierii (Afryka Północna)]

Badania prowadzono w latach 2004–2005 w miejskiej populacji oknówek gniazdujących na blokach mieszkalnych i innych budynkach Annaby, w północno-zachodniej części Algierii. Poprzez obserwację miejsc gniazdowych i zachowań lęgowych oknówek od wczesnej wiosny a następnie kontrolę czynnych gniazd ustalano datę rozpoczęcia składania jaj w poszczególnych gniazdach. Prowadzone dalej systematyczne kontrole co najmniej raz w tygodniu umożliwiły określenie wielkości zniesienia, zmierzenie jaj oraz liczby piskląt bezpośrednio po kluciu i przed wylotem z gniazda. Analiza danych lęgowych wskazuje, że rozpoczęcie składania jaj wykazuje pewne zróżnicowanie między latami i jest uwarunkowane końcem okresu deszczowego (Fig. 1, 2). Średnio ma miejsce w pierwszej połowie maja (Tab. 1). Mniej niż połowa par wyprowadza dwa lęgi w sezonie (38–45%). Przeciętna wielkość zniesienia w pierwszym lęgu (4.7 jaj) i w drugim lęgu (3.5 jaj) jest wyższa niż oczekiwana teoretycznie dla południowego krańca zachodnio-palearktycznego zasięgu lęgowego oknówki. Im później następuje przystępowanie do lęgów tym wielkość zniesienia się zmniejsza (Tab. 3). Przy znacznej wielkości zniesienia, sukcesy klucia i wylotu okazują się stosunkowo niskie w porównaniu z innymi badanymi populacjami (Tab. 2). Północnoafrykańskie oknówki produkują stosunkowo małe jaja (Tab. 3) zgodnie z opisaną w literaturze tendencją geograficzną.



T. Cofta

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