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Timing of breeding in the Feral Pigeon *Columba livia* f. *domestica* in Słupsk (NW Poland)

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Abstract. The study was conducted from 1997–2001 in the city of Słupsk. Observations of individually marked birds were conducted from blinds located at city-centre sites where Feral Pigeons breed. The pigeons bred throughout the year, with peak broods in spring and summer. Different pairs timed their breeding such that the beginning of the season (from October to September of the next calendar year) overlapped the dates of completion (from April to December). 10% of pairs had already begun breeding in the autumn, while 86% did so between January and May. The remaining pairs (young ones, in particular) started breeding even later, mainly because of the lack of suitable nesting sites. The breeding period most often ended between August and October (75% of pairs), when the pigeons began their moult. 91% of the young birds joined the breeding population in their second calendar year of life. The remaining young birds had their first broods in the first or third calendar year of life. Pairs of young birds started nesting 2–3 months later than adult birds. The average length of a pair's breeding season was 183 days.

Key words: Feral Pigeon, *Columba livia* f. *domestica*, chronology, reproduction, structure of breeding population

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INTRODUCTION

The Feral Pigeon reproduces in all months of the calendar year, even in winter (Dunmore & Davis 1963, Murton et al. 1972, Häkkinen et al. 1973, Sengupta 1974, Dilks 1975, Johnston 1984, Dabert 1987, Johnson & Janiga 1995). Its breeding activity is most intense in the spring and summer, and then it decreases markedly in autumn and winter (Riddle 1971, Janiga 1985, Janiga & Kocian 1985). A distinct drop in the number of broods between August and October is associated with the birds' moult (Murton et al. 1974a, Dilks 1975, Kotov & Noskov 1978, Preble & Heppner 1981, Johnston & Janiga 1995), while in winter it is due to deteriorating weather conditions.

Johnston & Janiga (1995) distinguished two segments of the population, one which does not reproduce seasonally, as it also breeds in winter, and a second which reproduces similarly to the Rock Dove — from spring to the period of moult. The reason for the heavily protracted breeding period in a number of the birds is thought to be inherited from domestic pigeons, which can have even twelve broods in a year (Levi 1974).

The aim of this study was to determine the timing of the beginning of the breeding period and of its final conclusion in specific pairs, to define the duration of the reproduction period in the population studied.

METHODS AND MATERIAL

The study was conducted in Słupsk (N Poland, 54°28'N, 17°10'E), a medium-size town of 100 000 inhabitants. The course of the breeding season was observed from the mid-1997 until 2000 in 5 breed-

ing colonies, and in 2001 in 3 colonies. Birds of two colonies located in lofts nested mainly on the floor close to the walls or some other object. The three remaining colonies were situated in towers. Birds built nests at different levels, especially in the upper parts of the structures, on beams, in niches in walls and on the roof construction. Nests on the floor of a tower were scarce.

Before the investigation began, all birds from these colonies were individually marked with colour rings. Pigeons were caught at night after closing all outlets. Breeding pairs and their territories were identified from observations conducted every 2–3 weeks from blinds located in the breeding places. In addition, nests were checked twice a week between February and August, and once a week for the remaining period. Fledglings and immigrants appearing in the colony during the study were subsequently ringed.

The age structure of a colony was determined only after the first year of the study, i.e. in the second breeding period (Table 1). Those individuals that had reproduced in the previous breeding season were considered experienced birds. Birds in their first, second or third calendar year of life which were breeding for the first time were defined as inexperienced. Immigrants not presenting any distinct characteristics of an immature bird, and who undertook breeding, were excluded from the analysis. They were included in the group of birds experienced in looking after broods in the following season.

Table 1. The age structure (%) of studied breeding pairs (N). Exp — experienced, i.e. pairs, which bred earlier, Inexp — inexperienced, i.e. pairs of individuals breeding for the first time, Others — (a) pairs of immigrants of an unknown age, (b) mixed pairs of experienced and inexperienced individuals, (c) experienced and immigrants and (d) inexperienced and immigrants.

Season	N	Exp	Inexp	Others			
				a	b	c	d
1997/98	54	—	—	—	—	—	—
1998/99	90	47	18	6	11	7	11
1999/00	113	52	11	4	21	4	8
2000/01	97	62	13	3	15	1	6

The day the first egg was laid in the first brood after the autumn moult was considered the date of the beginning of the breeding season for a given pair. The end of the breeding season was the final day the last brood was cared for (either the offspring left the nest or the brood was lost) before the break for moult and winter rest.

RESULTS

Beginning of the breeding season

Feral Pigeons bred during all months of the calendar year in Słupsk. The first pairs started their breeding season directly after moult, i.e. in October or November (Fig. 1). In 2000, 5% of the birds began their breeding season from October to December, while 18% of birds did so in 1998. The majority of pairs initiating breeding during these months were experienced breeders. Only one young male was observed to have begun breeding in December of his first calendar year of life.

Most pairs began their breeding season between January and May (Fig. 1), with January, February or March being the peak months of breeding initiation for 74% to 93% of the pairs studied. The latest months when pairs initiated breeding were observed to be June and July. This most often occurred with a small group of inexperienced birds in their second calendar year of life that had problems finding suitable nesting sites. An outstandingly late start (in August and September) in the breeding season of 1998/99 (Fig. 1) was observed only in birds nesting in their first calendar year of life. However, all their broods were unsuccessful. After their loss, the birds entered a period of winter rest and undertook breeding in the spring of the next calendar year.

The start dates of the pigeon's breeding season differed among the various study years (χ^2 = 68.75, df = 15, $p < 0.001$) and no correlations were found with the ambient temperature ($r = -0.26$, $p > 0.05$) or the length of the day ($r = -0.42$, $p > 0.05$).

Experienced birds started breeding earlier than inexperienced ones (Fig. 2). Some adults began new broods directly after moult (even as early as October), but the majority started only in February (data pooled for the entire study period). The earliest inexperienced birds began breeding was in December. However April and May were found to be the peak months when they initiated breeding, so their breeding season was shifted 2–3 months later in comparison with experienced birds.

Completion of the breeding season

The dates the breeding period of Feral Pigeons ended in Słupsk were strongly extended in time. However, breeding was concluded at a higher

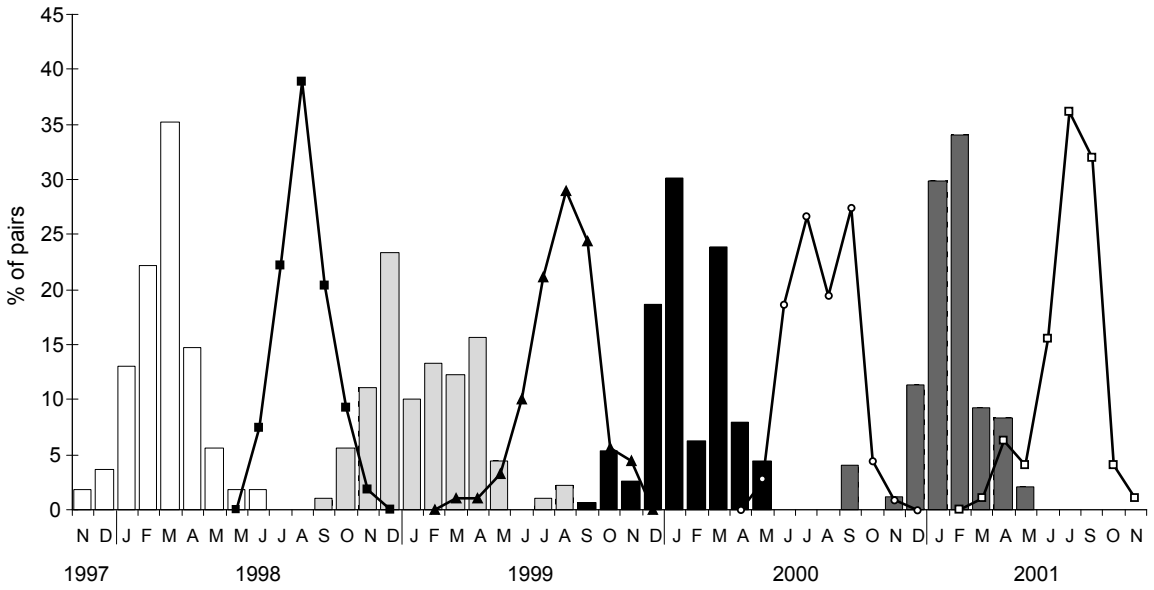

Fig. 1. Dates of beginning (columns) and ending (lines) of breeding seasons in the studied population of the Feral Pigeon. Sample size: N = 54 pairs (season 1997/98), N = 90 (1998/99), N = 113 (1999/00), N = 97 (2000/01).

rate between August and October (from 72.2% do 81.5% pairs), when the birds began moulting (Fig. 1). Earlier termination of the breeding season occurred between April and July for 7.4% to 26.8% of the pairs in various study years for a number of reasons. One reason was the death of a partner. The remaining individual could not find a new partner in the same season, or it joined another single bird and formed a new pair. A second important reason for earlier termination was the disturbance of pairs occupying nesting territories on the floor of a tower by fledglings that had fallen from nests located higher up. These fledglings could concentrate there in high numbers (even up to 25 individuals), and were the main cause of egg and hatchling mortality in the nests situated on the floor.

The last pairs (from 1% do 11.1%) to end their breeding season did so in November and December (Fig. 1). The timing of breeding completion by pairs differed among the seasons studied ($\chi^2 = 39.71$, df = 9, $p < 0.001$).

The length of the breeding season of pairs and the population

A pair in the population studied was involved in breeding on average 183 ± 74 days. The mean length of the breeding season of specific pairs was similar in subsequent years (ANOVA F = 1.40, df = 3, $p > 0.05$). Experienced pairs (n = 163) bred on average 203 ± 73 days (max. 369 days), while inexperienced ones (n = 79) 125 ± 62 days (max. 266 days) (Student t-test t = 8.12, df = 240, $p < 0.001$). The type of breeding location did not play any role, as pairs that occupied lofts (n = 98) bred over 189 ± 74 days and those in towers (n = 256) 179 ± 74 days (Student t-test t = 1.12, df = 352, $p > 0.05$). The breeding season in the population studied lasted for a total of 14 or 15 months (Fig. 1). Thus, subsequent breeding seasons overlapped, making it seem that Feral Pigeons are continuously reproducing.

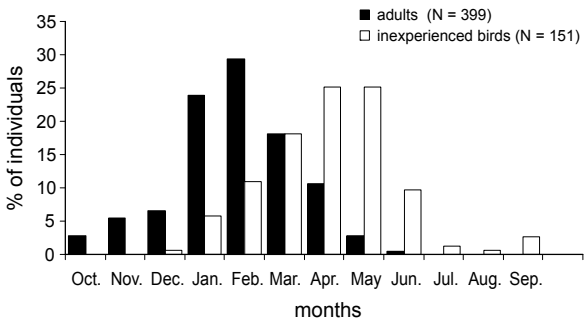

Fig. 2. Beginning of the breeding season by adults and inexperienced birds. Data pooled for the whole period of study.

Age of birds joining the breeding population

Birds that bred in their first calendar year of life constituted only 5.3% (n = 151) of individuals in the breeding population, and on average they

Table 2. Comparison of the average age (days) of birds starting reproduction for the first time.

	Sex		Breeding place		Seasons		
	Male (N = 83)	Female (N = 68)	Loft (N = 49)	Tower (N = 102)	1998/99 (N = 53)	1999/2000 (N = 58)	2000/2001 (N = 40)
Age (days) ± SD	338 ± 108.48	324 ± 78.34	281 ± 59.91	356 ± 100.59	329 ± 93.53	326 ± 108.03	345 ± 80.71
	t = 0.89, df = 149, p > 0.05		t = 4.80, df = 149, p < 0.001		ANOVA F = 0.50, df = 148, p > 0.05		

started their first broods at an age of 190 days (ca. 6 months). The youngest male that started breeding was 111 days old, while the youngest female was 174 days old.

A small number of birds first began breeding in their third calendar year of life. These birds constituted 4% (n = 151) of all breeding individuals in the colonies studied, and mainly represented males that had not found suitable nesting territory earlier.

The great majority of birds started breeding in their second calendar year of life. They constituted 90.7% of birds in the breeding population and their average age when they started reproducing was 326 days (ca. 11 months).

No difference in the age of males and females was noted in the timing of the start of reproduction. Nor were any significant discrepancies discovered among the study years. However, significant differences were found between the colonies (Table 2). In lofts, where the pigeons nested mainly on the floor, inexperienced birds began reproducing earlier, on average after 9 months of age, while in towers, where it was more difficult to find new territories, inexperienced individuals started breeding significantly later, after about 12 months of age.

DISCUSSION

The literature presents markedly different times for the beginning of the breeding season in Feral Pigeons. Some authors state that the first birds begin breeding as soon as January (Erskine 1976, Pikula et al. 1981, 1982, Janiga & Kocian 1985), February (Riddle 1971) or March (Kotov 1978). Others describe a continuous, yearlong nesting of their study populations, so that the breeding season is analysed within a calendar year (Sengupta 1974, Dilks 1975, Dabert 1987). There are also investigators who report the pigeons' ability to start the breeding season in October or November directly after moult (Goodwin 1960, Häkkinen et al. 1973, Kotov & Noskov 1978). The studies in Słupsk support the results of Johnston & Janiga (1995), who claimed that a smaller group with a non-seasonal reproduction period (beginning in the autumn and winter) can be distinguished from a larger group with a well-defined breeding season (beginning in the spring) in the population of Feral Pigeons. Only a small fraction of the Feral Pigeon population was found to be year-round breeders, undoubtedly consisting of birds experienced in reproduction. Such pairs were able to breed even in autumn and winter, irrespective of unfavourable weather conditions. Characteristic of these birds was an extraordinarily long breeding season, achieved by starting directly after moult and completing the season late in the year. An additional, however seldom, method observed that extended the duration of the breeding season was to care for nestlings during moult. Lofts & Murton (1968) and Kotov & Noskov (1978) also observed this. A break in reproduction (min. 12 days) occurred in every studied pair of the Feral Pigeons in Słupsk. Shorter breaks occurred during the time of moult, while longer breaks included both moult and the winter period.

The asynchrony in the start of the breeding season of Feral Pigeons is caused by multiple factors — historical, extrinsic and, in particular, intrapopulational. With regard to its history, the population of Feral Pigeons includes descendants of domesticated pigeons (Haag-Wackernagel 1998) which have a strongly protracted breeding season (Levi 1974). Extrinsic factors include difficult weather conditions that, together with a shortening photoperiod, inhibit the activity of the gonads (Lofts et al. 1966, Murton et al. 1973). Consequently, a major part of the population ceases reproductive activity. At the same time, however, food of anthropogenic origin, a favourable factor for breeding, is available throughout the year. Intra-populational factors include the birds' experience, which allows some of them to con-

tinue reproducing during unfavourable autumn and winter conditions. Young birds, which are known to reach maturity quickly (Kosonen & Tast 1988) are forced to start breeding later due to difficulties in finding suitable nesting territories in the limited space of the area occupied by a colony.

Completion of the breeding season by Feral Pigeon pairs seems to be more synchronised than its initiation. The most important factor that forces pairs to cease breeding is moult. The activity of gonads in most birds is strongly reduced during this period (Dunmore & Davis 1963, Häkkinen et al. 1973). The main period of moult in Feral Pigeons is August and September (Häkkinen et al. 1973, Kotov & Noskov 1978, Pikula et al. 1981, 1982, Haag 1988). At that time, despite continuing favourable weather and feeding conditions, pigeons stop reproducing and start the energetically costly process of plumage change to prepare for the coming winter. It appeared that some individuals were able to delay this process even to October or the beginning of November, while a very few others could combine reproduction with moult.

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STRESZCZENIE

[Chronologia i czas trwania okresu lęgowego gołębia miejskiego w Słupsku]

W latach 1997–2000 badania prowadzono w 5, a w 2001 roku w 3 wybranych koloniach lęgowych. Znajdowały się one w strychach i wieżach w centrum miasta. Przed rozpoczęciem badań wszystkie ptaki zostały zaobrączkowane indywidualnie kolorowymi obrączkami. W trakcie badań znakowano również pisklęta i imigrantów napływających z zewnątrz do badanych kolonii. Obserwacje par lęgowych prowadzono z kryjówek zbudowanych w miejscach rozrodu gołębi (wiosną i latem co 2–3 tygodnie, a w pozostałym okresie raz w miesiącu). Badano również zmiany w składzie par, liczbę lęgów, długość sezonu lęgowego i przerwy w rozrodzie.

Wiek ptaków ustalono dopiero w drugim roku badań, dzieląc gołębie na doświadczone, jeśli prowadziły one lęgi w poprzednim sezonie, i nie-

doświadczone – odbywające lęgi po raz pierwszy (Tab. 1). Imigrantów włączających się do rozrodu w badanych koloniach wykluczono z analizy, a w sezonie następnym włączono do grupy ptaków doświadczonych w rozmnażaniu się.

Gołębie rozmnażały się we wszystkich miesiącach roku. Rozpoczynanie pierwszych lęgów przez badane pary trwało od października lub listopada do nawet września następnego roku kalendarzowego (Fig. 1). Jednak tylko nieliczne pary rozpoczynały sezon lęgowy bezpośrednio po pierzeniu się tj. jesienią. Pary takie kontynuowały lęgi przez zimę, wiosnę i lato do następnego pierzenia się. Były one reprezentowane niemal wyłącznie przez pary doświadczone, które już miały lęgi w poprzednim sezonie.

Najwięcej par rozpoczynało sezon lęgowy w okresie od stycznia do maja (Fig. 1). Ostatnie pary (głównie młode) zakładały gniazda po tym okresie, co spowodowane było przede wszystkim brakiem miejsc gniazdowych. Bardzo późne rozpoczynanie sezonu lęgowego, stwierdzone w sierpniu i wrześniu 1999 roku, dotyczyło kilku bardzo młodych par gołębi, które założyły gniazda jeszcze w tym samym sezonie lęgowym, w którym się wykluły. Ptaki te po nieudanych próbach zaprzestały rozrodu do wiosny następnego roku.

Terminy kończenia sezonu lęgowego gołębi w Słupsku były również silnie rozciągnięte w czasie, nasilenie tego procesu miało miejsce w okresie od sierpnia do października – w okresie pierzenia się (Fig. 1).

Z powodu silnie rozciągniętych terminów rozpoczynania i kończenia sezonu lęgowego, długość sezonu lęgowego badanej populacji gołębi miejskich w Słupsku wynosiła 14 lub 15 miesięcy (Fig. 1). Tak więc, kolejne sezony lęgowe nakładały się na siebie dając efekt ciągłości rozmnażania się gołębi.

Długość sezonu lęgowego pary wynosiła średnio 183 dni. Najdłuższy sezon lęgowy trwał aż 369 dni. Pary doświadczone rozmnażały się średnio przez 203 ± 73 dni, a niedoświadczone przez 125 ± 62 dni ($t = 8.12$, $p < 0.001$). Większość młodych ptaków przystępowała do rozrodu w drugim kalendarzowym roku życia (90.7%) w wieku średnio 326 dni. Pozostałe ptaki zaczynały swój pierwszy sezon lęgowy w pierwszym lub trzecim kalendarzowym roku życia. Młode z kolonii lęgowych gniazdujących w wieżach przystępowały do rozrodu o ok. 3 miesiące później od młodych ptaków z kolonii zlokalizowanych w strychach (Tab. 2).

Ustalono, że osobniki młode rozpoczynały sezon lęgowy o średnio 2–3 miesiące później od ptaków dorosłych, (Fig. 2), czego przyczyną było prawdopodobnie szukanie partnera, a zwłaszcza miejsca gniazdowego.