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Breeding losses in an urban population of the Collared Dove *Streptopelia decaocto* in Słupsk, Poland

Wojciech GÓRSKI, Jacek ANTCZAK

Department of Zoology, Pedagogical University, Arciszewskiego 22b, 76-200 Słupsk, POLAND

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Abstract. During the 25 seasons (1974–1998), the breeding success of Collared Doves was determined by tracing the fates of 7882 nests found in Słupsk, Northern Poland. The kind of losses recognized were: complete nesting failures (CNF) and partial losses (PL), where only one nestling left the nest. Total breeding losses (TBL), were estimated by comparing the estimated total number of eggs laid (TNEL), with the total number of young fledged. In different years CNF varied from 51.8 to 75.7% ($\bar{x}$ = 61.1, SD = 5.1, n = 25 seasons, CV = 8%) while PL accounted for between 4.3 and 11.8% ($\bar{x}$ = 8.2, SD = 1.6, n = 25, CV = 19.5 %) of all eggs laid. TBL amounted to between 60.9 and 80% ($\bar{x}$ = 69.3, SD = 4.3, n = 25, CV = 6.2 %) of TNEL, and was highest at the beginning (February–April) of the breeding season, and at the end (September–October). The losses suffered during incubation ($\bar{x}$ = 70.6%, SD = 10.3, n = 25, CV = 15%) were much higher than at the nestling stage ($\bar{x}$ = 29.4%, SD = 10.3, n = 25, CV = 35%). Rooks and Jackdaws were the main nest predators of the Collared Dove population in Słupsk, while Magpies and domestic cats were less effective predators.

Key words: Collared Dove *Streptopelia decaocto*, breeding losses, urban ecology, predation.

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INTRODUCTION

The dynamic increase in the population of the Collared Dove *Streptopelia decaocto*, following its colonisation of Europe (Nowak 1965, Glutz & Bauer 1980, Cramp & Simmons 1984, Bijlsma 1988, Hengeveld 1989) is associated with nesting in human settlements, where the success of broods is relatively high owing to the limited species composition and low abundance of potential nest predators (Tomiałojć 1980, Górski 1989, 1993). Large number of studies have analysed the types and sizes of breeding losses for the species in many parts of its range (e.g. Hofstetter 1954, Lachner 1963, Marchant 1963, Kubik & Balat 1973, Gnielka 1975, Rana 1975, Saemann 1975, Bozsko & Juhasz 1981, Coombs et al. 1981, Mizera 1988, Robertson 1990, Górski & Górska 1991, Rana & Idris 1991). But only Górski (1989) addressed the issue on the basis of multi-year data from permanent study areas. The present study provides such multi-year data on the sizes and types of breeding losses incurred by an urban population of Collared Doves studied in a permanent study area for over 25 breeding seasons — a period during which the local population fluctuated markedly (cf. Górski 1993, Górski & Antczak 1998).

STUDY AREA, METHODS AND MATERIALS

The work was carried out in Słupsk, a medium-sized town of 80–100 thousand inhabitants, which is located in north-western Poland, not far from the Baltic coast (at 54°28'N, 17°10'E). The Collared Dove population here reaches breeding-season densities that are high in comparison with those obtained in studies in other European cities (Górski 1989). In the course of the 25 breeding seasons between 1974 and 1998, observations were made of the fates of nests within a permanent 3.57 ha city-centre study area taking in two avenues of planted limes *Tilia* sp. Densities over this time ranged between 4.2 and 33.1 pairs per ha (mean 21.1, SD = 6.8, n = 25 seasons). Nests were mainly monitored by ground-based observation, without examination of their contents, and only a small fraction were subject to checking with the aid of mechanical lift. Visits were at intervals of 2–3 days in the period between February and November. The results of breeding were established on the basis of the presence or absence of reared young from each nest, with these being easy to see immediately after they had left it. Direct observations allowed for the determination of the number of nests occupied in the study period (total 7882, between 64 and 636 in different years); the number of lost nests (total 4830, 39–377 per year) — with a distinction drawn between those lost in the first 15 days of occupation and thereafter; the number of nests enjoying breeding success, i.e. producing at least one fledgling ("successful nests" — 3052 in total, 25–259 per year); the number of nests not fully successful — producing only 1 fledgling (total 1328, 11–129 per year) and the numbers of fledglings (4776 and 39–395 per year). These data provided the basis for the present study, serving in the calculation of the further indices used here:

1) estimated total number of eggs laid (TNEL) assuming 2 eggs per full clutch as was confirmed by direct study of the contents of 63 nests (Górski & Górska 1995);

2) number of eggs and nestlings lost in complete nesting failures (CNF);

3) number of eggs and nestlings lost in successful nests producing 1 fledgling, i.e. "partial losses" (PL);

4) total breeding losses (TBL) taking in both complete nesting failures and partial losses (Appendices 1 and 2) and calculated by comparing TNEL with the total number of young fledged.

RESULTS

In the study period, complete nesting failures (CNF) took in more than 61% of all eggs laid (between 51.8% in 1975 and 75.7% in 1979), while partial losses affected 8.2% (range between 4.3% in 1979 and 11.8% in 1974) — Table 1, and 42% of the successful nests. The average figure for total breeding losses was of 69.3% of eggs laid (range 60.9% in 1994 to 80% in 1979), showing more limited variability (CV = 6.2%) than the two aforementioned indices (Table 1).

Table 1. Breeding losses (1974–1998) compared with the estimated total number of eggs laid.

Kind of losses	N	mean	SD	CV	min.–max.
Complete nesting failures (%)	25	61.1	5.1	8.3	51.8–75.7
Partial losses (%)	25	8.2	1.6	19.5	4.3–11.8
Total breeding losses (%)	25	69.3	4.3	6.2	60.9–80.0

The percentage distribution of total breeding losses through the season coincided to a large degree with the percentage of the estimated number of eggs laid (Fig. 1a). Complete nesting failures were more common in the first part of the breeding season (April and May), and partial losses more so in the middle and second half of the season, from May to August (Fig. 1b). The distribution of the percentage of nests predated by corvids (Fig.1c) — the main nest predators of the Słupsk population of doves — is more consistant with the pattern of complete nesting failures than with the pattern of partial losses (Fig. 1b).

Losses at the begining and end of breeding season were almost exclusively complete nest failures (Fig. 2). From February to July, CNF fell to around 48%, before rising again in August and September. In contrast, the partial losses show a different dynamic. The highest percentage of partial egg and nestling loss occurs between May and August (9–10% in each of these months).

No significant link was found between total breeding losses and the density of the breeding population of Collared Doves (r = –0.0063, ns). TBL was inversely correlated with the production of young (Fig. 3). Nests with losses at the laying and incubating stage (up to day 15) accounted for 70.6% of all lost nests (range 49% in 1997 to 87% in 1998), while failures at an nestling stage accounted for the remaining 29.4% (range 13% in 1998 to 51% in 1997). Losses at an early breeding stage predominated

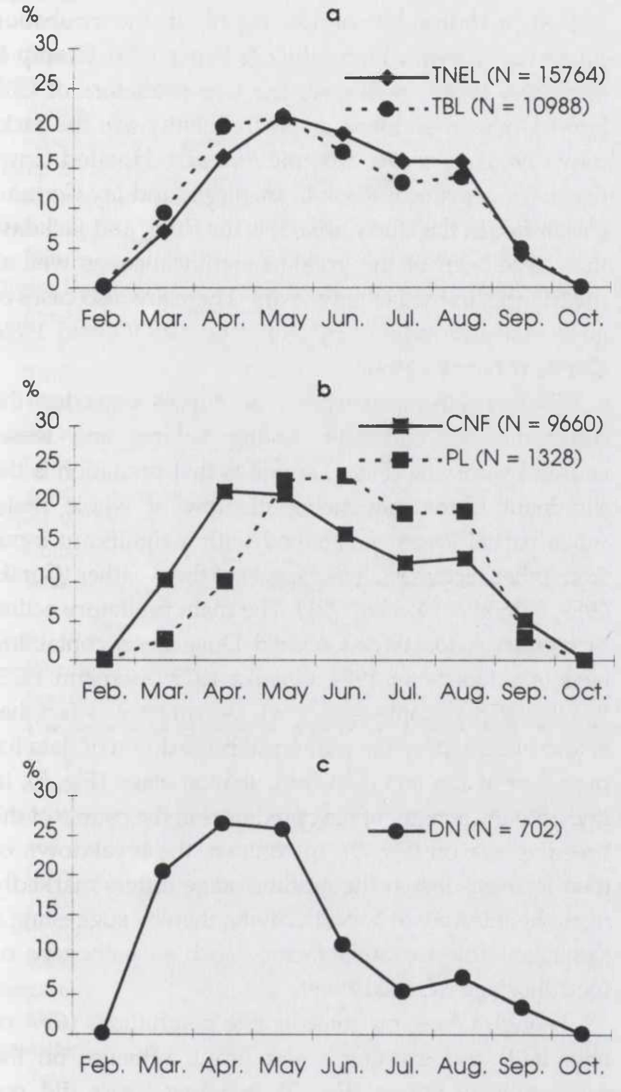

Fig. 1. Distribution (%) of the estimated total number of eggs laid (TNEL), total breeding losses (TBL), complete nesting failures (CNF), partial losses (PL) and number of nests depredated (DN) by corvids (1974-1998).

throughout the breeding season (Fig. 4), but were higher at the beginning and end (February, c. 91% of lost nests and October 100%), with declines to 75–76% in March–May, 64–65% in June–July and even to 42–40% of unsuccessful nests in August–September. The losses at an early breeding stage are predominated at the begining of the breeding season, the losses at a later breeding stage remain constant between April and September (Fig. 5)

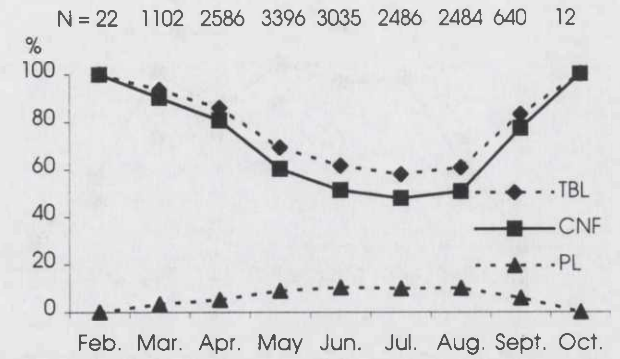

Fig. 2. Proportion of failed eggs and nestlings compared with estimated total numbers of eggs laid (N) (1974–1998). TBL — total breeding losses, CNF — complete breeding failures, PL — partial losses.

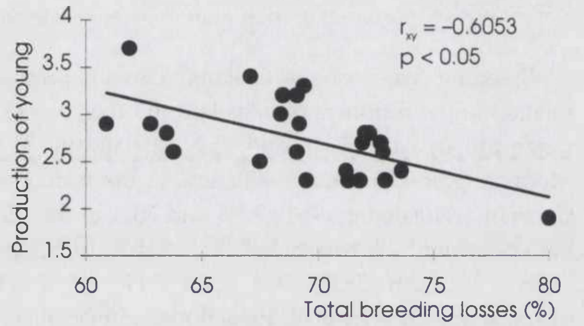

Fig. 3. Relationship between total breeding losses (estimated number of eggs and nestlings lost compared with total number of eggs laid-%) and production of young (number of fledglings/breeding territory/year) (1974–1998).

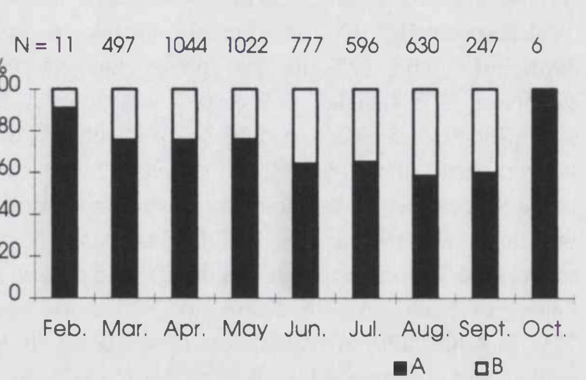

Fig. 4. Percentage losses at the laying and incubating stage (A — nests occupied for 1–15 days) and at the nestling stage (B — nests occupied over 15 days) amongst unsuccessful nests (1974–1998).

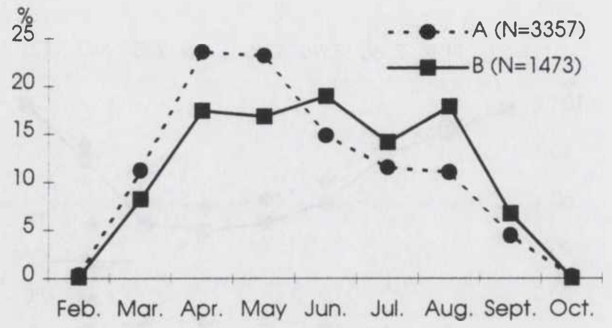

Fig. 5. Distribution (%) of nests lost at the laying and incubating stage and at the nestling stage (1974–1998). A — unsuccessful nests ocupied for 1–15 days, B — unsuccesful nests ocucupied over 15 days.

DISCUSSION

Breeding losses of the Collared Dove expressed in relation to the numbers of eggs laid in other parts of its range are between 31% and 75%, specifically 31% in Moravia (Kubik & Balat 1973); 46% in the former West Germany (Hofstetter 1954); 72% and 75% in the former East Germany (Saemann 1975, Gnielka 1975 respectively); between 56%, 74%, and 51%, in England (respectively Coombs et al. 1981, Robertson 1990); 65% in Iraq (Marchant 1963) and 68% in India (Rana 1975, Rana & Idris 1991). In turn, reported losses calculated on the basis of the number of lost nests have ranged between 27% and 87%; at 27% or 40% of occupied nests in the former West Germany (Lachner 1963 and Hofstetter 1954 respectively); 35% in Hungary (Bozsko & Juhasz 1981); 64% and 67% in the former East Germany (Saemann 1975, Gnielka 1975 respectively); 59% in England (Robertson 1990), as much as 87% in central Poland (Mizera 1988) and 71% in Iraq (Marchant 1963). Partial losses, expressed as the share of nests with successful broods in which only one fledgling is reared, ranged from 22–54%, and were at levels of 22% and 54% in East Germany (Gnielka 1975, Saemann 1975 respectively); 27%, 30% and 49% in West Germany (respectively Hofstetter 1954, Lachner 1963, Stollenz-Nath 1967); 38% in the former Czechoslovakia (Hudec & Cerny 1977) and 40% in Moravia (Kubik & Balat 1973). In the European part of the range, it has been possible to note an increase in losses as the colonisation of the species has proceeded.

All authors give the main cause of breeding losses as nest predation by corvids, mainly in the incubation phase (e.g. Nowak 1965, Glutz & Bauer 1980, Cramp & Simmons 1984). In Słupsk, the five predators of Collared Doves mentioned most frequently are the Jackdaw *Corvus monedula*, Magpie *Pica pica*, Hooded Crow *Corvus corone cornix*, Rook *C. frugilegus* and Jay *Garrulus glandarius*. In the study area, it is the Rook and Jackdaw that have been of the greatest significance, as well as the Magpie in the last few years. There are also cases of nests being plundered by domestic cats (Górski 1989, Górski & Górska 1991).

The consistency between the curves depicting the distribution of complete nesting failures and losses caused by corvids (Fig. 1) suggests that predation is the dominant factor influencing the loss of whole nests, while partial losses are shaped with a significant input from other factors such as aspects of the weather (Górski 1989, Górski & Górska 1991). The main predatory action of corvids is to attack Collared Dove nests containing eggs (e.g. Hofstetter 1954, Gnielka 1975, Saemann 1975, Bozsko 1978, Coombs et al. 1981, Górski 1989), a fact that is also indicated by the numerical breakdown of data for nests lost at the laying and incubation stage (Fig. 5), in line with the activity of nest predators in the course of the breeding season (Fig. 1). In contrast, the breakdown of data for nests lost at the nestling stage differs markedly from the intensity of corvid activity, thereby suggesting a significant role for other factors, such as pathogens or food shortages (Górski 1989).

Though taking on considerable magnitudes (69% of eggs laid) and exerting a significant influence on the production of young (Fig. 3), breeding losses did not determine the changes noted in the abundance of the Słupsk population of Collared Doves, since these changes were not found to depend on variations in the mean annual production of fledglings per breeding pair, but on summer losses of adult birds and young that had fledged (Górski 1989, 1993, Górski & Górska 1995).

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STRESZCZENIE

[Straty lęgowe miejskiej populacji sierpówki w Słupsku]

Sukces lęgowy miejskiej populacji sierpówki w Słupsku (54°28'N, 17°10'E, 80–100 tysięcy mieszkańców) badano w latach 1974–1998 śledząc losy łącznie 7882 gniazd zakładanych przez te ptaki na dwóch alejach obsadzonych lipami *Tilia* sp., usytuowanych w śródmieściu. Ostateczny wynik lęgu określano na podstawie wychowania bądź braku podlotów. Gniazda obserwowano z ziemi co 2–3 dni w okresie od lutego do listopada. Na podstawie bezpośredniego określenia wielkości zniesienia w próbie obejmującej 63 gniazda (Górski & Górska 1995) ustalono, że sierpówki składały 2 jaja i wynik ten przyjęto za stały dla całej populacji. Stwierdzono 3052 gniazda z sukcesem, przy czym w 1328 sukces był niepełny — wychował się tylko jeden młody. Łączna liczba wyprowadzonych młodych wynosiła 4776. Na podstawie tych rezultatów wyliczono kolejne wskaźniki:

1) oszacowaną całkowitą liczbę jaj złożonych w badanych gniazdach (TNEL);

2) liczbę jaj i piskląt utraconych w nieudanych lęgach (CNF);

3) liczbę jaj i piskląt utraconych w gniazdach o niepełnym sukcesie (PL), w których wychował się jeden podlot;

4) całkowite straty lęgowe (TBL), obejmujące zarówno straty jaj i piskląt w nieudanych lęgach, jak i w lęgach o niepełnym sukcesie.

Nieudane lęgi (CNF) obejmowały łącznie ponad 61% całkowitej liczby złożonych jaj, podczas gdy straty częściowe (PL) tylko 8,2% (Tab. 1). Procentowy rozkład całkowitych strat lęgowych (TBL) w trakcie sezonu lęgowego pokrywał się z rozkładem liczby złożonych

jaj (Fig.1 a). Nieudane lęgi (CNF) występowały częściej w pierwszej połowie (w kwietniu i maju) sezonu lęgowego a straty częściowe (PL) wykazywały największe nasilenie w okresie od maja do sierpnia (Fig. 1b). Wzorzec rozkładu w czasie strat powodowanych przez *Corvidae* — najważniejsze drapieżniki gniazdowe sierpówki w Słupsku (Fig. 1c) był bardziej zbieżny z wzorcem charakterystycznym dla strat całych lęgów (CNF) niż dla strat częściowych (PL).

Obydwa rodzaje strat wykazywały odmienną dynamikę, co rzutowało na ich udział w kształtowaniu całkowitych strat (TBL) w trakcie sezonu lęgowego (Fig. 2). Nie stwierdzono zależności między zagęszczeniem populacji lęgowej a wysokością TBL ($r = -0{,}0063$, ns), natomiast TBL były negatywnie skorelowane z produkcją młodych (Fig. 3). Gniazda, w których straty nastąpiły w pierwszych 15 dniach (składanie i wysiadywanie jaj) zawierały 70,6% ogółu utraconych lęgów, podczas gdy straty poniesione na etapie wychowywania młodych w gnieździe (lęgi utracone po 15 dniu od rozpoczęcia wysiadywania) obejmowały 29,4% nieudanych lęgów. Pierwszy rodzaj strat dominował w trakcie całego sezonu lęgowego, najbardziej na początku i pod koniec lęgów (Fig. 4). Obydwa rodzaje strat wykazywały odmienną dynamikę — straty jaj wykazywały wyraźny szczyt ilościowy w pierwszej połowie sezonu lęgowego, w kwietniu i maju, natomiast straty piskląt utrzymywały się na wysokim poziomie od kwietnia do sierpnia, z kilkoma wierzchołkami w tym okresie (Fig. 5). Straty jaj kształtowane są głównie przez drapieżnictwo gniazdowe (do najważniejszych drapieżników lęgów sierpówki na powierzchni należały gawron *Corvus frugilegus* i kawka *Corvus monedula*), podczas gdy na straty piskląt obok drapieżnictwa wpływają także czynniki pogodowe rzutujące na dostępność pokarmu i rozwój chorób.

Pomimo, że straty gniazdowe kształtują w znacznym stopniu wielkość produkcji młodych w populacji sierpówki w Słupsku, nie wpływają one jednak na długoletnie wahania liczebności tej populacji, które nie zależą od wysokości rocznej produkcji młodych na parę lęgową a od wielkości ubytku letniego obejmującego śmiertelność i emigrację pogniazdową lotnych młodych i ptaków dorosłych (Górski 1989, 1993, Górski & Górska 1995).

Appendix 1. Material — year to year perspective of data.

Kind of data	Years of study												
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Observed number of:													
— occupied nests	509	519	601	636	522	440	386	355	312	361	375	370	324
— failed nests	292	269	367	377	316	333	247	191	186	230	241	233	210
— occupied for 1–15 days	167	133	249	253	219	248	179	106	142	171	190	189	129
— occupied over 15 days	125	136	118	124	97	85	68	85	44	59	51	44	81
— successful nests	217	250	234	259	206	107	139	164	126	131	134	137	114
— successful nests producing 1 fledgling	120	105	90	129	90	38	68	64	55	55	58	66	57
— fledglings	314	395	378	389	322	176	210	264	197	210	208	171	148
Estimated number of:													
— eggs laid	1018	1038	1202	1272	1044	880	772	710	624	722	750	740	648
— eggs and nestlings lost in complete nesting failures	584	538	734	754	632	666	494	382	372	460	482	466	420
— eggs and nestlings lost in nest producing 1 fledgling	120	105	90	129	90	38	68	64	55	65	58	66	57
— total eggs and nestlings lost	704	643	824	883	722	704	562	446	427	525	540	532	477

Appendix 1 cd.

Kind of data	Years of study												Total
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
Observed number of:													
— occupied nests	273	304	315	154	156	162	138	149	156	187	114	64	7882
— failed nests	179	198	201	94	99	103	77	80	84	117	67	39	4830
— occupied for 1–15 days	124	150	155	77	78	83	46	59	67	76	33	34	3357
— occupied over 15 days	55	48	46	17	21	20	31	21	17	41	34	5	1473
— successful nests	94	106	114	60	57	59	61	69	72	70	47	25	3052
— successful nests producing 1 fledgling	40	37	47	20	26	19	22	16	30	36	19	11	1328
— fledglings	175	181	100	88	88	99	100	122	114	104	75	39	4776
Estimated number of:													
— eggs laid	546	608	630	308	312	324	276	298	312	374	228	128	15764
— eggs and nestlings lost in complete nesting failures	358	396	402	188	198	206	154	160	168	234	134	78	9660
— eggs and nestlings lost in nest producing 1 fledgling	40	37	47	20	26	19	22	16	30	36	19	11	1328
— total eggs and nestlings lost	398	433	449	208	224	225	176	176	198	270	153	89	10988

Appendix 2. Data on timing in the breeding season.

Kind of data	Month of beginning of nesting									Total
	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	
Observed number of:										
— occupied nests	11	551	1293	1689	1518	1243	1242	320	6	7882
— failed nests	11	497	1044	1022	777	569	630	247	6	4830
— occupied for 1-15 days	10	376	788	775	498	388	368	148	6	3357
— occupied over 15 days	1	121	256	247	279	208	262	99	0	1473
— successful nests	0	54	249	676	741	647	612	73	0	3052
— successful nests producing 1 fledgling	0	36	134	305	314	249	252	38	0	1328
— fledglings	0	72	364	1047	1168	1045	972	108	0	4776
Estimated number of:										
— eggs laid	22	1102	2586	3396	3036	2486	2484	640	12	15764
— eggs and nestlings lost in complete nesting failures	22	994	2088	2044	1554	1192	1260	494	12	9660
— eggs and nestlings lost in nest producing 1 fledgling	0	36	134	305	314	249	252	38	0	1328
— total eggs and nestlings lost	22	1030	2222	2349	1868	1441	1512	532	12	10988