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Breeding biology and ecology of Whinchat *Saxicola rubetra* on abandoned farmland of Opole Province (SW Poland)

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Abstract. In 2003-2007 the breeding biology and ecology of Whinchat *Saxicola rubetra* were investigated on the 500 ha mosaic agricultural landscape (cropland, abandoned cropland, meadows, pastures and young pine plantations) in SW Poland. In the area of uncultivated fields, meadows and pine plantations 36, 34, 31, 27 and 28 pairs bred consecutively in particular seasons of the study period. Most nests were situated in the abandoned fields in the grass and tansy *Tanacetum vulgare*. In the studied population the median date of egg-laying commencement fell on the 16th May. The first young fledged at the end of May. The average clutch size was 6.2 eggs (SD=0.8). The hatching success amounted to 76%. The average breeding success was 4.17 (n=117, SD=2.62) per nest, and 5.6 (n=87, SD=1.04) per successful pair. The overall breeding success was 74.1% (Mayfield method). The main reason behind the brood loss was predation (76.7% of all losses).

Key words: Whinchat, *Saxicola rubetra*, breeding success, breeding biology, abandoned fields, nest orientation.

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I. INTRODUCTION

Whinchat *Saxicola rubetra* is a small bird from *Turdidae* family (*Passeriformes*). It is a long-distance migrant, arriving in Poland in the 2nd ten-day period of April and leaving in the 3rd ten-day period of September. The earliest arrivals in Poland and other parts of Europe have been recorded as early as the 3rd ten-day period of March (GRAY 1974; FERIANC 1979; PARKER 1990; TOMIAŁOJĆ & STAWARCZYK 2003). Nests are built on the ground, hidden in dense vegetation (PARKER 1990; CRAMP 1996; PUDIL 2001). The clutch size varies from 4 to 7 eggs (BASTIAN & BASTIAN 1996; CRAMP 1996; SNOW & PERRINS 1998; MÜLLER et al. 2005). Local densities of Whinchat may fluctuate depending on habitat. In Poland it can be found all over the lowlands as well as on subalpine and alpine meadows up to 1300-1480 m a.s.l. (DYRCZ et al. 1991). Studies of marked populations have proved breeding site fidelity in this species, which is most visible in the adults with breeding success (PARKER 1990; BASTIAN & BASTIAN 1996; RÂBICEV 2001; MÜLLER et al. 2005).

The state of the breeding population of Whinchat in Poland is not sufficiently known. Based on different estimates it is classed as a scarce or fairly numerous species (TOMIAŁOJĆ & STAWARCZYK 2003). According to the latest data the Polish population is considered stable, whereas in most western European countries a widespread decline has been observed (BURFIELD & BOMMEL 2004). In this context some reports of decreasing abundance in certain parts of Poland are worrying (TRYJANOWSKI 2000; TOMIAŁOJĆ & STAWARCZYK 2003; GOŁAWSKI 2006). It is therefore essential to recognize factors likely to affect adversely the stability of the Polish population of Whinchat in the near future. The aims of this study were to determine the phenology of the breeding period, clutch size, hatching success, offspring production, breeding success and reasons of brood losses.

II. STUDY AREA

The research was conducted in an agricultural landscape in SW Poland (Fig. 1), in the Woźnicko-Wieluńska Upland, near Praszka (51°03' N; 18°26' E), 190-220 m a.s.l. (KONDRACKI 1994). The total size of the study area was 500 ha. The dominant form of land use in this region is arable, with crop fields covering about 87-93% of the total area studied. The area was managed extensively, with small-scale farming predominant. Narrow, elongated fields, dissected by numerous field margins, fallow fields and plantations of young trees, usually did not exceed 30 m in width. Dominant crop type was cereals (over 90%). Seventy plots with the total size of 65 ha (13% of the whole study area) were singled out in 2003 as potential breeding places of Whinchat. They comprised abandoned fields from 3 to 10 years old (ca. 52 ha), extensively used meadows (ca. 9 ha), young tree plantations situated on forest edges (ca. 3 ha) and pastures (below 1 ha). A gradual decline of the suitable breeding area within the farmland was observed in the consecutive years of study. Some meadows and set-aside land were turned into arable fields. Three types of plant associations were singled out on the abandoned fields: *Artemisio-Tanacetetum vulgaris* (54% of all abandoned fields), *Convolvulo arvensis-Agropyretum repentis* (23%) and *Koelerio glaucae-Corynephoretea canescenstis* (1%). The meadows belonged to the *Arrhenatheretalia* order (*Molinio-Arrhenatheretea* class) (MATUSZKIEWICZ 2005).

The potential predators, regularly observed in the study area, were: Hooded Crow *Corvus cornix*, Magpie *Pica pica*, Raven *Corvus corax*, Jay *Garrulus glandarius*, White Stork *Ciconia ciconia*, Red-backed Shrike *Lanius collurio*, Great Grey Shrike *Lanius excubitor*, Marsh Harrier *Circus aeruginosus*, Goshawk *Accipiter gentilis*, Kestrel *Falco tinnunculus*, Hobby *Falco subbuteo*, weasel *Mustela nivalis*, marten *Martes sp*., fox *Vulpes vulpes*, cat *Felis catus* and some rodents *Rodentia*.

III. METHODS

The research was conducted in 2003-2007. An average of 70 days was spent in each breeding season on the study area. In order to detect the arrival of first birds on the breeding grounds the observations started in mid-April. The territories of particular males were marked on 1:5000 maps. The whole study area was looked through systematically for nests, with one control lasting usually 3-4 days. A total of 117 nests were localized in the 5-year study period.

A male was considered single if it sang intensively late in the season, did not assist any female in nest building, did not feed nestlings at any point in the breeding season nor uttered distress calls when the observer approached his territory.

The nests were inspected several times during the season, in order to establish the egg-laying commencement and clutch size. Throughout the expected hatching period nests were controlled daily to determine the exact hatching date. For the nests only discovered after egg-laying or hatching, the hatching date was calculated backwards based on the stage of the nestlings' development.

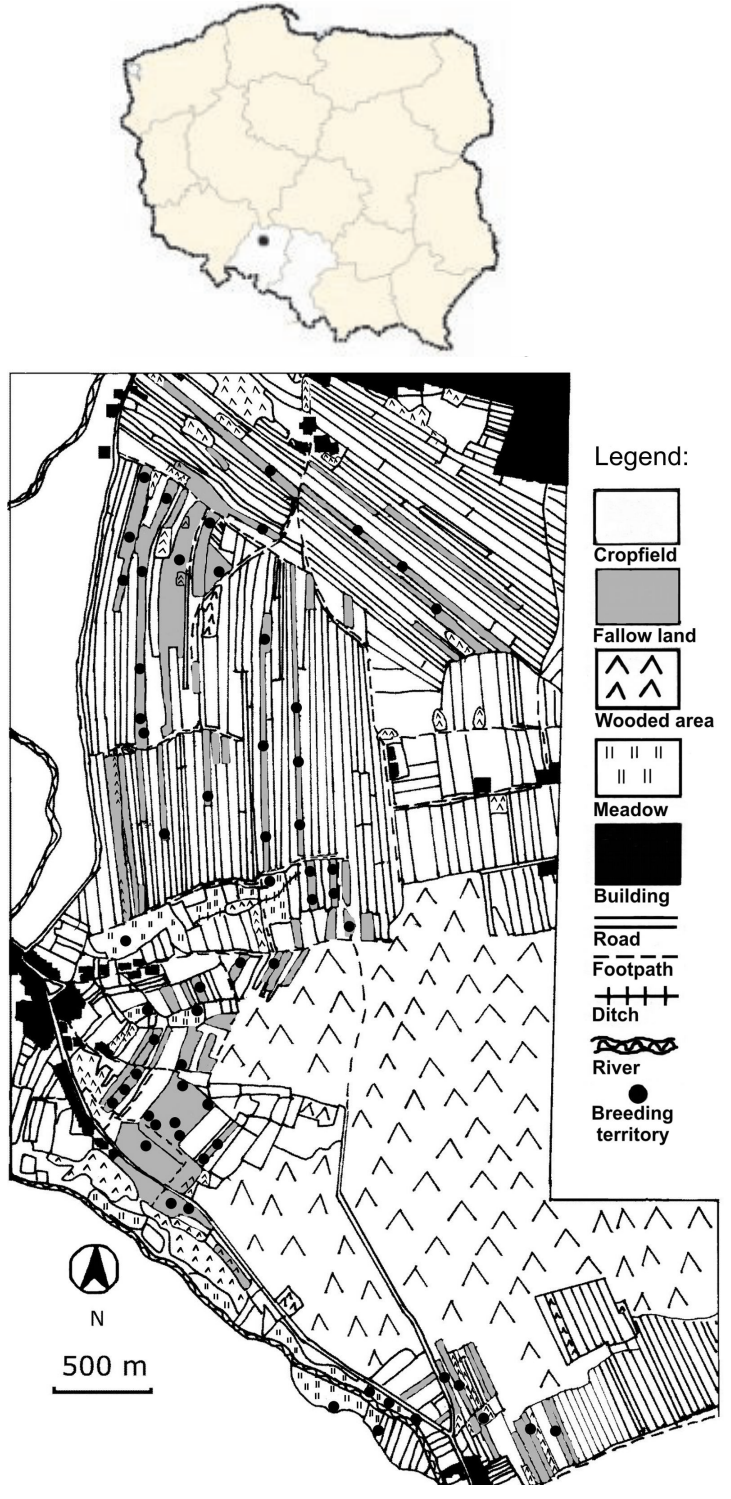

Fig 1. Location of Whinchat territories in 2003 in the agricultural landscape in the vicinity of Praszka city (SW Poland).

The collected data were subjected to statistical analysis with the use of the StatsDirect and Excel 2000 programmes. In order to establish the start date of breeding, the standardization of date was applied, assuming for all years 1st May=1. The breeding success was calculated with the traditional method (% of broods that ended successfully) as well as with Mayfield method (MAYFIELD 1975). The relation between the field size and the density was analyzed with the Spearman's rank correlation coefficient. The clutch size and average fledgling production between the years was analyzed with the Kruskal-Wallis test.

IV. RESULTS

Density of territories

A total of 246 occupied territories were localized on the study area in 2003-2007, on 44 parcels recognized as potential breeding sites. The size of the extensively managed patches of land, where breeding pairs or single males were recorded, ranged from 0.1 to 6.8 ha. The biggest number of territories was recorded in 2003 (n=60), and the smallest in 2006 (n=42). The studied population proved to contain almost 37% surplus of males that remained unpaired throughout the season. The female/male ratio varied in consecutive seasons and diverged considerably from 1:1 (being 1:1.5-1.7). As the uncultivated field area decreased over the years, so did the number of occupied territories (Fig. 2).

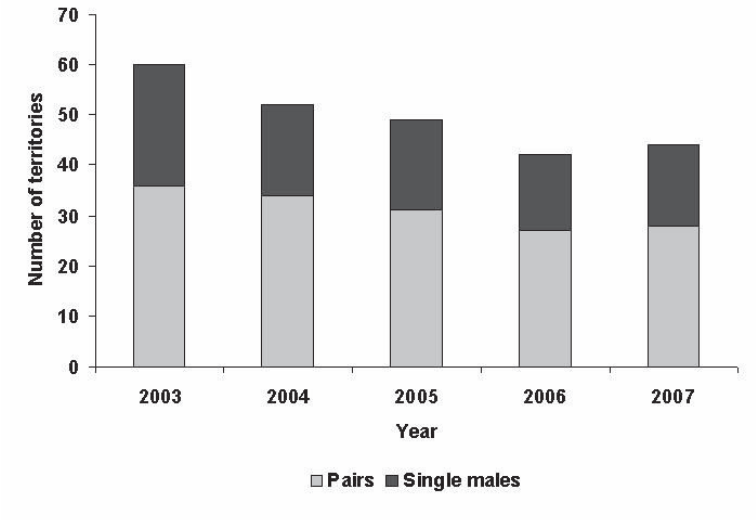

Fig. 2. The number of territories occupied by pairs and single males in 2003-2007 (n=246).

The breeding pair density, calculated for the whole study area (500 ha) amounted to 0.5-0.7/10 ha. The total density however, including the territories of both pairs and single males, ranged from 0.8 to 1.2/10 ha, being highest in 2003 and lowest in 2006. The breeding pair density calculated only for the area of abandoned fields, meadows and forest clearings/plantations (considered as potential breeding sites of Whinchat) reached between 5.6 and 7/10 ha. It changed as the subsequent years saw the reduction of suitable nesting areas. The extensively managed land parcels held, depending on their size, from 1 to 8 territorial males. The parcel size had a significant effect on the number of territories it held (Spearman correlation coefficient: n=228, r=0.59, p<0.0001). The average distance between nests was 132 m (n=106, SD=87.35), ranging from 20 to 450 m (n=109).

Arrival on breeding grounds and start of breeding

The arrival and occupying of territories by consecutive males lasted between 15 (in 2003) and 22 days (in 2006), counted from the date of the first record of a singing bird in the season. The earliest males were recorded on the 19th April (Me=2nd May), and females on the 28th April (Me=5th May).

The laying of the first egg took place after an average of 8 days following the first record of a female in the study area (n=5 seasons). In the consecutive years of study this period got progressively longer. In 2003 the first egg was recorded 4 days after the first observation of a female, while in 2006 and 2007 only after 10 days. The earliest egg was laid on the 1st May, and the latest on the 22nd June (Me=16th May). The breeding phenology of Whinchat suggests it nests mainly in May. As many as 89.7% of all broods in the studied population started in May (n=117), whereas in June the first egg was laid in 12 nests, which constitutes 10.3% of all broods (n=117). The egg-laying period was shortest in 2007 (36 days) and longest in 2006 (46 days).

The incubation lasts usually 13 days, although five cases of longer incubation were recorded – up to 15 days. Birds started breeding from the first ten-day period of May. The earliest nest-leaving date by young birds was the 30th May (2003) and the latest on the 21st July (2006). The breeding season in Whinchat lasted 47-69 days (period from the date of first egg-laying until leaving of the nest by last fledglings) (Table I).

Table I

Duration of the breeding season (the number of days from the date of first egg-laying to the last nestling leaving the nest) in 2003-2007

Year of study	2003	2004	2005	2006	2007
Date of the first egg laying (Median)	01.05 (n=28) (Me=10.05)	03.05 (n=24) (Me=12.05)	10.05 (n=21) (Me=18.05)	13.05 (n=17) (Me=20.05)	06.05 (n=16) (Me=18.05)
Date of the last egg laying in the last nest	14.06	14.06	17.06	27.06	10.06
Nest-leaving date for the last nestlings	8.07	8.07	3.07	21.07	20.06
Duration of breeding season	69	67	55	63	47

Construction and location of the nest

Only the female cleared the future nest site and collected the material (n=15). The male accompanied her at that time, following her closely (1-10 m).

Most (89%) of the 117 nests found had some shallow scrapes (2-5 cm) under the lining. The females also used natural hollows in the ground, up to 10 cm deep (n=3). The lining material consisted of dry stems and leaves of the last year's grasses and the outer edge of the nest was interwoven with fresh green moss. The analysis of 33 nests did not show any animal fur in the lining. In one case the lining contained two pieces of wool from a jumper. The female built the sides of the nest first, lining them with bits of dry vegetation, and then wove the inside and the bottom with concentrically arranged thin dry grass stalks and leaves. The nests situated on wet meadows and near ditches (n=13 nests) proved to have thicker lining than those from dry abandoned fields. In 27 cases a short corridor (5 to 17 cm long) leading to the nest interior was found, hidden in the vegetation.

Most of the 62 analysed nests faced north-east (24.2%) (P^2:P^2=23.935, df=7, p=0.003), south-east (21%) and east (19.4%). The smallest proportion of nests (3.2%) had west-facing entrance (Fig. 3).

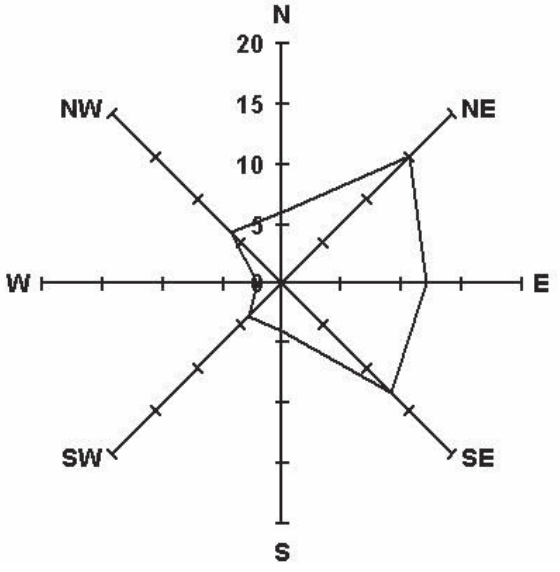

Fig. 3. Exposure of nest entrances (n=62).

The nests were usually well concealed in dense vegetation (89%, for n=117), covered with grasses (*Poaceae*). In most cases they were placed under some hanging vegetation (55%), which formed a natural roof above the nest. They could also be tucked away at the plant base (25%) or inside a bigger tuft of plants (20%). The whinchat nests were recorded in four out of six specified habitats: in wasteland (57%), abandoned fields (25%), meadows (13.7%) and in young tree plantations (4.3%) (n=117). None was found on field margins between crop fields, or within crop fields, pastures and recently (less than 3 years ago) abandoned fields. The type of vegetation most often chosen for nest location was grass (65%) and tansy (23%) (Fig. 4).

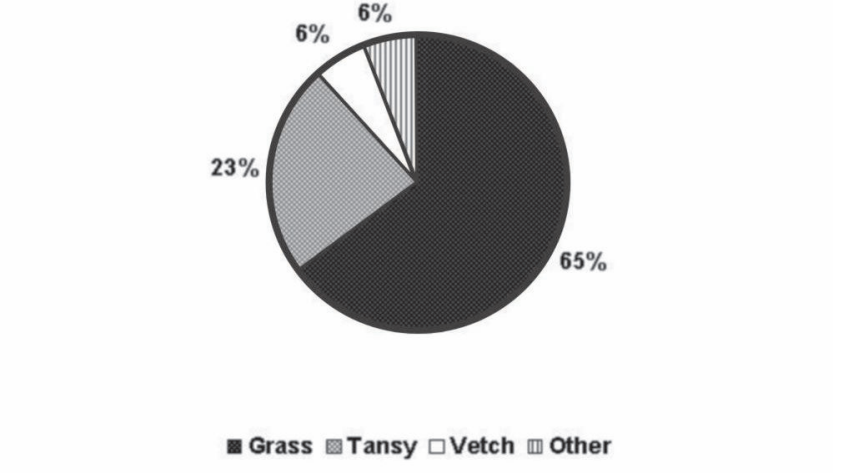

Fig. 4. Percentage breakdown of nest location with regard to different vegetation types.

Clutch size, hatching success and offspring productivity

The mean clutch size was 6.2 eggs (SD=0.8; median 6 eggs; 4-7 eggs). A total of 419 eggs were recorded in 67 nests found throughout the egg-laying and incubation period. The clutch size did not differ between the years (Kruskal-Wallis test: n=67, P^2=1.521, df=4, p=0.822), it decreased however as the breeding season progressed (Spearman correlation coefficient: n=67, r=-0.4, p=0.0006). The average clutch size amounted to 6.4 eggs in May (n=57, SD=0.70), and 5.5 (n=10, SD=0.97) in June. In most cases Whinchats laid 6 eggs (47.8%), while the least common were nests with 5 eggs (4.5%) (Fig. 5).

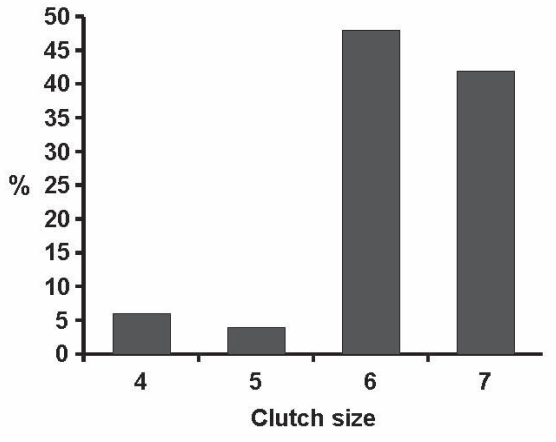

Fig. 5. The clutch size distribution in 2003-2007 (n=67).

The hatching success, defined as percentage of hatched nestlings fluctuated over the study period (only the nests with no damage caused by predators during egg-laying or incubation were considered). It was highest in 2003 (90%) and lowest in 2006 (53%). In 71.6% of the nests in the studied population all eggs hatched, while in 28.4% of nests at least one egg failed to hatch (for n= 67).

The average fledgling production per nest was 4.17 (n=117, SD=2.62), ranging from 3.5 (in 2003, n=28, SD=2.95) to 4.7 (in 2005, n=23, SD=2.37), while it reached 5.6 (n=87) per successfully breeding pair, being highest in 2003 (5.76, n=17, SD=0.9) and lowest in 2006 (5.2, n=14, SD=0.89) (Table II). The differences between the years were not statistically significant (Kruskal-Wallis test: n=87, df=4, T=4.478, p=0.423).

Table II

Average fledgling production per nest and succesful pair in 2003-2007

Year	Average fledgling production per nest			Average fledgling production per successful pair		
	N	Average	SD	N	Average	SD
2003	28	3.5	2.95	17	5.76	0.90
2004	27	4.5	2.39	22	5.6	1.00
2005	23	4.7	2.37	19	5.74	0.93
2006	18	4.0	2.36	14	5.2	0.89
2007	21	4.1	2.93	15	5.73	1.48
Total	117	4.17	2.62	87	5.6	1.04

Breeding success and reasons of the brood losses

The overall breeding success for all years, defined as the percentage of nests left by at least one young bird was on average 76%, and calculated with the Mayfield method – 74.1%. A total of 583 nestlings were recorded in 103 nests. Due to the losses during the feeding period, 487 birds left the nests. The main cause of losses was predation. Predators destroyed 23 (76.7%) out of 30 nests, where losses were recorded. Five nests were abandoned (16.7%), one trampled, most probably by roe-deer (3.3%) and in one the nestlings got soaked in water (3.3%). Apart from total losses, in two nests partial losses were recorded. On the edge of one of them a broken egg was found, the other contained a dead nestling. In both cases the breeding was successful. The losses in the period between hatching and leaving the nest amounted to 56.7%, over 13% higher than those sustained during egg-laying and incubation. A brood was classed as destroyed by predator when all eggs or nestlings unable to leave the nest were missing – in such cases the nest usually remained undamaged. In only 2 cases the nest structure also suffered.

Significant differences were recorded in the breeding success between well concealed and more exposed nests (Fisher's exact test df=1, p=0.0006). The losses in the latter (n=13) were higher (69.2%) compared to those well protected (20.2%, for n=104).

In four partially hatched broods (n=19) some unhatched eggs went missing. Such situations happened up to the second day after hatching of nestlings. In three cases the eggs were found up to 1 m from the nest (from 30 cm to 1 m), suggesting the parents apparently got rid of the unfertilized eggs. In other cases the unhatched eggs were not removed. On one occasion a dead 2-days old nestling was found next to the nest. Its body had some slight injuries, probably suffered as the parents removed the dead nestling from the nest. As I approached the nest, the pair flew off a short distance, uttering distress calls.

V. DISCUSSION

The density of territories

In Poland, like elsewhere in Europe, the density of Whinchat depends on the kind of inhabited biotopes. According to data for Silesia and Wielkopolska (western Poland) provided by DYRCZ et al. (1991) and BEDNORZ et al. (2000) it is least numerous among the arable fields, where its density is only 0.1-0.3 bp/10 ha, while on wet meadows and peat bogs it can reach from 0.5 to 10 bp/10 ha. Similar variation with regard to the occupied habitat was also reported from other parts of Poland (KLEINSCHMIDT 2001; CHMIELEWSKI et al. 2005).

The density of 0.5-0.7 bp/10 ha in the mosaic landscape (and 5.6-7 bp/10 ha for the area of abandoned fields, meadows and young tree plantations) can be regarded as average compared to other populations inhabiting similar biotopes. For example CHMIELEWSKI et al. (2005) recorded 8 bp/12 km^2 in the mosaic landscape, consisting of fields, meadows, fallow fields and mid-field plantations of young trees. A low density from the mosaic study area was also provided by ORŁOWSKI (2004) – 0.1 bp/10 ha (1.57 bp/10 ha for the abandoned fields only). KLEINSCHMIDT (2001) counted, with the help of transect method, 1.3-10 bp/10 ha on abandoned fields near Olsztyn (NE Poland). In Wielkopolska some old set-aside fields held 0.4 bp/10 ha (BEDNORZ et al. 2000), while on abandoned fields in central Finland 1.97-2.87 bp/10 ha were recorded (TÖRMÄLÄ 1980). According to HORA et al. (1997) there was 1.14 bp/10 ha on 1750 ha of mosaic landscape in southern Czech Republic.

The minimal distance between the nests in the studied population was 20 m and the maximal 450 m (average 132 m). The minimal distance according to KLEINSCHMIDT (2001) was 18 m, and the average distance between the nests situated along a railway embankment measured by GRAY (1973) amounted to 99 m (60-126 m). In Russia nests are usually 50-100 m apart (RÂBICEV 2001), while in

western Germany the mean distance between nests was 100 m (BASTIAN & BASTIAN 1996). The largest average distance of 330 m is quoted by CRAMP (1996 after SCHMIDT & HANTGE 1954).

Arrival on breeding grounds

The arrival of birds on the breeding grounds in the studied population fell during the end of the second ten-day period of April and lasted until the middle of May, which does not differ from the average arrival time in other parts of Poland (JERMACZEK et al. 1995; BEDNORZ et al. 2000; KLEINSCHMIDT 2001; TOMIAŁOJĆ & STAWARCZYK 2003, WIECZOREK & LINKOWSKI 2004). In some regions, however, a tendency to arrive earlier is mentioned. CHMIELEWSKI et al. (2005, after SAPALSKI 1862) pointed that in the Świętokrzyskie Mts. in the 1860s the first arrivals were recorded the 19-30th April, while currently first birds are seen as early as the 5th April. According to TOMIAŁOJĆ & STAWARCZYK (2003) the earliest arrival date in southern Poland was the 17th March 1990 near Tarnowskie Góry. The analyses of TRYJANOWSKI et al. (2005) show a strong influence of changes in population size on trends in detected birds' first arrival date. They claim that when the population size increases the probability of earlier detection also increases.

Similar arrival dates are known from other parts of Europe. In countries like Slovakia (FERIANC 1979), Austria (PARKER 1990), Germany (PARKER 1990; BASTIAN & BASTIAN 1996), Czech Republic (HUDEC 1983; KREN 2000; PUDIL 2001), Russia – Ural and western Siberia (RÂBICEV 2001), Belarus (GRIČIK & BARANOVSKIJ 2004) or Scotland (GRAY 1974), the beginning of April is quoted as the peak arrival time on the breeding grounds. There are, however, countries or regions, especially mountainous ones, where the earliest birds are only seen in May (PARKER 1990). In Northumbria (England) the first birds were recorded the 3rd May and on Farne Islands between the 9th and 25th May (BOWMAN & HOLLIDAY 2002).

Males in the studied population were found to arrive a few days before females. Similar observations were made elsewhere (PARKER 1990). GRAY (1973) reported males arriving 3 to 8 days before females. In NE Poland the arrival of first males was recorded between the 20-25th April (Me=24th Apr) and of females the 26th April 1st May (Me=28th Apr) (KLEINSCHMIDT 2001).

Start of breeding and duration of breeding period

There is usually one brood per year in Whinchat (CRAMP 1996; MÜLLER et al. 2005). In the case of breeding loss early in the season a new attempt can be made – with the same or different partner (BASTIAN & BASTIAN 1996). Monogamy is the dominant reproduction system, although sporadic cases of polygamy in males were observed (PARKER 1990; BASTIAN & BASTIAN 1996; SNOW & PERRINS 1998; PUDIL 2001; MÜLLER et al. 2005). Females start incubation after laying of the last egg, which results in all nestlings hatching within 24 hours (RAŠAJSKI & GAVRILOV 1981; REBSTOCK & MAULBETSCH 1993; BASTIAN & BASTIAN 1996). The incubation lasts on average 12-13 days (SNOW & PERRINS 1998; PARKER 1990).

In the studied population the start of breeding date proved to be closely correlated with the arrival date on the breeding grounds, with the first egg being laid 4-10 days after the appearance of the first female. The consecutive years of study saw ever later arrivals resulting in ever later commencement of breeding. A similar correlation was shown by PUDIL (2001). The start of breeding does not always depend on the arrival date though. RÂBICEV (2001) reports the arrival of birds in the Ural region and western Siberia at the beginning of April, while the breeding starts at the end of May or in early June. Similar data for Belarus are presented by NIKIFOROV & ÂMINSKIJ (1989) and GRIČIK & BARANOVSKIJ (2004). The authors report the egg-laying 20 days after arrival, with the peak of breeding commencement in the 2nd-3rd ten-day period of May (the earliest observation on the 12th May and the latest on the 16th July – very developed eggs). NIKIFOROV & ÂMINSKIJ (1989) consider the climatic conditions as a possible explanation of such late breeding starts. According to SNOW & PERRINS (1998) the laying of the first egg in NW Europe takes place from the end of April to the first ten-day period of May, while in the mountainous regions and countries east of Poland, with harsher climate, it is delayed until late May-early June (MÜLLER et al. 2005; NIKIFOROV & ÂMINSKIJ 1989).

It was also observed that in the lowland areas of Germany birds started breeding later in cold years compared to the warm ones (BASTIAN & BASTIAN 1996).

In the Czech Republic the start of the breeding season and its length were similar to the population from this study. The earliest egg-laying in the Czech population took place on the 1st May, and the latest on the 7th June (PUDIL 2001). However, in the more southerly Banat region birds started breeding on the 15th May (RAŠAJSKI & GAVRILOV 1981). Data from western European countries suggest breeding of this species takes place mainly in May (CRAMP 1996; BASTIAN & BASTIAN 1996; SNOW & PERRINS 1998). According to MÜLLER et al. (2005) the Whinchat usually has one brood per year and repeat broods are infrequent. Only 29 out of 59 lost broods in that population were repeated. In the population studied here only one such case was observed, where shortly after the loss due to trampling of the nest by animals, the female made an attempt to repeat the brood. Two broods a year were occasionally reported by FERIANC (1979 after GLADKOV 1954) and SNOW & PERRINS (1998), although according to NIKIFOROV & ÂMINSKIJ (1989) many pairs bred twice a year but there were no further details provided.

The egg-laying period in the studied population was lengthy and lasted 36-46 days. According to data collated by BASTIAN & BASTIAN (1996) its duration depends on the situation of the breeding grounds above sea level. The shortest period was recorded in Heidelberg area (25 days, 114 m a.s.l.) and the longest in Alps at 1450 m a.s.l. (43 days). In the population reported here the longest egg-laying period was in 2006, when birds started breeding the latest.

Nest construction and location

The nest is built exclusively by the female, accompanied closely by the male (PARKER 1990; BASTIAN & BASTIAN 1996; RÂBICEV 2001; KLEINSCHMIDT 2001), in line with my observations. Also the construction of the nest and its location did not differ from those recorded in other European countries. In most cases studied here the nests were hidden in dense vegetation, which is confirmed by other authors (PARKER 1990; BASTIAN & BASTIAN 1996; CRAMP 1996; PUDIL 2001; RÂBICEV 2001; KLEINSCHMIDT 2001). The nest building takes 4-5 days (BEZZEL & STIEL 1975). PARKER (1990) spotted tunnels leading to the nest entrance made of vegetation at some of the nests, although some nests in his study were not covered from above. This was also observed in the population studied here. Although some authors mention the presence of animal fur in the nest lining (PARKER 1990; RÂBICEV 2001), this was not the case here. According to BASTIAN & BASTIAN (1996) the thickness of lining depends on the temperature outside – if it is warm, the nests tend to have thinner lining. In the Opole population the nests situated in meadows were better lined than those placed in fallow land. This could be down to local differences in ground temperature and moisture. For example, grassy areas such as meadows retained dew for longer and felt colder in the early hours of the day compared to the dry and sandy abandoned fields.

Only two studies seem to deal with the nest entrance exposure (PUDIL 2001; KLEINSCHMIDT 2001). Among 64 nests located on flat ground from the population studied in NE Poland by KLEINSCHMIDT (2001), most had entrances facing N (n=19), NE (n=14) and E (n=10). The entrances of the nests placed on a ditch slope (n=18 nests) were always perpendicular to the slope, and thus their orientation was random. Most of the 41 nests found by PUDIL (2001) had entrances facing SE (n=15) and E (n=14). Based on data from the current study, as well as those provided by KLEINSCHMIDT (2001) and PUDIL (2001), it can be concluded that the Whinchat tends to direct the nest entrances towards the east (E, NE, SE), avoiding the west.

Clutch size, hatching success and offspring production

The population studied was characterised by a high average clutch size, amounting to 6.2 eggs (4-7 eggs; median=6), whereas the median was the same as for the populations in other European countries. The highest clutch size, of 8 eggs, was recorded in NW Poland (KLEINSCHMIDT 2001), Finland (CRAMP 1996 after HAARTMAN 1969a) and Russia (RÂBICEV 2001), while the lowest – 2 eggs – in Great Britain (CRAMP 1996). The average clutch size in particular countries ranged from

5.3 to 6.2 eggs (GRAY 1973; GRAY 1974; CRAMP 1996; FULLER & GLUE 1977; MÜLLER et al. 2005, BRITSCHGI et al. 2006).

In the population studied the clutch size did not change over the years, but it dropped as the season progressed, from 6.4 in May to 5.5 in June. Similar findings were reported by FULLER & GLUE (1977). In that case the mean clutch size in April-May was 5.88, going down to 5.31 in June-July. MÜLLER et al. (2005) found higher average clutch size in first broods, of 5.5 (range 4-7 eggs, n=57 nests), compared to average replacement clutches of 3.4 (3-4 eggs, n=7). BRITSCHGI et al. (2006) showed the existence of differences in the mean clutch size between intensively and extensively managed areas. It turned out that in the first case it amounted to 5.6 eggs, while on traditionally farmed areas it was 5.3 eggs (differences not statistically significant).

The fledgling production per nest was 4.17 in this study, reaching 5.6 per successful pair. This is high compared to other study results. GRAY (1973) found a higher fledgling production per nest (4.75), but lower per successful pair (5.42) (n=8 nests). Quite a high production per nest (5.48) was reported by PUDIL (2001), whereas according for MÜLLER et al. (2005) the average breeding success per successful pair and season was 4.9 fledglings. GRIČIK & BARANOVSKIJ (2004) established the mean nestling number in 22 nests in Belarus as 4.64.

Breeding success and reasons of brood losses

The breeding success in the studied population varied over the seasons, being on average 76% (74.1% with Mayfield method), which seems to be a very good result compared to other European populations. A higher breeding success was recorded in England – 86.5% (CRAMP 1996; HOYO et al. 2005). According to PUDIL (2001), losses in the Czech population in Mlada region were much higher – the success for 41 nests was 68% (39% with Mayfield method). MÜLLER et al. (2005) reported significant fluctuations of the breeding success in the populations studied in the Vna and Pradellas regions. The breeding success in Vna was 34-78%, and in Pradellas 5-59%. The authors maintain it was not correlated with density, but with agricultural intensification. The frequency of grass-cutting on meadows is seen as the main factor responsible for brood losses.

Unfavourable weather conditions may also adversely affect the breeding success. Low temperatures and rainfall reduce the insect activity, resulting in food shortages (PARKER 1990). Apart from that, nestlings from poorly concealed nests are more vulnerable to predators and rainwater inundation (own data).

The factors most commonly mentioned causing breeding losses in Whinchat are: predation, heavy rainfall damaging eggs and nestlings, trampling of nests by the grazing livestock, burning of meadows and growing intensification of farming through increased fertilization, pesticide use and more frequent and earlier hay-cutting in the breeding season (GRAY 1974; BASTIAN & BASTIAN 1996; HENDERSON et al. 2004; MÜLLER et al. 2005; BRITSCHGI et al. 2006).

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