WIADOMOŚCI PARAZYTOLOGICZNE
T. 49 (1) 2003: 31–38

PARASITES OF CHAFFINCH (*FRINGILLA COELEBS*) POPULATION. PART II. BLOOD PARASITES

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ABSTRACT. Blood parasites of Chaffinches caught from June to October near Łuknajno Lake (Mazurian Lakeland) were studied. Only parasites belonging to the genera *Haemoproteus* were found. A decrease in prevalence as the season progressed was observed. No differences in blood parasite infections in relation to the sex of the birds were found. Also males body weight was not affected by the presence of parasites.

Key words: blood parasites, Chaffinch, *Fringilla coelebs*, *Haemoproteus*, seasonal dynamics of infection.

INTRODUCTION

The large group of birds' blood parasites contains mostly protozoans belonging to the three genera: *Haemoproteus*, *Leucocytozoon* and *Plasmodium* (Atkinson and van Riper III 1991). They are transmitted from host to host by the bites of dipterans and are very widespread – they were found in 68% of studied bird species (Atkinson and van Riper III 1991). Various aspects of birds' blood parasite ecology have become more frequently studied in the last decades due to the hypothesis of Hamilton and Zuk (1982) about the relation between birds' ornaments, sexual traits etc. and the resistance of parasites. From that time the impact of parasites on the biology and ecology of birds, as well as on other vertebrate species, was carefully studied (e.g. Schall 1983, Rätti et al. 1993, Dale et al. 1996). Studies concerning the frequency of occurrence (prevalence) of parasites in birds' blood were carried out much earlier. However, they mostly dealt with the examination of a large number of species represented by only a few individuals (e.g. Peirce and Mead 1976, 1977; Bennet et al. 1982). Also, old methods of parasite investigation (the methods of blood sampling or analysis of internal tissues) were harmful to the subjects (Dymowska and Żukowski 1965, 1968; Godfrey et al. 1987). Nowadays, a drop of

bird's blood is obtained from the brachial vein without any long-term effects on the bird hosts (Lubjuhn et al. 1998), so the results from older studies can be verified.

In most of papers, only data about the prevalence of parasites could be found and the intensity of infection – number of parasites which occur in blood cells – is rarely reported. Also, seasonal variation in prevalence is generally not described in any great detail in wild birds, but it could be assumed that there is a seasonal variation in vector activity that might influence the occurrence of gametocytes of parasites in peripheral blood such as the brachial vein. Such a disappearance of parasites, which makes their detection difficult, is suggested by Valkiunas (1998).

In Poland, studies of parasite occurrence in birds' blood were carried out in the early 1960s. Many bird species were studied, mostly in three locations: near Wrocław, in the Bieszczady Mountains and in the Kampinos Forest (Ramisz 1960; Dymowska and Żukowski 1965, 1968). There were no studies in the North of Poland where there are very favourable conditions for vector breeding and development.

The Chaffinch *Fringilla coelebs* (Passeriformes, Fringillae) is a good species for further studies of aspects of its biology in relation to the influence of parasites. However, to plan such studies, the prevalence of parasites in the population should be studied earlier. The coccidian infection and co-occurrence of various parasites in Chaffinch were described previously (Gryczyńska et al. 1999, 2000). The aim of this paper was to describe the occurrence of blood parasites in the studied population, intensity of infection and seasonal dynamics of infection.

MATERIALS AND METHODS

The birds were studied near Łuknajno Lake (Masurian Lakeland, NE Poland) in two areas: in dry mixed coniferous forest and wet/swampy alder forest on the shore of the lake (situated ca. 1 km apart). However, there were no differences in blood parasite prevalence in birds caught in both forests ($\chi^2 = 0.74$, df = 1, ns) and the birds migrated between these areas. Thus, data for birds from those two areas were jointly elaborated.

Chaffinches were caught in mist nets (20 nets in each forest) from June to October 1998. A great number of birds were caught in June and September (19 individuals each month). Two the same birds were retrapped between June and August. A massive migration of Chaffinch occurred in the end of September and in October (Kania 1981), so it could be assumed that the investigated birds formed one population.

The caught birds were ringed, most of them were sexed and weighed (to an accuracy of 0.5 g), their age was determined (if possible) and then they were released.

A drop of blood was taken from the brachial wing vein and spread in a thick layer on a slide. The smears were dried, fixed in alcohol, stained with HEMACOL-

OR set and were analysed under x1000 magnification. Area of smears were carefully examined for the presence of parasites. The number of blood cells with parasites were counted per 1000 erythrocytes. Parasites in each smear were counted threefold and the results were averaged. A number of 1000 erythrocytes seems to be enough for the estimation of the intensity of parasitemia (Godfrey et al. 1987). The person who analysed blood smears (AP) was unaware of any other data connected with the smears.

In total, blood smears were obtained and analysed for the presence of parasites in 58 caught Chaffinches.

The terms „intensity of infection" and „prevalence": are used according to Parasitological Dictionary (Złotorzycka et al. 1998)

RESULTS

In Chaffinch' blood, only parasites belonging to the genera *Haemoproteus* were found. Taking into account all caught birds, this was more than half of the birds (53.4%, n = 58) infected with these parasites. The frequency of occurrence of *Haemoproteus* in birds' blood differs significantly between studied months (χ^2 = 9.48, $p < 0.01$, df = 2) (Fig. 1).

The intensity of infection in June (avg. 2.73 ± 1.95 parasites/1000 erythrocytes) almost significantly differs from that of September (avg. 1.14 ± 0.65 parasites/1000 erythrocytes) (Mann-Whitney U test, z = 1.81, $p < 0.06$) (Table 1). One male caught in June held on average 5 protozoans in 1000 erythrocytes, but in its blood later in August, only 1 parasite per 1000 erythrocytes was detected. During July-August,

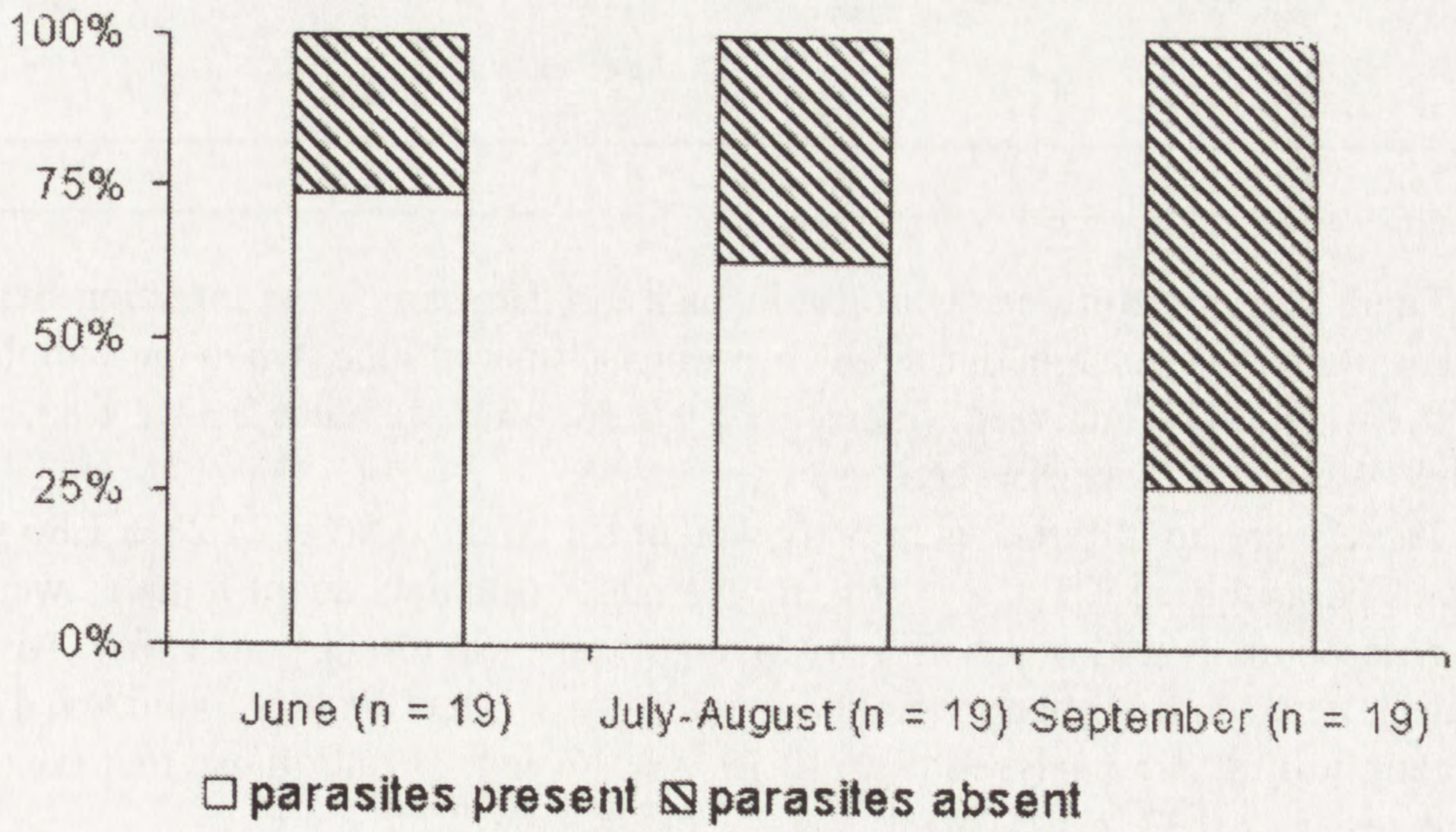

Fig.1. Seasonal changes in prevalence of Haemoproteus in Chaffinch

Table 1. Intensity of *Haemoproteus* infection in Chaffinch population from June to September

		Number of parasites/1000 erythrocytes	
June	avg ± sd	2.71 ± 1.94	
(n = 14)	range	0.67 – 7	
July – August	avg ± sd	4.21 ± 6.60	(2.33 ± 1.56)*
(n = 11)	range	1 – 23	(1 – 5.66)*
September	avg. ± sd	1.14 ± 0.65	
(n = 5)	range	0.67 – 2	
Total: June – September	avg ± sd	2.95 ± 4.04	(2.28 ± 1.69)*
(n=31)	range	0.67 – 23	

* – the most heavily infected bird was excluded from the analysis

one bird with a very high intensity of infection was caught. This might influence the results, therefore the averages from each month were not compared. Most Chaffinches revealed low to intermediate degrees of parasite intensity (Table 2).

There were no differences in blood parasite infections in relation to the sex of the bird. Blood of 50% of males (n = 20) and 75% of females (n = 8) contained parasites ($\chi^2 = 1.11$. df = 1, ns). However, among birds caught in June, all 6 females were infected whereas 38.5% of males (n = 13) were parasite-free.

Table 2. Distribution of *Haemoproteus* intensity in studied Chaffinches (%)

Intensity of infection (number of parasites/1000 erythrocytes)	Whole population	Adult birds total	Adult birds June only	Young birds
Low (<1)	35.5	27.8	28.6	27.3
Medium (1.1-3)	35.5	33.3	35.7	54.5
High (3.1-7)	25.8	33.3	35.7	18.2
Extremely high (> 20)	3.2	5.6	0	–
N	31	18	14	11

There were no differences in the intensity of *Haemoproteus* infection between males and females caught during the breeding season, in June (when the sample was great enough to be analyzed) (males 3.02 ± 2.10, n = 8; females 2.34 ± 1.83, n = 6; Mann-Whitney U test, z = 0.65, ns).

There were no differences in body weight for infected (avg. 21.28 ± 1.86 g, n = 9) and parasite free (21.4 ± 1.19 g, n = 8) males (the data about females were too poor, to be analyzed) of Chaffinch (Mann-Whitney U test, z = -0.1, ns). Also, no relation between male body weight and intensity of infection was found, even when all caught birds are analysed ($r_S = -0.18$, n = 17, ns), or only those that contained parasites ($r_S = 0.32$, n = 9, ns).

The differences in the prevalence of *Haemoproteus* infection between young

birds, in the first calendar year of their life (46% infected, n = 26) and adult birds (69% infected, n = 26) were almost statistically significant ($\chi^2 = 2.83$, $p < 0.1$, df = 1). However, there were no significant differences in the intensity of infection between adult and young birds (adult 3.84 ± 5.15, n = 18; young 1.91 ± 1.02, n = 11; Mann-Whitney U test, z = 1.02, ns).

DISCUSSION

There are at least 3 species from the genus *Haemoproteus* confirmed in the Chaffinch: *H. fringillae*, *H. danilewskii*, *H. orizivorae* (Dymowska and Żukowski 1968; Peirce and Mead 1978a,b), however the species were not distinguished in other studies (Peirce 1981). In the blood of this bird species other parasites, e.g. belonging to the genus *Leucocytozoon*, *Plasmodium*, *Trypanosoma* etc. were also found (Peirce 1981). In this study in Chaffinch blood, only protozoans belonging to the genus *Haemoproteus* were found. The haemosporidian prevalence of Chaffinches in the studied population is one of the highest ever found (Table 3).

Table 3. Prevalence of *Haemoproteus* sp. in Chaffinch

Study area	% with parasites	Total studied	Source
Masurian Lakeland	53	58	this study
Bieszczady Mts	80	5	Dymowska and Żukowski 1968
Suburb of Wrocław	31	13	Ramisz 1960
Kampinos Forest	11	38	Dymowska and Żukowski 1965
France	0	1	Bennett et al. 1982
England	17	35	Peirce and Mead 1976, 1977, 1978a,b
Europe (data combined)	32	341	Peirce 1981
Kazakhstan	2	259	Yakunin 1972

In many studies it was found that younger birds (mostly yearlings) have a lower prevalence of parasites than adults (Allander and Bennet 1994, Merilä et al. 1995, Dale et al. 1996). The findings of this study confirmed those results. Such results are probably connected with the shorter time of exposure to the vectors of blood parasites in young birds.

In the whole of the study, there were no differences in frequency of infection between males and females. Similar results were found in other passerine birds (e.g. Merilä et al. 1995, Dale et al. 1996, Rintamäki et al. 1997). However, when Chaffinches caught in June – during the breeding season – were compared, such differences appeared. Some males were uninfected whereas parasites were found in the blood of all females. This finding suggests an opportunity to study sexual selection in this species in relation to blood parasite infection. Males may differ in parasite

loads and/or resistancy and females may choose mates according to their parasite loads, as it is observed in other birds (review in Kruszewicz 1994).

The lack of a relation between blood parasite intensity of infection and body weight was also found in other studies (e.g. Bennett et al. 1988, Dale et al. 1996). However, the measurement of body weights were probably too inaccurate, to find any differences, unfortunately any other condition parameters like wing or tarsus length or haematocrit were not measured. However, previous studies did not find any relation between those condition parameters and *Haemoproteus* infection (e.g. Dale et al. 1996, Dufva 1996).

As microscope fields of vision contain various number of erythrocytes (100–250 e. g. Bennet et al. 1995, Dale et al. 1996) it is sometimes difficult to compare the results of various studies. Benett et al. (1988) defined high parasitemia for *Haemoproteus* parasites as 500 parasites/100 field of vision. It was stated that one field of view contains an average of 250 erythrocytes, thus high parasitemia was defined as more than 20 parasites per 1000 erythrocytes. Only one bird caught during the whole of the study held such high parasite loads. The most typical level of parasitemia in the Benett et al. (1988) study was 1.2 parasites/1000 erythrocytes, slightly less than found in this study (Table 1). It is possible that the most heavily infected birds could not survive or could not be trapped in mist nets. The way of bird sampling may influence the parasite intensity load found in birds, with the lowest intensity of infection observed in birds trapped in mist nets (Valkiunas 1998).

The important findings of this study were seasonal changes in prevalence of infection. In another study on captive birds (Allander and Sundberg 1997) it was found that the *Haemoproteus* parasites are present in the peripheral blood from early April to October. However, in wild Chaffinches a decrease in prevalence was observed as the season progressed (Fig. 1). There are at least two possible explanations. In autumn and later in winter there were no vectors for blood parasites, therefore parasites' gemetocytes could not occur in peripheral blood, or their number significantly decreased, and it was harder to find them in blood smears. It could be indicated by the studies of the same individuals in various times. The same male first caught in June and later in August still held parasites in its blood but at a smaller intensity.

On the other hand, it is possible that during August-September birds from different populations may occur in the studied sample, or young birds, which might be less infected, predominate in the sample. For Willow Tits *Parus montanus* migrating in Scandinavia, it was found that the prevalence increased as the migration period progressed (Rintamäki et al. 2000).

It seems that the most reliable data about prevalence of blood parasites in populations should be gathered in May-June, during birds' breeding season. So in planning similar studies it is worth knowing that seasonal changes in prevalence and intensity of infection may occur, and investigate only adult birds during the breeding season, as postulated by Valkiunas (1998).

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Zaakceptowano do druku 12 grudnia 2002