DEMOGRAPHIC STUDIES OF MIGRATING BIRD POPULATIONS: THE AIMS AND THE POSSIBILITIES

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ABSTRACT

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A critical review of the published papers concerning the population number dynamics of the birds trapped on the Courish Spit, and some other demographic studies is presented. The data suggest that population dynamics of passerine birds is dependent primarily on the weather, especially in spring. There are many limitations in obtaining precise demographic parameters from the birds caught on migratory routes. No less than thirty or forty years of trapping data can yield estimates that are approximately correct. The demographic studies of migrating birds are an important, but side, product of ringing efforts.

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INTRODUCTION

The trapping and ringing of migrating birds is a source of most valuable data for various demographic investigations. The numbers of birds caught during successive years are used for the study of population dynamics and for the study of age and sex structure of migrating populations, whereas the results of ringing are used for the study of survival rates and life span in nature. The principal numbers of trapping data and results of ringing, especially passerines, are obtained from full-grown birds caught on special bird stations. There are many trapping sites in northern and eastern Europe, particularly on sea-coast. In the last few decades, these stations have collected a great bulk of data, which has had large potential for yielding information about some demographic parameters. This primarily concerns population number dynamics. Following first papers on population dynamics based on trapping data (Berthold 1972; Busse 1973; Lipsberg and Rute 1974; Dolnik and Payevsky 1976, 1979; Hjort and Lindholm 1978) and the discussion on the level of significance of

this method (Berthold and Schlenker 1975, Busse 1980, Busse and Cofta 1986), there have been published a lot on this matter. However, so far, the long-standing questions about the causes of observed population dynamics remain open.

The objective of this paper is to compare well-known problems, which we can meet in demographic studies of birds trapped during migrations, and the possibilities of solution of these problems. I will discuss three issues: (1) number dynamics and its causes; (2) the „coastal effect", as a phenomenon, which involves difficulties in understanding of population structure; and (3) efficiency of bird ringing of various bird species, as a source of necessary and sufficient data for the estimations of survival rates. I will consider these issues by the examples from papers published by the staff of Biological Station Rybachy on the Courish Spit. The trapping data at this site have been collected during forty years.

MATERIAL AND METHODS

Birds have been trapped and ringed since 1957 by the staff of the Biological Station Rybachy at the field station „Fringilla" on the Courish Spit of the Baltic Sea. The birds have been caught every year from 1 April to 1 November in stationary „Rybachy-type traps", which resemble Helgoland traps but differ in their mode of construction and in size (up to 15 m in height). In 1957-1998, more than two million birds of 190 species were trapped and ringed. All birds captured, when possible were sexed and aged. Long-term dynamics of bird populations was estimated based on the numbers of birds trapped.

In all cited papers the population number trends were determined from the correlation coefficient of time-series (Pearson's correlation or Spearman's rank correlation), where one of the series of variables consists of numbers of birds captured and the other one – of consequent number of years. For the analysis of temperature influence, mean monthly air temperatures from February to June in the study area were used. Statistical analyses were carried out by standard methods (Hollander and Wolfe 1973, Sokal and Rohlf 1981). Significant differences refer to significance at the 5% level or higher.

RESULTS AND DISCUSSION

Population number dynamics

Of 190 bird species trapped, three species from family *Sylviidae* were selected for discussion, because they represent most common patterns of number fluctuations: Wood Warbler (*Phylloscopus sibilatrix*), Icterine Warbler (*Hippolais icterina*) and Garden Warbler (*Sylvia borin*) (Fig. 1-3).

For years 1960-1976, Dolnik and Payevsky (1976, 1979) analysed numbers of migratory birds and concluded that along with a significant decline recorded in a number of species, many other species showed fluctuations that corresponded to cycles

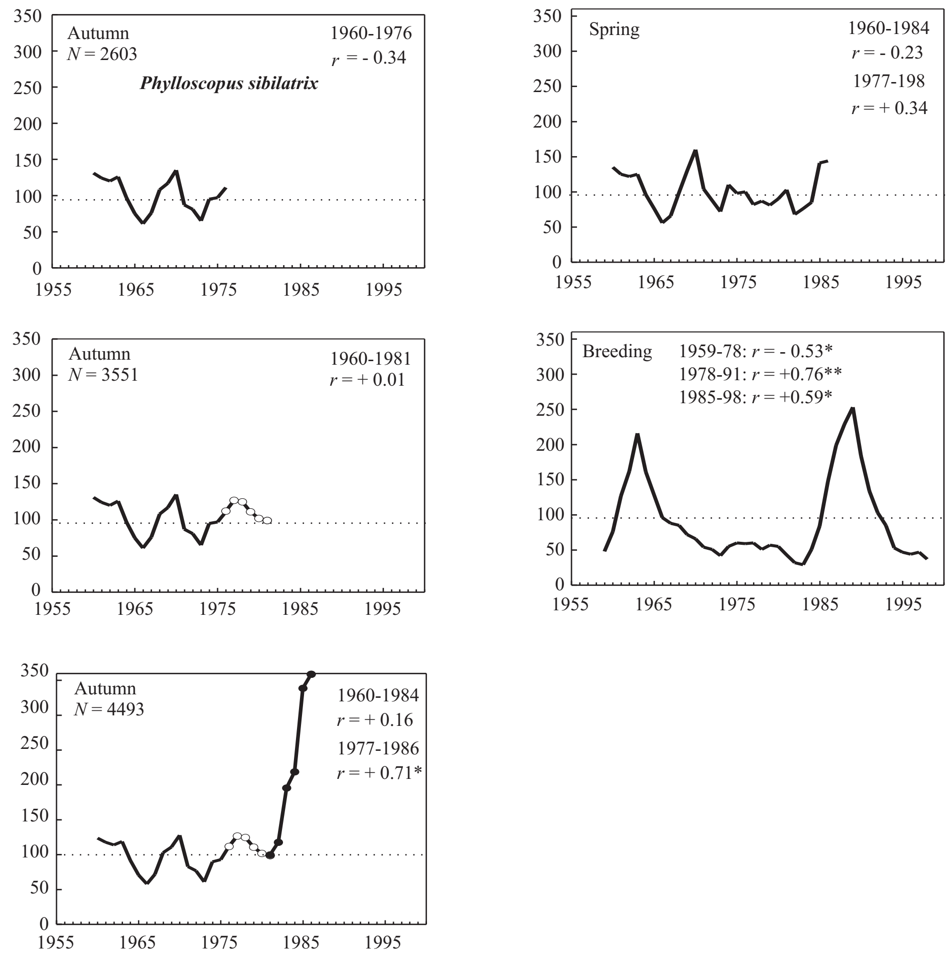

Fig. 1. Development of the knowledge on the Wood Warbler population dynamics based on trapping data on the Courish Spit. The data after Dolnik and Payevsky 1979 (autumn, 1960-1976), Payevsky 1985 (autumn, 1960-1981), Payevsky 1990 (autumn, spring, 1960-1986), and Sokolov 1999 (breeding, 1959-1998). Raw values were expressed as a percentage of the average number for all years and then were smoothed by the five year moving average. The correlation coefficient (*r*) of time-series is presented for different periods as it was done in original papers.

of 5-10 and more years. They suggested that trends in numbers were caused by several factors, with environment pollution by pesticides being probably most important. However, the analysis of numbers in the species of different trophic requirements failed to support this hypothesis.

For years 1960-1981, Payevsky (1985) confirmed that the new data did not contradict the earlier patterns of fluctuations. The validity of trapping figures as abundance estimates was supported by similar trends from different European sites (in Poland, Sweden, and Denmark), revealed in many species. As previously, the main factor, which was thought to be responsible for these trends, was environmental

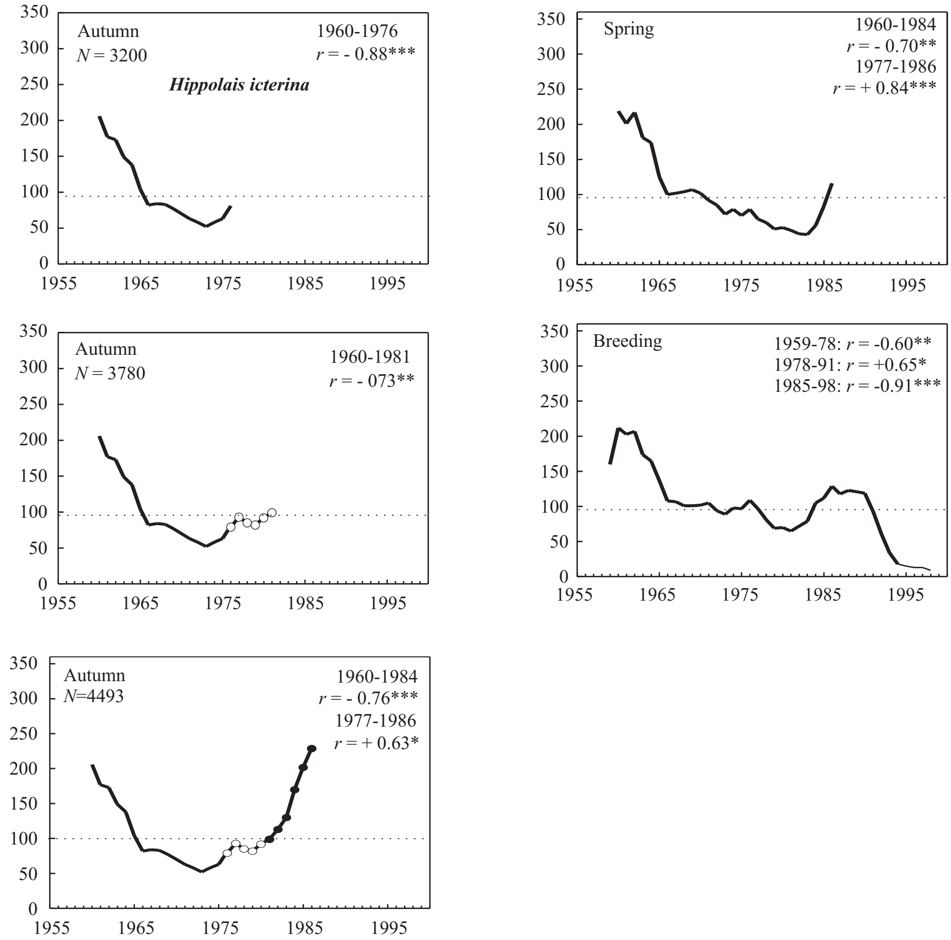

Fig. 2. Development of the knowledge on the Icterine Warbler population dynamics based on trapping data on the Courish Spit. Explanations as at Fig. 1.

pollution by agricultural toxins. Another possible factor – inter-specific competition – could be also important, as decrease in a dominant species may cause a growth in competitors, for which a weaker competition could appear more important than chemical pollution.

For years 1960-1986, in many species, Payevsky (1990) found a different picture starting to emerge. Considerable population decrease of some species during late 1960s and 1970s changed to growth in the 1980s. The comparison of trapping data derived from the traps located in different biotopes, and for spring and autumn separately, showed that the trends compared were similar. A hypothesis remained that the birds had natural cyclity of numbers with gradual declines or increases. For the first time for the data, it was suggested that the causes for observed trends may be weather-climatic factors.

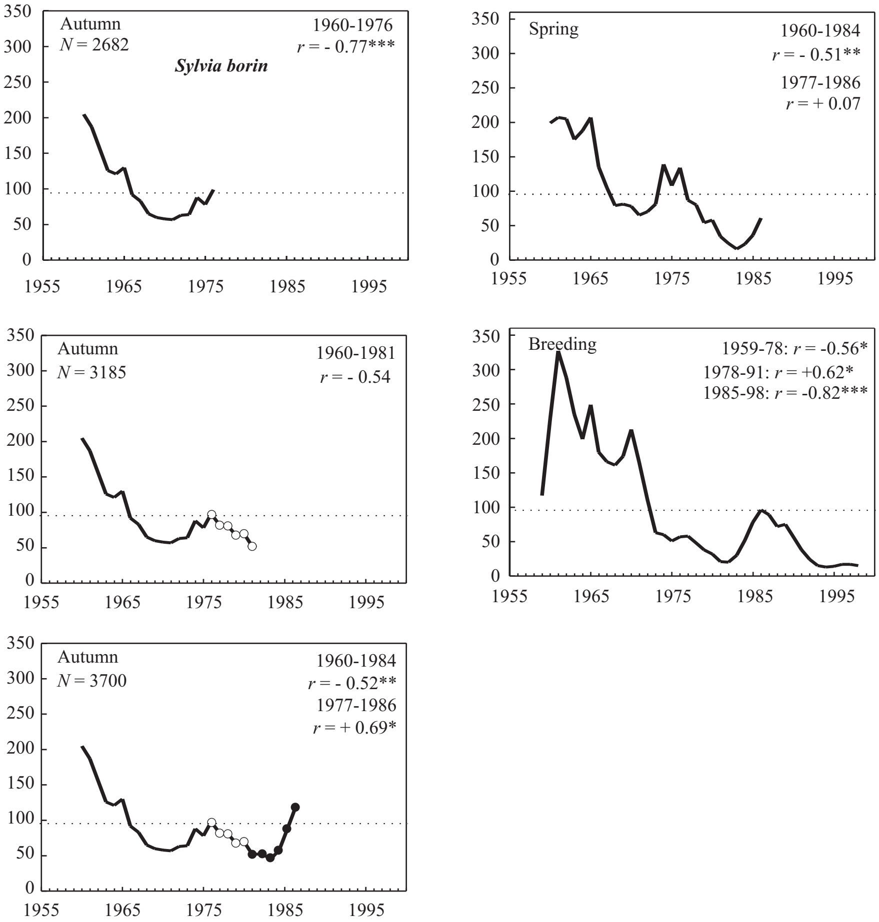

Fig. 3. Development of the knowledge on the Garden Warbler population dynamics based on trapping data on the Courish Spit. Explanations as at Fig. 1.

For years 1959-1998, in breeding birds, Sokolov (1999) revealed a significant trend towards later breeding of passerine birds in the 1970s and 1990s compared to the 1960s and 1980s. Sokolov and Payevsky (1998) have shown that these long-term trends in the timing of breeding were caused mainly by climatic factors, namely by fluctuations of air temperatures. Moreover, in the majority of species, the numbers of both adults during breeding and juveniles during post-fledging time were significantly higher in the 1960s and 1980s compared with the 1970s and 1990s. Almost in all species, a positive correlation between the number of juveniles and the mean temperatures of April and May was revealed. The number of yearlings in a breeding population was significantly higher following a year with high numbers of juveniles. Warm and early springs that were frequent during 1960s and 1980s influenced an early arrival and breeding, and enhanced breeding success. On the contrary, cold and late springs that dominated in the 1970s and 1990s delayed arrival and breed-

ing, and the breeding success was reduced. All the data suggest that population dynamics of birds was dependent mainly on the air temperatures, especially in spring (Sokolov 1999).

All above-mentioned patterns of number changes lead to the conclusion that only no less than thirty-years of trapping data can show a factual picture of natural population fluctuations in number. Although, at present, I prefer to explain the observed trends by the weather factors, this is not to say that the hypothesis of natural cyclity in bird numbers may be neglected. I believe that population trends in different regions may be caused by the complex of factors in an interaction. It would make no sense to seek for the single important factor responsible for all fluctuation observed.

„Coastal effect"

The „coastal effect", that is a disproportionately high percentage of immature passerine birds during the trapping at coastal sites, was well known in North America (Ralph 1978), and at present, this phenomenon has been broadly recorded for the Eastern Baltic coast (Payevsky 1985, 1998). Omitting the causes of such effect, it should be particularly emphasized that it concerns only the species of nocturnal migrants as opposed to the species of diurnal ones. This difference is clearly demonstrated by the example of proportions of adult birds in six species compared (Fig. 4). The comparison of the share of adult birds in diurnal and nocturnal migrants of pooled data for twelve species trapped (Fig. 5) shows that the observed difference in age composition is highly significant and it is typical for all passerine birds trapped at coastal sites. Such high proportion of immature birds is not consistent with potential productivity of the populations being discussed. The impact of the „coastal effect" on the demographic studies of migrants is apparent. We cannot use the trapping data of nocturnal migrants in the investigations regarding the age structure of migrating populations and its annual variations. Consequently, it is impossible to study the annual fluctuations in population productivity based on the trapping data of these species. The only possible aspect of the study on nocturnal migrants in this respect is the comparison of age structure during autumn and spring migration at the same trapping site (although a great care must be exercised in this case, too).

Efficiency of bird ringing

Bird ringing is an expensive and time-consuming effort, and the planning is crucial if the aim of the study is to produce accurate and precise estimates of population parameters (Brownie *et al.* 1985). However, a need of some new treatment of available results of ringing arises very often. When a new scheme is launched and bird trapping begins, it is impossible to forecast all aspects of future scientific work. Nevertheless, it is necessary to conceive the efficiency of bird ringing. Up to now, only general information about ringing efficiency is available. We know that recov-

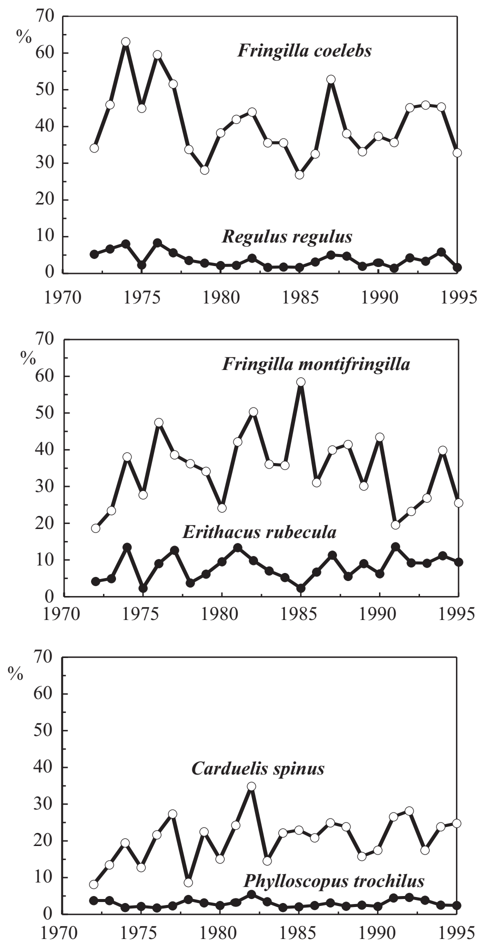

Fig. 4. Shares (%) of adult birds in numbers of six species trapped in autumn (1972-1995) on the Courish Spit. Diurnal migrants: Chaffinch, Brambling and Siskin; nocturnal migrants: Goldcrest, Robin and Willow Warbler.

ery rate is higher in large birds, especially in game birds and waterfowl, in comparison to songbirds, and that it is higher in the areas more populated by humans.

The analysis of ringing efficiency at the Courish Spit (Payevsky and Shapoval 1998) showed that the correlation between the numbers of ringed birds and the numbers of recoveries was not always direct and significant. This correlation varied for different species, different years, and for spring and autumn. In some years, the correlation in question was almost a direct functional dependence, but in other years, it was absent or even negative. For example, this correlation in two species (Fig. 6) during twenty-eight years was both species-specific and year-specific. Apparently, this is a result of high dependence of the recovery rate on conditions of every year (weather and crops of some plants). These factors may lead to more or less close contacts of birds with man.

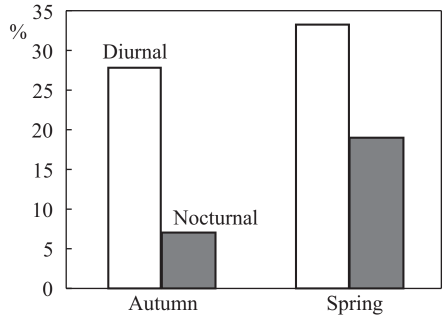

Fig. 5. Shares (%) of adult birds in diurnal and nocturnal migrants caught at the Courish Spit: pooled data for twelve species.

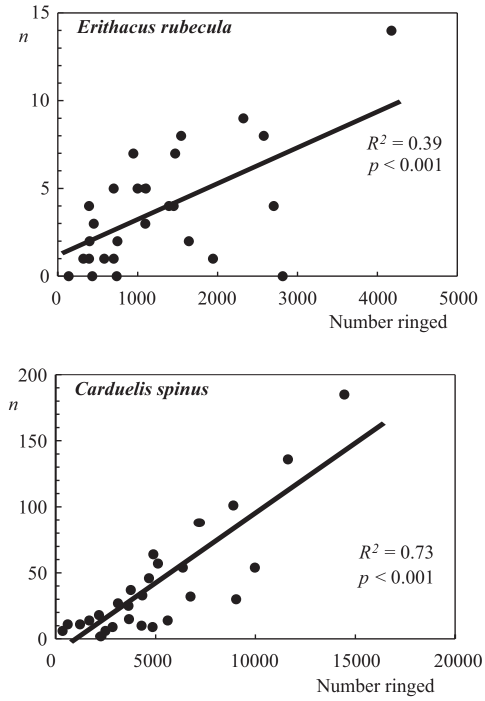

Fig. 6. Relationships between the number of ringed birds (1957-1984) of two passerine species and the number of recoveries (*n*) obtained.

From two million birds of 190 species which were ringed on the Courish Spit during 40 years, we obtained *ca* 8000 recoveries and *ca* 20 000 recaptures. In spite of such considerable amount of information, the results of ringing are insufficient for the estimation of some demographic parameters. For instance, the study of survival rates in birds by modern approaches, which are based on stochastic models with the method of maximum probability, requires the following conditions. Firstly,

the actual ringing period should be short (3-5 weeks) in relation to the survival period (usually 12 months). Secondly, the recovery rates should be reasonably high to use these methods (Brownie *et al.* 1985). Species having recovery rates below 1% are particularly troublesome for the calculations. The bulk of passerines belong to this group. One should ring at least 4 thousand birds during each season to obtain estimates of annual survival that are reasonably precise. In our recent studies of sex-specific survival rates (Payevsky *et al.* 1997), we hardly could choose ten species with adequate data of ringing recoveries from all the material collected at the Courish Spit during forty years.

All of the above is pointed out to realize that the demographic studies of migrating populations of passerines are possible on the results of only very long-term trapping and ringing, during no less than thirty or forty years. Because so long-term projects cannot be planned, the demographic studies of migrating birds are an important, but side product of the ringing efforts.

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