

BREEDING AND DEMOGRAPHIC PARAMETERS
AND RANGE EXPANSION
OF THE COMMON ROSEFINCH (*Carpodacus erythrinus*)

Vladimir A. Payevsky

ABSTRACT

Payevsky V.A. 2008. *Breeding and demographic parameters and range expansion of the Common Rosefinch (Carpodacus erythrinus)*. Ring 30, 1/2: 63-69.

Breeding biology, age structure and other population parameters of the Common Rosefinch, collected on the Courish Spit of the Baltic Sea, are presented. The results are compared with similar population characteristic in different parts of the range. All materials, especially the proportion of breeding yearling males, are discussed in connection with the process of range expansion of the species. The expectation of greater proportion of yearling males in new areas did not proved.

V.A. Payevsky, Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, 199034 St. Petersburg, Russia, E-mail: payevsky@zin.ru

Key words: Common Rosefinch, range expansion, demographic parameters, breeding biology

INTRODUCTION

The Common Rosefinch is of special interest for a demographic study due to its three peculiarities. First, this species intensively expands its range towards the north-west and west; second, it shows population and sex-related variation in the proportion of yearlings participating in breeding; and third, it shows a very low degree of natal philopatry. Theoretically, these three features may be related, as natal site infidelity may enable a quick colonisation of the new areas, where the age composition of the populations may differ from the composition in the ancestral range.

The onset of range expansion of the Common Rosefinch towards the west of its range was recorded nearly two centuries ago. The first stage of expansion started in the beginning of the XIXth century, when the range of the Common Rosefinch reached south-eastern Finland, eastern Germany, Czechoslovakia and Austria. In the newly colonised areas the Common Rosefinch for a long time remained a rare species and its breeding was only occasionally recorded there. In south-eastern Finland, eastern and

south-eastern Poland it bred sporadically in solitary pairs until the early XXth century. In the south-western part of the range the Common Rosefinch numbers were increasing since the last decade of the XVIIIth century until the mid XIXth century. The southern border of the breeding range in this part of Europe ran across upper flow of the Bug and the Dniester rivers, southern slopes of the Tatra Mountains and across southern Silesia. However in 1880-1930, the Common Rosefinch disappeared from many areas and the southern border of its range retreated to Pomerania and Masuria area (Józefik 1960, Bozhko 1980, Jung 1983).

The second wave of range expansion started in the 1930s and peaked in the 1960-1970s. In the St. Petersburg Region of Russia the Common Rosefinch was common already in the end of the XIXth century, but in the 1940-1950s its numbers increased sharply, especially in suburban and city parks. Simultaneously its numbers increased in Finland, Sweden, Karelia and many parts of the European USSR (Österlöf and Stolt 1982, Malchevsky and Pukinsky 1983). In the subsequent years the numbers continued to increase and the range was expanding further to the north, reaching the White Sea coast and 64°N latitude parallel in Finland. In Sweden the numbers recorded increased from 30 pairs in 1959 to 1400 in 1974. Currently the breeding range of the Common Rosefinch in Scandinavia has crossed the Arctic Circle, reaching 67°N latitude parallel on the Swedish-Finnish border, and it includes most of Sweden and southern Norway (Stjernberg 1985, Cramp and Perrins 1994, Isenmann 1994).

Range expansion towards the west mainly proceeded along the Baltic and North Sea coasts. The first breeding record from the Netherlands dates back to 1987, and in Scotland – to 1982. The main wave of expansion to the British Isles started in spring 1992 along the whole east coast, resulting in the first breeding records in England in the same year (Wallace 1999).

It is quite possible that any natural range expansion demographically is based on the stable excess of birth rate over mortality rate and on higher than normal population density. Various factors, and first of all, favourable weather and environmental conditions may cause primarily population growth and, as a consequence, range expansion to new areas.

The aim of this paper is to analyse some demographic parameters of the Common Rosefinch recorded annually over 40 years of study at the Eastern Baltic and to compare some population characteristics from different areas in connection with the process of expansion.

MATERIAL AND METHODS

The data presented here were collected by the staff of the Biological Station Rybachy on the Courish (= Curonian) Spit of the Baltic Sea. Birds of different species were trapped and ringed from 1957 onwards at the "Fringilla" field station (55°05'N, 20°44'E, Kaliningrad Region, Russia). The birds were trapped every year from April to November in three Rybachy-type funnel traps by a method that strictly standardised trapping effort (for a detailed description see Payevsky 2000).

I believe that the traps operated annually control the same local population during breeding, and the number of birds captured during this period is a relative estimate of numbers. Trends in numbers were analysed by correlation of time-series (one-tailed regression), and by Spearman rank correlation, where one variable was the year series, and the other was the trapping figure. From 1957-2000, a total of 5645 Common Rosefinches were trapped and ringed. A total 965 birds were recaptured. All birds were aged and sexed using plumage colour, and also specific details of wear and moult were recorded following Svensson (1992) and Busse (1984) with our supporting evidence (Vinogradova *et al.* 1976). Wing length, body mass and fat score were recorded. During the breeding season also breeding state, by the size of cloacal protuberance, and incubation patch development were recorded.

Breeding biology of the Common Rosefinch was studied throughout 33 years in 1959-1995, except for 1961, 1967, 1988, and 1993. A total of 269 Common Rosefinch nests were found, including 258 with eggs or nestlings. Nest fate was followed in 190 pairs. Breeding success was estimated by the Mayfield (1975) method to evaluate the daily rate of egg and nestling losses. A nest was considered successful if it fledged at least one young. In order to test for the possible difference between the decades, the breeding data were pooled into three groups: 1959-1971, 1972-1982, and 1983-1995.

RESULTS

In spite of year-to-year fluctuations of trapping numbers, generally during 1959-2000 the number dynamics of adult Common Rosefinches did not show a steady trend, positive or negative, except for separate decades (Payevsky 1990, Sokolov 1999 and subsequent analysis).

The breeding territories of Common Rosefinches on the Courish Spit occupied the same habitats during different years. In most cases these habitats were mixed forests with shrubs of Red Currant (*Ribes rubrum*) and Dewberry (*Rubus caesius*), and the edges of Scotch Pine (*Pinus silvestris*) and Mountain Pine (*P. montana*) plantations. The nests were recorded on 17 plant species, but birds favoured Red Currant, Common Juniper (*Juniperus communis*), Dewberry and Mountain Pine.

The size of a complete clutch varied over the whole season between 3 and 6, with the average 4.72 ± 0.07 ($n = 190$). The mean clutch size did not change during the study years (Table 1). The proportion of successful breeding attempts also did not change between the periods: it was 71.4% in 1959-1971, 63.1% in 1972-1982, and 60.6% in 1983-1995 ($\chi^2 = 0.106-0.487$, *ns*). However, the breeding success calculated by Mayfield method declined significantly in 1983-1995 compared to other periods (Table 1). Partial losses were caused by embryonic mortality and by small fraction of unfertilised eggs. When not developing eggs were found in a clutch, their number varied between one and three. Proportion of eggs that were not developed among those survived to hatching was 4.8%. The main reason of egg and nestling mortality was predation. On the Courish Spit Marten (*Martes sp.*), Weasel (*Mustela sp.*), Red Squirrel (*Sciurus vulgaris*), Magpie (*Pica pica*) and Hooded Crow (*Corvus corone cornix*) were recorded as nest predators.

Table 1
Variations of clutch size and breeding success of the Common Rosefinch
in different years on the Courish Spit

Years	Number of controlled nests	Median date of first egg laying	Average size of completed clutch	Number of eggs with known fate	Number of survived nestlings	Breeding success, % (after Mayfield 1975)	
						Mean \pm SE	χ^2 test of difference, $df = 1$
1959-1971	20	7 Jun.	4.6	62	45	53.6 \pm 1.9	1.8, <i>ns</i> 4.1, $p < 0.05$
1972-1982	74	6 Jun.	4.7	235	167	56.5 \pm 1.1	
1983-1995	96	5 Jun.	4.6	381	242	46.5 \pm 0.1	

Age of males in the breeding pairs was determined in 45 cases. In 26 nests the males were old, with red plumage, and in 19 – yearling, with grey plumage (42.2%). Breeding performance of adult and yearling males was determined for nests of adults and nests of yearlings (Table 2). The difference between clutch sizes (4.88 vs 4.54) was not significant (t -test: $t = 1.74$, *ns*). Breeding success rate was somewhat higher in the yearling group, but the difference also was not significant (Table 2). Thus, no significant variation in the breeding performance was found in relation to the age of breeding males.

Table 2
Comparison of breeding characteristics between old males (*Ad*)
and yearling males (*Imm*) of the Common Rosefinch

	Number of controlled nests	Median date of first egg laying	Average size of completed clutch	Number of eggs with known fate	Number of survived nestlings	Breeding success, % (after Mayfield 1975)	
						Mean \pm SE	χ^2 test of difference, $df = 1$
<i>Ad</i>	18	3 Jun.	4.88	83	50	50.8 \pm 1.8	0.25, <i>ns</i>
<i>Imm</i>	13	8 Jun.	4.54	49	35	56.0 \pm 2.1	

DISCUSSION

Several hypotheses have been proposed to explain the causes and mechanisms of the Common Rosefinch expansion (Bozhko 1980, Stjernberg 1985). The main ones implicate quick population growth caused by landscape and climate change. In the late XIXth and XXth centuries major landscape changes occurred in the European USSR, Finland, and Sweden that facilitated a broad occurrence of suitable habitats: lumbering and cutting in the contiguous forests, growing popularity of suburban settlements, growing of secondary forests. Furthermore, in the years preceding the second expansion wave May and June air temperatures were higher than in the preceding years, thus vegetation development was accelerated. Breeding success rate of the

Common Rosefinch is directly dependent on the concealed location of its rather conspicuous nest, and early foliage growth provides better shelter from predators.

The high productivity of Common Rosefinch populations in the 1930s forced juveniles to settle in more open habitats, and their offspring imprinted such habitats and went further west where such habitats were abundant. Natal philopatry is less typical of Common Rosefinches than of other birds (Sokolov 1991) and spring settlement of yearlings in new areas is more likely. Besides, high air temperatures, both during postfledging dispersal and during spring migration stimulate young birds to disperse farther and to settle in new areas (Stjernberg 1985).

In spite of a large numbers of studies of Common Rosefinch biology in different regions of Europe and Asia (Kovshar 1979; Bozhko 1980; Zimin 1981; Payevsky 1981, 1985; Iovchenko 1986; Cramp and Perrins 1994), a controversy still remains concerning the participation of yearling males in breeding. The difficulty of distinguishing between yearling males and females and clear separation of yearling and older males by plumage dictate the necessity of long-term stationary observations of nests. Yearling males may breed alongside with adults, but the percentage of their involvement in the breeding apparently varies broadly between the populations. At the same time, all yearling females captured during the breeding season in Karelia (Zimin 1981) and on the Courish Spit had incubation patches. Such sex-related bias in the participation of yearlings in the breeding has been reported among European songbirds for the Starling (*Sturnus vulgaris*).

The percentage of yearling males in the breeding population of Common Rosefinches much varies on the annual basis and between the regions. In southern Finland the ratio of breeding adult males (with red plumage) to yearling males (with grey plumage) varied between 7 : 2 and 10 : 0 in different years. On average, there were 7.1 adults per one breeding yearling. In Sweden this ratio was on average 6 : 1 (Bozhko 1980). At another Finnish site 9 adults were recorded per one breeding yearling (Stjernberg 1979), in Karelia this figures varied between 1.2 and 4.2, on average 2 (Zimin, 1981). In Tien Shan at one site 4 adults bred per one yearling (Kovshar 1979), and at another site this ratio was 5 : 1 (Iovchenko 1986). These ratios probably do not reflect the true proportions of breeding adults and yearlings, because yearlings are known to occur at the nests of old males, sometimes to help, and at times their number exceeds one (Nankinov 1974, Bozhko 1980, Cramp and Perrins 1994). However, yearling males do breed, like adults, in monogamous pairs, even though rare cases of polygyny have been reported for adults. A competition for mates exists among males, but mate choice by the female is neutral towards the characteristics of the male, and no females remain unmated (Stjernberg 1979, Björklund 1990).

It might be expected that due to range expansion young birds and yearlings, in particular yearling males, occur more frequently in new habitats and generally in north-western and western populations of the species. However, the geographic distribution of adult: yearling male ratios does not follow this logic. If that is the case, in what way the range expansion may to arise? It may be assumed that the expansion took place by gradual settlement of the young birds in new areas, and that their breeding performance was sufficiently high and stable for a part of their offspring to continue this process.

ACKNOWLEDGMENTS

The author is most grateful to all former and present-day researchers at the Biological Station Rybachy for all the years of our joint efforts in bird ringing and nest searching.

REFERENCES

- Björklund M. 1990. *Mate choice is not important for female reproductive success in the Common Rosefinch (Carpodacus erythrinus)*. Auk 107, 1: 35-44.
- Bozhko S.I. 1980. *Der Karmingimpel, Carpodacus erythrinus*. Neue Brehm-Bücherei. No. 529. A. Ziemsen Verlag, Wittenberg Lutherstadt, pp. 1-124.
- Busse P. 1984. *Key to sexing and ageing of European Passerines*. Beitr. Naturk. Niedersachsen 37, Suppl.: 1-224.
- Cramp S., Perrins C.M. (Eds). 1994. *The Birds of the Western Palearctic*. Vol. VIII. Oxford Univ. Press, Oxford, pp. 1-899.
- Iovchenko N.P. 1986. [*The ecology of Scarlet Rosefinch, Carpodacus erythrinus (Pall.) in Kirgiz Ala-Tau (Tien-Shan)*.] Proc. Zool. Inst. Acad. Sci. Russia 147: 7-24. (In Russian).
- Isenmann P. 1994. *L'extension géographique actuelle du Roselin cramoisi Carpodacus erythrinus en Europe*. Alauda 62, 3: 81-88.
- Józefik M. 1960. *Modifications of the south-west border of the range of Erythrina erythrina erythrina (Pall.) during the last two hundred years*. Acta orn. 5, 11: 307-324.
- Jung N. 1983. *Struktur und Faktoren der Expansion des Karmingimpels, Carpodacus erythrinus, in Europe und Kleinasien*. Beitr. Vogelkd. 29, 5/6: 249-273.
- Kovshar A.F. 1979. [*Songbirds in the sub-high-mountains of the Tien-Shan*.] Nauka Press, Alma-Ata, pp. 1-312. (In Russian).
- Malchevsky A.S., Pukinsky Y.B. 1983. [*Birds of Leningrad Region and neighborhood areas. History, biology, and conservation. Vol. 2. Songbirds*.] Leningrad Univ. Press, Leningrad, pp. 1-504. (In Russian).
- Mayfield H.F. 1975. *Suggestions for calculating nest success*. Wilson Bull. 87, 4: 456-466.
- Nankinov D.N. 1974. [*On the ecology of Scarlet Rosefinch in Leningrad region*.] Proc. VI All-Union Ornithol. Conf. Moscow. Part 2: 92-93. (In Russian).
- Österlöf S., Stolt B.O. 1982. *Population trends indicated by birds ringed in Sweden*. Ornis scand. 13, 2: 135-140.
- Payevsky V.A. 1981. [*Demographic parameters of Scarlet Rosefinch population on the Courish Spit*.] Absr. X Baltic Ornithol. Conf. Riga. Part 2: 153-155. (In Russian).
- Payevsky V.A. 1985. [*Avian Demography*.] Nauka Press, Leningrad, pp. 1-285. (In Russian).
- Payevsky V.A. 1990. [*Population dynamics of birds according to trapping data on the Courish Spit of the Baltic Sea during twenty seven years*.] Zool. zh. 69, 2: 80-93. (In Russian).
- Payevsky V.A. 2000. *Rybachy-type trap*. In: Busse P. *Bird Station Manual*. SE European Bird Migration Network, Gdańsk, pp. 20-24.
- Sokolov L.V. 1991. *Avian Philopatry and Dispersal*. Proc. Zool. Inst. Russ. Acad. Sci. 230: 1-233.
- Sokolov L.V. 1999. *Population dynamics in 20 sedentary and migratory passerine species of the Courish Spit on the Baltic Sea*. Avian Ecol. Behav. 3: 23-50.
- Stjernberg T. 1979. *Breeding biology and population dynamics of the Scarlet Rosefinch Carpodacus erythrinus*. Acta Zool. Fenn. 15, 1: 1-88.
- Stjernberg T. 1985. *Recent expansion of the Scarlet Rosefinch (Carpodacus erythrinus) in Europe*. Proc. XVIII Int. Ornithol. Congr. Moscow: 743-753.

- Svensson L. 1992. *Identification Guide to European Passerines*. Stockholm: pp. 1-368.
- Vinogradova N.V., Dolnik V.R., Yefremov V.D., Payevsky V.A. 1976. [*Identification of sex and age in passerine birds of the USSR.*] Nauka Press, Moscow, pp 1-192. (In Russian).
- Wallace D.I.M. 1999. *History of the Common Rosefinch in Britain and Ireland, 1869-1996*. Br. Birds 92, 9: 445-471.
- Zimin V.B. 1981. [*On the ecology of Scarlet Rosefinch in Karelia.*] In: [*The ecology of terrestrial vertebrates of north-western USSR.*] Petrozavodsk, pp. 13-31. (In Russian).