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Source: Acta Ornithologica, 38(1) : 53-58

Published By: Museum and Institute of Zoology, Polish Academy of Sciences

URL: https://doi.org/10.3161/068.038.0111

ACTA ORNITHOLOGICA
Vol. 38 (2003) No. 1

A survey of the Bearded Tit *Panurus biarmicus* during the non-breeding season in a landscape of western Poland

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Surmacki A., Stępniewski J. 2003. A survey of the Bearded Tit *Panurus biarmicus* during the non-breeding season in a landscape of western Poland. Acta Ornithol. 38: 53–58.

Abstract. The population of Bearded Tit was studied on a 1872 km^2 study area of predominantly agricultural landscape in W Poland, near Poznań. During the non-breeding period (October–March) surveys were made every 10–14 days on a sample of 44 marshlands selected at random out of 240 suitable habitat patches found in the study area. Bearded Tits were found at least once in 66% of the patches surveyed, but the average percentage of patches occupied per single survey was 25% and did not vary across the non-breeding season. Re-occupancy of individual reed-bed patches in successive surveys averaged 54% and was lowest during early autumn and in the second half of the winter. 39% of the sites occupied during the winter were used as breeding sites in the spring following or preceding the survey. Of 17 breeding sites, 16 were used by Bearded Tits also outside the breeding season. The numbers of birds recorded peaked in second half of October and declined thereafter. Flock size averaged 3.1 (range 1–55) birds and correlated with total number of Bearded Tits recorded during the single survey. Birds mostly foraged on reed seeds taken from reed ears. Foraging on the ground occurred mostly at the beginning and at the end of non-breeding season. Searching for invertebrates peaked in December–January.

Key words: Bearded Tit, *Panurus biarmicus*, non-breeding season, reedbed, foraging

Received — April 2003, accepted — June 2003

INTRODUCTION

Breeding populations of Bearded Tit in Europe have distinctly patchy and changeable range (Hagemeijer & Blair 1997). Some of them, temporary disappear while others colonize brand new areas (Wilson 1993, Strehlow 1997, Bertoli & Leo 1998). Climatic conditions during the non-breeding season are among the main factors affecting dynamic pattern of Bearded Tit distribution (Spitzer 1972). Although the species is sedentary in general, it shows a wide variety of wintering strategies; from short-distance migrations to staying in breeding areas over the whole winter (Dürr et al. 1999). Consequently, decisions made by birds in autumn and winter strongly affect their entire populations (Bauer & Berthold 1996, Cramp 1998).

Knowledge on the occurrence and numbers of Bearded Tits during the non-breeding season remains rather limited. Some studies were carried out on selected, large breeding populations (Einstein 1985, Tomovcik 1999). In Western Poland, however, Bearded Tits tend to occupy many isolated wetlands patches rather than single large site (Kuźniak 2000). In such circumstances, reliable data on wintering populations may be obtained only by surveying, within a short time period, more extensive areas encompassing many patches of suitable habitat. Distribution of Bearded Tit on the regional level was usually assessed based on opportunistic observations made by birdwatchers (Jesionowski et al. 1982, Dyrcz et al. 1991, Kuźniak 2000, Walasz et al. 2000) or from ringing data (Axell 1966, Dürr et al. 1999). The main disadvantage of both methods is their long time-window over which the data are collected, often exceeding 10 years. This means, that the final picture is based on observations summarized over many years in which few generations of Bearded Tits are involved.

The main aim of the survey was to investigate distribution and changes in numbers of Bearded Tits outside the breeding season on the level of a metapopulation occupying multiple patches of suitable habitat in a landscape matrix rather than single local populations. In addition, data on habitat use and foraging behavior were collected.

STUDY AREA AND METHODS

Surveys were conducted in Poznań province (W Poland; 52°N, 16°E). The study plot covered 1872 km^2 of a landscape typical for the region (Bednorz et al. 2000). Arable land was a prevailing habitat within the study area, while forests and marshlands accounted for 24% and 6% respectively (Fig. 1). Based on 1:25 000 maps, 240 marsh patches were identified within the study area, constituting a sampling frame (c.f., Thompson et al. 1998). Then, 44 patches were selected at random to obtain a simple random sample. All points were examined in the field before study. Only sites with a belt of reeds *Phragmites communis* wider then 5 meters were included into the survey.

Habitats surveyed were divided into three types: lakes and ponds with water surface exceeding 1 ha (n = 15), stream valleys (n = 10) and small marsh patches (n = 20).

Fieldwork was carried out between October 2000 and March 2001. Ten surveys were made in the selected marsh patches, with point counts conducted every 10–14 days. A single survey of the whole study area lasted 3–4 days. Dates of surveys are as follows: 1) 25–27 Sep., 2) 10–12 Oct., 3) 24, 25, 30 Oct., 4) 13–15 Nov., 5) 28, 29 Nov., 01 Dec., 6) 10, 12, 13, 15 Dec., 7) 3–5 Jan., 8) 23, 25, 29, 30 Jan., 9) 15, 16, 19 Feb., 10) 1–3 Mar. On each occasion, an observer spent 10 minutes per site, including 40 seconds of playback with Bearded Tit contact voices. Playback was also used to attract birds and determine their number, sex and foraging behavior. More details of the method are described by Surmacki (in press). Observations of foraging birds were classified to one of three height classes:

1) low (ground, water, ice and snow cover);

2) middle (vegetative parts of plants like steams, twigs and *Carex* leafs);

3) upper (reed and cattail ears).

It was assumed that searching vegetative parts of plants and surface of water is connected with foraging on invertebrates (Christoleit 1925, Koenig 1951, Wawrzyniak & Sohns 1986, Cramp 1998).

In spring of 2001 all the sites of Bearded Tits were surveyed again to search for breeding birds. In all sites two 10 minute point counts were performed; first in the middle of May and the second in June. During each visit 5 minutes of playback with contact voices was performed. A site was regarded as occupied by breeding birds if at least at one occasion young or adult Bearded Tits were seen or heard. In the preceding breeding season, i.e. in 2000, most of the sites in question were surveyed in a similar fashion either in June or July. Because most Bearded Tits occupy the same breeding site for few consecutive years (Dürr et al. 1999), data on occupancy of breeding sites from 2000 and 2001 were pooled in further analyses.

The breeding population of Bearded Tit in a whole study area is estimated at 23–27 pairs (Kuźniak 2000, A. Surmacki — unpubl. data).

RESULTS

Outside the breeding season Bearded Tits were at least once recorded on 29 of all controlled sites (66%, Fig. 1). Occupied sites were distributed randomly among three habitat classes: 48% of them were on lakes, 28% in stream valleys and 24% in marsh patches ($\chi^2 = 2.75$, df = 2, p = 0.25). Number of visits at which birds were heard or seen in a particular site varied between 1 and 8 (mean ± SD = 3.9 ± 2.5). Mean number of sites occupied during single survey was 11.3 (± 2.2) i.e. 25% and this proportion didn't change markedly through the survey period ($\chi^2 = 1.78$, df = 9, p = 0.99, Fig. 2). Percentage of sites occupied during one survey that were found occupied again during the next survey averaged 54%. This re-occupancy rate raised slightly from September till December, then decreased (Fig. 2).

Breeding Bearded Tits were recorded in 17 (39%) of all controlled sites (8 in 2000 and 13 in 2001, Fig. 1). Of these 53% were lakes, 29% — stream valleys and 18% — small marsh patches. Breeding birds were found in 59% of sites where the species was recorded at least once during the non-breeding season. All breeding sites, except for one, were at least once occupied by Bearded Tits also in autumn and winter. The percentages of habitat types used by birds during breeding and non-breeding seasons did not differ significantly ($\chi^2 = 0.22$, df = 2, p = 0.87).

During autumn and winter surveys the total of 348 Bearded Tits were observed on 113 occasions. The sex was determined for 206 individuals. The proportion of males in the sample was 55.3% and the sex-ratio did not deviate from 1:1 ($\chi^2 = 1.08$, df = 1, p = 0.30).

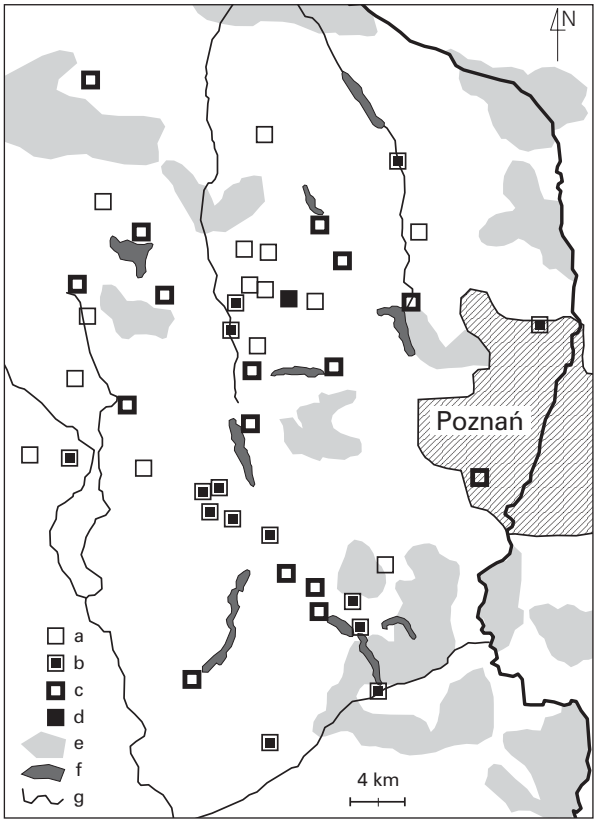

Fig. 1. Distribution of habitat patches surveyed within the study area. a — not occupied sites, b — sites occupied in non-breeding season, c — sites occupied in non-breeding and breeding season, d — sites occupied in breeding seasons, e — woods, f — lakes, g — rivers, HF – a site where high flying was observed.

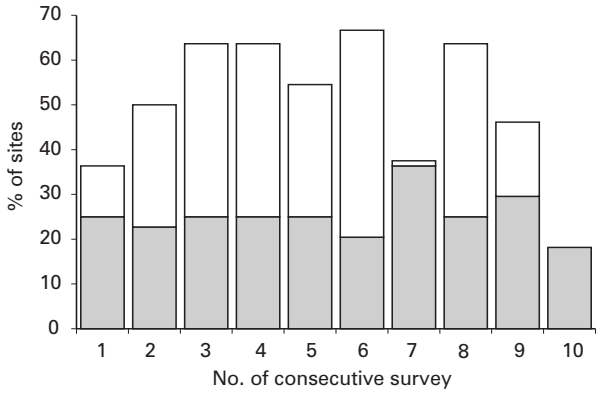

Fig. 2. Seasonal variation in the site occupancy during the non-breeding period. Grey bars — percentage of sites occupied, white bars — percentage of occupied sites which were re-occupied during the next survey. Cf. Study area and methods for dates of surveys.

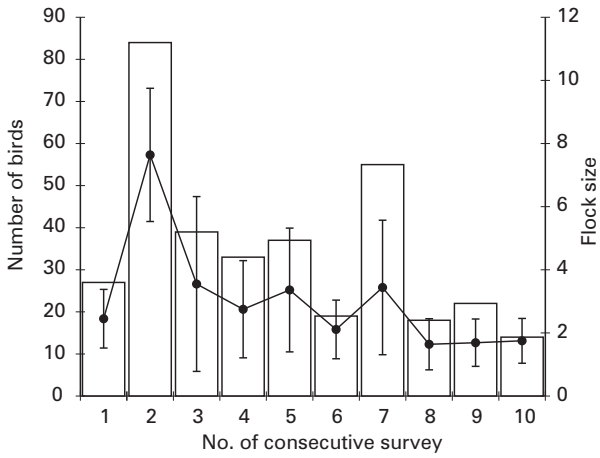

Fig. 3. Seasonal variation in mean flock size (black dots, with whiskers indicating ± SD, N = 113) and total number of Bearded Tits recorded during single survey (white bars, N = 348). Cf. Study area and methods for dates of surveys.

The peak of bird numbers noted at the beginning of October was followed by a gradual decline till the end of the survey (Fig. 3). For the whole survey period, the mean number of individuals in a flock was 3.1 (± 5.1). Small flocks and solitary birds predominated (median = 2, mode = 2). The mean flock size recorded during single survey was positively correlated with the total number of birds recorded over the whole study area at that time ($r_s = 0.93$, $p < 0.0001$, n = 10, Fig. 3). The biggest flock (n = 55) was observed on 12 October and comprised birds performing typical high-flights over reeds (*sensu* Cramp 1998).

Flock size did not differ significantly according to habitat type (Kruskal-Wallis ANOVA, H = 1.53, n = 44, p = 0.47). However, in relation to the availability of habitats, significantly more observations were made on lakes and stream valleys than in small marsh patches ($\chi^2 = 20.21$, df = 2, $p < 0.0001$, n = 111).

Size of flocks noted in former or future breeding sites did not differ from that recorded in other non-breeding sites (Mann-Whitney U-test, z = -1.35, p = 0.18). However, in sites used for breeding Bearded Tits were observed markedly more often in the non-breeding period (72% of surveys) than in sites where they did not breed (28%; $\chi^2 = 24.96$, df = 2, $p < 0.0001$).

140 records of foraging Bearded Tits were collected during surveys. Frequency of foraging birds was not related to the habitat type ($\chi^2 = 0.96$, df = 2, p = 0.62). In most cases, birds were eating reed seeds sitting on reed ears (n = 59). Taking food from the ground, ice or water surface was observed in 33 birds. Relatively large number of Bearded Tit (n

= 26) were searching surface of reed steams, especially places between leaves and stalks, similarly to Blue Tits *Parus caeruleus*, which often joined their flocks. Other foraging places were represented by fewer observations: water surface (n = 11), clumps of *Carex* grass (n = 5), bushes (n = 5) and ears of cattail (*Typha* sp., n = 1). Intensity of foraging in three height classes of the reed-bed changed across the survey period (Fig. 4). Birds searched the ground most intensively at the beginning and the end of the non-breeding season (Fig. 4). The main exploration of upper and middle parts of vegetation took place in October and November, respectively. (surveys no. 3–5 on Fig. 4).

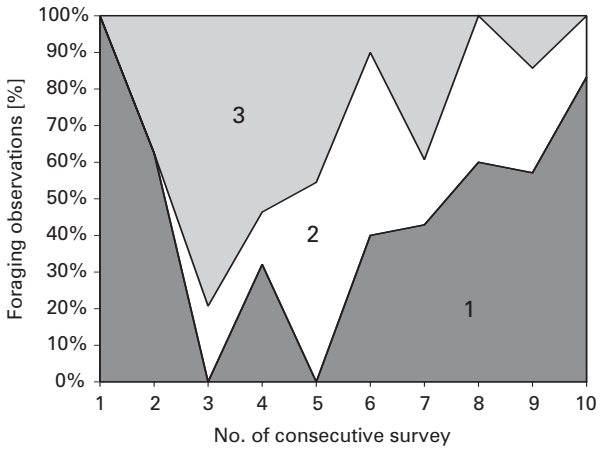

Fig. 4. Seasonal variation in use of three height classes by foraging Bearded Tits. Three height levels distinguished: 1— low (ground, ice, water), 2 — medium (steams, leafs, twigs), 3 — high (ears of reed and cattails). Cf. Study area and methods for dates of surveys.

DISCUSSION

Within the study area, distribution of Bearded Tit during the non-breeding period showed an extensive overlap with areas used breeding. On almost all breeding sites birds were recorded also during the autumn or winter.

Thus birds either overwinter in their breeding places or breed in sites where they spend last winter. These two kinds of site fidelity were found in respectively 35.7% and 36.8% of Bearded Tits ringed and recaptured in Germany (Dürr et al. 1999). Another explanation is that Bearded Tits may start occupying their breeding sites already at the end of winter, as it was reported by Wawrzyniak & Sohns (1986).

On the other hand, in autumn and winter Bearded Tits were recorded also outside their breeding sites. In total, frequency of suitable habitat patches occupied during the non-breeding season was almost twice as high as the proportion of patches used for breeding (Fig. 1). Similar, seasonal extension of Bearded Tit distribution in autumn and winter was found also e.g. in England (Cramp 1998). Birds observed on previously unoccupied habitat patches could originate from local breeding populations as well as from more distant areas. According to Dürr at al. (1999), Bearded Tits perform two kinds of autumn movements: short-distance (30–99 km), which are undirected and long-distance (100–700 km), directed to SSW-W and ESE-S. Similar movements were also observed in England and Sweden (Cramp 1998). In the present study, seasonal movements of Bearded Tits are indicated by lower re-occupancy rates of particular sites in early autumn and late winter (Fig. 2).

The peak of Bearded Tits observed in autumn (Fig. 3) is typical for the species and formed mainly by young birds (Cramp 1998). Their eruptive appearance in September and October is due to fast development of breeding populations, with individual birds laying usually 3–5 clutches per one pair (Wawrzyniak & Sohns 1986, Stępniewski 1995). The high flying performed by large flocks, like the one observed in the study area, is considered as a start to autumn dispersion of young Bearded Tits (Cramp 1998). Further movements are performed by smaller groups which separate from the main flocks during high flying (see Results, Cramp 1998). The gradual decrease of mean flock size over the winter observed in the present survey, associated with the gradual decline of overall Bearded Tit number (Fig. 3) is probably caused by the continuing dispersal. Dürr et al. (1999) found that 20% of the juveniles and 12.1% of the adults do not return to their natal and former breeding sites in spring. On the other hand, many Bearded Tits which stayed for a winter could die due to unfavorable weather conditions to which they are particularly vulnerable (Spitzer 1972). The decrease of mean flock size at the end of winter (Fig. 3) is probably effect of splitting flocks into the breeding pairs (Wawrzyniak & Sohns 1986).

Some of Bearded Tits in the studied area stayed in their breeding sites while other, mainly young, intensively explored further areas. The autumn peak following by asteady decrease and the total number of observed birds suggest that most of Bearded Tits wintering in study area originate from local breeding populations (see Einstein 1985).

More frequent observations of non-breeding Bearded Tits on lakes and in stream valleys may be explained by presence of flooded reed beds which are lacking in temporary drying small marsh patches. Earlier surveys revealed that Bearded Tit prefer to breed in high moisture reeds, where predation pressure is limited (Beemster et al. 1999, Hoi & Hoi 2001). Similar mechanism of habitat selection may act also outside the breeding season. However, Hoi & Hoi (2001) found that in autumn, Bearded Tits shifts towards more dry reed-beds. Relatively low occurrence of species in small marsh patches should not be linked with area-dependent shortage of resources (e.g. food, shelters from predators). The mean flock size in this habitat did not differ from that noted for lakes and stream valleys. Moreover, frequency of foraging birds was the same across all habitats. It is more probable that Bearded Tits which disperse in random directions have a greater chance to find a reed-bed on lake or stream than a small marsh patch, by virtue of its larger area. Data on Bearded Tits found in small, isolated marsh patches are scare (Surmacki 1998, Głowaciński et al. 2001). Adaptation to this new habitat type may have a key importance for increase of the species' range in some parts of Europe. The dispersal of Bearded Tit is undirected and mainly depends on presence of reed-beds (Cramp 1998, Dürr et al. 1999). In intensively used farmland of western Poland, small reed patches may be used as a "stepping stones" by dispersing Bearded Tits.

Some authors claimed that habitat preferences of Bearded Tits in spring and non-breeding season are different. In autumn and winter birds tend to occupy smaller and drier reed-beds (Dyrcz et al. 1991, Hoi & Hoi 2001). However, detection of seasonal differences in habitat occupation pattern in Bearded Tit probably demands a more detailed and fine scale research than surveys we made.

Bearded Tits in the study area showed a variety of foraging strategies known for the species during the non-breeding season (Cramp 1998). The high percentage of birds foraging on reed ears confirmed importance of reed seeds in the winter diet (Bibby 1981). At the end of winter frequency of this behavior declined while searching on ground, snow or ice became more frequent (Fig. 4). This change was due to a gradual falling of seeds and necessity of taking frozen water, important in digesting process (Dittberner & Dittberner 1982). Experiments done by Hoi & Hoi (2001) revealed that Bearded Tit preferences for particular vegetation strata change through the year independently of food availability. Birds occur in mainly on ground during the breeding season, while in autumn and winter prefer upper parts of vegetation. Similar pattern was observed during the present survey: most birds foraged on ground just after and before breeding season (Fig. 4). Relatively high percentage of Bearded Tits searched for invertebrates in the middle of winter (Fig. 4), what might be surprising given physiological adaptation to plant diet at time (Cramp 1998). One of possible explanations is strong preference to upper vegetation strata in Bearded Tits outside the breeding season (Hoi & Hoi 2001). The second reason may be relatively mild weather conditions during survey period, which made invertebrates more accessible. Even at the beginning of December active flies Diptera were observed at the reed-bed edges.

ACKNOWLEDGEMENTS

Piotr Tryjanowski gave many valuable advices on early draft of manuscript. Przemysław Chylarecki helped in statistics and improved English. Ewa Wailszewska translated German literature. Chris van Turnhout provided information on the occurrence of Bearded Tit in Netherlands as well as appropriate papers. The research was financed by grant No. PBWB 207/2000 from Adam Mickiewicz University.

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STRESZCZENIE

[Wąsatka w okresie nielęgowym — występowanie w skali wycinka krajobrazu Wielkopolski]

Badania prowadzono od połowy października 2000 do początku marca 2001 w okolicach Poznania, na powierzchni 1872 km^2 (Fig. 1). Jest to obszar typowo rolniczy o lesistości nie przekraczającej 25%. Udział terenów podmokłych wynosi około 6%. Ptaki liczono w 44 losowo wybranych trzcinowiskach o szerokości co najmniej 5 m, wybranych losowo spośród 240 obecnych w obrębie powierzchni próbnej. Przeprowadzono 10 liczeń punktowych trwających 10 min. W czasie każdej kontroli, próbowano również wabić wąsatki za pomocą głosów kontaktowych, odtwarzanych z magnetofonu w celu ich dokładnego policzenia. W latach 2000 i 2001 wszystkie badane miejsca skontrolowano również w celu wykrycia ptaków lęgowych. Stanowiska podzielono na trzy grupy w zależności od środowiska, w którym się znajdowały: jeziora, doliny małych cieków wodnych i małe bagienka.

W czasie całego okresu badań nielęgowe wąsatki stwierdzono w sumie na 29 stanowiskach, czyli 66% spośród 44 kontrolowanych (Fig. 1). Liczba zajętych stanowisk na całej powierzchni w czasie pojedynczej kontroli wynosiła średnio 11.3 (± 2.2), tj. 25%. Na poszczególnych stanowiskach ptaki były stwierdzane wielokrotnie. Prawdopodobieństwo powtórnego stwierdzenia wąsatek w danym płacie siedliska wynosiło średnio 54%, będąc najmniejsze na początku i pod koniec okresu nielęgowego (Fig. 2). Wąsatki zajmowały trzy typy środowisk, proporcjonalnie do ich częstości w badanej próbie. Ptaki lęgowe obserwowano na 17 stanowiskach. Większość miejsc lęgowych (n = 16) była wykorzystywana przez wąsatki także poza sezonem lęgowym (Fig. 1). Największą liczebność ptaków zanotowano w drugiej połowie października, po czym nastąpił jej stopniowy spadek trwający aż do marca (Fig. 3). Spadkowi całkowitej liczebności towarzyszyło również zmniejszanie się wielkości stad (Fig. 3). Wąsatki najczęściej żerowały wybierając nasiona z kłosów trzcin. Najwięcej ptaków szukających pokarmu na ziemi stwierdzono na początku i końcu badanego okresu (Fig. 4). Znaczny był odsetek wąsatek przeszukujących wegetatywne części roślin w poszukiwaniu bezkręgowców, zwłaszcza w miesiącach zimowych (Fig. 4).

Uzyskane wyniki wskazują, że część badanej populacji spędza zimę w miejscach lęgowych, podczas gdy reszta osobników intensywnie koczuje. Szerokie występowanie gatunku poza okresem lęgowym można tłumaczyć łatwą adaptacją do nowych środowisk (np. oczek wodnych) oraz nietypową dla tego okresu dietą (bezkręgowce). Obserwowane zmiany liczebności oraz wielkości stad są zapewne efektem stopniowej dyspersji osobników młodych pochodzących z miejscowych populacji lęgowych.