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# Autumn migration patterns of buntings (*Emberiza* spp.) in eastern Fennoscandia

I. M. Bannikova

Institute of North Industrial Ecology Problems, the Kola Science Center, Russian Academy of Sciences, 14 Fersmana Str., 184209, Apatity, Russia

***Author***
**Iuliia M. Bannikova**
E-mail: y.bannikova@ksc.ru
SPIN: 3074-4417
Scopus Author ID: 58756035200
ResearcherID: HKM-8529-2023
ORCID: 0000-0003-4134-3723



***Abstract.*** The paper examines the migration chronology of three bunting species (*Emberiza* spp.) in eastern Fennoscandia (Russia), focusing on autumn when most captured individuals were first-year birds undertaking their first migration. The data were gathered in the southern part of the Kola Peninsula by trapping and measuring migrating birds. The study found that juvenile Reed Buntings (*E. schoeniclus*) exhibited post-fledging dispersal from 26 July to 30 August (n=142), while their autumn migration occurred between 15 August and 18 September (n=206). Adult Reed Buntings migrated from 26 July through 18 September. Juvenile Rustic Buntings (*E. rustica*) dispersed from 8 to 31 August (n=11) and migrated from 14 August to 19 September (n=88). Juvenile Little Buntings (*E. pusilla*) showed dispersal movements from 1 to 21 August (n=7) followed by migration between 9 and 25 August (n=22). Sample sizes permitted detailed migration analysis only for adult Reed Buntings. Significant temporal overlap between dispersal (post-fledging migration) and autumn (post-moult) migration was observed in Rustic and Little Buntings.

***Keywords:*** avian migration, dispersal, autumn migration, Kola Peninsula, bunting, eastern Fennoscandia

# Миграция овсянок (*Emberiza* spp.) в восточной Фенноскандии

Ю. М. Банникова

Институт проблем промышленной экологии Севера, Кольский научный центр РАН, ул. Ферсмана, д. 14, 184209, г. Апатиты, Россия

***Сведения об авторе***
**Банникова Юлия Михайловна**
E-mail: y.bannikova@ksc.ru
SPIN-код: 3074-4417
Scopus Author ID: 58756035200
ResearcherID: HKM-8529-2023
ORCID: 0000-0003-4134-3723



***Аннотация.*** Исследовались сроки миграции трех видов овсянок (Emberiza spp.) в восточной Фенноскандии (Россия) в осенний период. Данные собраны в южной части Кольского полуострова путем отлова и прижизненного обследования мигрирующих птиц. Дисперсия (расселение) молодых особей тростниковой овсянки (*Emberiza schoeniclus*) проходила в период с 26 июля по 30 августа (n = 142), молодых овсянок-ремезов (*E. rustica*) — с 8 по 31 августа (n = 11), молодых особей овсянки-крошки (*E. pusilla*) — с 1 по 21 августа (n = 7). Осенняя миграция молодых тростниковых овсянок проходила с 15 августа по 18 сентября (n = 206), взрослых птиц — с 26 июля по 18 сентября. Осенняя миграция молодых овсянок-ремезов проходила с 14 августа по 19 сентября (n = 88), тогда как у молодых овсянок-крошек — с 9 по 25 августа (n = 22). Исследование выявило значительное перекрытие сроков миграций между дисперсией и осенней миграцией овсянки-ремеза и овсянки-крошки в восточной Фенноскандии.

***Ключевые слова:*** миграция, дисперсия, осенняя миграция, Кольский полуостров, овсянки, восточная Фенноскандия

## Introduction

Although passerine migrations in Europe have been extensively analyzed (Berthold 1995; Hüppop, Hüppop 2003; Jenni, Kéry 2003; Newton 2008; Chernetsov 2012; Noskov et al. 2020; Payevsky 2020), some knowledge gaps still persist. For instance, existing regional studies on the Kola Peninsula remain limited (Bianki et al. 1993; Kokhanov 1998; Boyko, Chigrova 2006), particularly for buntings (Panov 2011; Noskov et al. 2020). An example of seminal research is the study by Bianki et al. (Bianki et al. 1993), which summarizes data from the Kandalaksha Nature Reserve starting with its establishment in 1932 until 1993. Bianki's work documents long-term monitoring of avifauna in the White and Barents Seas regions. The authors present data on Reed Buntings obtained through visual observations, noting that the last recorded sightings of these birds in the Barents Sea occurred in mid-September. In contrast, in the southern Kola Peninsula, Reed Buntings were observed later, from the end of September until late October. Meanwhile, the migration of Little Buntings begins at the end of July and continues until the end of August (Noskov et al. 2020).

Ringing studies in northern Karelia (a more southern region of Fennoscandia) reveal earlier, compressed migration windows for juvenile versus adult Reed Buntings (Panov 2011), while Leningrad region data show juvenile Reed Buntings dispersing from late July to early August, with Rustic Buntings displaying broader migratory timing from late June through September (Noskov et al. 2020).

The study species breed near the northern edge of their range and migrate to wintering grounds through the southern Kola Peninsula. The range of the Reed Bunting spans Europe, Russia, and parts of the Middle and Far East (Hagemeijer, Blair 1997; BirdLife International… 2019), with European wintering populations (Field et al. 2007; Orłowski, Czarnecka 2007; Robledano et al. 2010; Noskov et al. 2020, Šálek et al. 2022).

The ranges of the Rustic Bunting and Little Bunting stretch from Scandinavia to Kamchatka (BirdLife International 2016; 2017). Similarly to the Reed Bunting, their migration strategy includes two phases for adults and three for juveniles (Rymkevich 1990; Noskov et al. 2020). These species, with the most distant wintering sites, spend their winters in Asia (Zhang et al. 1992; Kim et al. 2011; Jiao et al. 2016; Takeuchi 2019; Katayama et al. 2021).

The reported study examines the phenology and conditions of dispersal and autumn migration for three *Emberiza* species during migration and stopovers. Specifically, it addresses the following questions:

1) What are the temporal patterns and body condition of juvenile migrants?

2) What is stopover duration and related energetic status of juveniles?

3) What is the regional stopover ecology?

Building upon recent findings (Wobker et al. 2021), we hypothesize that short-distance migrants (Reed Buntings) will initiate and complete migration later than long-distance counterparts. Following Panov (Panov 2011), we predict delayed adult migration relative to juveniles.

Furthermore, incorporating evidence from Collet and Heim (Collet, Heim 2022) demonstrating prolonged stopovers in short-distance migrants, we anticipate briefer migratory stopovers in long-distance Rustic and Little Buntings compared to Reed Buntings.

## Methods

The study was conducted in the northern European part of Russia within the Fennoscandian physiographic region. Fieldwork took place at two locations: the Luvenga scientific base of the Kandalaksha Nature Reserve along the White Sea coast (67.103705, 32.698332), and former agricultural meadows located 2.16 km northeast of the base (67.116372, 32.667239). Data collection occurred from 26 July to 18 September 2022. It involved trapping migrating birds using mist nets, ringing them, and measuring various biometric parameters. The analysis only covered birds with accurately determined age. Between 16–18 mist nets were operated continuously during this period, with daily trapping con-

ducted from sunrise to sunset except during periods of high winds exceeding 15–18 m/s or sustained rainfall.

A total of 511 buntings were captured during the study period, including 372 Reed Buntings (*Emberiza schoeniclus*), 106 Rustic Buntings (*E. rustica*), and 33 Little Buntings (*E. pusilla*). For each individual of the three species, we recorded species identification, age, sex (Svensson 1992; Svensson et al. 2009), fat index (Vinogradova et al. 1976), weight, wing and tail length, and moult stage. The moult stages are identical for all three species. The studied species exhibit different migration strategies at the edge of their range: Reed Buntings are short-distance migrants, while Rustic Buntings and Little Buntings are long-distance migrants.

The moult breaks down into six distinct phases: stage 1 marked by initial breast feather loss, stage 2 characterized by shedding of medium and greater coverts, stage 3 showing completed replacement of greater coverts, stage 4 featuring growing undertail coverts, stage 5 with fully grown undertail coverts and partial feather regrowth in other areas, and stage 6 demonstrating more than 50 % feather regrowth across multiple body regions (Rymkevich 1990).

First-year buntings go through three distinct migratory phases, two of which occur in autumn. The latter includes post-fledging dispersal (corresponding to moult stages 1–3) and autumn migration toward wintering grounds (stages 4–6). Stopover duration was calculated for recaptured individuals as the interval between initial and subsequent captures. Due to limited sample sizes, detailed migration pattern analysis was only feasible for adult Reed Buntings among the three species studied.

## Results

### *Reed Bunting*

The migration period for Reed Buntings (*Emberiza schoeniclus*) spanned from 26 July to 18 September, encompassing both juvenile and adult birds (Fig. 1A). Our captures included 348 juveniles (88 females, 113 males) and 24 adults (12 females, 11 males), as detailed in Table 1. Juvenile males outnumbered females by a factor of 1.28, while adult sex ratios were nearly balanced. Analysis using 90 % confidence intervals revealed the core migration period for juveniles occurred between 6 August and 15 September, with adults showing a slightly earlier window from 29 July to 15 September. Body mass measurements showed juveniles averaged 18.1 ± 1.45 g (range: 13.3–21.8 g), comparable to adults at 17.95 ± 1.62 g (range: 16.5–22.1 g). Fat index was 0–1 in 92 % of juveniles (n=348) and 95.8 % of adults (n=24).

Most individuals were actively moulting: 82 birds were in stage 2, 48 in stage 3, 10 in stage 1 and 2 not yet moulting (Fig. 1B). Dispersal activity peaked during the sixth pentad of August (26–30 August), when 35 juveniles were captured. The median body mass during dispersal was 17.9 ± 1.39 g (range: 14.6–21.2 g).

The post-moult autumn migration of juveniles took place from 15 August to 18 September (n = 206). Moult stage analysis showed that 115 individuals were in stage 4, 31 in stage 5, 14 in stage 6, and 46 had already completed moulting (Fig. 1). Migration activity peaked on

**Table 1**

**Number of juvenile and adult buntings captured during dispersal and autumn migration in eastern Fennoscandia**

**Таблица 1**

**Численность молодых и взрослых овсянок, отловленных в период дисперсии и осенней миграции в восточной Фенноскандии**

| Species | Juvenile | | | | | | Adult | | |
|---|---|---|---|---|---|---|---|---|---|
| | Dispersion | | | Autumn migration | | | Autumn migration | | |
| | Total | ♀ | ♂ | Total | ♀ | ♂ | Total | ♀ | ♂ |
| Reed Bunting | 142 | 88 | 113 | 206 | 72 | 99 | 24 | 12 | 11 |
| Rustic Bunting | 14 | 4 | | 88 | 36 | 31 | 2 | | 1 |
| Little Bunting | 7 | | 1 | 24 | 1 | 1 | 2 | 1 | |

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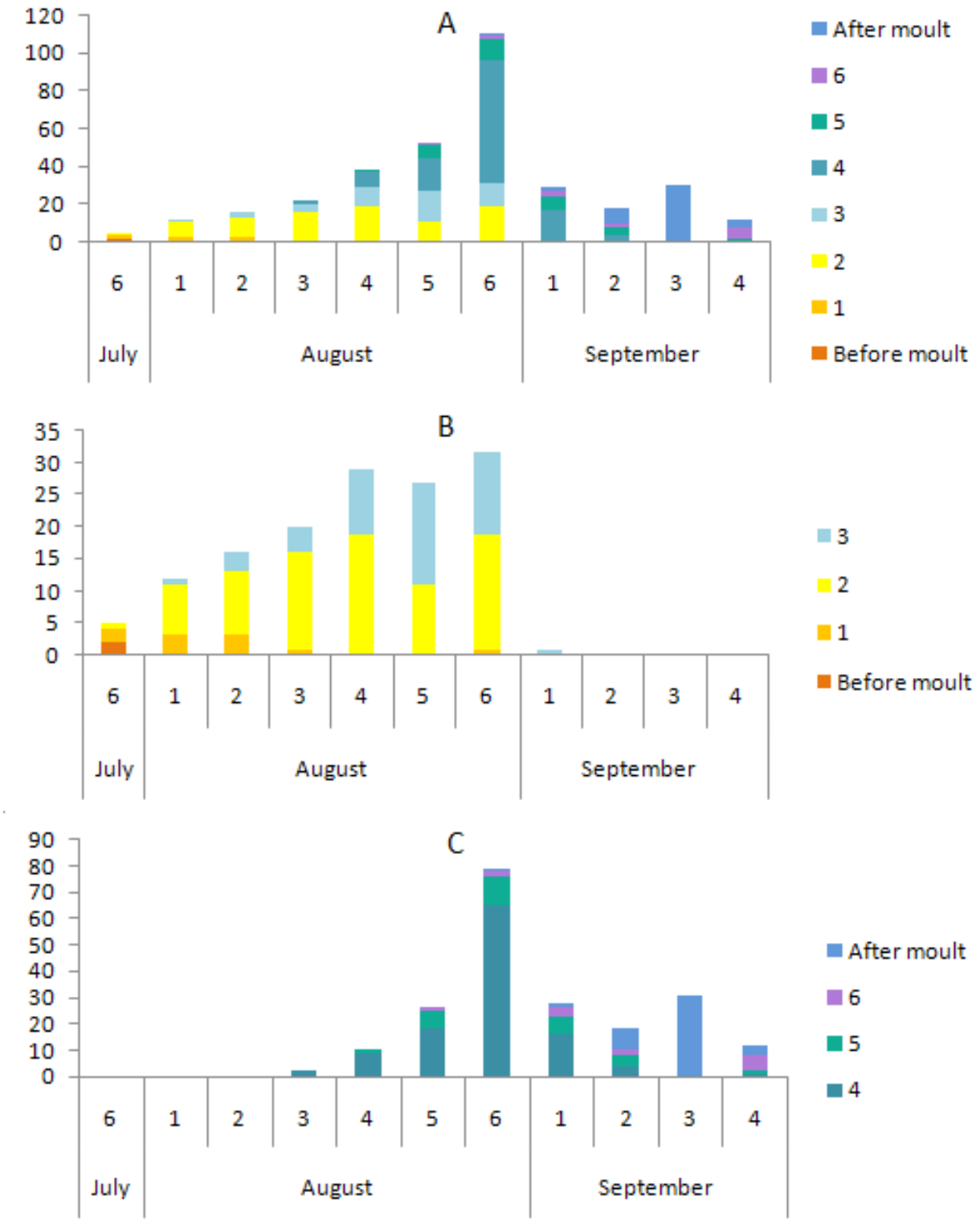


**Fig. 1.** Migration dynamics of Reed Buntings (*Emberiza schoeniclus*) in eastern Fennoscandia during the 2022 summer-autumn season. All captured migrants were first-year birds. Data are presented in 5-day intervals (pentads) showing: *B* — dispersal (pre-moult or moult stages 1–3); *C* — autumn migration (moult stages 4–6 or post-moult)

**Рис. 1.** Миграционная активность тростниковой овсянки в восточной Фенноскандии в летне-осенний сезон, включая всех отловленных птиц в 2022 г. Все мигранты были первого года жизни. На рисунке изображены пятидневки каждого месяца, когда птицы были отловлены. *B* — миграция дисперсия (после линьки или на 1–3 стадиях линьки); *C* — осенняя миграция (4–6 стадии линьки или после ее завершения)

30 August (6th pentad of August) with 79 captures. Across the migration period, juveniles maintained a median body mass of 18.2 ± 1.47 g (range: 13.3–21.8 g).

Analysis of combined data from both study sites revealed distinct temporal peaks in migratory activity. The Luvenga scientific base showed peak activity during 4–5 September, while the meadow site exhibited earlier peak movement from 26–31 August.

Recapture data included 46 individuals (2 adults, 44 juveniles). Both adult recaptures represented transient migrants, being caught only on their initial capture day. Among juveniles, 5 individuals (12.8 % of recaptures) were transient, while the majority showed longer stopover durations. The most frequent recapture intervals were 5 days (12.8 %) and 6 days (15.4 %), with several juveniles remaining in the area for extended periods (12–26 days) and revealing 3–5 recaptures. Recaptured juveniles accounted for 20 % of all juveniles captured in July, 13.8 % in August, and 7.8 % in September.

Juvenile Reed Buntings exhibited stopover behavior in 12.4 % of cases (n = 43), with stopover durations ranging from 1 to 26 days. During the post-fledging dispersal phase, only 7 % of migrants were recaptured, remaining in the area for an average of 6.6 days (range: 1–26 days; median: 6 days). In contrast, stopovers during autumn migration were less frequent (5 %), with an average duration of 7.2 days (range: 1–20 days; median: 5 days). Adults showed an 8% stopover rate, with all the recaptured adults in transit.

Adult autumn migration spanned from 3 August to 17 September (n = 21), with a median body mass of 18.9 ± 1.65 g (range: 16.5–22.1 g).

### *Rustic Bunting*

The migration period for Rustic Buntings (*Emberiza rustica*) spanned from 8 August to 13 September, encompassing individuals of all age groups (Fig. 2A). Our captures included 104 juveniles (40 females, 32 males) and only 2 adults (1 male), as detailed in Table 1. The limited adult sample size precluded meaningful analysis of this age group. Analysis using 90 % confidence intervals revealed the core migration period for juveniles occurred between 18 August and 10 September. Body mass in juveniles averaged 17.5 ± 1.14 g (range: 15.0–20.5 g). The fat index was 0 or 1 in 96 % of the birds.

The juvenile post-fledging dispersal period extended from 8 to 31 August (n = 11). Captured individuals exhibited three distinct moult stages: three at stage 1, five at stage 2, and three at stage 3 (Fig. 2B). Dispersal activity peaked on 25 August (fifth pentad of August) with four captures. Median body mass during dispersal was 17.7 ± 1.49 g (range: 16.1–20.5 g).

The autumn migration phase occurred between 14 August and 19 September (n = 88). Moult stage distribution showed 33 individuals at stage 4, 14 at stage 5, 29 at stage 6, and nine with completed moult (Fig. 2C). Migration peak was on 27–29 August (sixth pentad) with 38 captures. Throughout this period, juveniles maintained a median body mass of 17.5 ± 1.1 g (range: 15.0–20.2 g).

During the study period, ten juvenile birds were recaptured, with all recaptures occurring between 23 August and 7 September. Only one individual was identified as a transient migrant. The most frequent intervals between recaptures were 2 days (22.2 % of cases) and 4 days (22.2 %). Two juveniles were recaptured multiple times (two to three occasions), remaining in the study area for 6 and 12 days, respectively. These recaptured juveniles represented 15.4 % of all birds captured during August and September.

Throughout the entire trapping period, only 15 % (n = 16) of juvenile Rustic Buntings exhibited migratory stopover behavior, with stopover durations varying from 1 to 11 days. Among these, 2 % were observed during the dispersal phase, with a mean stopover duration of 5 days (range: 4–6 days; median: 5 days). During autumn migration, only 13.5 % of migrants made stopovers, remaining in the study area for an average of 3.6 days (range: 1–11 days; median: 3 days).

### *Little Bunting*

The migration of juvenile and adult Little Buntings (*Emberiza pusilla*) was documented from 1 August to 17 September (Fig. 3). We captured 31 juveniles (1 female, 2 males) and 2 adults (1 female) during this period (Table 1). Analysis using 90 % confidence intervals revealed the core

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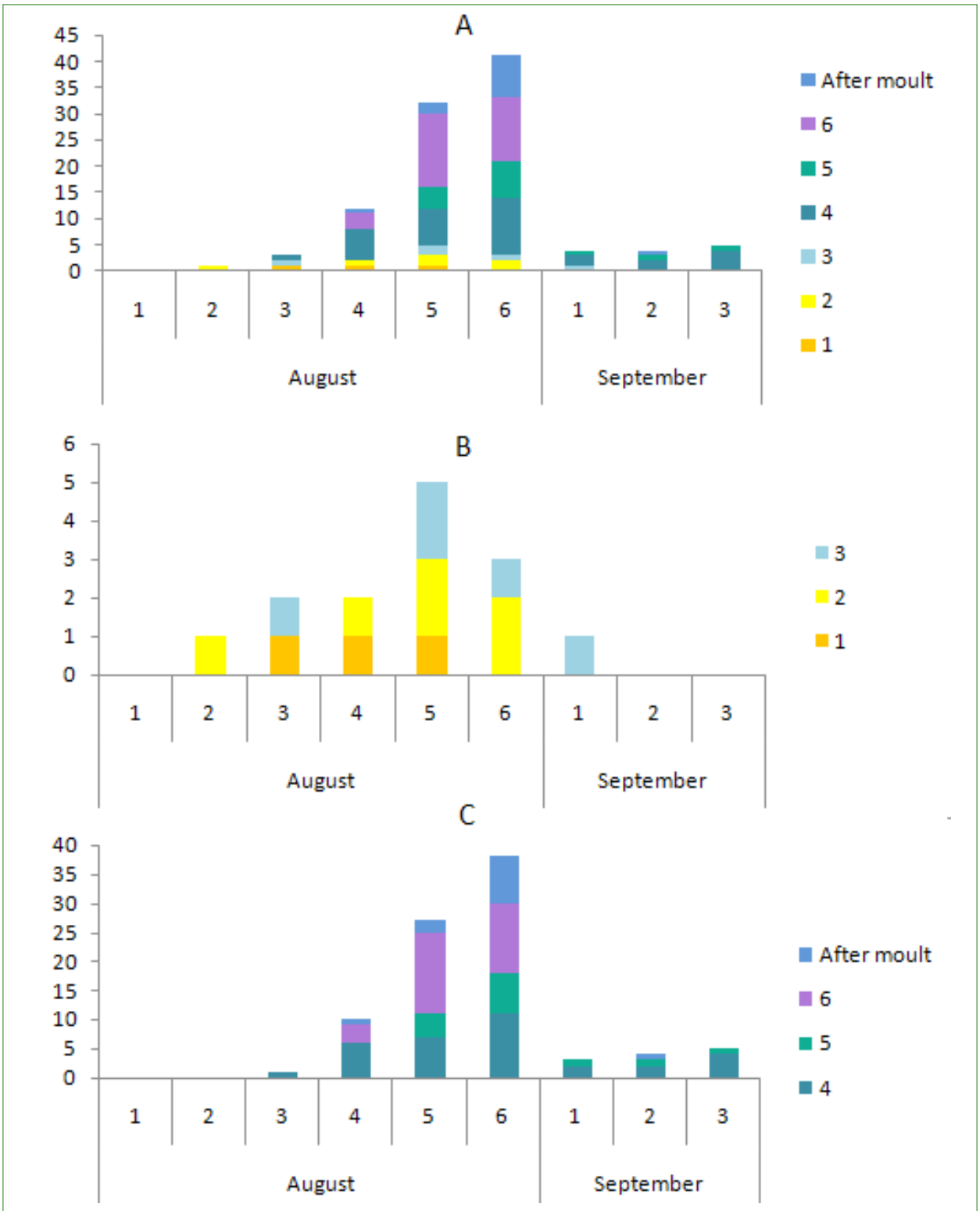


**Fig. 2.** Migration dynamics of Rustic Buntings (*Emberiza rustica*) in eastern Fennoscandia during the 2022 summer-autumn season. All captured migrants were first-year birds. Data are presented in 5-day intervals (pentads) showing: *B* — dispersal (pre-moult or moult stages 1–3); *C* — autumn migration (moult stages 4–6 or post-moult)

**Рис. 2.** Миграционная активность овсянки-ремеза в восточной Фенноскандии в летне-осенний сезон, включая всех отловленных птиц в 2022 г. Все мигранты были первого года жизни. На рисунке изображены пятидневки каждого месяца, когда птицы были отловлены. *B* — миграция дисперсия (после линьки или на 1–3 стадиях линьки); *C* — осенняя миграция (4–6 стадии линьки или после ее завершения)

migration period for juveniles occurred between 5 and 25 August. Juvenile body mass averaged 14.1 ± 1.36 g (range: 12.5–19.1 g) across the study period. The limited adult sample size prevented meaningful analysis for this age group. All juveniles exhibited fat scores of 0 or 1.

The juvenile post-fledging dispersal migration occurred from 1 to 21 August (n = 7). Among these birds, one was at moult stage 1, four at stage 2, and two at stage 3. The autumn post-moulting migration took place from 9 to 25 August (n = 22). Of these, 18 individuals were at moult stage 4, three at stage 5, and one at stage 6. The migration peak occurred on 15 August (fourth pentad of August), with ten individuals captured. The median body mass was 14.2 ± 2.04 g (range: 12.8–19.1 g) during dispersal and 14.06 ± 1.09 g (range: 12.5–17.7 g) during autumn migration. In total, two juveniles were recaptured between 9 and 19 August.

## Discussion

The studied bunting species face temporal constraints during both reproduction and migration phases. The dispersal (post-fledging) and autumn (post-moulting) migrations of juvenile birds differ in their timing. The migratory patterns of Reed Buntings — short-distance migrants wintering in continental Europe — differ markedly from those of Rustic and Little Buntings, which winter in Asia. Specifically, Reed Buntings exhibited longer, less temporally overlapping migratory periods compared to their Asian-wintering congeners. This extended migration duration in Reed Buntings likely reflects their short-distance migration strategy. In the southern Kola Peninsula, Reed Buntings initiate migration earlier and terminate later than both Rustic and Little Buntings (Fig. 1). These findings align with studies of *Emberiza* species in the Russian Far East, where short-distance migrants similarly displayed later migration onset but prolonged duration (Wobker et al. 2021).

Reed Buntings were captured more often than the other studied species, with capture rates 3.34 times greater than Rustic Buntings and 11.6 times greater than Little Buntings. This aligns with existing literature that describes the Reed Bunting as the most abundant bunting species in the region (Bianki et al. 1993; Khlebosolov et al. 2007; Polikarpova 2018). Our findings indicate that Reed Buntings ringed in the southern Kola Peninsula were in the initial stages of autumn migra-

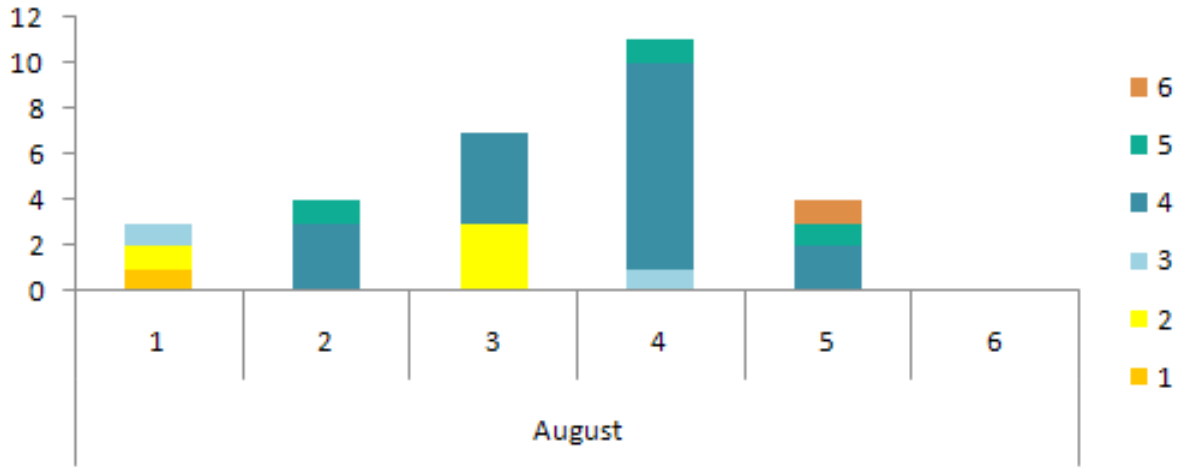


**Fig. 3.** Migration dynamics of Little Buntings (*Emberiza pusilla*) in eastern Fennoscandia during the 2022 summer-autumn season. All captured migrants were first-year birds. Data are presented in 5-day intervals (pentads) showing: *B* — dispersal (pre-moult or moult stages 1–3); *C* — autumn migration (moult stages 4–6 or post-moult)

**Рис. 3.** Миграционная активность малой овсянки в восточной Фенноскандии в летне-осенний сезон, включая всех отловленных птиц в 2022 г. Все мигранты были первого года жизни. На рисунке изображены пятидневки каждого месяца, когда птицы были отловлены. *B* — миграция дисперсия (после линьки или на 1–3 стадиях линьки); *C* — осенняя миграция (4–6 стадии линьки или после ее завершения)

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**Table 2**

**Numbers of migrants in dispersal and autumn migration, and the duration of their migration stopovers in eastern Fennoscandia**

**Таблица 2**

**Численность мигрантов во время дисперсии и осенней миграции и продолжительность их миграционных остановок в восточной Фенноскандии**

| | Reed Bunting | | Rustic Bunting | | Little Bunting | |
|---|---|---|---|---|---|---|
| | Dispersion | Autumn migration | Dispersion | Autumn migration | Dispersion | Autumn migration |
| Total number of migrants (%) | 142 (40.8 %) | 206 (59.2 %) | 14 (13.5 %) | 88 (84.6 %) | 7 (23.3 %) | 22 (73.3 %) |
| Number of birds on the migration stopover | 22 | 18 | 2 | 14 | - | 2 |
| Average stopover duration | 6,6 | 7.2 | 5 | 3.6 | - | 1 |
| Median stopover duration | 6 | 5 | 5 | 3 | - | 1 |

tion when captured. This is evidenced by the predominance of juveniles at moult stage 4 (55.8 % of captures), which corresponds to the onset of active movement toward wintering grounds according to (Rymkevich 1990; Panov 2011; Noskov et al. 2020). The earlier initiation of dispersal observed in Reed Buntings compared to their congeners suggests that the southern Kola Peninsula may serve as a primary departure area for this species' autumn migration.

The autumn migration of adult Reed Buntings, compared to juveniles, is marked by both later initiation and earlier completion. This compressed migration window in adults likely reflects their adaptation to local conditions and earlier initiation of migration (Payevsky 2012; Kiat, Izhaki 2016). Additionally, adult Reed Buntings initiate migration earlier than juveniles in both southern Fennoscandia (Noskov et al. 2020) and the Russian Far East (Wobker et al. 2021; Bozó et al. 2022).

Wobker et al. (Wobker et al. 2021) demonstrated that migration distance shapes autumn migration phenology. Our findings support this conclusion, revealing significantly greater temporal overlap between dispersal and autumn migration phases in the long-distance migrant Asian buntings (Rustic and Little Buntings) compared to the European-wintering Reed Bunting. This overlap is likely due to the substantial time constraints imposed by their approximately 7,000 km migration route between breeding and wintering areas.

Some Buntings made stopovers in the southern Kola Peninsula, with stopover behaviour varying significantly among the species. During post-moult autumn migration, Reed Buntings exhibited longer average stopover durations than Rustic Buntings (Table 2). As a short-distance migrant with relatively proximate wintering grounds, Reed Buntings' extended stopovers may facilitate a more prolonged overall migration period compared to the Asian-wintering Rustic Bunting. A similar pattern has been observed among buntings in the Russian Far East (Collet, Heim 2022) and other short-distance migrants (Wobker et al. 2021).

The autumn post-moult migration likely incorporates individuals from more northern breeding populations whose migration routes intersect the southern Kola Peninsula. This may account for the observed disparities in migrant proportions across species. We hypothesize that the majority of Rustic and Little Buntings breed in different parts of the peninsula. This assumption is supported by the dif-

ferential ratios between dispersing local birds and autumn migrants: Rustic Buntings showed a 6.7-fold increase in autumn migrants, Little Buntings 3.1-fold, and Reed Buntings 1.45-fold.

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