CHARACTERISTICS OF VISIBLE AUTUMN MIGRATIONS OF THE DUNNOCK
PRUNELLA MODULARIS (LINNAEUS, 1758) IN NATIONAL PARK “PRYPIAT-STOKHID” IN 2012–2017

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The aim. The main purpose of the study was to find out the peculiarities of autumn migrations of birds, in particular such little-studied species as the Dunnock. This is necessary for the development and implementation of a management plan in the National Park for a whole complexes of migratory birds and separate species, first of all rare or small in number quantity.

Materials and methods. Our research was conducted at the Prypiat River near Svalovychi village in Liubeshiv district, Volyn region of Ukraine in September and October 2012–2017. Observations were performed visually, starting in the morning half an hour before sunrise and ending in the evening half an hour after sunset (all hours of the light part of a day, without interruption). The light part of a day was divided into hours of observations, taking into the daily changes of sunrise and sunset. Flight altitude was determined visually, and flight directions – by 8 rhumbs.

Results. There were 2124 individuals of the Dunnock counted during the study of visible autumn migration birds at one observation point in 2012–2017. The most bird migrated in flocks, but a significant part of them flew alone. The most numerous migrants this species were in small flocks – 2–5 individuals (89.9 % of all counted birds in flocks). There are from 2 to 38 individuals in one flock, on average – 3.2±0.15 individuals. The main passage lasted from the 2nd decade of September to the middle of the 2nd decade of October. The majority of them flew in the morning, in the first 3 hours of observations (75.5–83.5 % of all counted birds in different years, in average 79.6 %). The majority birds of this species were observed in flight within altitudes between 30 and 40 m (59.4 %) and the predominant direction of flight was W (52.4 %) and some less – SW (45.4 %).

Conclusions. According to the results of 6-years research, the peculiarities of visible autumn migrations of the Dunnock have been clarified (the main passage – the 2nd decade of September – middle of the 2nd decade of October, majority of birds flew in the first 3 hours of observations, used altitudes between 30 and 40 m and the W and SW directions of passage). The results of our research are the basis for the further study of this species, planning and implementation of conservation measures for birds in the National Park “Prypiat-Stokhid”. The obtained data are also a supplement to the state of study of this species in Ukraine

Keywords: birds, Dunnock, visible autumn migrations, characteristics, National Park “Prypiat-Stokhid”

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1. Introduction

There are Dunnock Prunella modularis (Linnaeus, 1758) nests in the Carpathians and the Crimean Mountains mainly, occasionally in the northern region of Ukrainian Polissia [1]. This species is possibly breeding (breeding not confirmed) and was considered rare during migrations in National Park “Prypiat-Stokhid”. The Dunnock is little-studies species of bird not only our National Park or West Polissia region, but also in Ukraine in general. Only single birds were observed during breeding season and not annually in National Park. Therefore, the main information about this species was collected during the migration period, in particular during the study of visible autumn migrations of birds.

This information is necessary for the development and implementation of a management plan in the National Park for a whole complexes of migratory birds and separate species, first of all rare or few numerous.

2. Literature review

The Dunock is rare breeding, few numerous migratory and smaller-studied bird species in the National Park “Prypiat-Stokhid” and the NW of Ukraine generally. There were no publications about autumn migrations of this species and other bird species from the territory of this National Park before its creation in 2007. The study of visible autumn migration of birds in the National Park began in 2012 and lasted 6 years. The first results of our study of visible autumn migrations of birds in National Park were published in 2014 [2] and last – in 2017 [3]. These publications provide annual data and peculiarities of autumn migrations of birds (analysis by bird orders and some families and species, its counts, observation hours, height and direction of the passage). Migrations of this species have been studied by different researches in Ukraine but they mostly concerned the phenology of migrations [4, 5]. In recent years, not only migrations of birds are studied (time, directions and height of passage [6, 7], morphometric data of birds [8], change of bird plumage during migration and identification of it age) [9] and biometrical differentiation [10], but also applied directions of research of migratory birds are being developed. Thus, in particular, studies are conducted related to the influence of wind power plant [11, 12] or possible
impact due to possibility of its construction on migratory
birds [13] and influence of geomagnetic field on migrato-y activity of birds [14]. Migrations of the Dunnock as
well as other species of birds have certain peculiarities
(begining and ending of the passage, intensity, height
and direction of migration) in a separate area. Therefore,
their study is important for the development and imple-
mentation of measures to protect their migration ways in
national parks and other protected area.

3. The aim and objectives of the research
The aim of the research is to study the peculiarities
of visible autumn migrations of the Dunnock, to de-
termine the importance of the area for the protection
of its migration ways and to supplement the data on the
study of the species.
To achieve this aim, the following objectives are
identified and solved:
1) to find out the main peculiarities of visible au-
tumn migrations (dynamics of flight during the light part
of the day, altitude and direction);
2) estimate the number of migratory birds and dis-
tribution of birds in migratory flocks;
3) determine the main period of migration of this
species.

4. Materials and methods of the research
The research were conducted on the territory of
National Park “Prypiat-Stokhid” at left (northern) bank
of the Prypiat River near Svalovychi village in Liubeshiv
district, Volyn region of Ukraine (N 51°52’ E 25°39’)
during the part of September until the beginning of the
end of 2nd decade of October 2012-2017. The number of
observation days varied in different years: 4-12.X,
22.IX-20.2012, 09.IX-10.X.2013, 22.IX-19.X.2014,
21.IX-20.X.2015, 19.IX-19.X.2016 and 18.IX-17.X.2017.
Visible autumn migrations were studied according
to conventional method [15, 16] with some of our chang-
es and additions [2, 3, 17–19]. Migratory birds were ob-
served visually, starting in the morning half an hour be-
fore sunrise and ending in the evening half hour after
sunset (all hours of the light part of a day, without inter-
ruption). The width of the accounting corridor for these
birds was 200 m (100 m to the left and right of the obser-
vation point). The light part of a day was divided into
hour of observations (morning and day observation
hours – No. 1–11 and evening observation hours – No. 2
and No. 1), taking into the daily changes of sunrise and
sunset (observation time decreased daily by 1.5–2 min).
All observation hours were complete (a full hour), except
last before evening hour (No. 11 – on beginning observa-
tions in the September and No. 10 – on ending observa-
tions in the October) which was incomplete (less or more
than 1 hour). Flight altitude was determined visually, and
flight directions – by 8 r humbs, taking into account the
experience of other researchers [16]. All data on the
number of account birds of each species, altitude and di-
rection on their flight during the observation hour were
recorded in a notebook. Species were determined visual-
ly and by voice. The binoculars were used during observa-
tions of migratory birds. The photographing was some-
times used to count the number of birds in large flocks
and to identify species. In addition, the time of precipita-
tion and wind directions were registered in observation
hours. The weather data from the Liubeshiv meteorologi-
cal station was used and analysed [2, 3, 17–19].
A total of 1980 hours were spent on studying of
visible autumn migrations of birds in 2012–2017 at a sta-
tionary point near Svalovychi village in National Park
“Prypiat-Stokhid”.
Calculation and verification of data were per-
formed in the program Microsoft Office Excel 2003.
Used the conventional methods of statistical data pro-
cessing – determined the error of the mean with an accu-
racuy of 0.01 [20].

5. Research results
There were 2124 individuals of the Dunnock
counted during the study of visible autumn migration of
birds in 2012–2017 (Table 1).
There were different numbers of migratory birds
in different years (the most was counted in 2014 and the
least in 2013). The most bird migrated in flocks, but a
significant part of them flew alone (Table 1), which is
typical for this species [21]. For the analysis of autumn
migrations of the Dunnock, the total of birds counted for
2012–2017 was used.
The distribution of the number of birds in flocks
during visible autumn migrations in 2012-2017 is shown
in Table 2.

| Indexes       | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | Total |
|---------------|------|------|------|------|------|------|-------|
| Individuals   | 329  | 270  | 591  | 249  | 387  | 298  | 2124  |
| Birds in flocks (%) | 58.7 | 54.1 | 60.9 | 53.8 | 71.3 | 72.2 | 62.3  |
| Single birds (%) | 41.3 | 45.9 | 39.1 | 46.2 | 28.7 | 27.8 | 37.7  |
Table 2

| Year | Flock size (number of flocks / birds), % | Total of birds in flock (limit) | Average number of birds in flock, (limit) |
|------|----------------------------------------|---------------------------------|------------------------------------------|
|      | 2–5 | 6–10 | 11–15 | 16–20 | >20 | Total / Total of birds |
| 2012 | 85.7 | 59.6 | 8.9  | 19.7  | 9.7 | 20.7 | 5.4 | 19.7 | 56 | 3.4±1.30 | (2–12) |
| 2013 | 87.5 | 58.2 | 5.0  | 16.4  | 16.4 | 15.1 | 2.5 | 15.1 | 40 | 3.6±1.00 | (2–22) |
| 2014 | 88.7 | 65.6 | 7.6  | 9.7   | 9.7  | 6.1  | 0.9 | 6.1  | 106 | 3.6±0.20 | (2–22) |
| 2015 | 96.2 | 88.1 | 3.8  | 11.9  | 11.9 | –    | –   | –    | 53  | 2.5±0.75 | (2–9)  |
| 2016 | 86.7 | 58.3 | 9.3  | 9.1   | 9.1  | –    | –   | –    | 75  | 3.7±0.75 | (2–38) |
| 2017 | 94.5 | 79.1 | 2.7  | 7.4   | 7.4  | –    | 1.4 | 7.9  | 74  | 2.9±0.20 | (2–17) |
| Total| 89.9 | 66.8 | 6.4  | 15.6  | 15.6 | 10.1 | 0.3 | 1.3  | 0.7 | 404 | 3.2±0.15 | (2–38) |

The most numerous migrants this species were in small flocks – 2–5 individuals (in average 89.9 % of all counted birds in flocks). A small number of flocks with more than 5 birds were observed, and only a few flocks contained more than 20 individuals. A total of 404 flocks of the Dunnock were registered, in which 1324 birds counted. There were from 2 to 38 individuals in one flock, on average – 3.2±0.15 individuals (Table 2).

Visible migrations of birds were analysed according to observation hours during the light part of a day, altitude and flight directions. Without knowledge of these peculiarities [16], it is not possible to plan and implement measures the management for the protection of migratory birds.

Dynamics of the number of the Dunnock counted for the autumn passage in 2012–2017 is shown on Fig. 1.

The flight of this species was observed from the middle of the 1st decade of September (only solitary birds flew) to the end of the 2nd decade of October, and the main passage lasted from the 2nd decade of September to the middle of the 2nd decade of October. The greatest intensity of its flight was in the 3rd decade of September – 1st decade of October (Fig. 1). These flight times of the Dunnock are generally similar to those obtained in other regions of Ukraine [1, 13] and slightly different (earlier) than in the south, as in Hungary in particular [6].

The main influence on the intensity of migration birds had air temperature and precipitation, less – power and direction of the wind. In particular, the increase in the number of migratory these birds coincided with maximum increase the air temperature mainly (September 2012, September–October 2015, partly in October 2013 and 2016) and with a sharp drop in the air temperature sometimes below +5 °C (October 2012 and 2017). Passage of the Dunnock not observed during strong winds (more then 7–8 m/sec) and heavy rainfall.

Dynamics of passage during light part of a day is one of the most important characteristics of bird migration (Table 3).

The Dunnock is nocturnal migrant. The peak of its migrations occurs on the last night hours before sunrise [7]. In the early morning hours, these birds complete the night flight [1]. Therefore, during the visible autumn migrations, majority of them flew in the morning, in the first 3 hours of observations (75.5–83.5 % of all counted birds in different years, in average 79.6 %). Most birds flew for the second hour of observations (Table 3). A small number of there birds flew in other hours of observations.

Bird flight altitude is one of the important characteristics of bird migration also (Table 4).

As can be seen from table 4, prevalent majority of species flew at altitudes of 31–40 m (44.2–82.1 % of all counted birds in different years, average 59.4 %). Migratory birds were flying at higher altitudes when accompanying and cross winds prevailed. Some migratory birds flew at altitude where species could not be identified. Therefore, their total number was usually greater than the number of birds counted, as indicated by other researches [16].

Bird flight directions are one of the important characteristics of bird migration also (Table 5).
Fig. 1. Dynamics of the number of Dunnocks on the autumn passage in 2012–2017

Table 3

Dynamics on passage of the Dunnock during light part of a day in autumn 2012–2017

| Year | Total number of birds (%) that flew during one observation hours (morning and day – No. 1–11, evening – No. 2–1) |
|------|---------------------------------------------------------------------------------------------------------------|
|      | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 2       | 1       |
| 2012 | 29.8    | 35.0    | 14.9    | 8.5     | 7.6     | 3.0     | 0.6     | 0.3     | 0.3     | –       | –       | –       | –       |
| 2013 | 19.6    | 32.2    | 26.3    | 10.0    | 9.3     | 2.2     | 0.4     | –       | –       | –       | –       | –       | –       |
| 2014 | 20.8    | 34.0    | 26.2    | 13.0    | 3.9     | 1.9     | –       | –       | –       | 0.2     | –       | –       | –       |
| 2015 | 25.3    | 34.1    | 16.1    | 9.2     | 11.7    | 3.6     | –       | –       | –       | –       | –       | –       | –       |
| 2016 | 30.5    | 24.8    | 22.7    | 8.0     | 11.9    | 1.3     | 0.8     | –       | –       | –       | –       | –       | –       |
| 2017 | 32.9    | 36.9    | 13.7    | 10.1    | 3.7     | 2.0     | 0.7     | –       | –       | –       | –       | –       | –       |
| Total | 26.0    | 32.7    | 20.9    | 10.2    | 7.5     | 2.2     | 0.4     | <0.1    | <0.1    | –       | <0.1    | –       | –       |
Table 4

| Year | 1–10 m | 11–20 m | 21–30 m | 31–40 m | 41–50 m | >50 m |
|------|--------|---------|---------|---------|---------|-------|
| 2012 | –      | –       | 4.2     | 82.1    | 12.2    | 1.5   |
| 2013 | –      | –       | 8.9     | 55.5    | 22.6    | 13.0  |
| 2014 | –      | 1.7     | 34.7    | 61.6    | 2.0     | –     |
| 2015 | 3.6    | 11.3    | 25.3    | 44.2    | 9.2     | 6.4   |
| 2016 | –      | –       | 20.4    | 59.7    | 18.9    | 1.0   |
| 2017 | –      | –       | 20.8    | 46.0    | 26.2    | 7.0   |
| Total| 0.4    | 1.8     | 21.1    | 59.4    | 13.5    | 3.8   |

Table 5

| Species | Direction of the passage (%) |
|---------|------------------------------|
|         | W | SW | S | SE | E |
| 2012    | 72.9 | 27.1 | – | – | – |
| 2013    | 18.5 | 81.5 | – | – | – |
| 2014    | 58.2 | 41.8 | – | – | – |
| 2015    | 67.1 | 30.1 | 2.8 | – | – |
| 2016    | 53.0 | 45.7 | 0.8 | 0.5 | – |
| 2017    | 46.7 | 52.0 | 1.3 | – | – |
| Total   | 53.9 | 45.4 | 0.6 | 0.1 | – |

Almost all birds migrated between the western and south-western direction. Slightly more than half of all counted birds flew to the west (on average 53.9 %) and slightly less than half – to the southwest (on average 45.4 %). Although in some years most of them flew in south-western direction (2013 and 2017).

Migratory birds used the accompanying and side winds of varying strength often and headwinds sometimes, but less power.

6. Discussion of the research results

The visible autumn migrations of the Dunnock were first studied in the park and have certain features. Long-term study of bird migrations (2012–2017) allowed to more objectively and exactly to determine the peculiarities of their migrations, which is important for understanding natural processes, planning and implementing measures to protect migratory routes.

According to our observations of migrations during daylight hours made it possible to establish the intensity, altitude and direction of flight. In particular, it was found that most of these birds flew in the morning, in the first three hours of observations, which is similar to the results of other researchers [1, 7]. But the species is mainly a nocturnal migrant and most birds fly before sunrise, which can be determined using other research methods only [6]. Therefore, our studies did not give a complete picture of the migration of the species, particularly at night. The total number of the Dunnock can be from several times to several tens of times greater. The most birds migrated in flocks (62.3 % of all counted birds), but a significant part of them flew alone. Most of these birds flew at altitudes between 30 and 40 m in National Park “Prypiat-Stokhid”, and in Ukrainian Carpathians the flight of their passage is slightly lower [13]. The period of the main autumn flight of the species in the National Park is similar in other areas of Ukraine [1, 13] and partly in Hungary [6, 8].

Study limitations. The study of visible migrations of birds requires a lot of time. One observer cannot cover a longer period of study (both light and dark part of a day) throughout the fall and spring and over large areas. Therefore, the full picture of the migrating Dunnock has not been fully studied.

Prospects for further research. The study of the visible autumn migrations of the Dunnock contributed to the addition of data on this little-studied species in Ukraine. The materials of our research are the basis for further study of visible autumn migrations of this species, possibly with a combination of other research methods and the preparation of recommendations for the protection of migratory routes of birds in general.

7. Conclusions

1. The peculiarities of visible autumn migrations of the Dunnock have been clarified generally: majority of them flew in the morning, in the first 3 hours of observations (79.6 % of all counted birds), within altitudes between 30 and 40 m (59.4 %) and the predominant direction of flight were W (53.9 %) and some less – SW.

2. 270–591 individuals of these birds were counted during visible autumn migrations in different years, and since this species is mainly a nocturnal migrant, its total number can be from several times to several tens of times greater.

3. The main passage lasted from the 2nd decade of September to the middle of the 2nd decade of October. The results of our research are the basis for the further study of this species, planning and implementation of
conservation measures for birds in the National Park “Prypiat-Stokhid”. The obtained data are also a supplement to the state of study of this species in Ukraine.

Conflicts of interest
The authors declare that they have no conflicts of interest.

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