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RUFF, *PHILOMACHUS PUGNAX* (AVES, CHARADRIIFORMES), MIGRATION IN WESTERN UKRAINE

Iu. Strus

West-Ukrainian ornithological station
Grushevsky str., 4, Lviv, 79005 Ukraine
E-mail: yurastrus@gmail.com

Ruff, *Philomachus pugnax* (Aves, Charadriiformes), Migration in Western Ukraine. Strus Iu. — In the paper we discuss migration dynamics, biometry and stopover ecology of Ruff (*Philomachus pugnax* Linnaeus, 1758) in the Cholgini ornithological reserve. Also the observations, made in other regions of the western Ukraine, were used in the analysis. The base materials for this paper were collected during 1995–2012 by West-Ukrainian ornithological station, by conducting regular bird counts, ringing and taking measurements of migrating waders using standard methods. During Ruff spring migration two major waves of passage occured: the first one is from the end of March till early April and the second — from the end of April to the end of May. The average number of a flock was equal 12 individuals. In the autumn passage dynamics of two waves can also be seen. The first wave is observed in July with the peak in the middle of month. Second wave occurs in August and in first two decades of September, with maximum bird numbers in the end of August. The passage dynamic of Ruff in the Cholgini reserve is very similar to the dynamic in other continental staging sites. Significant difference was found in the wing length between the adult and juvenile Ruffs. The potential flight range of juvenile females was 3236 km, juvenile males — 2380 km, adult females — 2740 km.

K e y w o r d s: waders, migration, *Philomachus pugnax,* biometry.

Миграции турухтана, *Philomachus pugnax* (Aves, Charadriiformes), на западе Украины. Струс Ю. М. — Рассматриваются динамика миграции, биометрия и особенности пребывания на месте миграционной остановки турухтана (*Philomachus pugnax* Linnaeus, 1758) на примере орнитологического заказника «Чолгинский». Также анализируются данные, полученные во время наблюдений на других территориях запада Украины. Базовый материал, лежащий в основе работы, собран путём проведения регулярных учётов птиц, кольцевания и промеров биометрических параметров общепринятыми методами. Во время весенней миграции турухтана выявлено две основных волны пролёта: первая приходится на период от конца марта до начала апреля, вторая — на конец апреля — конец мая. Средняя численность скоплений турухтана в заказнике весной составляла 12 особей. В динамике осеннего пролёта можно также выделить две волны. Первая в июле, с пиком численности в средине месяца. Вторая волна в августе, а также в первых двух декадах сентября с максимальной численностью птиц в конце августа. Динамика миграции турухтана в заказнике «Чолгинский» в общем сходна с таковой в других пунктах остановки. Обнаружены достоверно меньшие длина крыла и масса молодых самок относительно взрослых. Потенциальная дальность полёта турухтанов для молодых птиц рассчитана как 3236 км, молодых самцов — 2380 км, взрослых самок — 2740 км.

К л ю ч е в ы е с л о в а: кулики, миграция, *Philomachus pugnax,* биометрия.

Introduction

Environmental transformations that had happened in the western Ukraine during XIX–XX centuries — first of all, drainage of huge areas of wet meadows and bogs — caused a major decline of the breeding wader populations and extinction of some species as local breeders. One of those species is Ruff, *Philomachus pugnax* Linnaeus, 1758 — wader, which up to the middle of XX century was breeding in the Polissia region and in the XIX century even in the vicinity of Lviv (Strautman, 1963). Ruff numbers declined also in scale of Eurasia, especially in the temperate climate zone. Main breeding grounds of Ruff are now located in Arctic (Rakhimberdiev et al., 2011). Now on the Ukrainian territory this species has status only as a migrating bird (Fesenko, Bokotey, 2002).

Besides of changes in the breeding distribution, there were also shifts in the migration routes of Ruffs, namely, shift of the main flyways to the east, because of changes in the agricultural practice in the western European countries (Rakhimberdiev et al., 2011). Significant increase of the migrating Ruffs numbers took place in Belarus (unpublished data of Karlionova in Meissner et al., 2011). Currently, great numbers of Ruffs also stays during the spring migration on the west-Ukrainian stopover sites. Changes of Ruff flyways happened in circumstances of stable breeding population numbers, indicating flyways redistribution but not population numbers tendencies (Rakhimberdiev et al., 2011).

We think that increasing role of the east European habitats as stopovers for migrating Ruffs makes studying of this species' migration important.

Until now, there were no detailed studies of Ruff migration in western Ukraine. Some aspects of the species migration were published previously in faunistic reviews and in some articles on birds migration phenology (Strautman, 1963; Khymyn, 1990; Novak, 1999; and others). Papers about migration dynamic, biometry and stopover ecology of Ruffs were not published yet. The aim of this paper is to fill some gaps in knowledge about the migration of Ruffs in western Ukraine.

Material and methods

We studied Ruff migration during 1995–2012 mainly on the territory of the Cholgini ornithological reserve (49°55' N, 23°26' E), which is situated in Yavorivskyi district of Lviv region near Yavoriv town. The reserve comprises 820 ha of open habitats including two shallow ponds associated with a former sulphur extraction plant.

Before 2000, the reserve was covered by meadow vegetation and water, but in recent years it has become extensively overgrown by *Calamagrostis* sp., willows and reeds. This has had a negative effect of the variety and number of waders using the reserve. Detailed description of the reserve and succession of vegetation on this territory were published before (Shydlowskiy et al., 2003).

Wader ringing was conducted in the reserve in August during 1995–2012 within work of West-Ukrainian ornithological station. However no waders were ringed in 2006, and in 1999 ringing extended from early July to early September.

Waders were caught using walk-in traps, located in the shallow parts of one of the ponds. The design of the traps was based on W. Meissner (1998). Traps were checked every two hours, from dawn to dusk. In 1995 five traps were deployed, in 1996 and 1997 seven traps. During 1998–2012 the number of traps deployed was fairly constant at 10 ± 2.

Ruffs were aged according to the criteria described by Prater (Prater et al., 1977), and the following measurements were taken: tarsus length (Svensson, 1992), bill to feathering and nalospi (Prater et al., 1977), total head length (THL; Green, 1980) (all to ± 0.1 mm using callipers) and wing length (Evans, 1986) (to ± 1 mm using ruler with end-stop). Body mass (to 1.0 g or 0.1 g using spring or electronic balances accordingly) and fat score (Busse, 2000) were also recorded. We used data from retrapped birds to estimate body mass change, and derive a rough estimate of how long individual birds stopped in the reserve. Primary moult was recorded according to Busse (2000).

The potential flight range of Ruffs departing from the Cholgini Ornithological Reserve was calculated using formula from Castro and Myers (1989) (eq. 1):

$$R = 26.88 \cdot S \cdot L^{1.614} (M_1^{-0.464} - M_2^{-0.464}), \quad (1)$$

where R — potential flight range (km), S — flight speed (km/h), L — wing length (cm), M_1 — lean body mass (*LM*) (g), and M_2 — body mass with fat reserves (g). For these calculations we used flight speed of 60 km/h (Zwarts et al., 1990). Lean body mass (*LM*) was calculated as mass of 10 % of lightest birds.

Also waders were counted on a regular basis during 1995–2012. Counts covered the whole of the autumn migration period of Ruffs in 1995–1999, and in 2010–2012. In most years counts were conducted in August almost every day. Spring migration counts were carried out in 1999, 2002, and 2010–2012.

Count data are presented divided into five day periods called pentads. For each pentad the mean and maximum number of Ruffs is given taking all study years together.

Some additional data on Ruff migration (numbers of concentrations, habitat use) was gathered during expeditions in 2010–2012 along the Sluch valley from Sarny to Veryn in Sarnenskyi and Dubrovytskyi districts of Rivne region and during counts in Prypiat valley in 2012 from Ratne to Lubiaz in Ratnivskyi and Lubeshivskyi districts of Volyn region.

Statistical analyses were carried out using R software (version 3.0.1, R Core Team, 2013). Normality of data distribution was checked by the Shapiro-Wilk test. The significance of differences was tested using t-test or Mann-Whitney test depending on data distribution. Corrections for multiple comparisons were made by p. adjust function using false discovery rate (fdr) procedure.

Results and discussion

Migration dynamics

Ruff is one of the most common and numerous species of waders at migration in the Cholgini reserve and in western Ukraine. It occurs both on spring and autumn passages. On spring migration numbers of the migrating Ruffs are much bigger than in autumn, especially in the flooded valleys of the Polissia rivers. During the expeditions along rivers Pripiat and Sluch we observed huge concentrations of Ruffs. For instance, in April of 2011 flocks up to 2000 individuals were observed in the Sluch valley (our unpublished data). On autumn passage there are no such numbers of staging Ruffs. The same situation occurs in whole continental Europe (Radovic et al., 1999; Wymenga, 1999; Chernichko, Chernichko, 2003).

The earliest observation during spring migration falls on 10.03.1999 (45 individuals), latest one — 26.05.2002 (31 ind.). In the Spring passage dynamic (fig. 1) two waves of a migration occur: the first one in the period from the end of March to early April and the second from the end of April to the end of May. In the middle of April nearly all the birds disappear. The same gap in spring passage was reported by P. Kunysz and J. Hordowski (1992). Average number of the flock in Spring was 12 individuals.

Autumn migration starts in the Cholgini reserve in the second decade of June. The earliest observation was on 18.06.1998 — 2 ind. In autumn passage dynamics two waves can also be seen. The first wave is observed in July with a peak in the middle of the month. The second wave occurs in August and in the first two decades of September, with the maximal numbers in the end of August. The same dynamics is seen on the Hel peninsula (Meissner, Sikora, 1995), in the east Poland (Polakowski, Junievicz, 1998), the south Poland (Kruszyk, Zbroński, 2002). The first wave comprises juvenile and adult birds, second one mainly the juveniles. The latest registration of Ruff in autumn falls on 24.10.2008 — 2 ind.

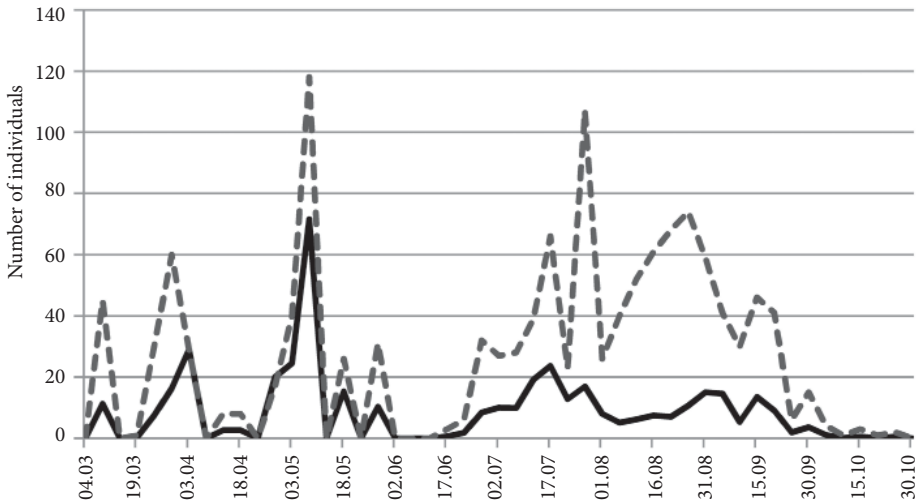

Fig. 1. Migration dynamics of Ruffs in the Cholgini ornithological reserve in 1995–2012 (solid line — mean count in the pentad, dashed line — maximum count).

Рис. 1. Динамика миграции турухтанов в орнитологическом заказнике «Чолгинский» за 1995–2012 гг. (сплошная линия — среднее количество на пентаду, пунктир — максимальное количество).

The average flock of Ruffs in autumn did not exceed 7 birds. The maximum numbers of birds we have counted on: 8.05.2002 (118 ind.), 29.07.1996 (107 ind.), 28.08.1998 (74 ind.), 19.08.2002 (68 ind.). Mean autumn passage date falls on 30 July, 1 quartile — 16 July, 2 quartile — 1 September.

Very similar migration dynamics of Ruff was observed on other European continental staging sites (Kunysz, Hordowski, 1992; Kruszyk, Zbroński, 2002; Polakowski, Juniewicz, 1998).

Biometry

In total for the period 1995–2012, 155 individuals of Ruff were captured. Among them juvenile ♂ — 35, juvenile ♀ — 92, adult ♂ — 5 and adult ♀ — 22.

Distributions of all measurements of females except of the mass were normal (table 1). In juvenile males distributions were normal in case of the total head and the wing length. In adult males all distributions were normal (but note small sample size, n = 5). Between

Table 1. Results of the Shapiro-Wilk test of normality of distribution of measurements

Таблица 1. Результаты проверки нормальности распределения промеров тестом Шапиро-Уилка

Sex	Age	Parameter (W/p)				
		tarsus	bill	THL	wing	mass
♀	ad	0.970 0.712	0.938 0.181	0.936 0.165	0.963 0.543	0.862 0.006
	juv	0.988 0.650	0.981 0.232	0.972 0.059	0.981 0.248	0.952 0.005
♂	ad	0.900 0.411	0.7979 0.078	0.799 0.080	0.872 0.277	0.985 0.959
	juv	0.882 0.005	0.794 0.0001	0.959 0.333	0.959 0.323	0.891 0.010

Note. W — Swhapiro-Wilk criteria; p — significance level.

Table 2. Biometrics of Ruffs caught in the Cholgini ornithological reserve in August 1995–2012

Таблица 2. Биометрические показатели турухтанов, отловленных в орнитологическом заказнике «Чолгинский» в августе 1995–2012 гг.

Sex	Parameter	ad	juv								
		M	σ	Min	Max	n	M	σ	Min	Max	n
♀	Tarsus	42.5	1.23	40	44.6	22	42.3	1.55	38	46	89
	Bill	31.3	1.26	29	33.7	22	31.2	1.25	28	34	89
	Nalospi	24.8	0.84	24.3	25.8	3	24.6	0.87	22.7	26.5	61
	THL	61.8	1.18	58.6	63.6	22	61.7	1.38	56.9	64.8	89
	Wing	160.8	2.37	156	165	22	159.3	2.81	150	165	89
	Tail	54.7	3.79	52	59	3	58.8	4.06	51	67	52
	Mass	107.0	14.51	90	138	22	98.6	12.83	78	142	80
♂	Tarsus	50.4	4.24	46.2	57.3	5	50.7	2.30	46.6	59.6	34
	Bill	35.7	2.73	33.4	40.4	5	35.5	2.82	33.9	43.1	34
	Nalospi	26.5	0.07	26.4	26.5	2	27.9	1.74	25.8	29.3	26
	THL	71.4	2.54	69.4	75.7	5	70.9	1.24	67.4	73.4	34
	Wing	188.0	4.30	181	192	5	190.0	3.10	183	198	34
	Tail	64.0	–	–	–	1	68.2	3.78	62	76	22
	Mass	175.9	18.02	152	200	5	156.2	15.2	138	198	31

Note. M — mean value; σ — standard deviation; min — minimal value; max — maximal value; n — sample size.

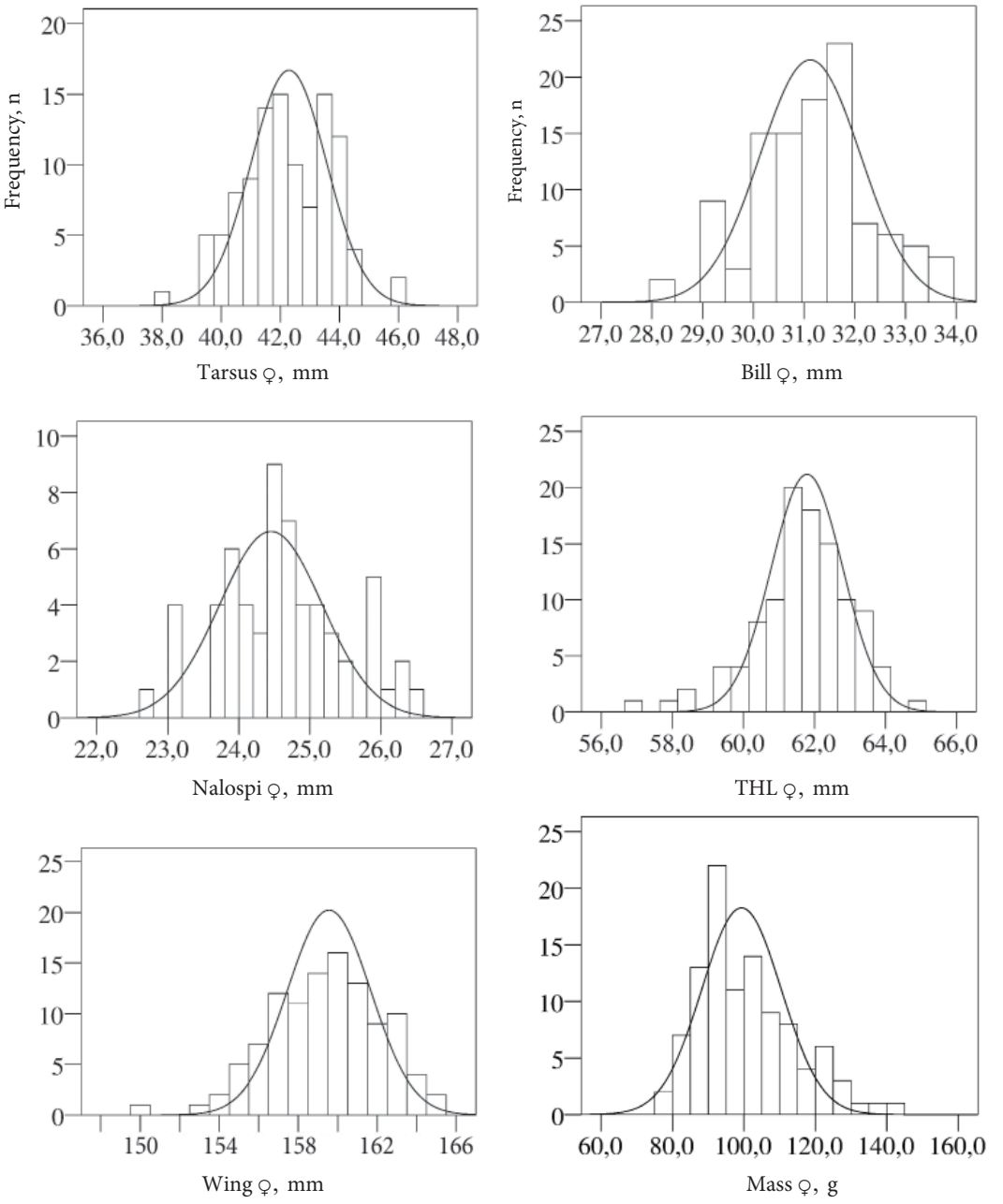

Fig. 2. Distributions of biometrical measurements of female Ruffs caught in the Cholgini ornithological reserve during 1995–2012.

Рис. 2. Распределение биометрических показателей самок турухтана, отловленных в орнитологическом заказнике «Чолгинский» в 1995–2012 гг.

adult and juvenile females significant difference was found only in wing length and mass. Wing length (table 2) of the juvenile females is smaller ($t = -2.98$, $p = 0.025$) but only on 1.8 mm. Such small difference results in almost unimodal distribution of the wing length (fig. 2).

Mass of adult females is bigger than in juveniles (Mann-Whitney test: $W = 1176.5$, $p = 0.029$). In males a significant difference between age groups was not found, but this can be caused by small sample size. A difference in all biometrical parameters between the Sex groups is highly significant ($p < 0.0001$), because in Ruff a sexual dimorphism in a size is known. Males are much larger than females (Prater et al., 1977).

Distributions of all measurements except of tarsus length in females were unimodal (fig. 2) what is consistent with literature data (Meissner, Zięcik, (2005) had reported unimodality in all measurements of Ruffs except of tarsus + toe length).

Length of stay, fat amounts and potential flight range

The average duration of stay was 2.2 days, the maximum — 3 days. But this estimations are based on only 4 recaptures. Moreover, we have previously shown (Strus, Shydlowskiy, 2013) that real length of the stay of waders during a migration can be much longer than it is shown by a recapture data. According to our visual observations, some flocks can stay in the reserve for approximately two weeks. Moreover, it was shown by previous studies that the duration of stay of Ruffs can reach even 23 days (Serra et al., 1990; Bacetti et al., 1998; Verkuil et al., 2010). Four recaptured individuals in the Cholgini reserve had lost the mass with the rate of 1.08 g/day. In literature next mass gain rates in Ruffs are reported: in Britain — 1.87 g/day (Anderson, 1973); in south Belarus 0.39–2.4 g/day (Meissner et al., 2011).

Among the captured birds the mean mass of 10 % of the heaviest juvenile males was 123.7 g. 10 % of the lightest birds had the mass 81.7 g. The mean fat amount of this juvenile males reached 52.3 % of their lean mass. The mass of 10 % of the heaviest adult females was 133.3 g, lightest — 92.3 g, fat amount — 44.4 %. In the juvenile females 123.7 g, 81.2 g and 52.3 % respectively.

With the fat amounts accumulated in the Cholgini reserve Ruffs, if taking into account the flight speed 60 km/h, the potential flight range of the juvenile females equals 3236 km, juvenile males — 2380 km, adult females — 2740 km. Majority of Ruffs ringed in Europe winters in the west and south Africa. Also a lot of birds winter on the European, Atlantic, and Mediterranean coasts (Lebedeva, Dobrynina, 1985; Fransson et al., 2008). According to our calculations of potential flight ranges Ruffs departing from the Cholgini reserve are capable to reach in one flight European Atlantic or Mediterranean costs, or north coast of Africa, but not the South African wintering sites. It is known that in Ruff there is a tendency for females to migrate to Africa and for males to winter in Europe (Gill et al., 1995). Perhaps much shorter potential flight range of juvenile males in comparison to juvenile females can be explained by this phenomenon.

In conclusion we can state that during spring migration numbers of migrating Ruffs in the west Ukraine are much higher than in autumn. In the passage dynamics in spring and in autumn at least two waves of migration occurs. The highest numbers of ruffs in spring occurs during second wave in May and in autumn during July–September although migration finishes in the end of October. According to our calculations fat amounts accumulated by Ruffs in the Cholgini reserve are enough to reach in one flight European Atlantic or Mediterranean costs, or north coast of Africa, but not the South African wintering sites.

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