Waders in agricultural habitats of European Russia

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Analysis of data on the occurence of wader species in various types of agricultural habitats of European Russia shows that 63% of all wader species and 41% of breeding waders in this area inhabit agricultural landscapes. Waders prefer natural meadows, used for hay-harvesting, various kinds of open pastoral habitats, and rice fields (in southern Russia). In recent years many waders have populated other arable lands, especially cereal crops and various types of fallow lands. Due to the ability of waders to use agricultural areas for breeding, some species have expanded northwards in recent decades following an increase in the extent of agricultural areas in the northern part of European Russia. Crude indices of vulnerability for wader species breeding in agricultural areas of European Russia has made it possible to identify three broad groups of species requiring different types of attention from ornithologists and agricultural workers. Species whose occurence on farmland is most important in terms of conservation include: Great Snipe *Gallinago media*, Sociable Plover *Chettusia gregaria*, Collared Pratincole *Glareola pratincola*, Curlew *Numenius arquata*, Stone Curlew *Burhinus oedicnemus* (Group I), with Black-tailed Godwit *Limosa limosa*, Marsh Sandpiper *Tringa stagnalis*, Black-winged Pratincole *Glareola nordmanni*, Lapwing *Vanellus vanellus*, Common Snipe *Gallinago gallinago* and Redshank *Tringa totanus* in Group 2.

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Анализ данных встречаемости видов куликов в разных типах сельскохозяйственных угодий Европейской России показывает, что 63% всех видов куликов и 41% гнездящихся в этом регионе куликов обитает на сельскохозяйственных ландшафтах. Кулики предпочитают естественные луга, используемые под сеноуборкой, разные типы открытых пастбищ и рисовые поля (на юге России). За последние годы многие кулики населили другие пахотные угодья, особенно хлебные поля и разные типы залежей. Из-за способности куликов использовать сельскохозяйственные угодья для гнездования за последние десятилетия некоторые виды расширили свой ареал в северном направлении вслед за расширением сельскохозяйственных районов на Европейском Севере России. Используя грубые показатели уязвимости отдельных видов куликов, гнездящихся в сельскохозяйственных районах Европейской России, стало возможным определить три основные группы видов, нуждающихся в разных типах внимания со стороны орнитологов и сельскохозяйственных работников. К самым важным видам с точки зрения охраны, встречающимся на сельскохозяйственных угодьях, относятся : дупель *Gallinago media*, кречетка *Chettusia gregaria*, лугая тиркушка *Glareola pratincola*, большой кроншнеп *Numenius arquata*, авдотка *Burhinus oedicnemus* (первая группа), и (во второй группе) большой веретенник *Limosa limosa*, поручейник *Tringa stagnatilis*, степная тиркушка *Glareola nordmanni*, чибис *Vanellus vanellus*, обыкновенный бекас *Gallinago gallinago* и травник *Tringa totanus*.

Introduction

The major part of non-forested European Russia is currently used for agriculture. Given the extent of human activities in such areas it is extremely important to evaluate their effect on nature and on birds in particular. For such purposes, however, the necessity of large-scale generalizations concerning species composition, numbers, responses to agricultural activities *etc.* is obvious. Unfortunately no such summary data have yet been published for our country.

In this paper we have made the first attempt to analyze the role of agricultural habitats in supporting populations of waders for European Russia. As waders are typical open-nesting birds, they can be considered as good models for the studies of interrelations between birds and agriculture. Owing to ecological peculiarities of this group, one can observe different effects of agricultural change on birds: whilst some waders suffer from drastic habitat changes and continuous disturbance by human activities, others can benefit from the appearence of new types of open areas which increase ecological possibilities.

Study areas and methods

Extent and typology of agricultural habitats in European Russia

Agricultural habitats occupy approximately half of the whole territory of European Russia and cover in total about 114 m hectares (data for 1986; Kibalchich 1991). They have been traditionally separated by agriculturalists into the following types: arable lands (*c.* 78.5 m ha), hay meadows (*c.* 8.1 m ha) and pastures (*c.* 27.3 m ha). Within arable lands we have separated six different subtypes for this analysis:

- bare fallow - ploughed areas, left unsowed in summer;
- other kinds of fallow lands, such as fields, left for one or more years unploughed after harvesting;
- winter cereals;
- spring cereals;
- rice fields;
- various cultivated crops, such as potatoes, sugar beet, other vegetables, maise, sunflowers *etc.*,
- fields with perennial crops, *i.e.* alfalfa, clover, medical herbs *etc.*

The extent of the first two subtypes (bare fallow and other fallow) in 1986 was 7.98 m ha; all cereal crops (winter and spring cereals with rice) occupied 38.0 m ha with winter cereal being most abundant; various cultivated crops and perennial crops were planted respectively on 22.45 and 9.66 m ha (Kibalchich 1991).

Hay meadows should be currently subdivided into at least two groups, as traditional natural meadows are currently being changed to artificially sown, high-productive leys; consequently, the area of natural meadows has decreased in the latest 30 years by 41.7% (Kibalchich 1991).

With respect to pastures, in the northern parts of European Russia they are represented mostly by intensively grazed tussocky types, while in central and especially southern Russia they are either highly overgrazed dry pastures, or moderately grazed pastures with a medium height of grass-cover.

Figure 1 shows those areas of European Russia where agricultural habitats prevail over other habitat types.

Methods used for wader censuses in agricultural habitats of European Russia

Several traditional methods have been used in Russia for bird censuses including wader counts: 1) censuses of regular or temporary routes with futher calculations to give densities values. The most widespread methods are those of Ravkin (1967) and Naumov (1963) with some later modifications. Although these methods have been worked out mostly for forest birds, they are widely used in many wader counts; 2) counts along linear routes, often made in studies of waders on river-banks or other coastal sites; 3) censuses of regular or temporary plots (including regular transects) which we consider to be the only acceptable method for wader studies.

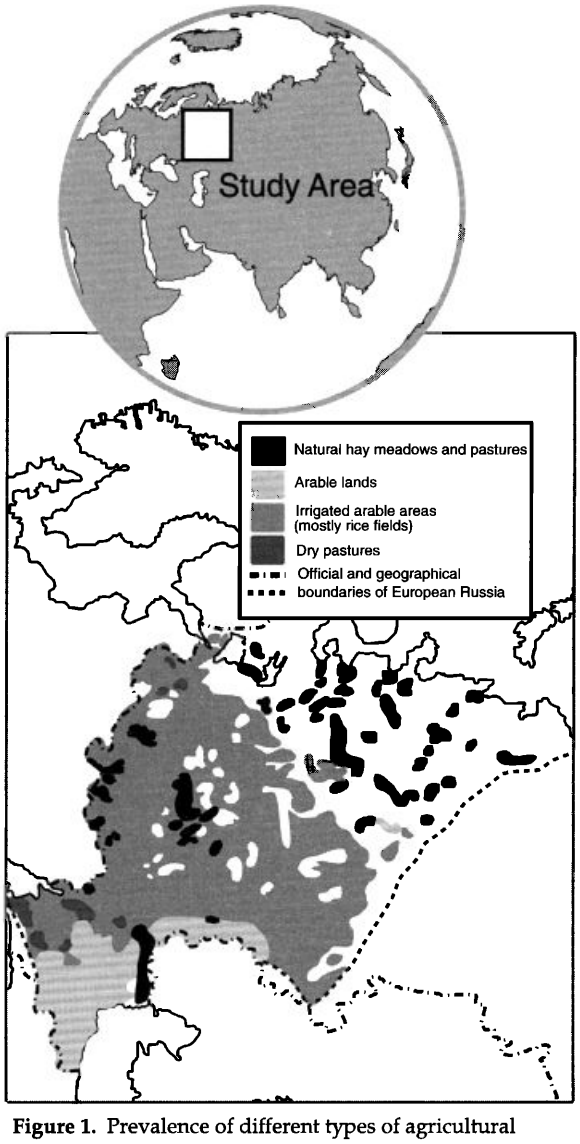

Figure 1. Prevalence of different types of agricultural habitats on the territory of European Russia according to Tochenov (1983).

Unfortunately, lack of agreement between ornithologists working on waders in European Russia and elsewhere in Russia as to which kind of methods should be used for waders means that the numerous dispersed data on wader numbers or densities are often incomparable. For this paper we have selected only those estimates that were either presented in the form of densities, or could be transformed into similar density estimates if the author has given the total surveyed area.

Results and discussion

Status of different wader species in agricultural habitats of European Russia

A total of 48 wader species, including vagrants, have been recorded in European Russia. Thirty-nine of these species have been confirmed as breeding (Kozlova 1961-1962; Stepanyan 1990).

Table 1. Status of different wader species in agricultural habitats of European Russia.

	STATUS		HABITATS USED							
Species	Breeding	Feeding or recorded occasionally	Rice fields	Cereals	Perennial crops	Bare fallows	Other fallows	Grazed tussocky pasture	Trad. natural meadows	Other field types	Source of data
Burhinus oedicnemus	✔									Overgrazed dry pasture	Belik & Bakhtadze 1982
Pluvialis squatarola		✔				●					Zinoviev 1980
Pluvialis apricaria		✔		Winter	●				●		Belik 1990; Zinoviev 1980
Charadrius dubius		✔	●						●		Kazakov *et al.* 1984; Butiev & Lebedeva 1990
Charadrius morinellus		✔				●					Zinoviev 1980; Tilba 1990
Vanellus vanellus	✔										Numerous data, almost all habitat types
Chettusia gregaria				Spring			●			Moderately grazed pastures	Fomin 1977; Davygora *et al.*1989; Khokhlov & Vitovich 1990 Khokhlov 1987;
Himantopus himantopus	✔		●							Moderately grazed pastures	Kazakov *et al.* 1984, 1988
Recurvirostra avocetta		✔	●								Kazakov *et al.* 1984
Haematopus ostralegus longipes		✔			●						Belik & Bakhtadze 1982
Tringa ochropus		✔	●						●		Kazakov *et al.* 1984; Zinoviev 1980, Butiev & Ezhova 1987
Tringa glareola	✔		●					●	●	Arable	Kazakov *et al.* 1984; Zinoviev 1980
Tringa nebularia		✔	●		●			●	●		Kazakov *et al.* 1984; Zinoviev 1980, Vinogradov 1985
Tringa totanus	✔		●					●			Zinoviev 1980; Kazakov *et al.* 1984
Tringa erythropus		✔	●								Kazakov *et al.* 1984
Tringa stagnatilis	✔							●	●		Semago *et al.* 1993
Actitis hypoleucos	✔								●		Butiev & Lebedeva 1990
Xenus cinereus	✔							●			our data
Philomachus pugnax	✔		●				●	●	●		Priklonsky 1977; Zinoviev 1980; Belik 1990
Lymnocryptes minimus			●					●			Ochapovsky 1973; our data
Gallinago gallinago	✔		●					●	●		Kazakov *et al.* 1984; Zinoviev 1980, Butiev Ezhova 1987; Konstantinov & Kutjin 1993
Gallinago media	✔		●					●	●		Kazakov *et al.* 1984; Zinoviev 1980, Nikiforov & Gibet 1987
Scolopax rusticola		✔	●							Arable	Tilba 1990; Kazakov *et al.* 1984
Calidris minutus		✔	●								Kazakov *et al.* 1984
Calidris alpina		✔	●								Belik 1990
Numenius arquata	✔		●	Winter, spring			●				Kazakov *et al.* 1984, 1990; Butiev & Lebedeva 1990
Limosa limosa	✔		●				●	●	●		Kazakov *et al.* 1984; Zinoviev 1980
Phalaropus lobatus		✔	●								Kazakov *et al.* 1984
Glareola pratincola	✔			Spring							Kazakov *et al.* 1984; Kazakov 1973
Glareola nordmanni	✔			Spring						Moderately grazed pastures	Kazakov *et al.* 1984; Denisov & Frolov 1991

Among these species 30 (63% of European wader fauna) use various types of agricultural habitats, 16 (41% of breeding fauna) nest in farmland habitats. Data on the status of waders in agricultural areas of European Russia are summarised in Table 1.

In some cases waders can also use rather untypical agricultural sites, *i.e.* for Stone Curlew *Burhinus oedicnemus* nesting in the orchards has been proved in Saratov region (Mezhnev 1990). Such unusual records have not been included in Table 1.

The breeding of some wader species in agricultural habitats has not yet been proved, but seems quite possible. For example, Ringed Plovers Charadrius hiaticula were recorded as breeding in the wet tussocky pastures of the Pripyat river flood-plain, Belarus (the southernmost breeding area of the species in the whole of the former USSR; Nikiforov *et al.* 1991), and therefore it seems probable that it can also occur in similar habitats in European Russia.

Table 2. Data on the densities of waders breeding in main types of farmland habitats in different parts of European Russia.

Species	Area	Period	Source	Type of agricultural habitat	Density (ind/10 ha)
Little Ringed Plover	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Arable	0.004
	Oka valley (Oksky Nature Reserve)		Polyakova & Radetsky (1973)	Spring cereals	2.0
Lapwing	Western Manych Lakes,	early June 1974	Kazakov *et al.* (1984)	Rice fields	9.4-13.7
	Western Manych Lakes	late June 1975	Kazakov *et al.* (1984)	Rice fields	3.0-4.0
	Vologda region	1970-1985	Butiev & Ezhova (1987)	Natural meadows	0.5
	Vologda region	1970-1985	Butiev & Ezhova (1987)	Tussocky pastures	3.6
	Vologda region	1993	our data	Tussocky pastures	3.6
	Vologda region	1983-1985	our data,	Winter cereals	0.41
	Vologda region	1983-1985	our data	Bare fallow	0.3
	Vologda region	1983-1985	our data	Perennial crops	0.17
	Vologda region	1970-1987	our data	Natural meadows	3.2
	Vologda region		Butiev & Lebedeva (1990)	Arable	1.5
Lapwing	Tver region,	1983-1984	Vinogradov (1985)	Perennial crops	0.2-2.0
	Kyanda settl., Onega Peninsula		Butiev (1973)	Arable	0.6-1.0
	Kyanda settl., Onega Peninsula		Butiev (1973)	Natural meadows	2.0-3.0
	Kyanda settl., Onega Peninsula		Butiev (1973)	Tussocky pastures	0.2-2.0
	Oka valley (Oksky Nature Reserve)		Polyakova & Radetsky (1973)	Spring cereals	2.0-18.0
Black-winged Stilt	Western Manych Lakes	June 1974	Kazakov *et al.* (1984)	Rice fields	2.9-3.2
	Western Manych Lakes	June 1975	Kazakov *et al.* (1984)	Rice fields	0.6-0.8
Green Sandpiper	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Natural meadows	0.26
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Arable	0.11
Wood Sandpiper	Tver region	1983-1984	Vinogradov (1985)	Perennial crops	0.02-0.20
	Tver region	1983-1984	Vinogradov (1985)	Tussocky pastures	0.21-2.0
Redshank	Western Manych Lakes	late June 1974	Kazakov *et al.* (1984)	Rice fields	2.1-2.
	Western Manych Lakes	late June 1975	Kazakov *et al.* (1984)	Rice fields	0.2-0.3
	Vinogradovo, Moscow region,	1981-1982	Morozov (1990)	Tussocky pastures and natural meadows	0.5-0.72
	Sheredar floodplain, Moscow region	1987-1988	Morozov (1990)	Tussocky pastures and natural meadows	0.34
Marsh Sandpiper	Moscow region, Kirzhach district	1980-1982	Garushants *et al.* (1990)	Tussocky pastures	0.1-0.12
	Vinogradovo , Moscow region	1981-1982	Zubakin *et al.* (1988)	Tussocky pastures	1.0-1.1
	Sheredar floodplain, Moscow region	1980-1982, 1988	Morozov (1990)	Tussocky pastures	0.2-0.24
Common Sandpiper	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Natural meadows	0.41
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Arable	0.001
Terek Sandpiper	Vologda region		our data; Butiev & Lebedeva (1990)	Tussocky pastures	1.2-4.0
	Oka valley (Oksky Nature Reserve)		Polyakova & Radetsky (1973)	Spring cereals	4.0
	Vinogradovo, Moscow region,	1982-1985	Morozov (1990)	Vegetated fallow land & tussocky pastures	0.4-0.88
Ruff	Tver region	1983-1984	Vinogradov (1985)	Tussocky pastures	0.21-2.0
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Natural meadows	0.07
Common Snipe	Vologda region	1970-1985	Butiev & Ezhova (1987)	Tussocky pastures	0-3.2
	Vologda region	1970-1985	Butiev & Ezhova (1987)	Natural meadows	0.01-0.1
	Tver region	1983-1984	Vinogradov (1985)	Perennial crops	0.02-0.2
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Natural meadows	0.2
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Arable	0.05

Table 2.(continued) Data on the densities of waders breeding in main types of farmland habitats in different parts of European Russia.

Species	Area	Period	Source	Type of agricultural habitat	Density (ind/10 ha)
Great Snipe	Vologda region	1970-1985	Butiev & Ezhova (1987)	Tussocky pastures	0.1-4.1
	Vologda region	1993	our data	Tussocky pastures	3.0
	Moscow region, Kirzhach district,	1980-1982	Garushants *et al.* (1990)	Tussocky pastures	0.1-0.20
	Sheredar floodplain,	1981-1982,	Morozov (1990)	Natural meadows	0.08-0.25 (males)
	Moscow region	1987-1988			
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Natural meadows	0.69
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Arable	0.21
Curlew	Vologda region	1970-1985	Butiev & Ezhova (1987)	Tussocky pastures	0.5-0.8
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Natural meadows	0.48
	Vologda region	1970-1987	Butiev & Lebedeva (1990)	Arable	0.26
	Vologda region	1983-1985	our data	Spring cereals	0.2-5.0
	Vologda region	1983-1985	our data	Perennial crops	0.1
	Kostroma region	1984-1989	Balandin & Kuznetsov (1990)	Natural meadows	0.6
	Moscow region, Kirzhach district	1980-1982	Garushants *et al.* (1990)	Tussocky pastures	0.06-0.08
	Sheredar floodplain,	1980-1983,			
	Moscow region	1987-1988	Morozov (1990)	Tussocky pastures	0.12-0.2
Black-tailed Godwit	Vologda region	1993	our data	Tussocky pastures	0.80
	Vinogradovo, Moscow region	1980-1982	Zubakin *et al.* (1988)	Tussocky pastures and natural meadow	1.4-1.44
	other parts of the Moskva and Klyazma flood-plains	1980-1982	Morozov (1990)	Tussocky pastures and natural meadows	0.1-0.13

Wader numbers in different types of agricultural habitats in European Russia

Significant differences in methods of wader censuses have in many cases resulted in the incompatibility of data. Accordingly in Table 2 we have included only broadly compatable data. Unfortunately, numerous census results could not be included as they were calculated on the basis of linear lengths of survey routes.

Our review of wader densities in various farmland areas shows that the most important breeding habitats are:

1) tussocky pastures, where comparatively high densities are found of Lapwing *Vanellus vanellus*, Wood *Tringa glareola* and Terek *Xenus cinereus* Sandpiper, Common *Gallinago gallinago* and Great Snipe *G. media;*

2) natural hay-meadows supporting rather large densities of Lapwing and, to a lesser extent, of Great Snipe and Curlew *Numenius arquata;* and

3) rice fields, where Lapwing, Black-winged Stilt *Himantopus himantopus* and Redshank *Tringa totanus* reach almost the largest wader densities in farmland. In many cases rather high breeding densities are also observed in different types of arable areas, therefore, large numbers of several species in cultivated crops are of particular interest.

Development of adaptations to agricultural activities and effects on population status and range

Population status and abundance of a species in any habitat is likely to be closely related (amongst other factors), with the time when it first started to colonise that habitat. For example, Lapwing, currently the commonest farmland wader, was numerous in Russia on various bogs but only occasional on farmland, even at the beginning of the 20th century (Biancki 1912 in Nankinov 1973). Obviously, its colonisation for breeding into hay-meadows, pastures and later to arable lands happened in different parts of European Russia between the 1920s and 1940s. The northern boundary of breeding range in Lapwing has expanded northwards as a result of its colonisation of agricultural areas since the 1950s (Myrberget 1962; Moltoni 1962 in Nankinov 1973; Semenov 1980).

This expansion still continues. The increase in the extent of arable lands in northern European Russia that has occured since the 1970s (Kibalchich 1991) made it possible for Lapwing to expand its range into these new arable areas (Figure 2). In the north of European Russia it was recorded in 1982 in artificially sown hay-meadows near Vorgashor settlement, Bolshezemelskaya tundra (Morozov 1987) and in 1972 in natural hay-meadows near Ust-Ukhta and Kedva settlements in the Pechora basin (Estafiev 1977).

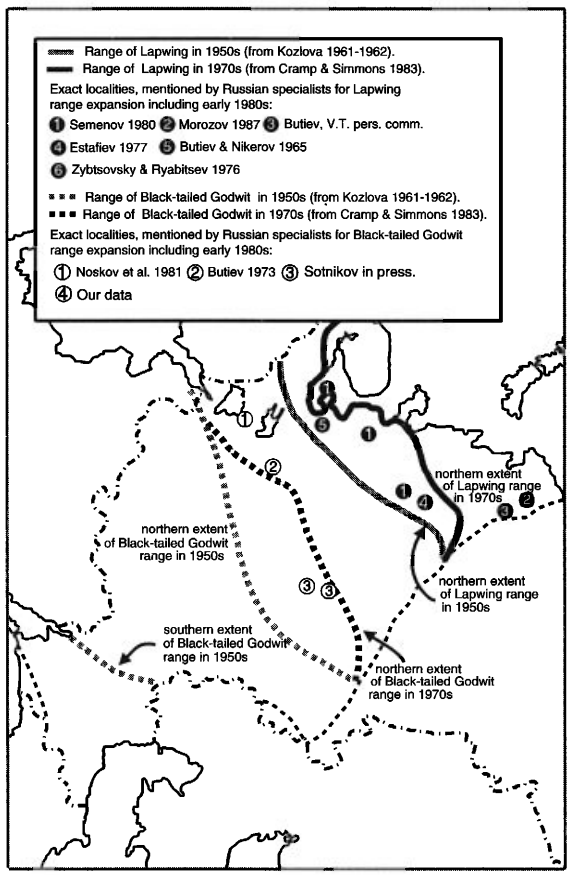

Figure 2. Changes in ranges of Lapwing and Black-tailed Godwit at the territory of European Russia.

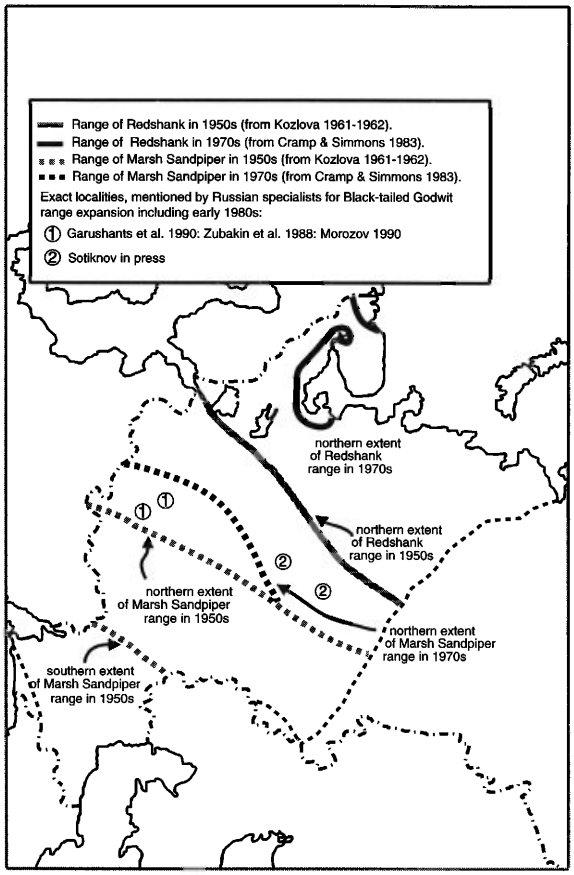

Figure 3. Changes in ranges of Marsh Sandpiper and Redshank at the territory of European Russia.

Similar tendencies of northwards range expansion are observed in other farmland breeding waders. For example, the spread of Black-tailed Godwit *Limosa limosa* (Figure 2) and Marsh Sandpiper *Tringa stagnalis* (Figure 3) in European Russia is also due to their colonisation of more northern tussocky pastures and natural meadows (although in some areas, for example in Vologda region, Black-tailed Godwit breed on peatlands as well). Breeding areas of Redshank (Figure 3) in northern European Russia also occur in hay-meadows and tussocky pastures.

The start of a significant period in wader colonisation of Russian farmlamd was in the 1950s-1970s. At that time the first nests of Ruff *Philomachus pugnax* (1958; Priklonsky 1977) and Curlew (1950s; Zhelnin 1962; Leonovich & Nikolaevsky 1981) were recorded. This was not coincidental, as this period was also a time of intense agricultural development in Russia.

Factors influencing waders on European Russian farmland

One of the main negative effects on waders is the early time of cultivation and harvesting. In those fields with perennial herbs in Tver region, the mortality of Lapwings from early spring harvesting is on average 1.1 nest per 100 ha, in potato fields during mid-summer mechanical cultivation it is 2.1 chicks per 100 ha (Nikolaev 1992). Data on the adverse effects of early hay-harvesting are known from the Moscow region for several wader species, including Ruff, Great Snipe, Black-tailed Godwit and Redshank (Zubakin *et al.* 1988; Morozov 1990).

For Lapwing, it was proved that nests are destroyed by agricultural transport and human disturbance (Nankinov 1973). In recent years this species appears to be amongst those birds suffering from the intensification of grassland management with the conversion of natural meadows into sown leys.

Although most wader species that breed on hay-meadows or pastures require moderate grazing for maintainance of optimal vegetation structure (*e.g.* Redshank, Marsh Sandpiper, Curlew, Black-tailed Godwit; Zubakin *et al.* 1988; Morozov 1990), their nests are often trampled by cattle as well. It is known that some protective measures are taken locally: for example in the flood-plain pastures of western Manych, breeding Black-winged Stilts are fairly safe due to the use of electric fences (Kazakov *et al.* 1988).

Among the factors affecting breeding success in waders, the recent use of toxic chemicals should be considered among the most important. However, only limited data on this problem exist for Russia. Khokhlov *et al.* (1991) reported the direct mortality of Lapwing and Redshank chicks after treatment of arable areas with chemicals (herbicides and pesticides), and negative effects are known also for Stone Curlew (Mezhnev 1990).

Table 3. Estimates of vulnerability of waders breeding in agricultural habitats in European Russia.

	Species scores (see text)															
Factor	Gmed	Cgre	Gpra	Narq	Boed	Vvan	Llim	Gnor	Tsta	Ggal	Ttot	Ppug	Xcin	Tgla	Cdub	Ahyp
Restrictness to agricultural habitats	0	1	1	1	1	0	1	1	1	1	1	1	2	2	2	2
Range size in European Russia	1	0	0	2	0	2	1	0	1	2	2	2	1	1	2	2
Range trend in European Russia	1	0	0	1	1	2	2	1	2	1	2	1	2	1	1	1
Relative numbers in European Russia	1	0	1	1	1	2	1	2	2	2	2	2	2	2	2	2
Relative number in agricultural habitats of European Russia	1	1	0	1	1	2	1	1	1	1	1	1	1	1	0	0
Population trend in European Russia	0	0	0	0	0	1	1	1	1	1	2	1	1	1	1	1
Response to early harvest.	0	1	1	0	1	0	0	1	0	1	0	0	1	1	2	2
Response to chemical use	0	0	0	0	0	0	1	0	1	0	0	1	1	1	1	1
Response to pasturing	1	0	0	0	0	1	1	0	1	1	1	1	1	1	2	2
Response to alteration of natural meadows to artifical leys	0	2	2	0	2	0	0	2	1	1	1	1	1	1	2	2
Possibility of survival in other habitats	0	1	1	1	1	0	1	1	0	1	1	2	1	2	2	2
TOTAL INDEX	**5**	**6**	**6**	**7**	**8**	**10**	**10**	**10**	**11**	**12**	**13**	**13**	**14**	**14**	**15**	**15**

Species: Gmed - Great Snipe; Cgre - Sociable Plover; Gpra - Collared Pratincole; Narq - Curlew; Boed - Stone Curlew; Vvan - Lapwing; Llim - Black-winged Stilt; Gnor - Black-winged Pratincole; Tsta - Marsh Sandpiper; Ggal - Common Snipe; Ttot - Redshank; Ppug - Ruff; Xcin - Terek Sandpiper; Tgla - Wood Sandpiper; Cdub - Little Ringed Plover; Ahip - Common Sandpiper

For wader species breeding in natural hay meadows within river flood-plains and in rice fields, a very important factor is a stable water level. Khokhlov *et al.* (1991) showed that breeding success in Lapwing and Black-winged Stilt nesting in rice fields, drastically decreases when the water-table rises during egg-laying or incubation periods.

The adverse consequences of drainage within agricultural habitats, can be presumed for many waders, but have only been demonstrated for Curlew and Common Snipe in Lithuania (Kurlavicius 1986). There, Curlew completely avoids drained agricultural areas even after several (up to ten) years after drainage. Common Snipe, which occur only in the year following draining also decreases in numbers (from 6.4 to 5.3 territories per km^2).

Table 3 summarises data on the status and vulnerablity of wader species breeding in farmland. It includes rank codes for several specific criteria (following Sukhanova & Mischenko's (1990) scheme, suggested for rare bird species of the Moscow region). It can provide only a crude estimate of vulnerability as it assumes that the different factors listed have equivalent ecological impact, which is probably not the case. The following criteria and codes were used:

• degree of restriction of a species to agricultural habitats (0 - almost all the population occurs in farmland, 1 - about half of the population, 2 - breeds only occasionally in farmland);

• range size of a species in European Russia (0 - occurs only in extreme northern or southern parts, 1 - occurs in about half of the European Russia, 2 - occurs in almost all European Russia);

• range trend of a species in the analysed area (0 - decreasing, 1 - stable or no data, 2 - expanding);

• relative numbers in the whole of European Russia (0 - rare or extremely rare, 1 - more or less common, 2 - rather abundant);

• relative number in agricultural habitats of European Russia (0 - rare or extremely rare, 1 - more or less common, 2 - rather abundant);

• overall population trend in European Russia (0 - declining at least locally, 1 - stable or no other data, 2 - increasing at least locally);

• response to early harvesting or cultivation (0 - strong negative, 1 - response seems moderate - no data, 2 - no obvious response);

• response to chemical use (0 - strong negative, 1 - response seems moderate - no data, 2 - no obvious response);

• response to pasturing (0 - strong negative, 1 - moderate pasturing is nesessary, 2 - no response);

• response to alteration of natural hay-meadows into artificially sown high-productive ones (0 - strong, can cause a decline, 1 - moderate or no data, 2 - no response);

• possibility of survival in other habitats of European Russia (0 - other sites are almost not used by species, 1 - possible, although other sites are also decreasing or negatively affected, 2 - exists rather successfully in other sites).

The crude index of vulnerability indicates three groups of waders:

1). a group of extremely vulnerable species, that require special protection measures within agricultural habitats: Great Snipe, Sociable Plover, Collared Pratincole, Curlew and Stone Curlew;

2). vulnerable species, whose conservation on farmland requires special attention, and special ornithological studies as well (for probable inclusion in group I): Black-tailed Godwit, Lapwing, Marsh Sandpiper, Black-winged Pratincole, Common Snipe, Redshank and Ruff; and

3). waders, that are nowadays rather secure within agricultural areas or use them only occasionally: Wood and Terek Sandpipers, Little Ringed Plover and Common Sandpiper. Although these waders are still fairly safe, they still require adequate protection measures when breeding in farmland, especially as a consequence of the rapid changes in agricultural practices that are currently occuring in European Russia.

Conclusion

Analysis of data on the occurence of wader species in various types of agricultural habitats of European Russia has revealed, that 63% of the total wader species and 41% of the list of breeding waders in this area are inhabiting agricultural sites. The types most preffered by waders are natural meadows, used for hay-harvesting, various kinds of open pastoral habitats, and rice fields (in southern Russia). In recent years many waders populated other arable lands as well, especially cereal crops and various types of fallow lands. Due to the ability of wader species to use agricultural areas for breeding, some of them have expanded northwards in the past few decades, following the increase in size of agricultural areas in the northern part of European Russia. In many cases, for example Curlew, Black-tailed Godwit, Common Snipe *etc.* these are now probably the main alternative habitats that can be used in place of natural breeding areas which have been seriously affected by human activities.

Estimates of vulnerability for wader species breeding in agricultural areas of European Russia made it possible to separate three groups of species that require different types of attention both from specialists and agricultural workers. The most important is protection for breeding in agricultural sites for the following species: Great Snipe, Sociable Plover, Collared Pratincole, Curlew, Stone Curlew. Less affected (at least on the recent level of our knowledge) are Black-tailed Godwit, Marsh Sandpiper, Black-winged Pratincoles, and Lapwing. The inclusion of the latter species in this second group is closely connected with their status, since, for example, Lapwings now breed mainly within agricultural sites and have almost no possibility of survival elsewhere.

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