The importance of the peatlands of the Upper Volga area as habitats for breeding waders

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In the Tver region 31 wader species were recorded and of these, 19 species breed there, 11 species are considered rare and ten of these rare species breed in different peatlands. Golden Plover *Pluvialis apricaria* and Whimbrel *Numenius phaeopus* breed only on raised bogs, Marsh Sandpiper *Tringa stagnatilis* and Great Snipe *Gallinago media* breed only on fens. Ruff *Philomachus pugnax*, Redshank *Tringa totanus*, Black-tailed Godwit *Limosa limosa* and Curlew *Numenius arquata* are widely distributed on peat-bogs and have their maximum density on fens. Single breeding records of Jack Snipe *Lymnocryptes minima* are known for eutrophic and mesotrophic bogs. In the last decade Terek Sandpipers *Xenus cinereus* have started to breed on transformed peatlands. Wader species composition and abundance vary considerably among peatlands of different types due to differences in their size, forest-cover and the presence of open water areas. The large raised bogs, with complex habitats from marginal eutrophic parts to central areas with peat-ridges and open water areas, have the highest number of rare breeding wader species (up to seven), although their density is rather low (2.1±0.3 pairs km^{-2}). The most marked fluctuations in numbers are found on small bogs and in dry years some species do not breed there at all. Egg and chick predation is higher on long narrow bogs than on rounded ones of the same area. In recent decades the increase in Hooded Crow *Corvus cornix* numbers at the bogs has negatively influenced the breeding success of wader species. Overall, 160 bogs in the region were excluded from drainage and peat-industry plans in the 1980s and all forest-cutting is planned to stop by 1993. With the development of anthropogenic activities in the region, the relative value of peatlands as a habitat for rare wader species will probably increase in the near future.

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В Тверской области был зарегистрирован 31 вид куликов, из которых 19 видов гнездятся, 11 считаются редкими, среди редких видов 10 гнездятся в различных торфяниках. Золотистая ржанка *Pluvialis apricaria* и средний кроншнеп *Numenius phaeopus* гнездятся исключительно на верховых болотах, поручейник *Tringa stagnatilis* и дупель *Gallinago media* обитают только на низинных болотах.Турухтан *Philomachus pugnax*, травник *Tringa totanus*, большой веретенник *Limosa limosa* и большой кроншнеп *Numenius arquata* широко распространены на торфяниках, достигая максимальной плотности на низинных болотах. Известны единичные случаи гнездования гаршнепа *Lymnocryptes minimus* на евтрофных и мезотрофных болотах. Последнее десятилетие на преобразованных торфяниках начала гнездиться мородунка *Xenus cinereus*. Видовой состав и численность куликов значительно меняются в зависимости от разных типов торфяников из-за различий в их площади, лесном покрове и наличии открытых водоемов. На крупных верховых болотах со сложными биотопами, от евтрофных участков на краю до центральных частей с торфяными гребнями и открытыми водоемами, обитает большинство редких куликов (до семи видов), хотя плотность их гнездования довольно низка (2,1±0,3 пар/км^2). Самые заметные колебания численности отмечаются на небольших болотах, где в сухие годы некоторые виды вообще не гнездятся. Потери яиц и птенцов от хищничества выше на удлиненных, узких болотах, чем на округлых той же площади. За последние десятилетия возросла численность серой вороны *Corvus cornix*, что отрицательно повлияло на успех гнездования разных видов куликов. В целом, в 1980-х годах 160 болот в регионе были исключены из планов для осушения болот и торфяновых разработок, и к 1993 году запланировано прекращение вырубок лесов. При развитии в регионе антропогенной деятельности вполне возможно, что в ближайшем будущем относительная ценность торфяников как местообитание редких видов куликов увеличится.

Introduction

Waders, being one of the most diverse groups of non-passerine birds on peatlands, play an important role in the functioning of peat-bog ecosystems. The importance of peat-bogs as wader habitats is determined by their environmental characteristics, their vulnerability to human activities, and the accelerated rates of reduction of the virgin peat-bog areas in many parts of European Russia. Conservation of peat-bogs in economically well-developed regions is one of the most promising ways of protecting rare waders and maintaining species diversity.

The main objective of this study was to evaluate the present status and main trends in wader populations on the peat-bogs of the upper Volga river area which are affected by human activities, and analyse the role of peat-bogs for the conservation of this group of birds. Special attention was paid to collecting data on distribution, numbers, population densities and habitat characteristics on the different types of virgin and transformed peat-bogs of the study region.

Study Area and Methods

The studies were conducted from 1980-1991 in the upper Volga river area, mostly in Tver' region (formerly Kalinin region) and partly in the neighbouring areas of Novgorod, Pskov, Smolensk and Vologda administrative regions. Seventy peat-bogs, occupying a total of about 270,000 ha (45% of the total peat-bog area in the region) were surveyed during the studies, 67% of which were oligotrophic raised bogs), 23% were eutrophic fens (eutrophic swamps), and 10% were mesotrophic bogs. The vast raised bogs with ponds, pools and ridges (covering about 1000 ha), which support the most diverse wader fauna, due to their complicated structure, amount of water and absence of forests, were explored the most carefully. When selecting the peat-bogs to be surveyed, we based our selection on data from a special regional list of peat-bogs compiled by the Ministry of Geology for the peat industry which contained the most complete data on typology, size, vegetation and the level of economic development for each of these peat-bogs. No other marshy habitats were explored during the present study.

In total, about 3,000 km were covered on foot and 200 km were explored by boat. The most detailed studies were conducted on the bogs of the south-western and western parts of the upper Volga area (Valday upland), and in the areas of the Upper Mologa river and the Volga-Shosha lowland. In other areas, only certain selected peatlands were visited.

While planning the survey routes, we analysed 1:100,000 scale topographic maps, plans of the peat-lands, and aerial photos. Aerial observations from small planes and helicopters were made before visiting some of the large peat-bogs. About 500 questionnaires about the birds were circulated, and information from these and personal communications with local inhabitants and game-managers (more than 1,000 people) were also used. Routes were planned taking into account the circular structure of a peat-bog from its periphery to the centre (edge zone, strips of sparse low trees, open areas, pool-ridge complexes *etc.*) thus making it easier to locate sites which were used by waders. On very large peat-bogs several survey routes were used, crossing the widest parts with stops in the "forest-islands" within the bog.

The main bulk of the surveys were conducted in the breeding period during May to June, as later, there was a rather rapid departure of waders to neighbouring water bodies and uplands. Visits were made in the morning, from sunrise until 10 or 11 am and in the evenings. Censuses were conducted either on a repeated or on a single route during the breeding period; all birds were counted, regardless of their distance from the observer. Each census route was 10 to 15 km long, and their total length was 270 km. Densities were estimated later, using the separate-group method with calculations according to average observation distances (Ravkin 1967). Densities were not estimated for the rarest wader species. Abundance values were calculated in accordance with the area of defined habitats. In local areas with very high wader densities (pond-ridge and pool-ridge complexes), a nest mapping method was used, together with registrations of alarming birds (Durcz & Tomialojc 1974; Svensson 1978).

Results and Discussion

Different wader species use peat-bogs in different ways: from rare visits during migration, to regular breeding within the bogs. In the upper Volga area 31 wader species have been recorded, 18 of which are more or less connected with different types of virgin and/or transformed peat-bogs, and 14 of which breed there (Table 1). Besides the species mentioned in Table 1, Jack Snipe *Lymnocryptes minima* also probably breed in the peat-bogs of the region.

Oligotrophic raised bogs

This type of peat-bog prevails in the study area, both in the total area (67% of all peat-bogs) and in the size of individual bogs (on average 580 ha). Almost all the breeding areas of Golden Plover *Pluvialis apricaria* and Whimbrel *Numenius phaeopus* were located on the open bogs with pool-ridge complexes on the Valday upland of the western upper Volga area, which adjoins the breeding areas of these species in the Pskov and Novgorod regions, as well as in northern Belarus (Malchevsky & Pukinsky 1983; Kozlov & Kuzmenko 1989; Mischenko *et al.* 1991). The distribution and numbers of these species are not stable because the study area is at the limits of their breeding range: during the last century they underwent a local

Table 1. Wader species composition in the upper Volga peatlands.

Species	Raised bogs	Mesotrophic bogs	Eutrophic fens	All types of transformed peat bogs
Pluvialis apricaria	++	-	-	-
Charadrius dubius	-	-	-	-
Vanellus vanellus	+++	+++	+++	+++
Tringa ochropus	-	+++	+++	+++
Tringa glareola	++	++	++	+
Tringa nebularia	+++	+++	++	++
Tringa totanus	+	-	+	-
Tringa erythropus	✸	-	✸	-
Tringa stagnatilis	-	-	+	+
Actitis hypoleucos	+	-	-	-
Xenus cinereus	-	-	-	+
Phalaropus lobatus	*	-	-	-
Philomachus pugnax	+	+	+	-
Gallinago media	-	-	+	-
Gallinago gallinago	+++	+++	+++	+++
Numenius arquata	++	++	++	+
Numenius phaeopus	++	-	-	-
Limosa limosa	+	+	++	-

- absent or not recorded at this type of peat-bog;
+ extremely rare breeding species, only single records from some bogs known;
++ rare breeding species, recorded in low numbers from most of the surveyed peat-bogs;
+++ common breeding species, dozens of breeding pairs were recorded from most of the surveyed bogs;
✸ occurs during migration and post-breeding movements only.

expansion and increased in numbers eastwards (Figure 1). According to published data, in the first half of the 20th century the Golden Plover was recorded only as a vagrant species to Tver' region (*e.g.* Stanchinsky 1927; Tretyakov 1940). Breeding was confirmed there for the first time in the early 1980s, on the bogs of the south-western upper Volga area (Avdanin 1983). Whimbrel were probably breeding there in small numbers before that, as young birds were being found (Zinoviev 1980). Recently, several hundred pairs of each species were found breeding in the region. Breeding of Golden Plovers and Whimbrels further north in Vologda region has not yet been proved (Nemtsev 1988).

Significant changes in numbers were found in two other waders which inhabit the peat-bogs: Lapwing *Vanellus vanellus* and Greenshank *Tringa nebularia*. Lapwing was not a regular breeding species on raised bogs at the beginning of the 20th century (Stanchinsky 1927), whereas now it is found on most peat-bogs of this type. Greenshank was formerly a sporadic breeding species of raised bogs (Stanchinsky 1927; Zinoviev 1980), but has now become a common breeder and on some bogs recently, the most common breeding wader (Avdanin 1983).

In general, the largest number of breeding wader species (up to 11) was recorded in the western upper Volga area, on vast raised oligotrophic bogs with pool-ridge complexes similar to the eastern Baltic bog type. Most of these bogs represent a wide range of habitats, but pond-pool-ridge complexes are the

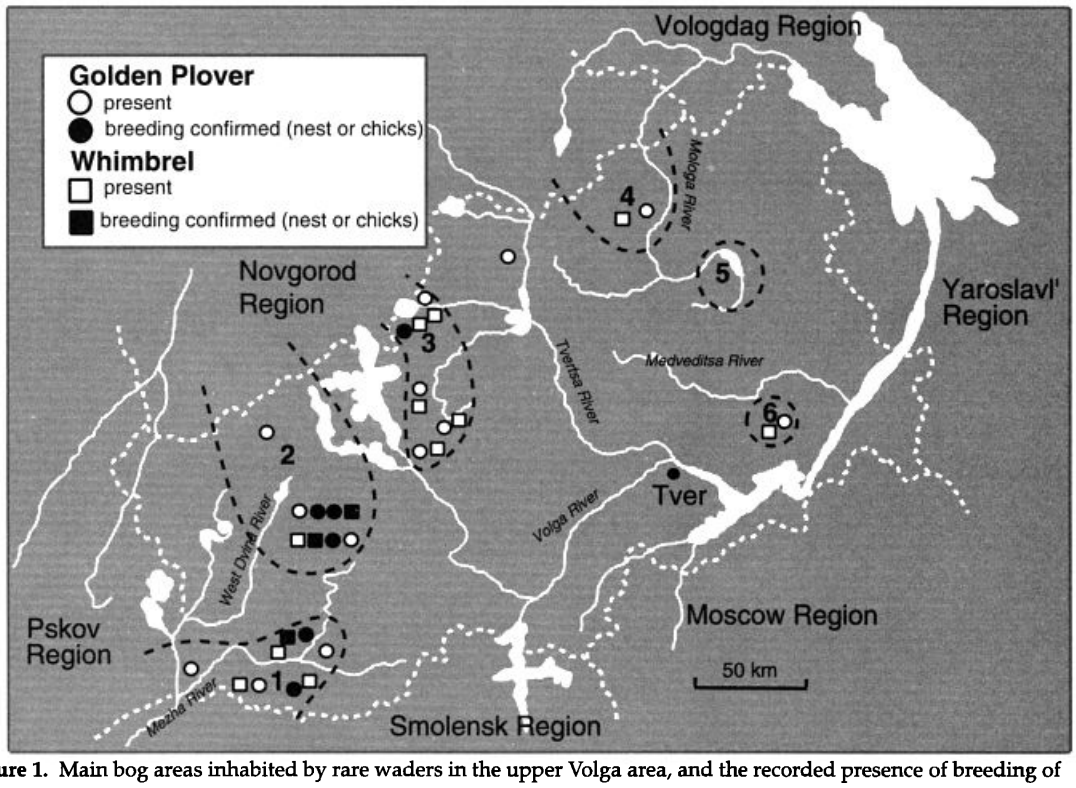

Figure 1. Main bog areas inhabited by rare waders in the upper Volga area, and the recorded presence of breeding of Golden Plover and Whimbrel. Dashed lines outline the main bog complexes inhabited by rare waders:
1 - Zharkovsko-Svitsky area; **2** - Verkhnevolzhsko-Zapadnodvinsky (the upper Volga - the Western Dviva) area;
3 - Shlinsko-Tsninsky area; **4** - Molozhsko-Lesnoi area; **5** - Verkhnemolozhsky (the upper Molga) area; **6** - Orshinskiy area.

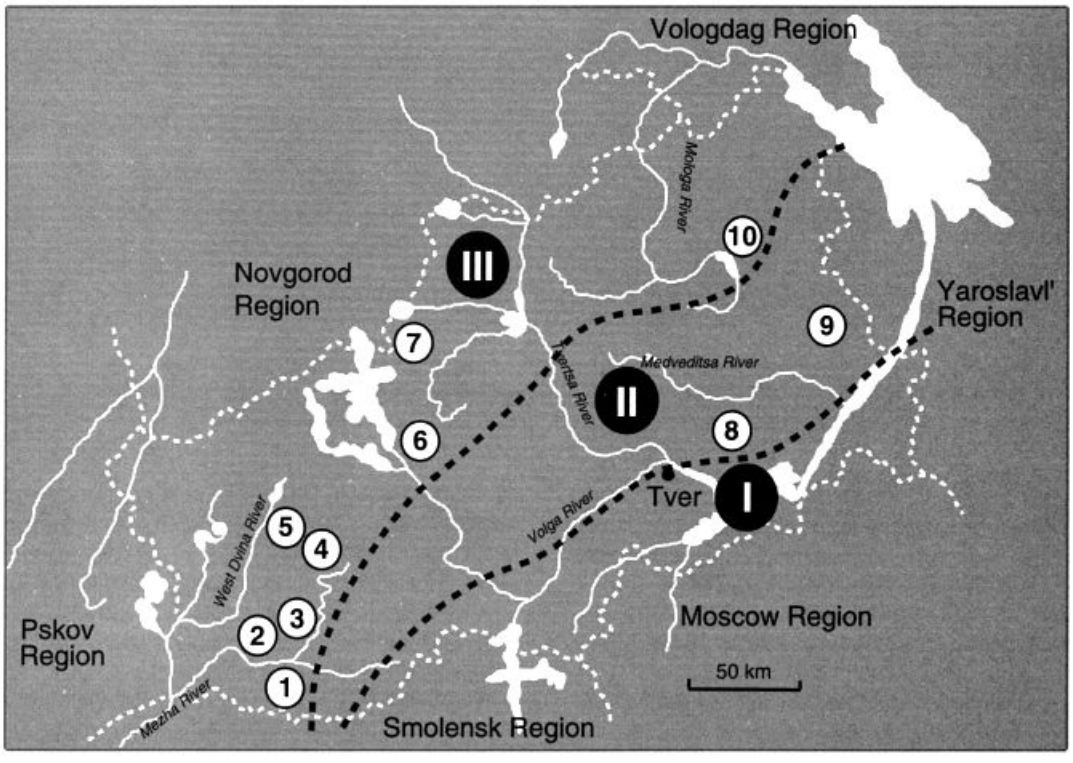

Figure 2. Economic development of peatlands in Tver' region and the most important (key) bogs. Numbered circles show the bogs that were identified as Important Bird Areas for Bird Life International's Project.

1 - Budnyanskiy Mokh (raised bog; 3156 ha) **2** - Zharkovskiy Mokh (raised bog; 38863 ha)
3 - Stakhovskiy Mokh (fen; 10296 ha) **4** - Kat'kin Mokh (raised bog; 3970 ha)
5 - Derzkiy Mokh (raised bog; 6704 ha) **6** - Chistik (up-river moor; 8402 ha)
7 - Zakaznik (raised bog; 1997 ha) **8** - Orshinskiy Mokh (raised bog; 30.000 ha)
9 - Savtsinskoye (fen; 4569 ha) **10** - The upper Mologa wetland complex (17.000 ha)
I - zone of intense economic development of peatlands (most are drainaged and worked out)
II - zone of moderate economic development of bogs (about 50% of large peatlands are exploited and drained)
III - zone with rather well-conserved peatlands (wood-cutting and drainage for forestry prevail)

most preferred habitat of waders. All the nest-sites of Golden Plover and Whimbrel, and most of the nest-sites of Greenshank, Wood Sandpiper *Tringa glareola* and Curlew *Numenius arquata* were situated here. These wader species often form mixed compact colonies consisting of 10 to 20 pairs. Similar densities of waders inhabit the meso-eutrophic parts on the edge of raised bogs preferred by Lapwing, Common Snipe *Gallinago gallinago* and Black-tailed Godwits *Limosa limosa*, which are only rarely recorded in the central oligotrophic parts.

Extremely rarely, Redshank *Tringa totanus* and Ruff *Philomachus pugnax* breed on the peatlands, in single pairs, inhabiting only the edges; very rarely, single pairs of Common Sandpiper *Actitis hypoleucos* can also be found in the vicinity of oligotrophic lakes. Waders usually avoid the areas covered with low sparse pines and low shrub thickets. Woodcock *Scolopax rusticola* and Green Sandpiper *Tringa ochropus* nested in low numbers on the forest "islands" within the bogs.

The east European type of pine-*Sphagnum* peatland, with dense tree vegetation and rather little water, which prevail in the other parts of the upper Volga area are less attractive to waders due to their low habitat diversity (Zinoviev & Nikolaev 1988). The proportion of boggy areas in the region decreases from 12.0% - 1.4% eastwards, and the proportion of raised bogs decreases from 60.4% - 1.4% in the same direction, as does their size, and there is a corresponding increase in the degree of human modification of peat-bogs (Figure 2). This leads to a reduction in numbers of breeding waders to only five species, of which Greenshank, Lapwing and Common Snipe are the most common, with Curlew recorded more rarely. The only exception is the vast

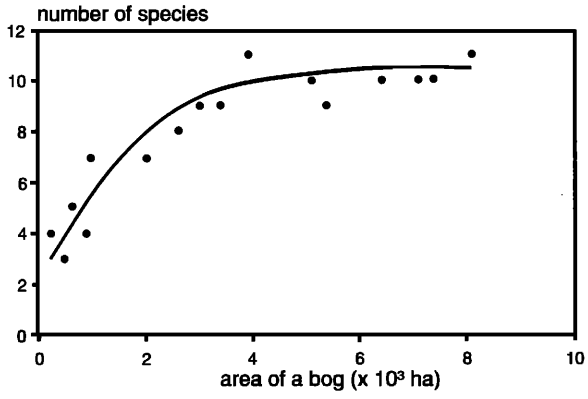

Figure 3. The relationship between the number of breeding wader species and the size of raised bogs in the upper Volga area. Trend line fitted by eye.

raised bog, Orshinskiy Mokh, not far from Tver' town. There, in the eastern undeveloped part, the most easterly colonies of Golden Plovers and Whimbrels were located, and rather large numbers of Curlews and Black-tailed Godwits were observed.

The total wader population density on the raised bogs was, on average, 6.0±1.6 km^{-2}. Greenshank

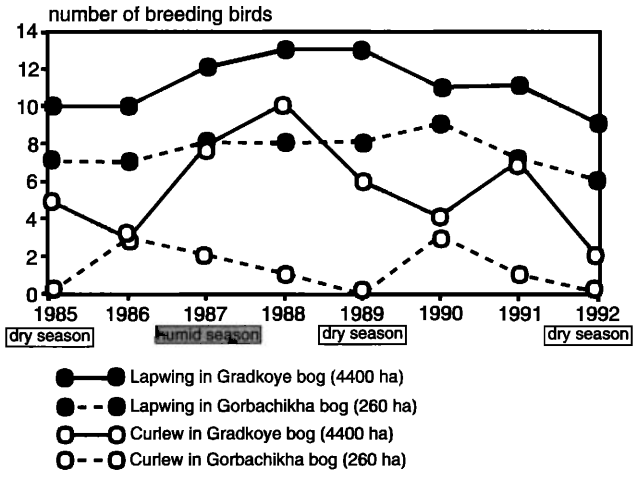

Figure 4. Changes in the numbers of Curlew and Lapwing on different sized raised moors in the upper Volga area 1985-1992.

(1.5±0.3 km^{-2}), Lapwing (1.3±0.5 km^{-2}), Common Snipe (1.0±0.5 km^{-2}), and Curlew (0.7±0.3 km^{-2}) are the most common species. As the size of the bogs increases, there is a logarithmic increase in the numbers of breeding waders; usually the bog has to exceed 4,000-5,000 ha ($r=0.89$, $p<0.01$; Figure 3) to hold the maximum number of species. However, if separate raised bogs are situated close to one another (a bog-system), then individual bogs of around 1,000 ha are sufficient. On the small and middle-sized bogs (not more than 1,000 ha), annual fluctuations in wader numbers were sharper than on the large peatlands. In some dry seasons, some wader species did not breed there at all, while in years with high precipitation, the wader population density can be two to three times higher than usual (Figure 4).

The shape of the peat-bog may indirectly influence breeding success in waders. On elongated bogs with a long perimeter, nest mortality was higher than on rounder bogs of a similar size because the nests are more accessible both to men and ground predators.

Mesotrophic peat-bogs

Only eight wader species were recorded on these bogs which are restricted in distribution (10% of the boggy area), are smaller in size (on average 110 ha) and support a rather low habitat diversity. However, wader population density on mesotrophic peat-bogs is higher than on oligotrophic peat-bogs: overall density averages 15.6±3.3 km^{-2}, with Common Snipe (8.2±1.2 km^{-2}), Lapwing (2.5±0.7 km^{-2}) and Greenshank (2.1±0.3 km^{-2}) being the most common species. The highest diversity and population density of waders was found not on the uniform mesotrophic bogs, but on the mesotrophic edges of moors and fens. The majority of waders were nesting on the open *Sphagnum*-sedge areas, but Wood Sandpiper, Greenshank and Common Snipe were also found in places overgrown with pines and birches.

Eutrophic fens

These peatlands had similar numbers of breeding wader species to the raised bogs, but as they are less widely distributed (23% of the boggy area) and are smaller in size (on average 120 ha), their significance for birds is not as high. Eutrophic fens were the main breeding habitat of Common Snipe and Black-tailed Godwit, the number of Lapwing is two to four times higher than on other types of peatlands and they are the only habitat on which Marsh Sandpiper *Tringa stagnatilis* and Great Snipe *Gallinago media* were recorded breeding. The latter two waders rarely occur on fens and have only been recorded on the vast bog-flood-plain complexes of the Volga, Mologa, Zapadnaya Dvina, Shosha and other rivers. There, Great Snipe was recorded mostly on wet flood-plain meadows which have grass-herb-sedge vegetation and large numbers of Lumbricidae worms. As in other areas of the forest zone, this species is characteristic of the meadow flood-plain communities (Nikiforov & Gybet 1987). In general, the flood-plain bog complexes support a

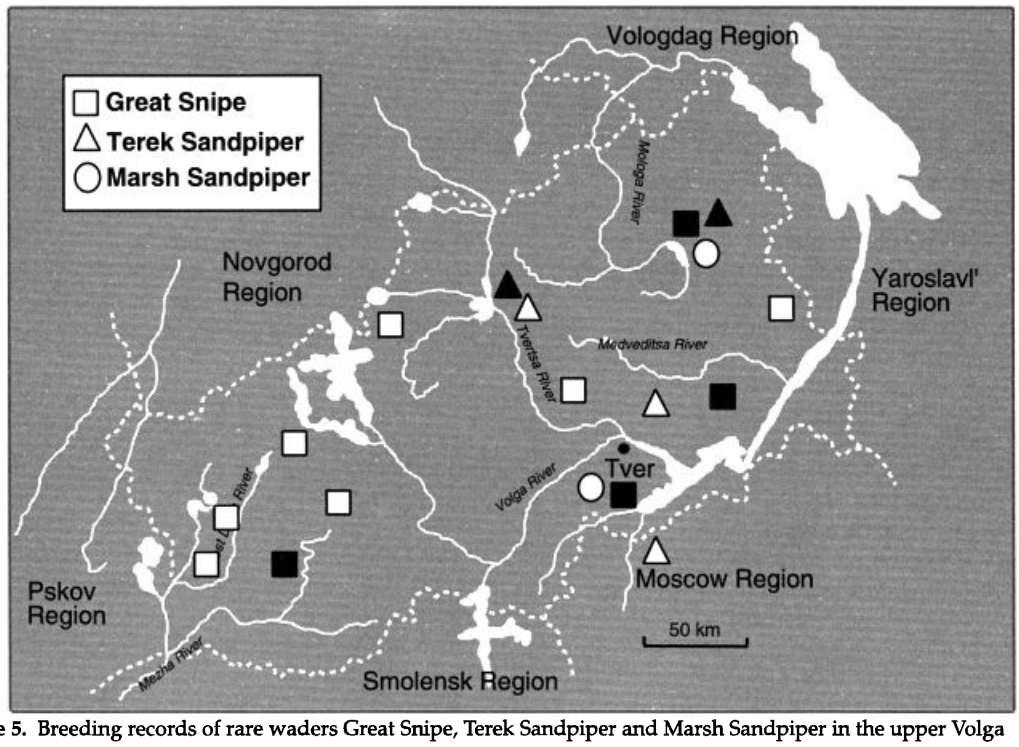

Figure 5. Breeding records of rare waders Great Snipe, Terek Sandpiper and Marsh Sandpiper in the upper Volga area. Open symbols are recorded presence, filled symbols are confirmed breeding (nests or downy chicks found).

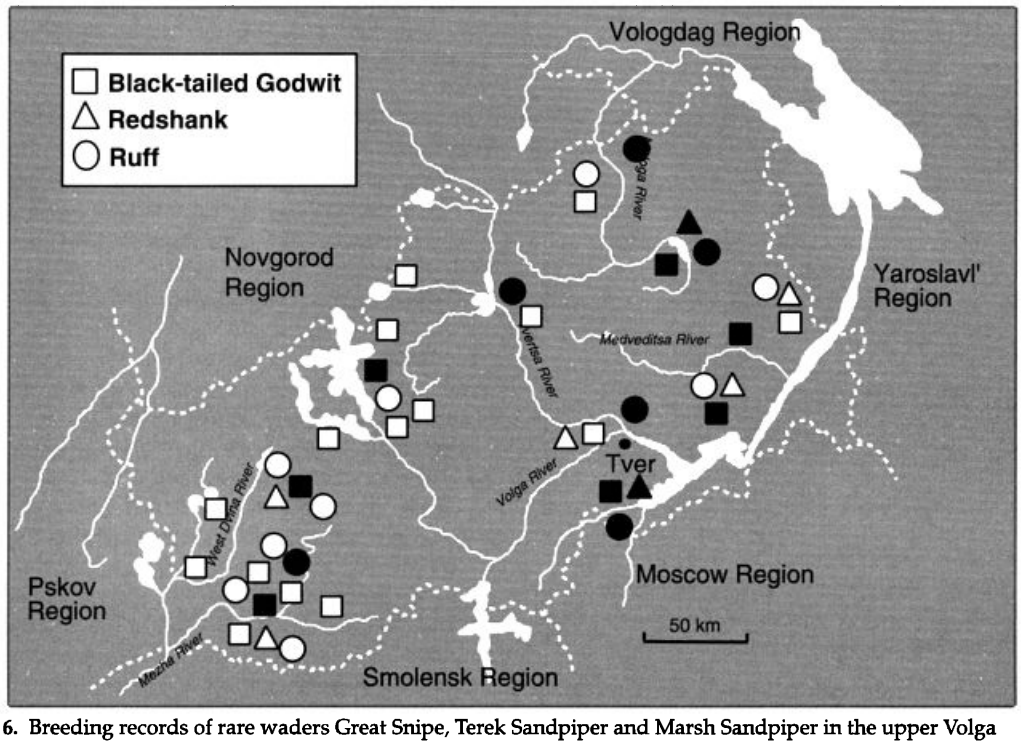

Figure 6. Breeding records of rare waders Great Snipe, Terek Sandpiper and Marsh Sandpiper in the upper Volga area. Open symbols are recorded presence, filled symbols are confirmed breeding (nests or downy chicks found).

richer wader fauna than do the separate watershed fens (Figures 5 & 6).
Compared with other types of peatlands, the wader density on the fens is the highest, averaging 20.3±4.4 km^{-2}, the commonest species being Common Snipe (9.3±1.5 km^{-2}), Lapwing (6.0±1.8 km^{-2}), and Green Sandpiper (2.5±0.9 km^{-2}). Mixed colonies of Lapwing and Black-tailed Godwit, including single pairs of Redshank, Ruff, Common Snipe, Great Snipe, and Curlew are characteristic of this type of peatland. Such colonies can consist of 30-50 breeding pairs.

The richest wader communities recorded on individual fens were on those bigger than 1,000 ha which provided a mosaic habitat structure, from the black alder *Alnus glutinosa* and birch *Betula* spp. associations to the open sedge-moss floating mats, bogs and water bodies. The presence of open low-grass associations is a requirement for waders breeding on fens.

Nest-sites of waders on the boggy and almost impassable fens are better protected from disturbance and predation than those on the raised bogs. During the breeding period they are mostly unvisited by people, due to the absence of large berry-fields and good lakes for fishing, and limited hay-making occurs only on some of them (this was more intense in the past). In contrast with nearby dry meadows, regular spring floods here delay the breeding of waders by an average of two to three weeks.

Fens which are located in flood-plains and lake depressions are important as areas of wader concentrations during the migration period. At the Mologa wetland complex, up to 3,000 Ruff per day and flocks of up to 65 Black-tailed Godwit were recorded in the first ten-day period of May (Zinoviev & Orlova 1983). On the flood-plain fens of the lower Shosha and lower Inyukha rivers (Ivan'kovskoye water reservoir, eastern Tver' region) up to 1,000 Ruff, 200 Black-tailed Godwit, and 100 Curlew per day were recorded at the end of August and in September.

Transformation of peatlands and their conservation problems

Intensified transformation of peatlands and their dissection into small fragments has been taking place recently. About 40% of the peatlands are either already managed or are now under economic development. The most drastic changes occur when milling cutter technology is used: not only is the vegetation eliminated, but also a large amount of peat is taken and thus the bog changes into a wide, flat field with numerous drainage canals. Species of waders which bred here formerly, with the exception of single pairs of Lapwing, do not do so any more, but Little Ringed Plover *Charadrius dubius* and Terek Sandpiper *Xenus cinereus* appear and breed on the fields near pools and drainage canals. As those fields which remain wet become vegetated, they become more attractive for breeding Greenshank and Common Snipe.

The large, already developed peat-pits of various sizes and ages (20 to 90 years old) are at different stages of vegetation and may have areas of moss floating mats and moss islands, reed-beds and pine-birch thickets along the edges. This environment is better for breeding waders, but as these habitats are accessible to people and predators, disturbance, clutch predation and chick mortality are higher. Green Sandpiper and Common Snipe are common there, and Wood Sandpiper and Greenshank breed occasionally on the floating mats.

The old peat production areas have partly, or mostly, lost their importance as wader habitats due to drying out and colonisation by trees and shrub vegetation and are inhabited by typical forest birds. Drainage for forestry purposes also gradually changes the appearance of natural peatlands as they dry out and the open parts grow over with low shrubs, pines and birches, the area of favourable habitat for waders is reduced. Only the Green Sandpiper remains in such areas. On the partly transformed peatlands, which cannot be completely dried out, the population of waders and other fauna is noticeably impoverished and does not rehabilitate to a natural level.

Agricultural drainage mostly affects the fens situated in flood-plains, or within the agricultural landscape. Such fens suffer not only from drainage, but also from felling of trees, clearance of shrub vegetation and ploughing. In most years these areas are sown with forage or cereal crops. Distribution of waders on peatlands under drainage becomes sporadic and their numbers quickly change. Lapwing become more widespread and their numbers increase, and Little Ringed Plover begin breeding locally on places with sparse vegetation. Curlew remain in single pairs on pastures and clover fields and, like Redshank, Marsh Sandpiper and Black-tailed Godwit can also breed in small, marshy (not completely drained) depressions. The majority of these waders visit drained habitats only in search of food. On drained peatlands, birds suffer from intensified disturbance, the use of agricultural machinery, pasturing, and high numbers of Hooded Crow *Corvus cornix* and Magpie *Pica pica*. The boggy habitats of waders in the central and eastern parts of the upper Volga area and in the flood-plains of large rivers (*e.g.* Mologa, Medveditsa, Tvertsa, Shosha *etc.*) suffered most from economic development. In the western part of the region the after-effects of forest melioration were the strongest and the effects of peatland development were only local.

As the peat resources decrease in most of the developed areas, new areas, often situated a considerable distance from the centre of the peat-industry are being used. This increases the threat to the peatlands, which are important for waders and

other birds, including rare species which may not be known about by ornithologists and conservationists. The main measure for the maintenance of species diversity and numbers of waders in the areas where peatlands occur, should be the protection of their habitats by excluding peatlands from economic development plans. The list of protected bogs in Tver' region contains 160 bog areas with a total area of about 330,000 ha. They are important, not only from an ornithological point of view, but also for the maintenance of the water table and conservation of other natural resources. Several of these protected bogs are situated within the Centralno-Lesnoi Biosphere Reserve (south-western Tver' region), the others are under regional protection as landscape, hydrological, botanical or zoological sanctuaries. The ten that are the most valuable, from an ornithological point of view, were suggested for inclusion in the list of Important Bird Areas in Europe (Figure 2).

It should be taken into account that many other rare bird species (Golden Eagle *Aquila chrysaetos*, Merlin *Falco columbarius*, Black-throated Diver *Gavia arctica*, Black Stork *Ciconia nigra*) completely depend on these moorlands. This also increases the importance of peat-bogs as bird habitats. As the peat-bogs do not have large, high quality timber resources and are therefore of low economic interest, it would be easy for the forest ministry to found a reserve in this area. In general, ornithological exploration should be carried out before all the planned activities of peatland development, and special management plans should be developed for improving the bird habitats on already transformed peatlands.

Conclusion

Peatlands represent one of the least developed and most valuable habitats for waders in the temperate woodland zone. The highest diversity of wader fauna is observed either on the early (fens) or on the latest (moors) stages of bog formation. Economic development of peatlands leads to a reduction in numbers and complete cessation of breeding in the majority of wader species. The early stages of succession on the transformed bogs do not provide the "typical bog" waders with the necessary conditions for breeding, and thus these species are replaced there by other widespread waders. An increase in direct human disturbance, such as use of off-road vehicles, gathering of berries, game hunting etc. is currently taking place. Nevertheless, the role of virgin peatlands in wader conservation will be more and more important as human influences on bird habitats intensify.

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