ECOLOGICAL CONTRIBUTIONS OF CITIZEN SCIENTISTS: AVIFAUNA COMPOSITION IN DEPLETED PEAT PIT RESERVOIRS OF NIZHNY NOVGOROD

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ABSTRACT

The study aimed to evaluate the contribution of citizen scientists in identifying bird species in human-altered environments, specifically depleted peat pits in the Nizhny Novgorod oblast. The methods involved collecting and analyzing birdwatching records from the iNaturalist platform, focusing on eight IBAs with significant contributions. These records were compared with published species lists to calculate the extent of new species identifications. Results showed that citizen scientists contributed significantly to the avifauna data, identifying on average 50% of the total bird species recorded in these areas, with some IBAs showing up to 85.7% species contribution. The findings also highlighted a correlation between citizen science activity and the proximity of IBAs to major population centers. The most motivated citizen scientists have made a significant contribution to the study of the avifauna of IBAs.

Keywords: Important Bird Areas (IBAs), iNaturalist platform, Biodiversity monitoring, Anthropogenic habitats, Human-transformed ecosystems.

INTRODUCTION

The role of citizen scientists in modern science is growing rapidly (Allf et al., 2022; Callaghan et al., 2021; Forti et al., 2024; Suškevičs et al., 2024). Searching for "citizen science" and "participatory monitoring" keywords in the Scopus system give many thousands of results (Hajazi et al., 2024; Kassenova et al., 2024; Sambuaga et al., 2024; Sapanov et al., 2024). The data of citizen scientists are actively used in fauna research, in particular revealing the species composition of the avifauna of separate territories (Gryadunova et al., 2020; Matvienko et al., 2022; Prenda et al., 2024; Zhyrgalova et al., 2024).

In this article, we evaluate the role of citizen scientists in the study of the species composition of the avifauna of human transformed habitats using the example of reservoirs of depleted peat deposits in the Nizhny Novgorod oblast (Galkin et al., 2023; Gryadunova et al., 2020). Ornithological surveys convincingly confirm that such water bodies

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are very important for bird conservation (Bakka et al., 2024; Chudnenko and Bykov, 2018; Rakhimov et al., 2023; Solov'yeva et al., 2006; Spiridonov, 2009; Spiridonov et al., 2011), and often have the status of Important Bird Areas (IBAs) of various levels – from international to regional (Bakka et al., 2014, 2024; Heath and Evans, 2000; Kovalev et al., 2020; Sviridova and Zubakin, 2000; Yernazarova et al., 2023). Such territories, widespread in the forest zone of European Russia, are convenient models for studying the changes in landscapes caused by human impact (Asadulagi et al., 2024; Astashin et al., 2023a, 2023b; Baidalina et al., 2024; Kamerilova et al., 2023; Turner, 2010). Ornithologists surveyed the separate elements of bird populations important for the bird conservation on the water bodies of the depleted peat deposits of the Nizhny Novgorod oblast such as nesting colonies and sites or rare species. Thus, information on faunistic complexes is quite insufficient, and there are no species lists for such significant territories.

The results of surveys, including the prepared incomplete species lists, were published in (Bakka et al., 2014). IBAs monitoring is important for bird conservation, including an estimation of the habitat conditions, population trends and changes in bird species composition and numbers (Nguyen et al., 2024). A small number of professional ornithologists cannot continuously monitor the condition of many dozens of IBAs in the region. Citizen scientists provide significant assistance in this work. Now Nizhny Novgorod citizen scientists mainly use the iNaturalist to record their observations. The information posted on this site does not contain estimates of the bird number but allows us to refine and supplement the species lists, as well as confirm the presence of rare species in the studied territories.

Water bodies of depleted peat pits adopted as IBAs are places very attractive for citizen scientists due to their relatively close location from large settlements (Bugubayeva et al., 2024), the presence of large concentrations of birds and the presence of a significant number of rare species (Gorelkina et al., 2024).

MATERIALS AND METHODS

The data obtained by citizen scientists within the project "Important bird areas of the Nizhny Novgorod oblast" on the Inaturalist platform, on 9 IBAs, including reservoirs of depleted peat pits, have been analyzed (iNaturalist, 2023). Figure 1 illustrates location of these IBAs, Table 1 presents their characteristics.

Table 1. Characteristics of the studied territories.

| No.	IBA	Status	Area, ha	Distance from N. Novgorod, km
1	Chashkovskoe mire	regional	247.4	42.6
2	Peat pits of Volodarsk and Balakhna districts	international (global)	47421.7	33.5
3	Forests and swamps in the Semilovsky forestry and adjacent	international (European)	28872.9	183.3
4	The territory between Kovrigino village and Gorodets	regional	2298.6	52.6
5	Bogs and swamps in the Pavlovskoye Zaochye and an adjacent area of the Oka River floodplain	international (global)	45857.5	73.6
6	Peat bogs and pits near the villages of Frolischi and Chistoe	international (European)	20918.5	71.2
7	Bolsheorlovskaya	international (European)	99185.8	41.5
8	Sitniki peat pits	international (global)	4868.7	15.8
9	Peat pits near the Mezino railway crossing	regional	793.7	138.6
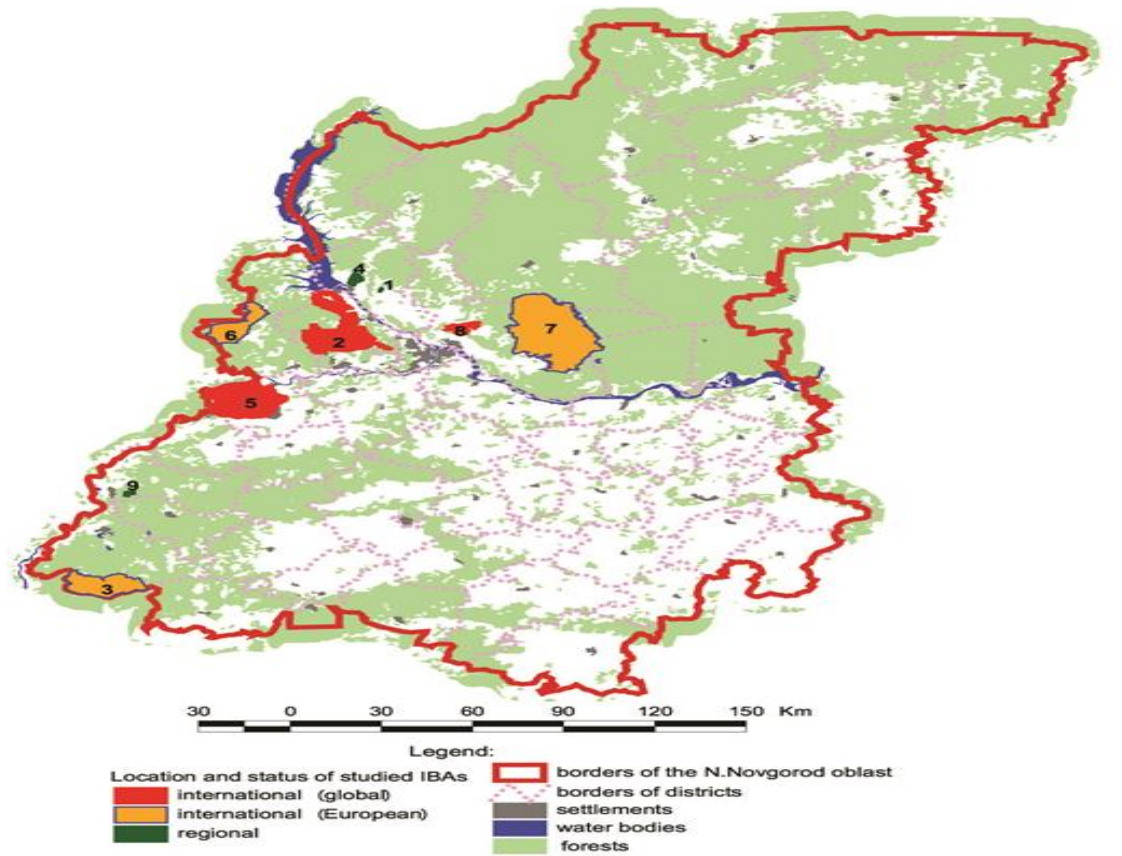
Figure 1. Location of the studied IBAs in the Nizhny Novgorod oblast.

The data for the analysis were 3171 observations of citizen scientists posted on iNaturalist. The number of citizen scientists who surveyed particular IBAs and the number of bird observations they posted on the site is shown in Table 2.

Table 2. Number of citizen scientist who surveyed particular IBAs and number of bird observations made and posted by them

No.	IBAs	Number of	
		observations	birdwatchers
1	Chashkovskoe mire	6	2
2	Peat pits of Volodarsk and Balakhna districts	471	26
3	Forests and swamps in the Semilovsky forestry and adjacent	14	1
4	The territory between Kovrigino village and Gorodets	7	2
5	Bogs and swamps in the Pavlovskoye Zaochye and an adjacent area of the Oka River floodplain	2286	21
6	Peat bogs and pits near the villages of Frolischi and Chistoe	104	18
7	Bolsheorlovskaya	144	13
8	Sitniki peat pits	139	14
9	Peat pits near the Mezino railway crossing	0	0

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We compared the data on the avifauna of the studied territories, presented by citizen scientists, with previously published information (Bakka et al., 2014). The share of additions (%) made by citizen scientists to the bird species list of each studied area are calculated. The correlation of the number of citizen scientists and the volume of information collected by them with the distance between the studied territories and the regional center and the IBA areas is determined.

RESULTS AND DISCUSSION

The results of comparing the data on the number of bird species recorded by ornithologists during the revealing of IBAs (Bakka et al., 2014) and citizen scientists during subsequent visits to the studied territories are presented in Table 3.

Table 3. Number of bird species recorded by ornithologists during the revealing of IBAs
and citizen scientists during subsequent visits to the studied territories

No.	IBAs	Number of registered bird species				
		In catalog (Chudnenko and Bykov, 2018)	On Inaturalist	Total	Shared for catalog and site	Only on site
1	Chashkovskoe mire	19	6	24	1	5
2	Peat pits of Volodarsk and Balakhna districts	30	98	107	21	77
3	Forests and swamps in the Semilovsky forestry and adjacent	9	11	19	1	10
4	The territory between Kovrigino village and Gorodets	3	5	7	1	4
5	Bogs and swamps in the Pavlovskoye Zaochye and an adjacent area of the Oka River floodplain	28	193	196	25	168
6	Peat bogs and pits near the villages of Frolischi and Chistoe	22	48	63	7	41
7	Bolsheorlovskaya	13	65	72	6	59
8	Sitniki peat pits	43	39	60	22	17
9	Peat pits near the Mezino railway crossing	12	0	12	0	0

Source: Bakka et al. (2014), Sviridova and Zubakin (2000).

There are 9 IBAs in the Nizhny Novgorod oblast with water bodies of depleted peat pits, and the most significant information is posted on the iNaturalist by citizen scientists for 8 of them.

The shares of bird species recorded by ornithologists during the revealing of IBAs (Bakka et al., 2014) and by citizen scientists during subsequent visits from the total number of bird species registered in the studied territories are presented in Table 4.

Table 4. The shares of bird species recorded by ornithologists during the revealing of IBAs and by citizen scientists during subsequent visits from the total number of bird species registered in the studied territories.

No.	IBAs	Percentage of the total number of bird species registered		
		Only in catalog	In catalog and on iNaturalist	Only on iNaturalist
1	Chashkovskoe mire	75	4.2	20.8
2	Peat pits of Volodarsk and Balakhna districts	8.4	19.6	72
3	Forests and swamps in the Semilovsky forestry and adjacent	42.1	5.3	52.6
4	The territory between Kovrigino village and Gorodets	28.6	14.3	57.1
5	Bogs and swamps in the Pavlovskoye Zaochye and an adjacent area of the Oka River floodplain	1.5	12.8	85.7
6	Peat bogs and pits near the villages of Frolischi and Chistoe	23.8	11.1	65.1
7	Bolsheorlovskaya	9.7	8.3	82
8	Sitniki peat pits	35	36.7	28.3
9	Peat pits near the Mezino railway crossing	100	0	0
	min	1.5	0	0
	max	100	36.7	85.7
	average	36	12.5	51.5
	Standard deviation	32.6	10.8	29.3

Source: Bakka et al. (2014).

The lack of citizen scientists' contribution to the list of avifauna of the studied territories can be considered as an exception. On average, citizen scientists identified about 50% of the bird species lists on IBAs. The maximum contribution reaches 85.7% of the revealed composition of the avifauna. It is very noteworthy that the percentage of species registered by both specialists and citizen scientists is small and averages about 12%.

The indicators characterizing the activity of citizen scientists (the number of observers and the number of observations) at different IBAs range significantly. There is a negative correlation of these figures with the distance from IBAs to the regional center and a positive correlation with the IBAs area (Table 5).

Table 5. Correlation between the activity of citizen scientists and the distance from IBA to the regional center and the IBA area.

The correlation coefficient between:	**Value**
the number of observations and the distance from IBA to Nizhny Novgorod	-0.08
the number of birdwatchers and the distance from IBA to Nizhny Novgorod	-0.52
the number of observations and the IBA area	0.29
the number of birdwatchers and the IBA area	0.49

The correlation between the number of observations and the distance from IBA to Nizhny Novgorod is very insufficient. If we delete IBA No 5 "Bogs and swamps in the Pavlovskoye Zaochye and an adjacent area of the Oka River floodplain", where one active birdwatcher made more than 2000 records, from the sampling, then the correlation coefficient will change to -0.46. This circumstance demonstrates the importance of the research efforts of motivated citizen scientists.

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CONCLUSION

- The rapidly developing activities of citizen scientists provide significant scientific results. Citizen scientists using the iNaturalist to record their observations make a significant contribution (on average about 50% of the number of identified species) to comply the faunistic list of IBAs, including water bodies of depleted peat pits. The activity of citizen scientists is of particular importance for the study of large IBAs located at a short distance from the regional center. The most significant contribution to the study of the IBA avifauna is made by single, most motivated citizen scientists.
- In the future, it is important to develop citizen science, increase the motivation of the participants, and develop Internet resources used to present results. This will allow us to get information not only about the species composition, but also about the status and the number of.

REFERENCES

1. Allf BC, Cooper CB, Larson LR, Dunn RR, Futch SE, Sharova M, Cavalier D, (2022). Citizen science as an ecosystem of engagement: Implications for learning and broadening participation, *BioScience 72(7),* 651-663. https://doi.org/10.1093/biosci/biac035;
2. Asadulagi MAM, Pershin IM, Tsapleva VV, (2024). Research on hydrolithospheric processes using the results of groundwater inflow testing, Water 16(3), 487. https://doi.org/10.3390/w16030487;
3. Astashin A, Vatina O, Podkovyrina V, Ogurcov A, Tihanov E, (2023a). Morphometric, hydrological characteristics and genesis of Lakes of the Povolzhskij section of the projected National Park Nizhegorodskoe Zavolzh'e, E3S Web of Conferences 420, 04010, https://doi.org/10.1051/e3sconf/202342004010;
4. Astashin AE, Ershova KV, Badin MM, Ufilina VA, Vatina OE, (2023b). Landscape structure of the territory of the peatland of international importance "Kamsko-Bakaldinskaya group of mires", Geosphere Research 2, 142-154. https://doi.org/10.17223/25421379/27/10;
5. Baidalina S, Akhet A, Baidalin M, Bayazitova Z, Bekimova G, Ualiyeva G, (2024). Enhancing nutritional value and production efficiency of feeds through biochemical composition optimization, Organic Farming 10(1), 80-93. https://doi.org/10.56578/of100105;
6. Bakka S, Kiseleva N, Lobov P, Galustyan O, Shestakova A, Matveeva A, (2024). Water bodies of former peat pits as the most important nesting sites for some species of Laridae in the center of European Russia, E3S Web of Conferences 539, 02033. https://doi.org/10.1051/e3sconf/202453902033;
7. Bakka SV, Kiseleva NYu, Denisov DA, Odrova LN, (2014). Klyuchevyye Ornitologicheskiye Territorii Nizhegorodskoy Oblasti [Important Bird Areas of the Nizhny Novgorod Oblast]: Manual. Ecocenter "Dront", Nizhny Novgorod;
8. Bugubayeva AU, Chashkov VN, Valiev KK, Kuanyshbayev SB, Kupriyanov AN, Mamikhin SV, Nugmanov AB, Shcheglov AV, Bulaev AG, Paramonova TA, Joldassov A, Uxikbayeva M, (2024). Improving the level of water quality and plant species diversity in the reservoir accumulating natural effluents from the reclaimed uranium-containing industrial waste dump, Brazilian Journal of Biology 84, e282386;
9. Callaghan CT, Poore AGB, Mesaglio T, Moles AT, Nakagawa S, Roberts C, Rowley JJL, Vergés A, Wilshire JH, Cornwell WK, (2021). Three frontiers for the future of biodiversity research using citizen science data, *BioScience 71(1),* 55-63. https://doi.org/10.1093/biosci/biaa131;

10. Chudnenko DE, Bykov YuA, (2018). Features and patterns of dynamics of fauna and birds' population in the turf quarry complexes, Ecosystems: Ecology and Dynamics 3, 5-28. https://doi.org/10.24411/2542-2006-2018-10013

11. Forti LR, Da Silva Passetti AMPR, Oliveira T, Freitas K, De Freitas Costa G, De Lima Maia JV, Queiros A, Lopes MADF, Szabo JK, (2024). Stronger together: Different community science platforms all contribute to wildlife research, Wildlife Research 51, WR23160. https://doi.org/10.1071/WR23160;

12. Galkin A, Pankov VYu, Fedorov YaV, (2023). Radius teplovogo vliyaniya kamer podzemnykh sooruzheniy kriolitozony [The radius of thermal influence of the chambers of underground structures of the cryolithozone], Arktika i Antarktika 4, 1-8. https://doi.org/10.7256/2453-8922.2023.4.69178;

13. Gorelkina AK, Timoshchuk IV, Mikhaylova ES, Neverov EN, (2024). Monitoring the state of waterbodies and taking into account anthropogenic impact, International Journal of Agriculture and Biosciences 13(3), 444-448. https://doi.org/10.47278/journal.ijab/2024.143;

14. Gryadunova AA, Koudan EV, Rodionov SA, Pereira FDAS, Meteleva NY, Kasyanov VA, Parfenov VA, Kovalev AV, Khesuani YD, Mironov VA, Bulanova EA, (2020). Cytoskeleton systems contribute differently to the functional intrinsic properties of chondrospheres, Acta Biomaterialia 118, 141-152. https://doi.org/10.1016/j.actbio.2020.10.007;

15. Hajazi MUA, Razalli MR, Yusoff YM, (2024). Mapping of collaborative innovation research: A bibliometric analysis, International Research Journal of Multidisciplinary Scope 5(4), 331-343;

16. Heath MF, Evans MI, (2000). Important Bird Areas in Europe: Priority Sites for Conservation. Vol. 1: Northern Europe. BirdLife International, Cambridge;

17. iNaturalist, (2023). Important bird areas of the Nizhny Novgorod oblast. Available at: https://www.inaturalist.org/projects/kotr-nizhegorodskaya-oblast (accessed June 15, 2024);

18. Kamerilova GS, Astashin AE, Astashina NI, (2023). Landscape-ecological approach to the organization of scientific research activities of university students, Vestnik of Minin University 11(2), 3. https://doi.org/10.26795/2307-1281-2023-11-2-3;

19. Kassenova Z, Iskakov Y, Bolat Y, Bauyrzhan K, Mezgil S, Dina I, Maira K, Dariga N, (2024). Effectiveness of oil-contaminated soil reclamation with humic preparations, International Journal of Agriculture and Biosciences 13(3), 474-487. https://doi.org/10.47278/journal.ijab/2024.154;

20. Kovalev AV, Kholmogorskaya OV, Korenkova MV, (2020). Structural dynamics of skin regeneration after thermal burns in controlled water environment (experimental study), Systematic Reviews in Pharmacy 11(12), 1564-1567;

21. Matvienko EV, Zolkin AL, Suchkov DK, Shichkin IA, Pomazanov VV, (2022). Applying of smart, robotic systems and big data processing in agro-industrial complex, IOP Conference Series: Earth and Environmental Science 981, 032002. https://doi.org/10.1088/1755-1315/981/3/032002;

22. Nguyen TTH, Dang TT, Nguyen TTN, Nguyen TH, Akhtar R, Nguyen HC, (2024). The impact of factors on environmental pollution in asean countries: The role of institutional quality, Multidisciplinary Science Journal 7(3), 2025086. https://doi.org/10.31893/multiscience.2025086;

23. Prenda J, Domínguez-Olmedo JL, López-Lozano E, Fernández de Villarán R, Negro JJ, (2024). Assessing citizen science data quality for bird monitoring in the Iberian Peninsula, Scientific Reports 14, 20307. https://doi.org/10.1038/s41598-024-70827-3;

24. Rakhimov II, Zainullin MA, Ignashev NE, (2023). Natural and technogenic water bodies as reserves for the conservation of biological diversity in the Republic of Tatarstan: Problem statement and analysis, The Academic Journal of Moscow City University, Series "Natural Sciences" 2(50), 21-36. https://doi.org/10.25688/2076-9091.2023.50.2.02;

25. Sambuaga D, Sumual TEM, Naharia O, Rotty VNJ, (2024). Public awareness on general environmental and sustainability issues, International Research Journal of Multidisciplinary Scope 5(4), 579-591;

26. Sapanov MK, Elekesheva MM, Sizemskaya ML, Kolesnikov AV, (2024). Ecological condition and invasiveness of Fraxinus pennsylvanica in different ecotopes of the arid Caspian region, Brazilian Journal of Biology 84, e284645. https://doi.org/10.1590/1519-6984.284645;

27. Solov'yeva VV, Yasuuk VP, Pures'kin MA, (2006). Hydrobotanical and ornithological features of reservoirs of the Samara region reservoins, Byulleten' Samarskaya Luka 18, 139-150;

28. Spiridonov SN, (2009). Rol' antropogennykh vodoyemov v sokhranenii redkikh vidov ptits [The role of anthropogenic reservoirs in the preservation of rare bird species], Vestnik of the Orenburg State University 6, 354-356;

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Alena Zaitseva[2], Yulia Morilova[2]

29. Spiridonov SN, Sarychev VS, Okolelov AYu, Isakov GN, Sucharev EA, (2011). Community structure of birds of industrial reservoirs of European Russia forest-steppe zone, Izvestia RAS SamSC 13(1), 153-160;

30. Suškevičs M, Storie JT, Kilvits C, Külvik M, (2024). What is the scientific evidence on the linkages between citizen science engagement levels and protected areas' governance outcomes? A systematic map and qualitative synthesis, Journal for Nature Conservation 82, 126712. https://doi.org/10.1016/j.jnc.2024.126712;

31. Sviridova TV, Zubakin VA (Eds.), (2000). Klyuchevyye Ornitologicheskiye Territorii Rossii [Important Bird Areas of Russia]. Russian Bird Conservation Union, Moscow;

32. Turner MG, (2010). Disturbance and landscape dynamics in a changing world, Ecology 91(10), 2833-2849. https://doi.org/10.1890/10-0097.1;

33. Yernazarova GI, Ramazanova AA, Turasheva SK, Almalki FA, Hadda TB, Orazova SB, Madenova AK, Admanova GB, Korul'kin DY, Sabdenalieva GM, Naimi S, Bukharbayeva Zh, Amangeldinova ME, (2023). Extraction, purification and characterisation of four new alkaloids from the water plant Pistia stratiotes: POM analyses and identification of potential pharmacophore sites, Research Journal of Pharmacy and Technology 16(7), 3410-3416. https://doi.org/10.52711/0974-360X.2023.00564;

34. Zhyrgalova A, Yelemessov S, Ablaikhan B, Aitkhozhayeva G, Zhildikbayeva A, (2024). Assessment of potential ecological risk of heavy metal contamination of agricultural soils in Kazakhstan. Brazilian Journal of Biology 84, e280583. https://doi.org/10.1590/1519-6984.280583;