OBSERVATIONS ON PRESENCE, ABUNDANCE, DYNAMIC AND DIVERSITY OF BIRD SPECIES (AVES) FROM THE DANUBE EVERGLADE (DOLJ COUNTY, ROMANIA)

ALEXANDRU CĂTĂLIN BIRĂU[*], SIMONA DUMITRIȚA CHIRILĂ[**] ,
ALMA LIOARA NICOLIN[***], DUMITRU MURARIU[****]

A valuable Data base getting along 25 years on 34 bird species from a protected area (Site Ramsar Bistreț, Dolj County, Romania) illustrates permanent presence of 24 water fowl with significant yearly differences between reported taxa. Ecological indexes and species abundance revealed an avian richness in 1998 and the lowest number of species in 2021. These differences could be on the one side because of natural conditions (temperature, relative humidity, drought), and on the other side – because of anthropic pressure, mainly hunting. Therefore the statute of the surveyed protected area should be a real refuge for the protected bird species in a part of the Danube Everglade.

Keywords: Bird conservation, ROSPA0010, water fowl, bird census.

INTRODUCTION

Over time, climate change has been shown to be a key factor in changes in bird distribution and abundance (Trautmann, 2018). Thus, birds are considered indicators of ecosystem condition (Gregory & Strien, 2010; Li *et al*., 2021). Among bird species, the most sensitive to climatic conditions are waterbirds (Jordán, 2017). They are used as important bio-indicators of wetland habitat change (Rahman & Ismail, 2018). In this context, it is essential to monitor the presence and activity of waterbirds to provide an early warning of the danger to our environment (Burger, 2006; Rahman & Ismail, 2018). Waterbirds have also been used as sentinel species in various environmental toxicology issues (Zhang & Ma, 2011; Rahman & Ismail, 2018).

According to the Ramsar Convention (1994), waterbirds are "ecologically dependent on wetlands". In this context, waterbirds use wetlands both for wintering – longer periods, and for 'stopovers' – for shorter periods (Warnock, 2010; Maneas *et al*., 2020).

One of Romania's important wetlands on the Danube Plain is the Bistreț Lake Complex (Dolj County). It has been declared a Special Protection Area since Romania joined to the European Union and since 2012 it has also received Ramsar site status, in order to conserve 24 waterbird species listed in Annex I of the Birds Directive (Ridiche *et al*., 2021). These include the Red-breasted Goose, the Lesser white-fronted goose, the Dalmatian Pelican or the Ferruginous duck, species that use the site for feeding, resting or nesting.

The aim of our study was to analyse the diversity and abundance of waterbirds and shorebirds species wintering in ROSPA0010 Bistreț, by analysing data collected in the International Waterbird Census, coordinated by Wetlands International (IWC) between 1988 and 2022.

MATERIAL AND METHODS

Study area

The study area is Lake Bistreț, which is one of the largest natural lakes in the Danube Plain, located in Dolj County (Ridiche & Vișan, 2008) and covers an area of 2.030 ha (Fig. 1).

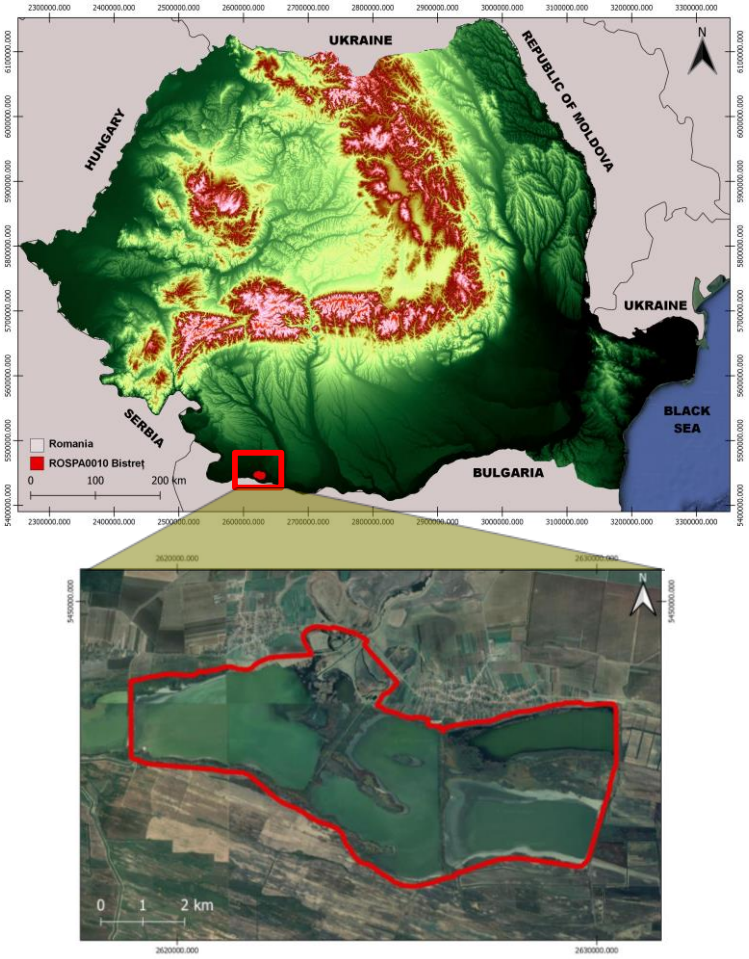

Fig. 1. Study area (© Simona Dumitrița Chirilă).

Data collection

The study analysed a dataset of observations collected over a 13-year period, with an output at the same time of year: mid-January, from 1988 to 2022. Between 1988 and 2019 data were collected from participants of the International Waterbird Census, that dataset was accessed from the online database of the Romanian Ornithological Society (Ornitodata) and the data collected between 2020–2022 are personal observations.

Field equipment consisted of Leica 42x10HD binoculars, Leica Apo-Televid 82 W telescope with Leica Vario 25-50x WW ASPH eyepiece and Canon 70D camera with Sigma 150–600 mm Contemporary telephoto lens.

Statistical analysis

Five statistical indices (abundance, Shannon index, Evenness index, Margalef index and Simpson index) were calculated in PAST version 4.03 (Hammer *et al*., 2001). Differences in the number of species and the number of individuals between years were analysed using Kruskal-Wallis and Mann-Whitney non-parametric post-hoc tests. The map of the study area was produced in QGIS version 3.24.1.

RESULTS

During the study period, 34 bird species from four orders were recorded. In turn, 24 species are aquatic and ten species are shorebirds, classified in the following seven families: Anatidae (19), Scolopacidae (5), Phalacrocoracidae (3), Laridae (3), Rallidae (3), Recurvirostridae (1) and Charadriidae (1). Most observations (19) were made in 2022, when the highest number of individuals (11,169) was also recorded.

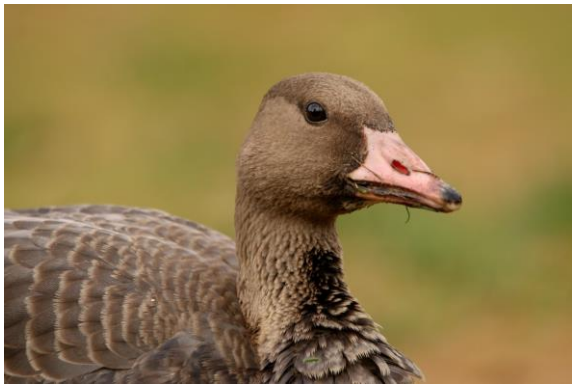

Fig. 2. Greater white-fronted goose (*Anser albifrons)* (photo: Alexandru Cătălin Birău).

Of the 34 species identified, if we consider only the aquatic ones, we found that 92% of them belong to the Order Anseriformes, in which the species *Anser albifrons* was dominant in number of individuals. The other three orders were represented as follows: Gruiformes – 3.4% species – through *Fulica atra*; Pelicaniformes – 1.9%, with most individuals of *Phalacrocorax carbo*; Charadriiformes with waders species, among which *Larus ridibundus* was the most frequent.

Of the 34 species of waterbirds and shorebirds, *Anser albifrons* (42.57%), *Anas crecca* (19.06%) and *Anas platyrhynchos* (17.35%) had the highest percentage frequency, and the species with the lowest frequency were *Vanellus vanellus* (0. 002%), *Gallinula chloropus* (0.002%), *Tachybaptus ruficollis* (0.002%), *Tringa stagnatilis* (0.004%), *Rallus aquaticus* (0.004%) and *Recurvirostra avosetta* (0.012%).

Fig. 3. Little grebe (*Tachybaptus ruficollis*) (photo: Alexandru Cătălin Birău).

According to IUCN (International Union for Conservation of Nature) criteria, 77% of the bird species surveyed are classified as non-Endangered, 12% are Near Threatened with extinction, and 12% are Vulnerable (i.e. at high risk of extinction). The species classified as Vulnerable are represented by: *Anas acuta*, *Aythya ferina*, *Cygnus columbianus* and *Vanellus vanellus*.

Some of the bird species analysed are also protected by Annex 1 of the Bern Convention: *Mergellus albellus*, *Cynus cygnus*, *Microcarbo pygmaeus*, *Recurviristra avosetta* and *Aythya nyroca* and by the Bonn Convention: *Calidris alpina*, *Larus cachinnans*, *L. canus*, *L. ridibundus*, *Limosa limosa*, *Numenius arquata*, *Recurvirostra avosetta*, *Tringa erythropus*, *T. stagnatilis* and *Vanellus vanellus*.

Fig. 4. Pygmy cormorant (*Microcarbo pygmaeus*) (photo: Alexandru Cătălin Birău).

Table 1

Characteristics of birds from the ROSPA0010 site

Taxa	Common name	No. observations	No. individuals	IUCN		Bern Convention	Bonn Convention
				Europe	Global		
Anseriformes							
Anatidae							
Anas acuta	Pintail	3	47	VU	LC		
Anas crecca	Eurasian teal	12	7849	LC	LC		
Anas platyrhynchos	Mallard	28	7146	LC	LC		
Anser albifrons	Greater white-fronted goose	15	17533	LC	LC		
Anser anser	Greylag goose	9	2481	LC	LC		
Mareca penelope	Eurasian wigeon	5	169	LC	LC		
Mareca strepera	Gadwall	8	356	LC	LC		
Tadorna tadorna	Common shelduck	8	366	LC	LC		
Netta rufina	Red-crested pochard	1	19	LC	LC		

Table 1 (continued)

Mergellus albellus	Smew	5	51	LC	LC	x	
Mergus merganser	Common merganser	1	60	LC	LC		
Spatula clypeata	Northern shoveler	5	91	LC	LC		
Aythya ferina	Common pochard	2	185	VU	VU		
Aythya fuligula	Tufted duck	1	8	NT	LC		
Aythya nyroca	Ferruginous duck	1	75	LC	NT	x	
Bucephala clangula	Common goldeneye	7	248	LC	LC		
Cygnus columbianus	Tundra swan	9	485	VU	LC		
Cygnus cygnus	Whooper swan	10	117	LC	LC	x	
Cygnus olor	Mute swan	18	629	LC	LC		
Charadriiformes							
Charadriidae							
Vanellus vanellus	Northern lapwing	1	1	VU	NT		x
Gruiformes							
Rallidae							
Fulica atra	Eurasian coot	8	1405	NT	LC		
Gallinula chloropus	Common moorhen	1	1	LC	LC		
Rallus aquaticus	Water rail	1	2	LC	LC		
Recurvirostridae							
Recurvirostra avosetta	Pied avocet	1	5	LC	LC	x	x
Laridae							
Larus cachinnans	Caspian gull	6	58	LC	LC		x
Larus canus	Common gull	4	52	LC	LC		x
Larus ridibundus	Black-headed gull	10	646	LC	LC		x
Scolopacidae							
Calidris alpina	Dunlin	2	82	LC	LC		x
Limosa limosa	Black-tailed godwit	2	117	NT	NT		x
Numenius arquata	Eurasian curlew	4	78	NT	NT		x

Table 1 (continued)

Tringa erythropus	Spotted redshank	1	11	LC	LC		x
Tringa stagnatilis	Marsh sandpiper	1	2	LC	LC		x
Pelecaniformes							
Phalacrocoracidae							
Microcarbo pygmaeus	Pygmy cormorant	8	69	LC	LC	x	
Phalacrocorax carbo	Great cormorant	9	735	LC	LC		
Tachybaptus ruficollis	Little grebe	1	1	LC	LC		

Table 2 shows the summary statistics on waterbird species from the ROSPA0010 site: number of observations, number of individuals, Simpson index, Evenness index, Margalef index, Shannon index and abundance.

Table 2

Summary statistics regarding the species of water birds from the ROSPA0010 site

Year	Taxa_S	Individuals	Simpson	Evenness	Margalef	Shannon	Abundance
1988	4	6130	0.31	0.44	0.34	0.56	2.43
2000	8	1129	0.74	0.56	1.00	1.50	0.55
2001	7	964	0.64	0.50	0.87	1.26	0.01
2005	12	507	0.76	0.48	1.77	1.74	0.01
2006	6	49	0.81	0.92	1.29	1.70	0.03
2007	6	1075	0.53	0.49	0.72	1.08	0.12
2010	15	421	0.85	0.59	2.32	2.18	0.00
2011	9	340	0.52	0.38	1.37	1.24	0.07
2013	3	807	0.02	0.35	0.30	0.06	0.01
2018	2	40	0.50	1.00	0.27	0.69	0.05
2020	15	10203	0.54	0.22	1.52	1.18	0.00
2021	12	7843	0.69	0.36	1.23	1.46	0.01
2022	19	11169	0.54	0.16	1.93	1.14	0.01

H specific diversity (Shannon index) of waterbird and shorebird species ranged from 0.06 to 2.18. The lowest diversity (0.06) was reported in 2013 and the highest diversity (2.18) was reported in 2010 (Table 1). The F-value was 1.051, showing no significant differences between years.

Waterbirds abundance ranged from 0.00 to 2.43 and was not significantly different ($p>0.05$). The highest value (2.43) was found in 1988, when 6130 individuals and four species were recorded. These species showed the following characteristics in the period 1988–2022: *Bucephala clangula*, with seven observations and 248 individuals; *Anas crecca*, with 12 observations and 7849 individuals; *Anas platyrhynchos*, with 28 observations and 7146 individuals and *Mareca penelope*, with five observations and 169 individuals.

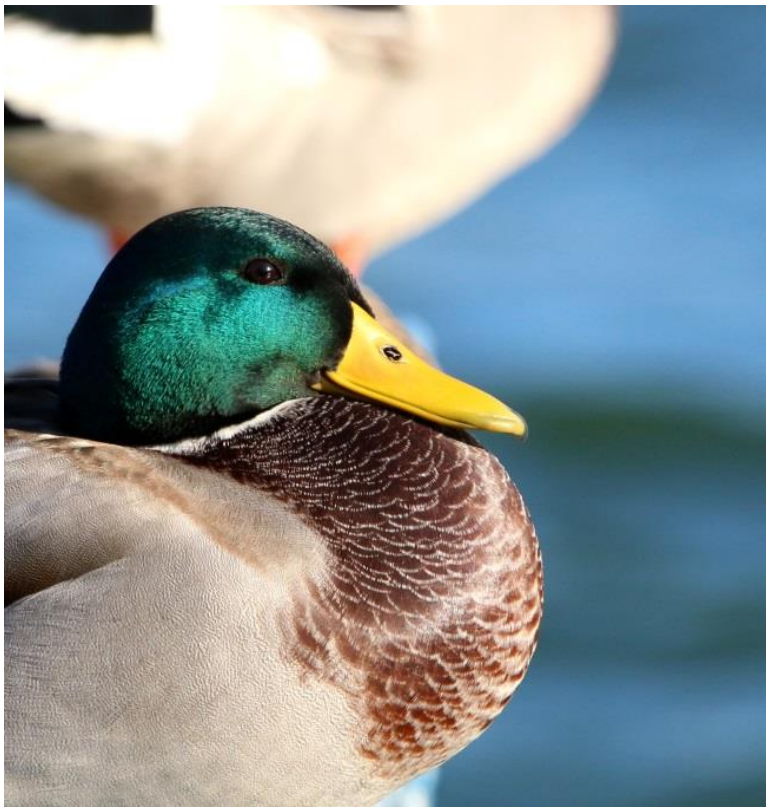

Fig. 5. Mallard (*Anas platyrhynchos)* (photo: Alexandru Cătălin Birău).

Uniformity (Evenness index) of waterbird and shorebird species ranged from 0.16 to 1.00. The highest value was reported in 2018 – the year in which *Cynus olor* and *Larus cachinnas* recorded the most individuals. In the case of *C. olor*, 18 observations and 629 individuals were recorded, and in the case of *L. cachinnans*, six observations and 58 individuals were recorded. The lowest Evenness index value was recorded in 2022, when the highest richness was reported, with 11,169 individuals and 19 species recorded. In this year, besides *Anser albirons*, *A. crecca* and *Anas platyrhynchos*, which recorded the most individuals, another species was

Anser anser. For the latter, nine observations were recorded, 2481 individuals, of which 1778 individuals were reported in 2022.

The species richness (Margalef index) of the bird community ranged from 0.30 in 2013 to 2.32 in 2010. The Simpson index averaged 0.570, indicating a moderately high degree of diversity/heterogeneity.

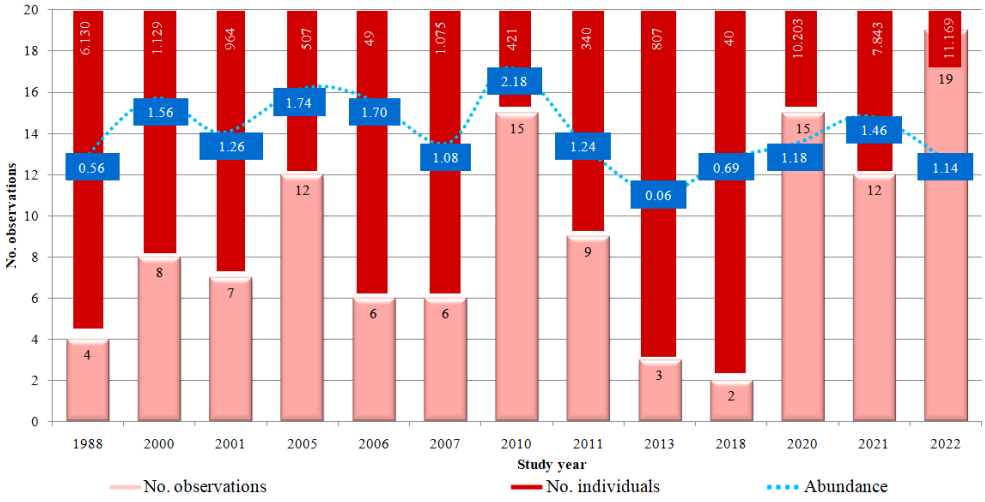

Fig. 6. The number of observations, the number of individuals and abundance in the period 1988–2022.

DISCUSSIONS

The low abundance and lower number of species in some years can be attributed both to natural factors: low temperatures leading to the freezing of water bodies, and to anthropogenic causes: hunting activities, in this case the difference between the first years of the study (1988–2020) and the last two years (2021–2022) – when hunting was stopped in Romania during the winter season – is evident, this factor being reflected in the higher number of birds present during our assessment.

CONCLUSIONS

1. The Bistreț Ramsar site is home to important wintering populations of Romania's wintering waterbird species. During the study, 24 aquatic species were identified, among which in recent years, the Greater white-fronted goose – *Anser albifrons* (17,533 individuals), the Common Teal – *Anas crecca* (7,849 individuals), the Mallard – *Anas platyrhynchos* (7,146 individuals) and the Greylag goose –

*Anser anser (*2,481 individuals) have stood out with large numbers. The highest number of observations was for the *Anas platyrhynchos* (28 observations).

2. There are differences in the species identified from year to year, with the most significant differences occurring between the early years of the survey – when data were collected by other participants in the International Waterbird Census, so we cannot be sure whether the differences were due to observer or natural causes – and the last 3 years – when we started the International Waterbird Census.

3. As far as shorebirds are concerned, their numbers are low and have not been consistently present throughout the study period. This is normal, given the tendency of many species to migrate to warmer places in winter. Of the ten shorebird species identified, species of the genus *Larus* recorded high numbers: the Common gull – *Larus canus* (52 individuals), the Caspian gull – *Larus cachinnans* (58 individuals) and the Black-headed gull – *Larus ridibundus* (646 individuals).

4. The highest diversity (2.42) of waterbird and shorebird was recorded in 2021, while the lowest bird diversity (0.08) was observed in 2013. Between years, there was a relatively significant difference in diversity. In this context, the variation in bird diversity between years is due to weather conditions and disturbance caused by hunters.

REFERENCES

BURGER J., 2006, *Bioindicators: Types, development, and use in ecological assessment and research*. Environmental Bioindicators, 1: 22–39.

GREGORY R. D., VAN STRIEN A., 2010, *Wild bird indicators: using composite population trends of birds as measures of environmental health*. Ornithological Science, **9** (1): 3–22.

HAMMER Ø., HARPER D.A.T., RYAN P.D. 2001, *PAST: Palaeontological statistics software package for education and data analysis*. Palaeontologia Electronica, **4**: 9.

JORDÁN D.P., 2017, *Waterbirds in a changing world: effects of climate, habitat and conservation policy on European waterbirds*. Academic dissertation, University of Helsinki.

LI X., ANDERSON C., WANG Y., LEI G., 2021, *Waterbird diversity and abundance in response to variations in climate in the Liaohe Estuary, China*. Ecological Indicators, **132**, 2021, 10828; https://doi.org/10.1016/j.ecolind.2021.108286.

MANEAS G., BOUSBOURAS D., NORRBY V., BERG H. 2020, *Status and Distribution of Waterbirds in a Natura 2000 Area: The Case of Gialova Lagoon, Messinia, Greece.* Frontiers in Ecology and Evolution, Sec. Conservation and Restoration Ecology. https://doi.org/10.3389/fevo.2020.501548

RAHMAN F., ISMAIL A., 2018, *Waterbirds: an important bio-indicator of ecosystem*. Pertanika Journal of Scholarly Research Reviews, **4** (1): 81–90.

RAMSAR CONVENTION, 1994, *Convention on Wetlands of International Importance Especially as Waterfowl Habitat 1971*. Available at: http://portal.unesco.org/en/ev.php-URL_ID=15398&URL_DO=DO_TOPIC&URL_SECTION=201.html (Accessed August 3, 2022).

RIDICHE M.S., VIȘAN C.L., 2008, *Agents that threat the stability of water birds population in special protection avifaunistical area* (SPA) *Bistre and some measures of counteracting them*. Muzeul Olteniei Craiova. Oltenia. Studii și comunicări. Științele Naturii, Tom. XXIV, 174–178.

RIDICHE M.S., KISS J.B., PETRESCU A., 2021, *Some considerations regarding the presence of the species Pelecanus onocrotalus Linnaeus, 1758 on lake Bistreț* (*Southwest Romania*). Muzeul Olteniei Craiova. Oltenia. Studii şi comunicări. Ştiinţele Naturii. Tom. 37, No. 2, 130–137.

TRAUTMANN S., 2018, *Climate Change Impacts on Bird Species*. Pp. 217-234. *In*: Tietze D.T. (Ed.), *Bird Species. Fascinating Life Sciences*. Springer, Cham, Switzerland, 266 pp.
WARNOCK N., 2010, *Stopping vs. Staging: the difference between a hop and a jump*. Journal of Avian Biology, **41**: 621–626.
ZHANG W.W., MA J.Z., 2011, *Waterbirds as bioindicators of wetland heavy metal pollution*. Procedia Environmental Science, 10 (Part C): 2769–2774.

***Ornitodata - Baza de date online a Societății Ornitologice Române, April 2022.
***https://www.wetlands.org/knowledge-base/international-waterbird-census/, april 2022.

Received July 21, 2022

[*] *University of Bucharest, Faculty of Biology, Splaiul Independenței No. 91–95, 060101, Bucharest, Romania*
e-mail: alex.offy@yahoo.com
[**] *Alexandru Ioan Cuza University of Iași, Blvd. Carol I 20A, Iași, RO-700505, Romania*
[***] *University of Life Sciences "King Michael I" from Timișoara, Romania*
[****] *Institute of Biology Bucharest, Romanian Academy, Splaiul Independenței No. 296, RO- 060031, Bucharest, Romania*