

Numbers and distribution of the Red-breasted Goose *Branta ruficollis* in southeast Romania

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Abstract

Southeast Romania is one of the most important wintering areas for the IUCN-designated vulnerable Red-breasted Goose *Branta ruficollis*, where regular monitoring has been undertaken as a contribution to the international Red-breasted Goose monitoring scheme from 2012 to 2022. Simultaneous roost counts were undertaken from November–February, covering 17 key sites for the species in southeast Romania, and all major wetlands in the country were surveyed in mid-January as part of the International Waterbird Census. The species was found wintering entirely near large lakes and wetlands in the lowlands of southeast Romania, exclusively concentrated in two regions: Baragan and coastal Dobrogea. Between 2012 and 2022, national totals

were estimated at between 8,660 and 23,783 individuals, with an average of 16,322 birds, which represents almost 30% of the global population. Population trends for the species in Romania over the same period are classified as “uncertain”. At the regional level, the 10-year period trend shows a moderate increase in Baragan region and a strong increase in coastal Dobrogea, but for the last five years the trend in both regions is uncertain. Solitary birds or small groups might be seen also in other wetlands across the western and eastern lowlands of the country for short periods of time, especially during migration. We found that 25% of observations of the geese were registered outside of the borders of the protected areas, in areas which may hold flocks of over 10,000 Red-breasted Geese. The current vulnerability of this population, and the uncertainty regarding its true global abundance and trends, highlights the need for continuous coordinated counts in the country, in order to understand how the species will adapt to the climate changes, which might have an influence on its total population size and distribution.

Key words: conservation, Danube Delta, goose monitoring scheme, Razim–Sinoe Complex, Special Protected Areas.

The Red-breasted Goose *Branta ruficollis* is a long-distance migratory species that breeds in arctic Russia, predominantly on the Taymyr, Gydan and Yamal Peninsulas and the nearby mainland (Hunter & Black 1996). Prior to the 1960s, the population wintered along the western coasts of the Caspian Sea, mainly in Azerbaijan, and in Iran and Iraq, but subsequently rapidly shifted to the western Black Sea coast, where the majority now congregate from December to February at 10–20 roost sites (BirdLife International 2021). Small groups of geese also winter in Hungary, Greece and Turkey. During mild winters significant numbers may remain in Manych-Gudilo in Russia and Syvash region in Ukraine (Cranswick *et al.* 2012; N. Petkov, unpubl. data). The species is listed as Vulnerable on the IUCN Red List (IUCN 2018), and is on Appendix II of the Convention on International Trade in Endangered Species, Appendix I and II of the

Convention on Migratory Species and Annex I of the EU Birds Directive. Incomplete census coverage, especially in the mid-2000s, make long-term population trends hard to determine (Cranswick *et al.* 2012). It is unclear whether observed count fluctuations reflect genuine population change or variations in count completeness and/or the wintering locations used by the population. Coordinated counts in mid-January 2003, 2004, 2005 and 2006 resulted in population estimates of 33,600, 52,800, 32,100 and 34,000 individuals respectively. The synchronised spring 2008 count in Kalmykia, Russia found 40,800 birds, and counts of 44,300 in the following winter (Cranswick *et al.* 2012) and 56,860 in autumn 2010 (Rozenfeld 2011a) suggested that counts in the mid-2000s might have been incomplete due to birds wintering away from their traditional surveyed sites. The latest global population estimate is of 44,000–56,000 individuals (Wetlands

International 2015), based on the IWC count in Bulgaria on January 2013.

The western bank of the Black Sea hosts three wintering goose populations in significant numbers: the Greater White-fronted Goose *Anser albifrons* (the most numerous), the Greylag Goose *Anser anser* and the Red-breasted Goose (Dereliev *et al.* 2000; Fox & Leafloor 2018; Snow *et al.* 1998). The first appearance of the Red-breasted Goose in Romania dates back to September 1890, when a goose was shot at Geaca, in the central part of Romania (Klemm & Kohl 1988). During 1909–1965, Red-breasted Geese were seen mixed with large flocks of White-fronted Geese, mainly along Great Island of Braila and Balta Ialomiței (the extensive area of lakes and marshes created by branches of the River Danube between Braila and Harsova and Calarasi and Harsova) (Carol 1934; Lintia 1935; Papadopol 1965; Talpeanu 1971; Scott 1939). Single birds were shot on 30 known occasions between 1910 and 1967, when flock sizes present ranged up to 48 individuals. Some were shot along the Danube and a few individuals in Transylvania along the River Olt and River Mures (Talpeanu & Paspaleva 1971). In 1962 and 1963, unusually large numbers of White-fronted Geese and Red-breasted Geese were seen at Calarasi, more in 1963 than in 1962 (Papadopol 1965). During 1964–1970, the lakes and marshes from the Great Island of Braila and Balta Ialomiței were drained and converted to farmland (Bogdan 1971; Dragomir & Inascu 1971; Popescu & Manolache 1971). The first flocks of Red-breasted Geese of > 10,000 birds in coastal Dobrogea (a Romania–Bulgaria transborder region) were confirmed

on 7 December 1968. One flock of geese between the villages of Istria and Sinoe was estimated at 500,000 White-fronted Geese and 25,000 Red-breasted Geese (Johnson & Hafner 1970; Ciochia & Hafner 1969) during the expedition organised by the International Wildfowl Research Bureau (IWRB). Although Hunter & Black (1996) and Hunter *et al.* (1999) reported counts of 25,000 individuals in 1967, 1968 and 1969, recent evidence showed that the 25,000 Red-breasted Geese were present only in 1968.

Between 1968 and 1974, wintering geese were counted in Romania during IWRB missions in those years, but the numbers fluctuated from hundreds to thousands (Dijksen *et al.* 1971; Dijksen & Smith 1974; Johnson & Biber 1971; Lebret 1975; Scott 1970). After a long period of inactivity, counts were resumed in 1988 and 1989, when numbers of Red-breasted Geese in coastal Dobrogea did not exceed 11,500 individuals (Munteanu *et al.* 1989; Munteanu *et al.* 1991; Weber 1990). In the same area, Sutherland & Crockford (1993) and Vangeluwe & Stassin (1991) counted about *c.* 34,000 during December 1990–January 1991, the first time that counts exceeded 30,000 along the Romanian Black Sea coast, and in January 1992 Vangeluwe & Snelthlage (1992) counted 26,913 Red-breasted Geese in coastal Dobrogea. Coordinated counts between Romania and Bulgaria during the winters of 1996/97 to 2000/01 gave a better impression about the numbers and distribution of Red-breasted Geese in Romanian and Bulgarian coastal Dobrogea (Dereliev *et al.* 2000; Kiss *et al.* 1997). In the 1990s, monitoring of the species only

covered coastal Dobrogea and sporadically areas along the River Danube in the Baragan region, but after 2000, the Romanian Ornithological Society started a long-term monitoring programme, as part of the internationally coordinated counts in Ukraine, Romania and Bulgaria.

Here, we present the most recent data of the Red-breasted Goose in southeast Romania following synchronised winter counts in the period 2012–2022. In particular, our goal is to determine: (1) the

species distribution in the country, (2) its wintering numbers, and (3) trends.

Methods

Study area

The study area covers geese roosts and foraging areas which are grouped into 17 polygons (Fig. 1) in the regions of Baragan (7) and coastal Dobrogea (10, including polygon no. 7, Oltina Lake), situated in nine Special Protected Areas (SPAs) in southeast

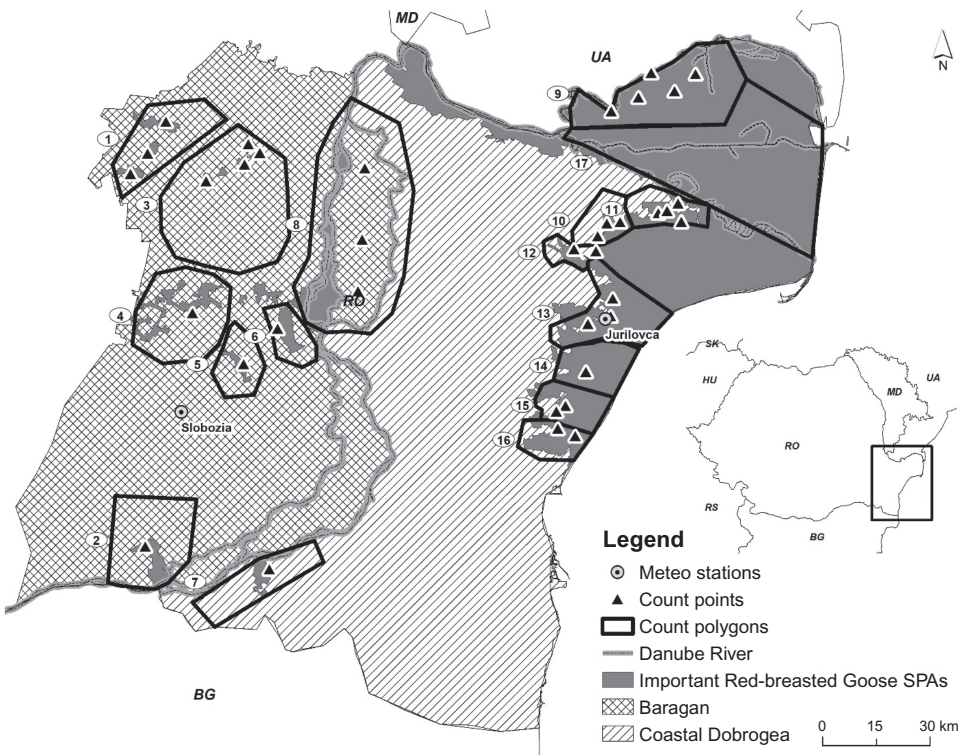


Figure 1. Distribution of the count polygon and points in southeast Romania during 2012–2022. 1 = Balta Alba–Amara–Jiriau Lakes; 2 = Lake Calarasi; 3 = Ianca–Plopu–Sarat Lakes; 4 = Lake Tataru; 5 = Lake Strachina; 6 = Bertești de Sus–Gura Ialomitei; 7 = Lake Oltina; 8 = Great and Small Islands of Braila; 9 = Pardina; 10 = Sabangia–Sarichioi; 11 = Murighiol–Dunavat; 12 = Lake Babadag; 13 = Salcioara–Jurilovca; 14 = Lake Sinoe; 15 = Istria–Nuntasi Lakes; 16 = Sacele–Traian; 17 = Danube Delta.

Romania where wintering numbers of Red-breasted Geese concentrate in Romania (Cranswick *et al.* 2012; Hulea 2002). Both regions are split by the River Danube and are situated within the steppe biogeographical region of Europe with a cold semi-arid climate (Beck *et al.* 2018). The land use is dominated by 60% agriculture, 34% wetlands and water bodies, 4% forests and 2% towns, villages and other urbanised territories (EEA 2018).

Goose counts

Since winter 2012/13, monitoring of Red-breasted Geese has been part of the national wintering goose monitoring programme coordinated by the Romanian Ornithology Society. The counts are implemented by well-trained volunteers, based on simultaneous roost counts (Bibby *et al.* 2000) at the most important lakes and wetlands situated throughout the southeast Romania wintering range of the species. The monitoring programme does not include all smaller wetlands, especially those too small to be suitable as goose roosts. Nevertheless, some of these small wetlands might be used by small numbers of geese as temporary roosts when the large flocks are shifting their traditional roosting sites. Such shifts might potentially be caused by changes in weather condition changes or high levels of disturbance, in which cases our count network may fail to detect them. For this reason, it is essential that counts cover as many wetlands as possible and are strictly synchronised and implemented under favourable weather conditions. However, in our study we miss only 10% of counts contributing to the trend calculation of

the species, which falls well below the recommended thresholds of 15–20% (ter Braak *et al.* 1994). At only two sites, Great Island of Braila and Pardina (the northernmost part of the Danube Delta), were geese counted on their foraging grounds due to the inaccessibility of the roosts, but these were still counted during morning flight following Bibby *et al.* (2000). Data from the Danube Delta's inland lakes were mostly collected by the local Danube Delta Biosphere Reserve rangers, from sporadic observations made within the counting dates. However, in the Danube Delta there is lack of vast foraging areas near the otherwise suitable roosts, so establishing counting points is very hard due to inaccessibility and other logistical issues.

Counts were implemented twice a month in November to February between 2012 and 2022. One count per month was planned to be synchronised with those in Bulgaria and Ukraine, in accordance with the Red-breasted Goose International Species Action Plan (Cranswick *et al.* 2012). Within all 17 polygons, 37 observation points (Supporting Materials Table S1) were established from where the roost counts were carried out. Counts in southeast Romania lasted two days, rarely three. Weather conditions and observer availability were the two main factors influencing coverage. International count dates were usually in mid- to late month, while the January count took place during the dates chosen for the International Waterbird Census (IWC) in mid-month. Experience suggests that the most accurate count data, both for numbers and species composition, are obtained when geese take off from

their roosts. The observers (thanked in Acknowledgements) take up places at preselected vantage points at the roosting area early in the morning, *c.* 15–30 min before the sunrise. The team usually consists of one to two experienced ornithologists equipped with binoculars (magnification 10 × 42 or 10 × 50) and spotting scopes (magnification 20–60×). If not disturbed, geese usually take off between 07:00 and 10:00 h at regular intervals in small or larger flocks that allows observers to record numbers precisely. All species of geese are counted in flight (Gregory *et al.* 2004; Bibby *et al.* 2000; Gilbert *et al.* 1998), but priority was given to counting Red-breasted Geese accurately. In cases where the morning count was compromised due to very rapid departure (challenging accurate species identification and counts), sudden loss of visibility, or high levels of human disturbance, the geese were also counted on their feeding areas during the day to confirm their true number and species composition. In such cases, observers checking foraging locations would wait for the Red-breasted Geese to take off, when the geese could be counted in flight. In many case, the observers were asked to take a panoramic photograph of the flock and later all geese were counted manually. If the counts of geese in the field were higher than the morning count, then the numbers found on the fields were taken as the count for that specific area. Counts in unfavourable weather conditions were avoided (*e.g.* in rain, snowfall and fog).

Data analysis

Field data were recorded on standard field forms which were later reported to the

national coordinator of the monitoring programme. After 2020, data were collected with the help of a smartphone application for Android and iOS operating systems (Ornitodata, version 2.2.0) using specially developed goose monitoring protocols. During the study period a total of 2,514 unique data inputs of the species were collected. The monthly numbers per season were obtained by adding the numbers of geese counted simultaneous in all 17 sites, for the pre-established counting dates. In cases where there were two counts per month, only the count with the highest numbers was used for that month/year combination. In order to describe species distribution at the national level, we have also added data from the results of the IWC in Romania and sporadic observations from different observers elsewhere (named in Acknowledgements). To test whether the weather had an effect on the monthly maximum Red-breasted Goose numbers, we analysed the count data in relation to the monthly mean air temperature and monthly mean snow cover in both regions, using a Generalized Linear Model (GLM) with Gaussian distribution and log link function as there is was no overdispersion in the data. The model multicollinearity effects were tested using the Variance Inflation Factors (VIF) function from the “car” package in R. For our selected model, we obtained a VIF lower than 4, indicating that our variables were not correlated.

The two monthly mean weather variables were selected because they had previously been used in similar study (Hulea 2002). The meteorological data covering the period November 2012–December 2021 were

provided by the Romanian National and Hydrological Agency for two weather stations: Slobozia (44°33'N, 27°23'E, 52 m a.s.l.) situated in the Baragan region, and Jurilovca (44°45'N, 28°52'E, 39 m a.s.l.) located in coastal Dobrogea (see Fig. 1). The two weather parameters were included as explanatory variables because geese are known to respond quickly to winter weather changes (Philippona 1966; Lok *et al.* 1992). Normality of the explanatory variables were tested using the Shapiro-Wilk test, which showed that the temperatures in the Baragan region ($W = 0.98851$, $P = 0.959$) and coastal Dobrogea region ($W = 0.95785$, $P = 0.1615$) were not normally distributed. Results for the other variable, snow cover, found that the data were normally distributed in both regions (Baragan: $W = 0.63945$, $P < 0.001$; coastal Dobrogea: $W = 0.38676$, $P < 0.001$). Models for the two regions were constructed using all combinations of these weather variables, using the statistical software R (version 2022.07.2; R Core Team 2018). Statistically significant results are reported as $P < 0.05$. Trend analyses were carried out based on annual indices calculated by Trends and Indices for Monitoring Data (TRIM) software, a specially developed programme for analysing ecological data with missing values, specifically in time-series of counts using Poisson regression (Statistic Netherlands version 3.52; Pannekoek & Van Strien 2001). The R-Trim package was used (Bogaart *et al.* 2018; R Core team 2018). Data ($n = 180$) used to calculate the species' overall trend for the period 2012–2022 was obtained from counts made at all 17 sites included in the goose monitoring programme in southeast

Romania. Trends (two regional and the combined national trend) were determined for two different time-spans: over 10 years (2012–2022) and over 5 years (2018–2022). Regional trends for both Baragan and coastal Dobrogea were calculated using data from sites within their respective polygons (Baragan 7; coastal Dobrogea 10 polygons). Data were missing from seven surveys in coastal Dobrogea ($n = 90$ counts) and nine ($n = 90$) from Baragan (*i.e.* 8% and 10% respectively of these data sets), as a result of incomplete geographical coverage because of a lack of volunteer observers or very bad weather conditions. The baseline year for the overall and regional trends was set as season 2012/2013 and the model used was Linear Trend.

The population trends were categorised using the following criteria based on slope and 95% confidence intervals (CI), as follows: strong increase (lower 95% CI > 1.05); moderate increase ($1.00 < \text{lower } 95\% \text{ CI} < 1.05$); stable (95% CIs enclose 1.00 but lower 95% CI > 0.95 and upper 95% CI < 1.05); moderate decline ($0.95 < \text{upper } 95\% \text{ CI} < 1.00$); strong decline (upper 95% CI < 0.95). When the trend was not significant and the confidence limits were large, the population trend was classified as uncertain (Gregory *et al.* 2007; van Strien *et al.* 2001).

In order to see the extent of effective protection provided by the Special Protection Areas (SPAs) designated under the European ecological network Natura 2000 for the conservation of the species, we overlapped all goose records ($n = 2,514$) collected in the study period with the boundaries of the 40 declared SPAs (<http://www.mmediu.ro/>

articol/date-gis/434) where the species is listed in the standard data forms.

All maps were made in ArcMap 10 (ESRI Redland, California, USA 2013).

Results

Between winters 2012/13 and 2021/22, numbers of Red-breasted Geese wintering in Romania were estimated at between 8,660 and 23,783 birds, an average of 16,322, which represents almost 30% of the species globally. The Red-breasted Geese arrive at the beginning of November in small numbers of between 1,000 and 5,000 individuals, and are highly dispersed across all wetlands in southeast Romania, although in some years, more than 10,000 have been registered in November. In December, numbers increase to *c.* 10,000 individuals, but occur in much more concentrated flocks. The highest count of 23,783 individuals was

registered in January 2022, which represents a 64% increase on the 8,660 birds counted in the beginning of the study period in 2012/2013, which was also the winter when fewest Red-breasted Geese were recorded. The monthly maximum numbers were found in January, but significant numbers are also sometimes seen in February, just prior the start of spring migration. Significant between-year fluctuations in numbers of the species were however evident in all months across the study period. The maximum numbers recorded during the monthly synchronised counts each winter over the study period are presented in Table 1. The wintering numbers show an upward trend, with two substantial peaks evident in 2016/2017 and 2021/2022 (Fig. 2), the last one also being the highest number registered during the study.

Table 1. Numbers of Red-breasted Geese recorded during synchronised counts in southeast Romania, 2012–2022. Monthly maximum numbers from each season are presented in bold.

Season	Nov	Dec	Jan	Feb	Mean
2012/2013	1,737	4,855	8,660	4,052	4,826
2013/2014	10,068	8,854	9,589	7,045	8,889
2014/2015	5,798	9,124	2,273	18,852	9,012
2015/2016	5,280	7,998	8,454	14,626	9,090
2016/2017	4,664	22,149	806	8,612	9,058
2017/2018	5,085	9,602	16,624	5,686	9,249
2018/2019	5,544	10,854	8,287	9,779	8,616
2019/2020	3,435	12,867	14,384	9,453	10,035
2020/2021	14,729	14,209	18,568	13,205	15,178
2021/2022	2,690	3,019	23,783	20,894	12,598

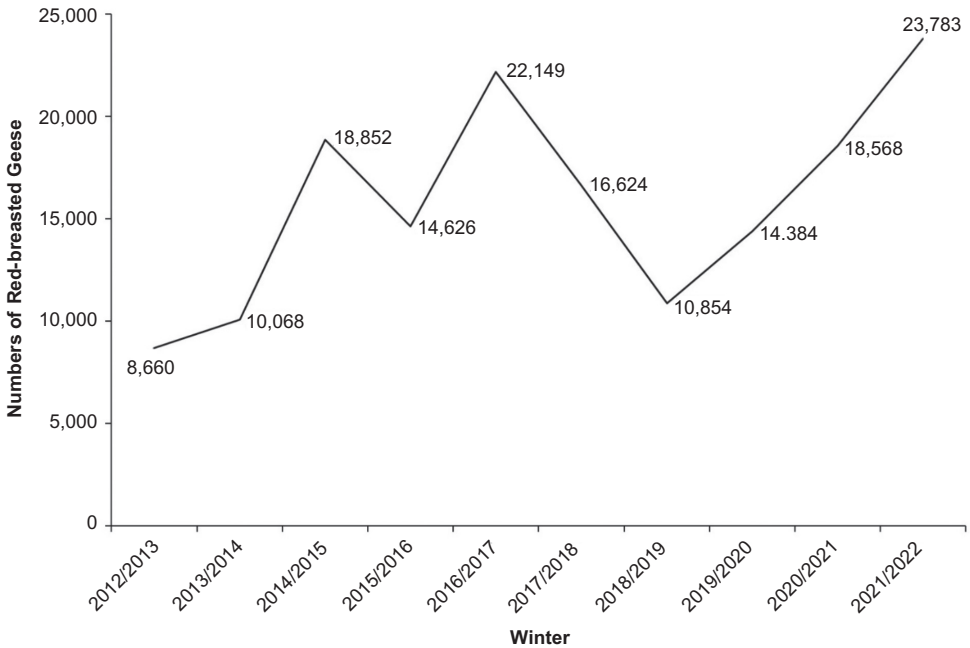


Figure 2. Maximum numbers recorded during the synchronised counts of Red-breasted Geese in southeast Romania during 2012–2022.

Over the course of the study, mean air temperature and snow cover had no effect on the Red-breasted Goose numbers counted in the Baragan region, but in the coastal Dobrogea region mean air temperature was found to have a significant influence on wintering by Red-breasted Geese (Table 2).

Based on the overall imputed trend calculated by TRIM for the 10-year period from 2012 to 2022, there was no apparent significant trend in numbers in southeast Romania (“uncertain”), although the same analysis showed a moderate increase in Baragan and a strong increase in coastal Dobrogea. The short-term trends (over a period of 5 years, 2018–2022) at southeast Romanian and the both regions were all found as uncertain (Table 3).

The goose counts confirmed that almost all wintering Red-breasted Geese in Romania were confined to Baragan and coastal Dobrogea (Fig. 3) in areas between 0–96 m a.s.l.

The nine sites declared as Special Protected Areas cover a combined area of 9,432 sq. km and comprise the most important areas in the country, holding significant numbers, normally within the range of 3,000–20,000 individuals (Fig. 4). Six other sites are identified as being of medium importance, while the remaining 25 are of lesser importance, primarily those which usually hold solitary individuals or small groups, mostly during migration. Within the declared SPA boundaries, the geese mainly use water bodies as

Table 2. General linear model (GLM, R v.3.1.2) summary for the effects of weather conditions on Red-breasted Goose numbers in Baragan and the Dobrogea coastal regions each month, in winters 2012/13–2021/22. * = statistically significant at $P < 0.05$.

Variable	Estimate	s.e.	<i>t</i>	<i>P</i>
Baragan region				
Air temperature	124.92	157.46	0.793	0.433
Snow cover	48.42	348.5	0.139	0.890
Dobrogea region				
Air temperature	−501.9	237.9	−2.109	0.042*
Snow cover	−275.6	324.4	−0.849	0.401

Table 3. Long-term and short-term trends (TRIM overall imputed model) for Red-breasted Geese in southeast Romania.

Region	Over 10-year period (2012–2022)	Over 5-year period (2018–2022)
Southeast Romania	Uncertain	Uncertain
Baragan region	Moderate increase	Uncertain
Coastal Dobrogea region	Strong increase	Uncertain

roosts (comprising 64.2% of the SPA area); otherwise they used parts of the remaining area, which is largely agricultural land.

Overall, 75% of all goose records were within the borders of the SPAs protected for the species; the rest were registered outside. Two SPAs (Small Islands of Braila and Danube Delta, and the Razim-Sinoe Complex) regularly held significant numbers (up to 10,000 individuals). Balta Alba-Amara-Jirlau, Calarasi, Tataru and Strachina Lakes were also major wintering grounds. It is important to highlight that almost half

of the Red-breasted Geese wintering in the country congregate to feed within fields outside of the protected areas (Fig. 5). For instance, the Great Island of Braila, which is one of the main foraging grounds in the Baragan region, has suitable crops for the whole season, capable of supporting > 10,000 individuals. Balta Ialomita and Balta Calarasi are two vast arable areas which are currently not under protection, but where the geese occur in significant numbers. The numbers counted at sites of medium and high importance for the geese is presented at Table 4.

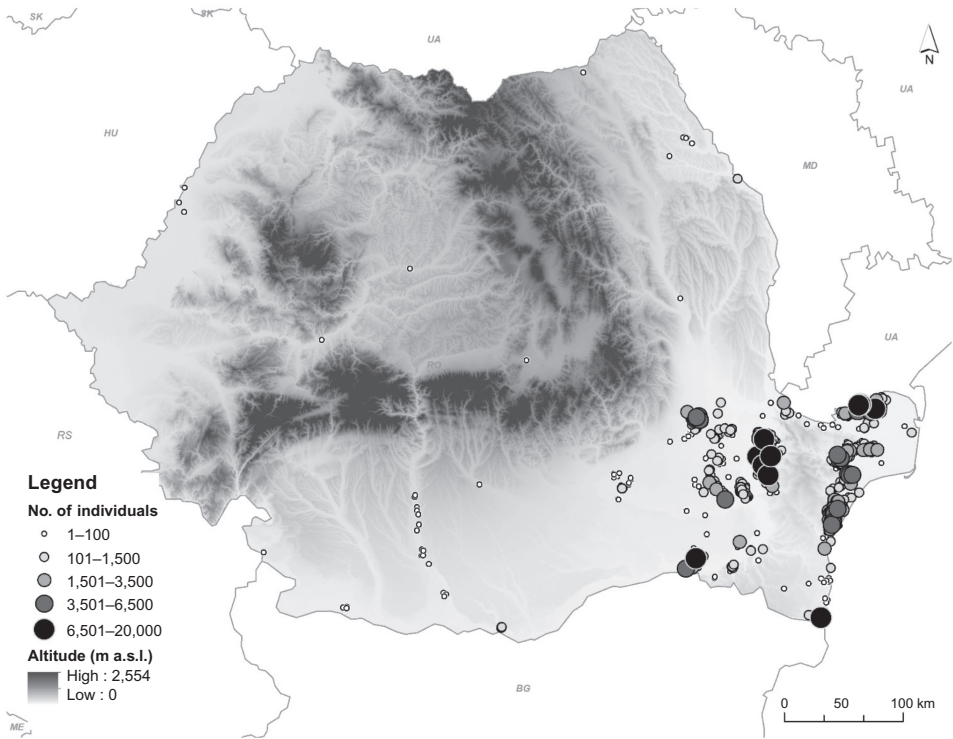


Figure 3. Numbers and distribution of Red-breasted Geese in Romania during winters 2012/13–2021/22. Count data are summarised in the Supporting Materials (Table S2).

Discussion

The present study provides the most recent data from long-term monitoring of Red-breasted Geese in southeast Romania based on systematic counts. The results reveal fluctuating wintering numbers, which reflects the overall global trend in abundance, but which is typical for species influenced by weather conditions at their wintering or staging areas (Doyle *et al.* 2020). After winter 2018/2019, there was a clear pattern of increasing numbers of wintering geese (Fig. 2). In the last two years, Romania has held most of the Red-breasted Geese

wintering in the region on the western bank of the Black Sea; *c.* 24,000 individuals were registered at single coordinated count in mid-January 2022, which represents 42% of the species globally. Numbers presented here were recorded from the core wintering range of the species in southeast Romania, where counts covered all major water bodies which are suitable as roosts for waterbirds. The roosts used by the geese in the southeast part of the country are usually large freshwater or brackish lakes (Hulea 2002), but often flooded pastures and arable fields can also offer secure conditions for the geese during the night (E. Todorov,

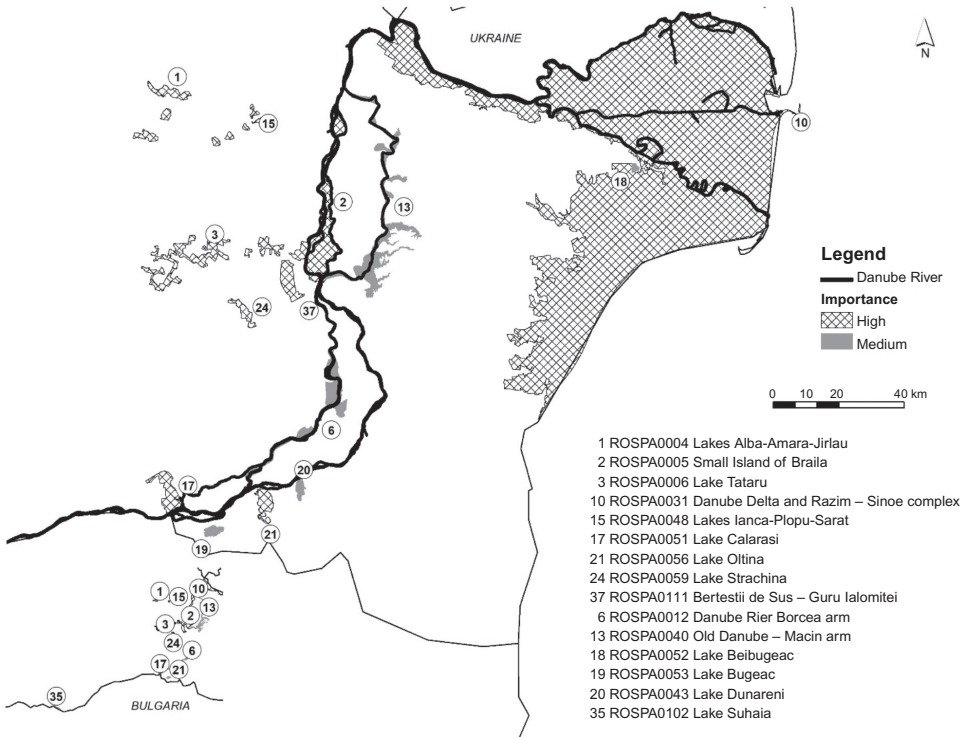


Figure 4. Distribution and importance of the Special Protected Areas (SPAs) in Romania for the Red-breasted Goose.

unpubl. data). We are fully aware that problems with species misidentification during the morning counts might affect our count data, especially when goose flocks are disturbed during the morning flight and all geese take off simultaneously, departing within very short periods. Since 2017, almost all participants therefore have prepared before the start of the field season, by calibrating their counting and estimating skills from a set of pictures and videos showing different sizes of goose flocks. Moreover, in the presence of large, single species flocks of Red-breasted Geese, observers were instructed to take

high-definition photographs of the flock, subsequently counted manually, individual by individual (Todorov 2020). Accepting that we cannot eliminate counting errors, we are confident that these have been minimised as much as possible and do not radically affect the count totals presented in this study.

Comparing our data with those from Hulea (2002), the distribution of the species remains unchanged in Romania. Almost the entire wintering numbers of the species are concentrated in two geographical regions of southeast Romania, in Baragan and coastal Dobrogea. The first large concentrations for the season are found usually in the Baragan

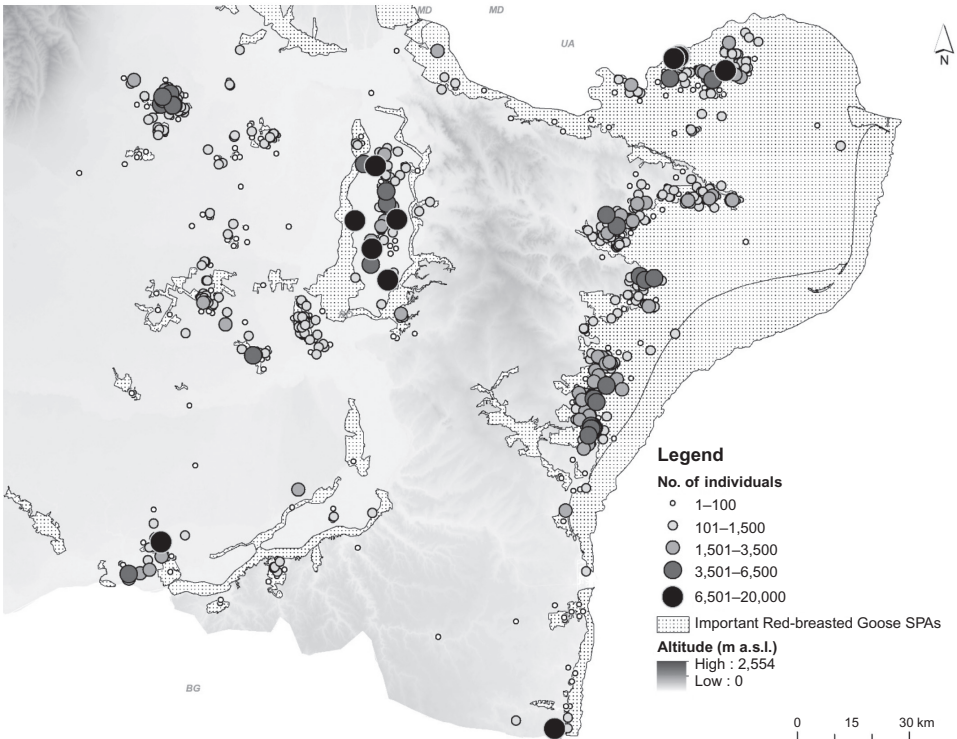


Figure 5. Presence of the Red-breasted Geese in the Special Protected Areas in southeast Romania during winters 2012/13–2021/22.

region. Counts made in areas such as Balta Alba and the Great Island of Braila can reach between 7,000 and 10,000 individuals (average 8,500), which represent 52% of the species occurring nationally and 17% of the global population. However, numbers present in November have not fluctuated so markedly (Fig. 6). Calarasi and Strachina lakes are two other key areas from Baragan where the geese arrive in uniform flocks in November (Supporting Materials Table S2). The second major influx of geese towards the end of December, also includes an increase in the numbers in coastal Dobrogea, especially in the Pardina area, part of the

Danube Delta. In January, when the lakes of the Baragan region become frozen and the fields are covered with snow, between-year fluctuations were clearly evident (Fig. 6), although in very recent years the winters have been milder than at the start of the study. This has also been a period when hunting of Greater White-fronted Geese has become more intense, increasing levels of significant disturbance that could lead some Red-breasted Geese and other species abandoning their roosts and dispersing in the areas along the Razim–Sinoe Complex. In January, the geese tend to move and disperse widely along the Razim–Sinoe

Table 4. Range of (rounded) annual wintering numbers in SPAs considered to be of medium and high importance for Red-breasted Geese in southeast Romania during winter 2012/13–2021/22..

Site code	Site name	Individuals
ROSPA0004	Balta Alba–Amara–Jirlau Lakes	1,000–8,000
ROSPA0005	Small Island Complex of Braila	7,000–10,000
ROSPA0006	Lake Tataru	100–3,200
ROSPA0031	Danube Delta and Razim–Sinoe Complex	6,000–10,000
ROSPA0048	Ianca–Plopu–Sarat lakes	100–1,200
ROSPA0051	Lake Calarasi	500–8,000
ROSPA0053	Lake Bugeac	100–230
ROSPA0054	Lake Dunareni	200–300
ROSPA0056	Lake Oltina	700–1,200
ROSPA0059	Lake Strachina	200–4,000
ROSPA0102	Lake Suhaia	170–1,200
ROSPA0111	Bertești de Sus–Gura Ialomiței	550–1,500
no protection	Great Island of Braila	7,000–10,000
no protection	Balta Ialomiței	1,000–5,000
no protection	Balta Călărăși	500–1,000

coastal lagoons. Here, there are several key roosts such as the natural lakes and fish farms of Murighiol, Sarinasuf, Sabangia, Sarichioi, Salcioara, Jurilovca, Sinoe, Istria and Nuntasi, where the geese usually concentrate in homogeneous flocks, but still mix extensively with Greater White-fronted Geese. In February, significant numbers remain in coastal Dobrogea, but in recent years Red-breasted Geese are also much more concentrated in homogeneous flocks in Baragan areas, *e.g.* on the Great Island of Braila where 10,000 geese occur in two to three large flocks. In the second half of

February, numbers of geese are already declining, most likely due to the start of spring migration. The largest homogeneous flock in Romania in recent decades was found near Vama Veche on the border with Bulgaria, where in January 2013 almost the entire global population was observed on Durankulak and Shabla Lakes in adjacent areas in Bulgaria, when > 20,000 were seen foraging in the Romanian crop fields but roosted on these two Bulgarian lakes.

Fluctuating wintering numbers in Romania are most likely to be influenced by the recent mild winters, with no more than 23,783

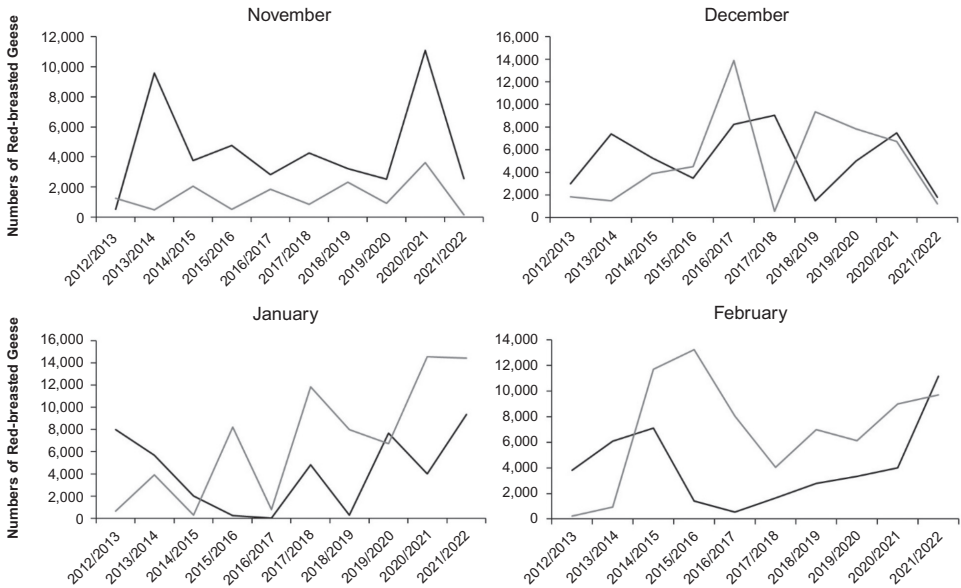


Figure 6. Monthly numbers of Red-breasted Geese counted in their main winter quarters in southeast Romania: Baragan region (heavy black line) and coastal Dobrogea region (light line) during winters 2012/13–2021/22.

individuals counted in late January 2022. Satellite tracking data indicates that in recent years some geese choose to spend the winter along the Ukrainian coast and also in the region of Rostov, southeast Russia (Lebedeva 2021; Iliev *et al.* 2022) which might explain the variation in numbers in Romania for years when they have numbered less than 20,000 birds.

The results of the 10-year study presented here showed a remarkable increase in abundance of 91% in coastal Dobrogea (based on TRIM analyses). It is difficult to explain the relatively small numbers found in coastal Dobrogea in winters 2012/13–2013/14 (Fig. 7), when coverage of the surveyed areas was very well organised, although it might be that the foraging sites in this region were less suitable than in

subsequent years. In some years, winter wheat grown in coastal Dobrogea does not develop well due to low precipitation, which may result in more geese moving back to the Baragan region. In Baragan, goose numbers fluctuate but have increased by 29% since the beginning of the study, although there has been less obvious change over the last five seasons. The national totals are mostly influenced by the numbers wintering in coastal Dobrogea, where the highest annual totals are recorded, and the long-term trend showed a strong increase (Fig. 7).

In southeast Romania several SPAs have been designated on the basis of goose species: the Balta Alba–Amara–Jirlau Lakes, the Braila Small Island Complex, Lake Tataru, Danube Delta and the Razim–Sinoe Complex, the Ianca–Popu–Sarat Lakes,

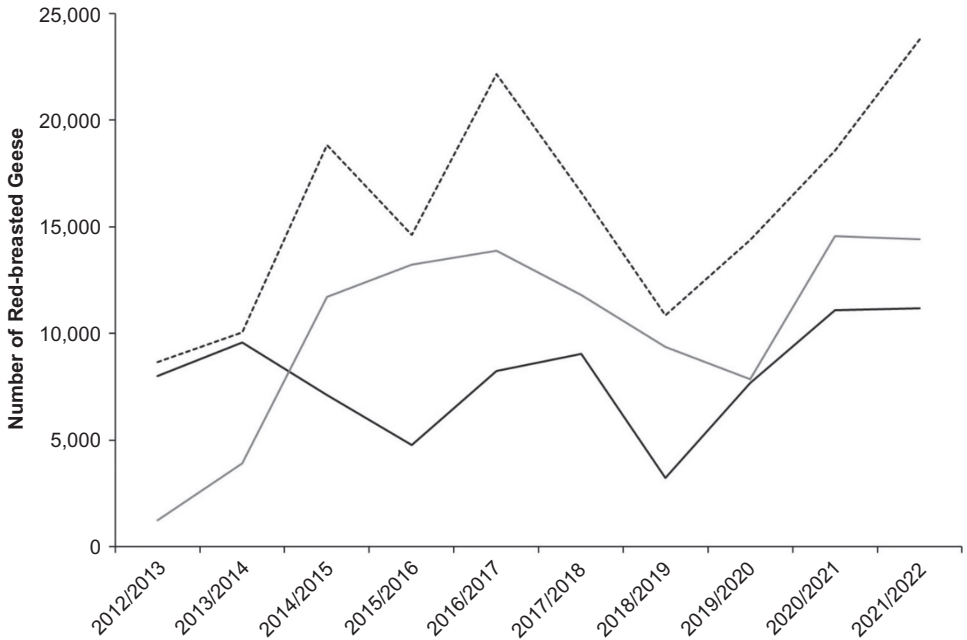


Figure 7. Maximum numbers recorded during the synchronised counts of Red-breasted Goose in Baragan (thick black line) and coastal Dobrogea (light line) during winters 2012/13–2021/22. The dash line represents the total numbers registered in southeast Romania.

Lake Calarasi, Lake Oltina, Lake Strachina and Berteşti de Sus–Gura Ialomiței; all have held significant numbers (Fig. 3). The results of this study reveal that 75% of the geese are using the SPAs declared for the species, which provides good evidence for the effectiveness of the SPA designation process. Despite this, our results show that 25% of wintering Red-breasted Geese were spending a significant part of the day outside of the SPAs (Fig. 4). These areas were mostly arable fields where the geese were feeding in mixed flocks with Greater White-fronted Goose, which is a quarry species in Romania. Unfortunately, preferred foraging grounds in the vicinity of the roosts (around Lake Calarasi, the Balta

Alba–Amara–Jirlau Lakes, the Great Island of Braila, Balta Ialomița, the Ianca–Plopu–Sarat Lakes and the areas between the localities Murighiol and Zebil) have no protection, especially during the hunting period. This likely exposes a significant proportion of the geese to unintentional shooting or poaching, but also to very high levels of disturbance. Such is the case at the Great Island of Braila, which has no legal protection yet flocks of > 10,000 individuals of Red-breasted Geese are found foraging there daily, unfortunately subject to significant disturbance caused by the hunters and farmers. The island is a well-known hunting ground for the Greater White-fronted Goose and, given the fact

that both species occur in mixed flocks, accidental cases of shooting Red-breasted Geese likely frequently occurs. Special conservation measures such as limiting hunting during the morning and evening hours and designation of no-hunting areas are urgently needed in this very important area.

Climate forecast models for Romania predict an increase in the mean air temperature by 1° C for the months of November–December (Busuioc *et al.* 2014). Continuing the long-term monitoring of goose abundance in the area therefore is essential to determine how the birds react to climate changes and how to take suitable conservation measures to protect them. A previous study on effects of weather (Hulea 2002) stated that geese in the northern areas of Dobrogea move southwards when air temperatures begin to fall. In our study, we confirmed that increasing Red-breasted Goose numbers in coastal Dobrogea correlated with decreasing air temperatures.

Away from the main wintering range in southeast Romania, numerous observations of solitary individuals or small groups of Red-breasted Geese have been noted in flocks of Greater White-fronted Geese, in different parts of the country. Usually around small wetlands or lakes in the plain regions of Moldova, Transylvania, Banat, Crişana and Oltenia.

In conclusion, we urge the continued winter monitoring of this vulnerable species by engaging the support of key stakeholders in the country, in order to maintain optimal quality and coverage of the data collected. It is also necessary to collect more data about movements of the species (*e.g.* by

satellite tracking GPS-tagged individuals), and on the demographic structure of the population. Enlarging the current protected areas network is urgently needed to ensure the safety of roosts and foraging grounds for the 30% of the species' global population which winters in Romania. Studies of habitat selection, goose grazing and the impact of contaminants and pesticides from agriculture should be considered as a high priority, as changing agriculture practises increasingly affect more and more Red-breasted Geese in farmland habitats. The results of these studies will contribute to fill the knowledge gaps and to inform the conservation community about the conservation measures needed to ensure the survival of the vulnerable Red-breasted Goose into the future.

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Photograph: Red-breasted Geese and Great White-fronted Geese in a mixed flock in southeast Romania, by Emil Todorov.