

## NEW DATA ABOUT THE BREEDING AND THE OCCURRENCE OF THE GOOSANDER (*Mergus merganser* Linnaeus, 1758) IN THE FĂGĂRAȘ MASSIF (SOUTH OF ROMANIA)

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**Abstract.** New data about the breeding and the presence of the goosander (*Mergus merganser* Linnaeus, 1758) in Romania are showed in this paper. A small breeding population of 5-17 pairs (3-6 pairs, on the Vidraru Reservoir) was found on four dam basins and, possibly, other reservoirs and streams from the envisaged area, that contains the Southern part of the Făgăraș Massif (the Făgăraș and the Iezer-Păpușa Mountains) from the Southern Carpathians, proving that the species benefits from the construction of the reservoirs. Together with other populations from Czechia, Slovakia and Romania, it links, over the Carpathian arch, the populations from Alps and Balkans, resulting in a large and continuous area of distribution in the favourable habitats from France to Greece. Our observations confirm the territorial expansion of the goosander in Europe registered the last time. The dam basins, where females with chicks were identified, are located between 804 and 1,093 m s.l.a., corresponding to the deciduous and mixed woods. The breeding was firstly found in the area in 2007, on Râușoru and Baci, but it may have happened earlier. Other aspects linked to the distribution, the preference of habitats, the dynamics, the density, the success of breeding etc. are discussed in the paper, too.

**Keywords:** goosander, breeding, Făgăraș Mountains, Romania.

**Rezumat. Date noi despre cuibăritul și prezența ferăstrașului mare (*Mergus merganser* Linnaeus, 1758) în Masivul Făgăraș (sudul României).** În lucrare sunt expuse informații inedite despre cuibăritul și prezența ferăstrașului mare (*Mergus merganser* Linnaeus, 1758), în România. În aria de interes, care cuprinde partea sudică a Masivului Făgăraș (Munții Făgăraș și Iezer-Păpușa) din Carpații Meridionali, a fost descoperită o mică populație cuibăritoare de 5-17 perechi (3-6 perechi, pe lacul de acumulare Vidraru) pe patru lacuri artificiale și, posibil, pe alte lacuri de baraj și râuri, probând că specia beneficiază de pe urma construirii lacurilor de acumulare. Alături de alte populații din Cehia, Slovacia și România, ea leagă, peste arcul carpatic, populațiile din Alpi și Balcani, rezultând o arie largă și continuă de distribuție în habitatele favorabile din Franța până în Grecia. Observațiile noastre confirmă expansiunea teritorială a ferăstrașului mare în Europa, înregistrată în ultimul timp. Lacurile de acumulare, unde au fost găsite femele cu pui, sunt situate între 804 și 1,093 m altitudine, la nivelul pădurilor de foioase și de amestec. Cuibăritul a fost prima dată găsit în zonă în 2007, pe Râușoru și Baci, dar el este posibil să se fi petrecut chiar mai devreme. Alte aspecte privitoare la distribuție, preferința de habitate, dinamică, densitate, succesul cuibăririi etc. sunt, de asemenea, discutate în lucrare.

**Cuvinte cheie:** ferăstraș mare, cuibărit, Făgăraș, România.

### INTRODUCTION

Most often, the occurrence of the goosander (*Mergus merganser* Linnaeus, 1758) in Romania was tangentially approached. The species was mentioned as a winter visitor in the majority of the generalist works (LINȚIA, 1955; IONESCU, 1964; RADU, 1983; GEORGESCU & GEORGESCU, 1996; KLEMM & KOHL, 1988; CIOCHIA, 2002 etc.), while, at the beginning of the 20<sup>th</sup> century, it was also registered as winter visitor, mainly on the Danube, rarely on the inland waters, but equally as a rare breeding species in the lagoons of the sea, where, on the Razelm Lake, 1 female with unfledged chicks, on July 10, 1901 and 1 male, on July 11, 1901 were found, as well as on the Danube, where, on the Strâmbu Mare and Uzunada islets, it was observed in 1908 and 1909 (DOMBROWSKI, 1912, quoted by LINȚIA, 1955). Later, it was still mentioned as a breeding species in the Danube Delta and as a visitor from October to March (VASILIU & RODEWALD, 1940), but, over two decades, the breeding was absent, the goosander being considered in Romania just a winter visitor on the Danube lakes, sporadically in the interior of the country and, after the water freeze, near the shores of the Black Sea (VASILIU & ȘOVA, 1968). However, according to BODEA et al. (1968), it was still observed in the Danube Delta, from middle October to the end of March, but also in summer, when the unfledged juveniles still proved its sporadic breeding in our country, from where it moved to the sea, in huge numbers, with the Danube and lakes freezing. The breeding in Dobrogea was also mentioned by TĂLPEANU (1969), in the lagoons or on the islets of the Danube, and by CRAMP & SIMMONS (1977, quoted in MARINCOVIĆ et al., 2008) based, probably, on ROSETTI-BĂLĂNESCU (1957), that considered it as an occasional breeder in the Danube Delta, and on SPITZENBERGER (1966), that saw it on the Danube, near Hârșova. Further, the breeding was not confirmed, and the goosander was mentioned as a winter visitor in Romania (BRUUN et al., 1999; DELIN et al., 2015), mainly on the lower Danube, especially in the Delta, also, on the lakes from Dobrogea, though with a few individuals, (IONESCU, 1968; RADU, 1979; CIOCHIA, 2001), on the lagoons or near the shores of the Black Sea (COTTA et al., 2008, reprinted from 1969 and updated) or as a passage species in the Danube Delta (RADU, 1979). Currently, it is reconsidered as a resident and migrator-breeder, respectively species of passage and winter visitor (SVENSSON et al., 2017). In the extra-breeding time, it was found in all regions of Romania (BÉCZY, 1975; SALMEN, 1982; MUNTEANU & MĂTIEȘ, 1983; MUNTEANU et al., 1989; BÉRES, 1997; FAZEKAS, 1997; GIURGINCĂ, 1997; ION, 1997; MITRULY, 1997; NEUMANN, 1997; SZABÓ, 1997; KISS, 1998; MUNTEANU, 2000; FENERU et al., 2002; GACHE, 2002; MITRULY, 2002; RANG, 2002; SZABÓ-SZELEY et al., 2004; KISS, 2005; BĂNICĂ, 2006; PAPP & FĂNTĂNĂ, 2008; ION et al., 2011; ONEA, 2011; RIDICHE, 2012), etc., where 150-500 individuals winter

(PETROVICI, 2015). Particularly, present on the dam basins from the middle course of the Argeş River (CONETE et al., 2006, 2008; 2012a, b; GAVA et al., 2004, 2007; MESTECĂNEANU et al., 2006, 2008; MESTECĂNEANU & GAVA, 2016), where it was observed on the Budeasa, Piteşti and Goleşti Dam Basins as winter species, summing 25 individuals during 2003-2010 (CONETE, 2011).

Regarding the occurrence in the mountain areas from Romania, it was not mentioned by RADU (1967) in the Carpathians, but it was considered a winter species in the Apuseni (KORÓDY-GÁL, 1974). Also, it was mentioned as regular, from October to April, in the upper hydrographical basin of Bistriţa Moldovenească during 1960-1973 (MUNTEANU, 2000) and, usually, present on the upper course of the rivers during winter, in Moldova (ION et al., 2011). In the summer of 2004, it was not found on the Vidraru Dam Basin, Făgăraş Mountains (PETRESCU, 2005), but the breeding was firstly proved in the high areas of Romania during the same year on Zetea Reservoir, located between Harghita and Gurghiu Mountains, on Vidra and Mălaia (uncertain) Reservoirs, from Lotru Mountains, and on Bicaz Reservoir, situated between Neamţ and Ceahlău Mountains (SZABÓ-SZELEY et al., 2004). A few later, the goosander was found in the breeding season of 2006 on the Râuşoru Dam Basin (MESTECĂNEANU & MESTECĂNEANU, 2006) and mentioned as present in the hydrographic basin of Râul Doamnei (MESTECĂNEANU, 2008a; ALEXIU & MESTECĂNEANU, 2008). The breeding was confirmed here in 2007 on Râuşoru and Văsălatu Dam Basins (MESTECĂNEANU, 2007, 2008b, 2011) and, subsequently, on Pecineagu and Vidraru (MESTECĂNEANU, 2019), as it was expected (MESTECĂNEANU, 2007).

In works of Atlas type about breeding, the goosander was not mentioned as breeder in Romania (CIOCHIA, 1992; WEBER et al., 1994; MUNTEANU et al., 2002) until 2012, when, based on the upper mentioned information, its breeding was considered very rare, strictly localized (MUNTEANU, 2012). PETROVICI (2015) confirms it in a few places, but not in the Făgăraş Mountains. Online databases attest the recent breeding in other places of the Romanian Carpathians and adjacent areas (<http://pasaridinromania.sor.ro/>, <https://openbirdmaps.ro/>, <https://ornitodata2.sor.ro/>, <https://rombird.ro/>, <https://ebba2.info/>), too.

Our aim is to bring to the ornithological attention new personal information on the breeding and the spatial and temporal occurrence of the goosander in the Făgăraş Massif (Argeş and Vâlcea Counties, South of Romania).

## MATERIALS AND METHODS

### The natural setting

The Făgăraş Massif includes the Făgăraş and the Iezer-Păpuşa Mountains. The Făgăraş Mountains are positioned in the North of the Argeş and Vâlcea Counties, respectively in the South of Sibiu and Braşov. They stand out through the highest tall of all Romanian mountains, the Moldoveanu Peak (2,543 m), followed by Negoiu (2,535 m), Viştea Mare (2,527 m), Lespezi (2,522 m) and other ca. 140 peaks more than 2,000 m s.l.a. and through a long narrow, dentated crest, long of 40 km, that always exceeds 2,000 m height, except the Zârna Pass. To the South, long ridges start, while, to the North, the versants are very abrupt. On the southern part, numerous glacial cauldrons are found in the upper hydrographic basins of the Negoiu, Capra, Buda, Valea Rea and Zârna streams, resulted from the Pleistocene Glaciation and sculpted in the crystalline and strongly metamorphosed rocks. The Cozia Ridge that links Cozia to the Frunţi, Ghiţu and Strungii heights, disposed to the South of the central crest, delimitates the Central Depression of the Făgăraş, also called the Loviştea Couloir. To the East of it, there is the Iezer-Păpuşa Mountains, a crystalline massif, which connects to the Făgăraş Mountains through the Mezea-Oticu Ridge. Iezer (2,462 m) and Roşu (2,473) are their main peaks (BARCO & NEDELICU, 1974; MĂCIU & POSEEA, 1982).

A rich hydrographical system starts from the Făgăraş Mountains predominantly to North and South. Avrig, Porumbacu, Arpaşu, Viştea, Sâmbăta, Sebeşu flow to the North, into the Olt River, while Boia and Topolog (tributaries of the Olt River, too), Capra, Buda, Vâlsan, and Râul Doamnei, with its abundant springs (all tributaries of the Argeş River), Boarcăşu and Luţele (tributaries of the Dâmboviţa River), generally head to the South. From the Iezer-Păpuşa Mountains, most of the waters follow a direction to the South, starting with Văsălatu and Bahna Rusului (tributaries of Râul Doamnei), from the West, continuing with Râuşoru, Bratia, Brătioara, Bughea and other feeders from the upper basin of Râul Târgului, from the South, then with Argeşelu, Râuşoru and other tributaries of Dâmboviţa, from the East. Some small streams flow to the North or to the East to discharge in Dâmboviţa, too (BARCO & NEDELICU, 1974; MĂCIU & POSEEA, 1982). The Olt River borders the Făgăraş Mountains to the West and Dâmboviţa River limits the Iezer-Păpuşa Mountains to the East. The Făgăraş Depression closes the perimeter to the North and the Jiblea-Arefu-Câmpulung line of depressions to the South (BĂLĂCEANU et al., 1975).

The natural lakes, 25 in the Făgăraş Mountains, 18 of them in the Argeş County, are cantoned to over 2,000 m s.l.a.: Bânda, Buda, Capra, Călţun, Căpriţa, Galbena I, II, III, Gălăşescu, Jghebuoasa, Paltinul, Podul Giurgiului, Viştea, Zarna, etc., and Iezer, from the Iezer-Păpuşa Mountains, are of glacial origin (UJVÁRI, 1972; BARCO & NEDELICU, 1974). Bălea (46,508 m<sup>2</sup> area, the largest of all), Podragu (15.5 m, the deepest of them), Urlea and Avrig are the most important glacial lakes on the northern slopes (BĂLĂCEANU et al., 1975; <https://muntii-fagaras.ro/>). Podul Giurgiului is located at the highest elevation of all, 2,261 m s.l.a., by BARCO & NEDELICU (1974), while the small lake Mioarele is the highest of them, 2,282 m s.l.a., by MĂCIU & POSEEA (1982).

Because of their importance in terms of power supply, a range of reservoirs and captations were arranged on the flowing waters towards South, starting with 1965. Vidraru (804 m s.l.a.), on the Argeș River, is the largest and the most known of them, being settled on the highly visited Transfăgărășan Route, while Râușoru (901 m s.l.a.), on Râul Târgului, and Pecineagu (1,093 m s.l.a.), on the Dâmbovița River, less known, from a less frequented area by tourists, belong to a second class of size. Further, Sătic-Speriata (794 m s.l.a.), Baciul or Văsălatu (875 m s.l.a.), Cumpănița (940 m s.l.a.), and Vâlsan (964 m s.l.a.) are, generally, dam basins of small extent (Table 1). Other reservoirs – from West to East: Boia 1 (436 m s.l.a.), Boia 2 (422 m s.l.a.), Boia 3 (401 m s.l.a.), on Boia River, Topolog (978 m s.l.a.) on Topolog River, Valea lui Stan (938 m s.l.a.), Limpedea (1,011 m s.l.a.), on the homonymous tributaries of the Argeș River, Dobroneagu (1,015 m s.l.a.) on the tributary with the same name of the Vâlsan River, Cernatu (854 m s.l.a.), Draghina (911 m s.l.a.), Bradu (945 m s.l.a.), on the homonymous tributaries of the Doamnei River, Lerești - Pojorâta (751 m s.l.a.), on Râul Târgului – generally, have minor dimensions and mainly serve to produce power. Also, some dam basins are found on the Olt Valley, between Turnu Roșu (362 m s.l.a.) and Călimănești (271 m s.l.a.; the cotes belong to Google Earth). It is worth to mention that Topolog, Valea lui Stan, Cumpănița, Dobroneagu, Cernatu, Bradu, Draghina, and Baciul transfer the water through a sequence of adductions to the Vidraru Dam Basin (Fig. 1). In the last time, micro-hydropower plants with insignificant captions were built on the Buda and Capra tributaries of the Argeș River.

Table 1. The main parameters of some dam basins from the Făgăraș Massif  
(by <http://tw.baraje.ro/rrmb>).

Name of reservoirs	Year of commissioning	River	Type of dam	Type of seal	Type of foundation	Height (m)	Length of dam (m)	Volume (km <sup>3</sup> )	Area (ha)	Length (km)	Scope	Area of hydrographic basin (km <sup>2</sup> )	Overflow debit (m <sup>3</sup> /s)	Type of overflow
Baciul	1966	Râul Doamnei	VA	x	R	34.0	105	0.7	6	6.2	h	204	470	1
Cumpănița	1968	Cumpăna	VA	x	R	33.0	100	0.3	3	0.9	h	5.6	151	1
Pecineagu	1984	Dâmbovița	ER	fc	R	105.0	276	69.0	182	9.0	shi	103	600	l/v
Râușoru	1987	Râul Târgului	ER	ie	R	120.0	380	60.0	190	4.4	shi	115	620	l/v
Sătic Speriata	-	Dâmbovița	PG/TE	fc	R/S	18.5	27	0.1	18	6.0	h	204	452	v
Vâlsan	1966	Vâlsan	VA	x	R	24.0	90	0.2	2	0.1	h	68	190	1
Vidraru	1965	Argeș	VA	x	R	166.0	305	465.0	1,000	11.0	h	286	660	l/v

**Legend:** VA – bow, ER – rockfall dam, PG – weight dam, TE – ground dam, x – unknown, f – uphill slope, c – concrete, I – intern core, e – clay, R – rocky outcrops, S – unrocky outcrops, H – height, L – length, V – volume, S – area, h – electric energy, s – water supply, i – irrigations, l – free overflow, v – overflow with dams, l/v – free and with valves.

The vegetation is diverse. At the foothills of the mountains, the old forests of *Quercus* L. were replaced by agricultural crops and the true woods start from ca. 600 m s.l.a. with the level of *Fagus sylvatica* L. that mounts up to ca. 1,300 (1,350) m s.l.a. The level of *Picea abies* (L.) H. Karst. follows and that ascends to ca. 1,700 m s.l.a., on the northern versants, and 1,800 m s.l.a., on the southern slopes. The mixed forests lie between the broadleaf forests and the coniferous forests and occupy lesser areas on the South and larger areas on the North. The alpine level is found over the tree line (BĂLĂCEANU et al., 1975). The vegetation of the dam basins is relatively scarce, though 29 vegetable associations were identified in the area of influence of Vidraru, Cumpănița, Vâlsan hydro-energetic systems. They can be grouped as follows: tall vegetation of eutrophic waters and swamps; short vegetation of the puddles and oozy soils; segetal and ruderal vegetation; rocky region vegetation; mesophilic lawn vegetation; woods clearing vegetation; mountain weed vegetation; river meadow vegetation; vegetation of foliage and resinous mixture; resinous forest vegetation (ALEXIU, 1999).

As for the aquatic fauna, among vertebrates, 17 species of amphibians and 12 species of fish were identified in the area, including the Făgăraș Piedmont. The most common are: *Rana temporaria* Linnaeus, 1758, *Salamandra salamandra* (Linnaeus, 1758), *Triturus montandoni* (Boulenger, 1880), *Triturus alpestris* (Laurenti, 1768), respectively: *Cottus gobio* Linnaeus, 1758, *Phoxinus phoxinus* (Linnaeus, 1758), *Salmo trutta fario* Linnaeus, 1758, *Barbus petenyi* Heckel, 1848 etc. (STĂNESCU, 1972a, b; LINELL & KALTENBORN, 2016). The fish fauna belongs to the trout zone, in the upper streams, and to the grayling and barbel zone, downstream. Mostly, they eat larvae of Trichoptera, Plecoptera, Ephemeroptera, some Amphipoda etc. (BĂNĂRESCU, 1964).

The reservoirs are generally oligotrophic (DIACONU, 2008).

The climate of the area has mountainous features, with differences depending on the height. In the previous century, the average temperature of the air varied from 4–6°C in the lower areas to –2–0°C on the peaks. July and

August were the warmest (7-8°C mean) and January and February, the coldest months (-11-8°C). The level of precipitations also varied between 900-1,000 mm/year, in the lower area, and 1,400 mm/year, in the alpine area. The months from the beginning of the summer were the most humid, while September was the driest (BĂLĂCEANU et al., 1975). The temperature of the waters decreased below 1°C in November, when the ice cape formed, and increased again in March-April (BARCO & NEDELICU, 1974). The temperature of waters that were very rich in oxygen and clear was relatively constant, with a variation of 7-8°C, and quite low rarely exceeding 16-18°C (BĂNĂRESCU, 1964). Today, in the conditions of the global warming, the temperatures are expected to be a few higher, while the level of precipitations should be higher in summer and winter and lower in spring (<http://www.carpathianconvention.org/>).

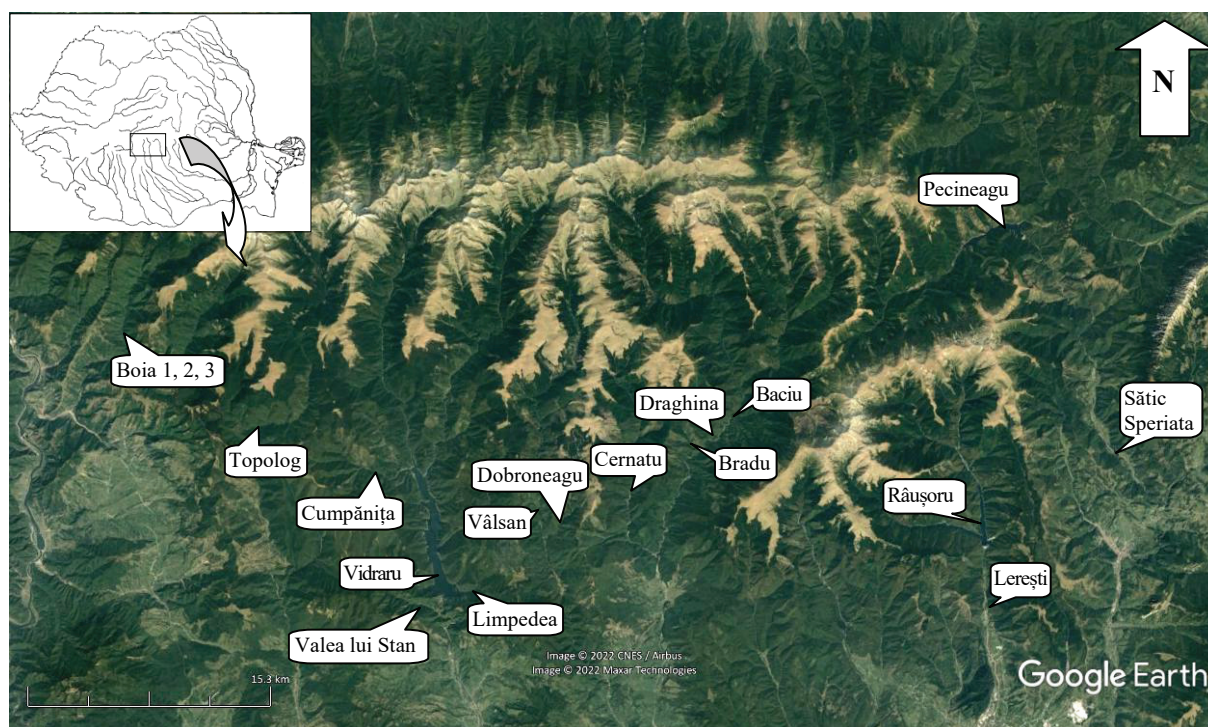


Figure 1. The map of the Făgăraș Massif and of the nearby area, with the checked dam basins and water captions (by Google Earth Database).

### Information about the species

The goosander is a large and long-billed diving duck. The male is black and white coloured, while the female is greyish, with dark red-brown head and the upper neck. The well fledged juvenile is like a paler female, with a white strip on the lorum (BRUUN et al., 1999; SVENSSON et al., 2017). The juveniles can fly from 30-50 days after hatching (<https://animaldiversity.org/>) and fledge when 60-70 days old. They become sexually mature at two years old (PETROVICI, 2015; <https://sanctuarysimon.org/>). It is a species of Holarctic type (MUNTEANU, 1974), but, as a breeder in Europe, the subspecies *Mergus m. merganser*, by MARTI & LAMMI (1997) is met in Iceland, U.K., Sweden, Finland, Belarus, Estonia, Latvia, Lithuania, and Russia (<http://datazone.birdlife.org/species/>), also Germany, Denmark, Norway, Poland (SNOW & PERRINS, 1998). The alpine population is distributed from France to Austria, but small populations are also found in the South-East of Europe (MARTI & LAMMI, 1997, <https://ebba2.info/>). The population from the Balkan Peninsula is considered boreal (MARINCOVIĆ et al., 2008) or a glacial relict (DOBREV et al., 2020). There were 36,000-60,000 breeding pairs in Europe, mainly in Fennoscandia (MARTI & LAMMI, 1997) or 134,000-206,000 mature individuals, in 2015 (<http://datazone.birdlife.org/>). In Romania, less than 100 pairs can breed (SVENSSON et al., 2017; <https://ebba2.info/>; <https://rombird.ro/>) or about 20-50 pairs (PETROVICI, 2015; <http://datazone.birdlife.org/>).

In the breeding season, it lives on the clear-water lakes and rivers, mainly in large forests and in mountains (MARTI & LAMMI, 1997). It requires slow flowing or deep waters, rich in fish, bordered by mature trees with holes for nesting (SVENSSON et al., 2017), but the nests are also placed on high banks, near waters (CIOCHIA, 2002).

It is regarded as an unthreatened species (LC – Least Concern), by IUCN (<https://www.iucnredlist.org/>), but, at the same time, it is present on the European Red List of Birds, 2015 (<http://datazone.birdlife.org/>). In Romania, it is not in The Red Book of the Vertebrates (BOTNARIUC & TATOLE, 2005), but is banned from hunting according to the Hunting Law 407/2006 (<http://www.mmediu.ro/>). Directive 2009/147/EC lists it in Annex II, part B, allowing its hunting under national legislation (<https://eur-lex.europa.eu/>).

### Time and method of work

The Southern area of the Făgăraș Massif, corresponding to the Argeș and Vâlcea Counties, was surveyed after 2000, except the reservoirs from the Olt River, where observations were sporadically achieved. An important part of the data was collected in 2006 from the Râușoru Dam Basin, when its avifauna was monthly monitored, while other regular observations were performed in the breeding seasons of 2014 and 2020 on the Vidraru Dam Basin, within an extensive scheme of monitoring of the national wetland avifauna, coordinated by the Romanian Ornithological Society. Here, in 2014, between April and July, a square of 2x2 km<sup>2</sup> from the end of the reservoir, that contains the Buda and Capra inlets, was 4 times monitored while, in 2020, between May and June, two squares of 2x2 km<sup>2</sup> from the end of the reservoir, the same as upper and the second downstream of it, were 3 times monitored. Other observational data were gathered as complementary information in projects led by the “Milvus” Group of Bird Protection, respectively by the Institute of Biology of the Romanian Academy. Not least, data were occasionally collected during an all year-round study of the mountains' avifauna. In the case of the reservoirs, the observations were performed from the shores using a terrestrial telescope, binoculars and a photo camera.

## RESULTS AND DISCUSSIONS

The dam basins modify the natural landscape and change the original biodiversity of the rivers where they are built (MUNTEANU, 1978; MUNTEANU & MĂTIEȘ, 1983). In the mountain areas, the animals adapted to living exclusively in the streams are particularly affected, see the case of *Romanichthys valsanicola* Dumitrescu, Bănărescu, Stoica, 1957 (PRĂVĂLIE, 2011), but, in the same time, some groups, like the aquatic migratory birds, benefit from the construction of reservoirs (MUNTEANU & MĂTIEȘ, 1983). In time, artificial lakes can become a place of breeding for many birds dependent on wetlands (MUNTEANU, 1978) and the goosander is one of them. Its natural colonisation on the artificial lakes was observed previously in other countries. For instance, the species inhabited the dam basins built in 1950 on the Drina River, in Western Serbia and the Eastern Republic of Srpska, starting with 1986. Later it dispersed on other reservoirs from both countries, as well as from Montenegro and the Federation of Bosnia and Herzegovina (MARINCOVIĆ et al., 2008). In Bulgaria, in the Eastern Rhodope Mountains, a new breeding population, probably appeared in 90s, was recently discovered, too, being considered a survivor of the glacial era (DOBREV et al., 2020). In Scotland, the first proof of breeding was in 1871 (MEEK & LITTLE, 1977), in the Czech Republic, in 1894, in Belarus, in 1984, in Netherlands, in 1996 etc. and there is a small population in Ukraine, too (SNOW & PERRINS, 1998). In Italy, the first breeding was recorded in 1996 (ZENATELLO et al., 1997), and since then the birds populated many lakes and rivers of the pre-Alpine area, the small lakes and rivers having a few pairs, with the mention that the process continues on the streams (BORDIGNON et al., 2018) with portions of rapid flow (ZENATELLO et al., 2009), which case we consider that it could be more about the recolonisation of the old quarters and not the colonisation. In Slovakia, the first record was in 2007 (LEŠO & KROPIL, 2007). Also, in Slovenia the trend is increasing (BASLE, 2019, quoted in DOBREV et al., 2020). The Geneva Lake, between France and Switzerland, was very important in the development of the population from the two countries (SAVIOZ et al., 2021). The southernmost population from Europe, 11-32 pairs (SCOTT & ROSE, 1996), found in the 1930s, breeds on the Prespa Lake, Greece and North Macedonia (HANDRINOS & AKRIOTIS, 1997, quoted in DOBREV et al., 2020), where, in the Greek part, the strength increased from 3-8 pairs, in 1990, to 50-100 individuals, in 1990-1995 (by Wetlands International, in CATSADORAKIS et al., 2016). It was supposed to be secluded from the populations that breed in the Central Europe (SCOTT & ROSE, 1996; HANDRINOS & AKRIOTIS, 1997) but, currently, our data combined with the data earlier mentioned seem to infirm this, as a continuity of range appears, at least between the Alps (France) and Balkans (Greece). However, according to KELLER (2009), a strong genetic differentiation is found between the European breeding populations (the Alpine, Iceland, British, Balkans and Northern European ones), while there are some interchanges among them, because, at least for the Alps, some males from the northern population couple with the local females that manifest a strong fidelity to the breeding grounds.

Until now, in the Făgăraș – Iezer-Păpușa Mountains, we found the goosander in the breeding season (April-August) on 7 dam basins (Râușoru, Baci, Vâlsan, Vidrar, Pecineagu, Boia 1 and 3) and other two places, and here only in May: one located ca. 1 km upstream from the end of Râușoru and another one at ca. 8-9 km upstream from the Boia Lakes, while juveniles were found only on Râușoru, Vidrar, Baci and Pecineagu (Fig. 1; Photos 1; 2; Table 2). Baci is the smallest of these reservoirs, with 6 ha, while Vidrar is the largest of them, with 1,000 ha, the average of all four being 344.5 ha. By comparison, the surface of the artificial lakes from Western Serbia and Eastern Bosnia is over 300 ha each (MARINCOVIĆ et al., 2008), while the Lesser Prespa Lake (4,740 ha), the Great Prespa Lake (24,500-27,000 ha) and the Ohrid Lake (35,800 ha), from Greece, Albania and North Macedonia (CATSADORAKIS et al., 2016) are much wider. In Romania, the reservoirs Bicaz (Izvorul Muntelui), Vidra, Zetea, Mălaia, where the species was firstly found as breeder (SZABÓ-SZELEY et al., 2004) have 3,100 ha, 1,240 ha, 234 ha, respectively 47 ha (<http://tw.baraje.ro/rrmb>), with an average of ca. 1,155 ha. On the other hand, the birds observed by us on streams can be unpaired individuals, but also breeding birds, if we consider that the feeding sites can be located up to 8 km far away from the nest site (MALLORY & METZ, 1998; <https://animaldiversity.org/>). According to SNOW & PERRINS (1998), the nests can be up to 1 km away from the water, from where the female escorts the chicks to the larger lakes, rivers, and bays downstream (<https://www.allaboutbirds.org/>). It can carry them in the beak, too (PETROVICI, 2015). The

juveniles could be also recorded on Vâlsan Dam Basin, where a pair was observed in 2015, respectively 2016, and on the Boia series of reservoirs, where a few specimens were identified in April and June. Also, Sătic seems to be a favourable site of breeding, though the disturbance is relatively high, because of the fishermen and other tourists, and, also, the Topolog Captation. We think that the other dam basins present a lower probability to host juveniles, because of their reduced area and, possibly, because of the scarcity of fish and as well as of the poor shelters. The proximity of the human settlements (the case of Lerești Dam Basin) can be invoked, though the birds adapt and can live even in the towns and parks (MARTI & LAMMI, 1997). The 5 individuals observed at Greblești, Vâlcea County, on March 27, 2021, suggest the breeding of the species on the Olt River, on the mountain segment. By the way, breeding can be very possible in the lower areas, as it was attested in Dobrogea at the beginning of the 20<sup>th</sup> century (DOMBROWSKI, 1912). Our observations confirm that the area of breeding is still in expansion in Europe (MUNTEANU, 2012), though, at the level of 2004, it was not considered sustained enough in Romania (SZABÓ-SZELEY et al., 2004). The birds bred on the dam basins after no more than 30 years after their construction - the case of Râușoru Reservoir, ca. 40 years - the case of Baci-Văsălatu, and 40-50 years - the case of Vidraru, where it was absent in 2004 (PETRESCU, 2005). On the Drina River, the situation was similar, ca. 30 years (MARINCOVIĆ et al., 2008). The increasing of the population was attributed to the sedentarism of some females and on the youth that return to the places of born (ZENATELLO et al., 2009) and, at least in the case of the Alpine population, on the hunting ban and, perhaps, of the water eutrophication and nest-box schemes (MARTI & LAMMI, 1997).

While the quota of the researched dam basins varies between nearly 400 and 1,100 m s.l.a., breeding birds have been found between 804 m (on Vidraru) and 1,093 m (on Pecineagu), i.e. an average of 918.25 m s.l.a. The mean of the reservoirs cote mentioned as the first places of breeding in Romanian mountains by SZABÓ-SZELEY et al. (2004) is 711 m s.l.a. (1,266 m – Vidra, 614 m – Zetea, 484 m – Bicaz, 480 m – Mălaia, cf. Google Earth), 200 m lower than in our case. That corresponds to the broadleaf and mixed forests level, where *Fagus sylvatica* is however prevalent, but where large patches are cultivated with *Picea abies*, for economic reasons. While wood exploitations are found in the vicinity of the basins, the birds seem to find adequate hollows to breed. *Dryocopus martius* (Linnaeus, 1758) is recognised as a good provisioner of holes (KEAR, 2003) and it has here a suitable habitat, being well represented. Also, the very abrupt and rocky shores can be used for it (DOBREV et al., 2020), but we could not find any nests, in 2014 and 2020, when the whole banks were monitored in 2x2 km<sup>2</sup> squares from the end of Vidraru Dam Basin and were crossed on foot. The female observed by us on May 22, 2021, at the confluence between the Boia and Sterminoasa Rivulets, was in a comparable habitat, where an unused nest of *Corvus corax* Linnaeus, 1758 was found on a high rocky wall, ca. 50 m away from the water. This nest could serve as a platform of breeding, as it was documented for the nests of squirrels (<https://www.allaboutbirds.org/>). In Italy, where the cote of the reproductive sites was much lower, between 30 and 494 m, the presence of the rocky banks seemed to be the key factor for the breeding (ZENATELLO et al., 2009). In Romania, where it favours the hilly and the mountainous areas (PETROVICI, 2015), the nests are made in a hollow or among the rocks, sometimes even on the ground, where the eight-nine eggs are covered in May (TĂLPEANU, 1969), or are placed on the shores of the mountain dam basins, in the herbaceous vegetation, close to the water (MUNTEANU, 2008, 2012). Rarely, on rivers, it can breed on stony shores, near a dead and fallen tree (PETROVICI, 2015). The species was not found on the upper glacial lakes from our area and the reasons could be the inadequate climate, the lack of sufficient food, shelters and places for nests, the size of the water bodies, the increased presence of the predators and the human disturbance (tourists, shepherds with dogs). It demands waters with a high productivity of fish and avoids floating or fringing aquatic vegetation or luxuriant submerged aquatic plants (SNOW & PERRINS, 1998). There are exceptions, for instance the Ohrid Lake, famous for its reach wetland vegetation and flora (IMERI et al., 2010). Usually, the waters are less than 4 m deep in summer, more in winter (<https://animaldiversity.org/>), but less than 10 m (DURINCK et al., 1994; PETROVICI, 2015). In our case, the depth of the water was much superior – between ca. 30 m, on Baci, and ca. 160 m, on Vidraru, near the dams (<http://tw.baraje.ro/rmb>), that means an average of ca. 100 m maximum depth, but, usually, the birds spend the time in less deep waters.

Their dynamics depends a lot on the weather and we do not know if some of the resident birds remain all the time in the area in the proper years, though MUNTEANU (2008) affirmed that the pairs are summer visitors on the grounds of breeding. While the birds were not signalled in October and November, practically, they can be considered present in the mountain region all year long. On Râușoru, where, in 2006, the species was constant and subdominant, the birds were observed between March and September and in winter – 1 ind., on December 13 (MESTECĂNEANU, 2008b, 2011) and, on Vidraru, in January and between March and June, but the research is ongoing. Râușoru, Vidraru, Baci are the only places where individuals outside the breeding season have been seen, though, theoretically, they can be met elsewhere, from where they leave, when the ice cape forms (at least on Baci, the smallest of them, this normally, happens in January and February). Likely, some individuals scatter now to the lower areas, where they were observed during winter (for instance, 1 individual was recorded heading on the wing to the North, on February 10, 2021, over Râul Doamnei, at Negreni, in the hilly area of the Argeș County, ca. 40 km South of Făgăraș Mountains). Once the ice melts, the birds reappear and disperse on the whole available surface of the lakes. In spring, the breeding individuals concentrate to the mouths of the streams, and mainly to the end of the reservoirs, where the waters are shallower. Immediately after the rise of juveniles, the most of the specimens move offshore, as we observed even on July 19, 2014, when no individuals were registered in the 2x2 km<sup>2</sup> monitored square from the end of Vidraru (Table 2).

A high strength was observed at the finish of the winter and the beginning of the spring, when most of the pairs settle (12 individuals, on February 28, 2016, on the Râșoru Reservoir, 44 individuals, on April 3, 2022, and 41 individuals, on April 9, 2022, on the Vidraru Reservoir), but migratory individuals are present. They come most likely from the West Siberia (SNOW & PERRINS, 1998). In Switzerland, for example, the number from January was higher than one from November, because of the wintering birds arriving from the North. Often, birds in their second calendar year persist until the end of March (KELLER, 2009), when the breeding birds return to the areas of breeding (SCOTT & ROSE, 1996). We saw such immature individual on Vidraru (19 individuals, on April 3, 2022, and 23 individuals, on April 9, 2022) that shortly disappeared (Table 2). The numbers decrease at the time of incubation, when many females are on the nests, then increase again after the hatching of the chicks (9 individuals on July 24, 2006 and 13 individuals, on June 06, 2007, on the Râșoru Reservoir, 9 individuals each, on June 30 and 1 July, 2007, and June 5 and 11, 2017, on the Baciú Reservoir, 21 individuals on May 18, 2014, at the end of Vidraru). Besides the spring and autumnal migration, also, a post-breeding migration for moulting is known between July and August (MARTI & LAMMI, 1997), though the males can congregate for that immediately after the mating (MADGE & BURN, 1988), and for this purpose they can fly even 2,000 km (LITTLE & FURNESS, 1985; KELLER, 2009). In the Alpine area, the females with chicks moult on the breeding places, while the others attach to the moulting flocks on the large lakes. The males' places of moulting are enigmatic and they can do this on the large lakes, too, or in other parts, to the North, suggesting, we think, the way of spreading in the new breeding grounds, because there are proofs that they leave the area of breeding after mid-May (KELLER, 2009). Almost all of them did this in Switzerland (KELLER & GREMAUD, 2003). The river breeders move to lakes and, in late August and early September, moulting and breeding waters often deserted (SNOW & PERRINS, 1998). We do not still have data on the moulting places of the local birds.

The nuptial display starts still February and March, on the free water of ice from the offshore and continues near the shores, in March, April, and the males usually leave their females after incubation (SNOW & PERRINS, 1998). The pairs breed alone or in loose groups (del HOYO et al., 1992) and the density ranges between 0.1 and 2 breeding pairs/km<sup>2</sup> on lakes, and reaches 0.2 breeding pairs/km<sup>2</sup> in some river systems (MARTI & LAMMI, 1997). In our case, the maximum density was 0.5 pairs/km<sup>2</sup> at the end of the Vidraru Dam Basin and 0.52 pairs/km<sup>2</sup> on the Râșoru Reservoir (MESTECĂNEANU, 2011). While MUNTEANU (2012) estimated only a pair or family/mountain dam basin, we evaluate that 3-6 pairs can raise their chicks on Vidraru, 1-3 pairs on Râșoru, 1-2 pairs on Pecineagu, 0-1 pairs on Baciú, 0-2 pairs on other dam basins, and 0-3 pairs on rivers, so the whole population from the Făgăraș – Iezer-Păpușa group of mountains is among 5 and 17 pairs. The small population from Vidraru is the most vigorous of all, while the population that breeds on the rivers from the area is very uncertain. In Britain, it was stated that the goosanders preferred the wider rivers (10-30 m), from the lower altitudes and with shallower gradients. Their density increased with the bankside tree cover in summer, not in spring, while the type of forest (deciduous versus coniferous) did not matter; it tended to decrease with the increasing amounts of riffle and white water (rich in air) and, consequently, the average maximum density was 0.54 birds/km of river (GREGORY et al., 1997). In Slovakia, the small existing population breeds on the river, too (LEŠO & KROPIL, 2007) while, in Switzerland, only 17% of all population does this (KELLER & GREMAUD, 2003). As a result, the lesser researched Olt River is the most susceptible from the area to host the majority of such breeding birds, then Dâmbovița and the other streams, since, according to PETROVICI (2015), in Romania, they prefer the upper course of the rivers and the reservoirs.

The breeding was first confirmed in 2007, on Râșoru (7 juveniles, on June 6) and Baciú (8 juveniles, on June 30 and July 1), but we suspect the breeding took place on the Râșoru Dam Basin in 2006 and even before. For the whole area, the average number of chicks/brood was 5.3, n=10, 2-9 chicks/brood, while for Vidraru it was 4.2 (n=5, 2-9 chicks/brood) and for the Râșoru, Baciú and Pecineagu together it was higher, 6.4 (n=5, 4-8 chicks/brood). The values must be taken cautiously, because the chicks had different ages, and the number of young chicks/brood is expected to be higher than the number of older chicks/brood (Table 2). By the way, the maximum value (9) was registered as the earliest observation of family. In addition, the juveniles from different families may mix where they are numerous (SNOW & PERRINS, 1998), if it is not the case here. 6.94 chicks/brood (range 1-19) was the average on some lakes from Italy, but it varied between 6.3 (KELLER & GREMAUD, 2003) and 7.4 (ZENATELLO et al., 2009) on other similar areas from the Central and Southern Europe (BORDIGNON et al., 2018). The relatively low mean can be explained by the predation, mostly on Vidraru, where the lowest number of chicks/brood (2) was recorded, but also on Râșoru, where *Larus michahellis* Naumann, 1840 was observed in both places as a non-breeding species, knowing that it feeds on chicks, if it has the occasion (SAVIOZ et al., 2021), but, equally, the Caspian gull (*L. cachinnans* Pallas, 1811), that roams through the area, can be suspected. Hawks, owls, Golden Eagles, and even fish are mentioned as predators, too (<https://www.allaboutbirds.org/>). Also, we consider that some terrestrial mammals, like *Lutra lutra* (Linnaeus, 1758), *Martes martes* (Linnaeus, 1758), *Martes foina* (Erxleben, 1777), *Vulpes vulpes* (Linnaeus, 1758) etc. could feed on chicks and eggs, and also the raven (*Corvus corax*) and, consequently, not all pairs have breeding success, e. g. being less 50% in some areas from Switzerland (KELLER & GREMAUD, 2003). Often, the female leaves the chicks until they can fly (SNOW & PERRINS, 1998), and we see youngsters alone, for instance 4 juveniles on June 14, 2020, on the Baciú Reservoir (Table 2). Thus, a lower number of females with juveniles results than the number of pairs or possibly couples seen mainly on the Vidraru Dam Basin, though in spring many of them are migratory. The incubation takes 30-32 days (SNOW & PERRINS, 1998), which means that the eggs start to be incubated in the Făgăraș area at the earliest in the first ten days of April, because the first observation of family in our case was May 18, 2014, on

the Vidraru Dam Basin. In Switzerland, the first families appeared at the end of April, which means that the egg-laying begun after mid-March (KELLER & GREMAUD, 2003). In Bavaria, the egg-laying started, usually, between mid-March and the end of April. So, females with newly-hatched chicks were mostly observed in May and at the beginning of June (BAUER & ZINTL, 1995; KELLER & GREMAUD, 2003).

Regarding the food, we cannot pronounce on it. Generally, it consists mostly of fish, but also mussels, shrimp, salamanders, rarely plant material and, in the breeding season, insects and other invertebrates. The ducklings feed on aquatic insects (SNOW & PERRINS, 1998; <https://www.allaboutbirds.org/>; <https://www.audubon.org/>) and, after 12 days old, on fish. According to BODEA et al. (1968), the goosander also feeds on frogs and shells. A preference for trout was observed but, rarely, it eats even birds and small mammals (PETROVICI, 2015). We found *Barbus petenyi* and *Salmo trutta fario* on Vidraru, but the fish fauna from the area is more abundant (STĂNESCU, 1972a, b; LINELL & KALTENBORN, 2016).

Table 2. The list of the observations of goosander in the area of the Făgăraș – Iezer-Păpușa group of mountains.

No.	Date*	Ind.	Place of observation	Breeding	Notes
1	30/06/2007	9	Baciu (Văsălatu) Dam Basin	C	1 f. + 8 j.
2	01/07/2007	9			1 f. + 8 j., the same as former
3	20/03/2016	2			1 p.
4	03/04/2016	1			1 f.
5	02/04/2017	1			1 f.
6	05/06/2017	9			1 f. + 8 j.
7	11/06/2017	9			1 f. + 8 j., the same as former
8	17/03/2019	2			1 p.
9	07/03/2020	2			1 p.
10	08/04/2020	1			
11	17/05/2020	1			1 f.
12	06/06/2020	1			1 f.
13	14/06/2020	4			4 j. poor fledged
14	17/06/2021	2	Boia 1 Dam Basin	Pr	2 f.
15	17/04/2021	1	Boia 3 Dam Basin	Pr	1 m.
16	22/05/2021	1	Confluence Boia Mică – Sterminoasa	Po	1 f.
17	31/05/2017	1	Confluence Râul Târgului – Valea Largă, upstream of the Răușoru Dam Basin	Po	1 f. in flight to the North, going beyond the Voina Chalet
18	27/03/2021	5	Greblești, Olt River	Po	3 i. on the water and 2 i. in flight
19	29/08/2020	5	Pecineagu Dam Basin	C	5 j. well fledged
20	09/05/2021	2			1 p.
21	26/04/2006	1	Răușoru Dam Basin	C	1 f.
22	22/05/2006	5			
23	24/07/2006	9			
24	29/08/2006	7			
25	07/09/2006	6			
26	13/12/2006	1			
27	27/03/2007	6			3 p.
28	06/06/2007	13			5 ad., 1 f. + 7 j.
29	28/02/2016	12			7 m., 5 f.
30	11/05/2017	1			1 f.
31	11/07/2017	3			3 f. or j.
32	11/04/2015	2	Vălsan Dam Basin	Pr	1 p.
33	31/05/2015	1			1 f.
34	01/05/2016	2			1 p.
35	26/04/2014	3	Vidraru Dam Basin	C	1 m., 2 f.*
36	18/05/2014	21			9 m., 1 p., 1 f. + 9 j. *
37	10/06/2014	9			1 ad., 1 f. + 4 j., 1 f. + 2 j. *
38	01/01/2017	9			
39	09/05/2020	15			5 m., 1 p. *, respectively 8 m. **
40	30/05/2020	15			1 p. *, respectively 8 m., 3 f., 1 p. **
41	28/06/2020	15			1 f. + 3 j., 1 f. + 3 j. *, respectively 7 f. **
42	23/01/2021	5			
43	06/01/2022	2			1 p.
44	13/03/2022	23			2 p., 2 gr.
45	20/03/2022	12			6 p.



46	27/03/2022	20			8 m., 12 f.
47	03/04/2022	44			12 m., 9 f., 2 p., 19 im.
48	09/04/2022	41			5 m., 3 f., 5 p., 23 im.
49	16/04/2022	10			4 m., 2 f., 2 p.
50	24/04/2022	8			5 m., 3 f.

**Legend:** \* – day/month/year; C – confirmed, Pr – probable, Po – possible; ind. – individual(s), m. – male(s), f. – female(s), p. – pair(s), ad. – adult(s), j. – juvenile(s), im. – immature(s), gr. – group(s); \* – into the upstream 2x2 km<sup>2</sup> square, \*\* – into the downstream 2x2 km<sup>2</sup> square.



Photo 1. Family on Baci (Văsălatu), June 5, 2017 (original).



Photo 2. Family on Vidraru, May 18, 2014 (original).

## CONCLUSIONS

Some major ideas can be kept:

1. In the conditions of the effect of the global warming, the population and distribution of the goosander in the Făgăraș Massif increased from null, at the beginning of 2000s, to 5-17 pairs, today, when the Vidraru Reservoir owns the most vigorous population from the area (3-6 pairs). The breeding space changed from Dobrogea (mainly the lower Danube and Delta), where it rarely bred until 1960s, to the mountains, where it mainly takes place today. Despite some genetic differentiation of the European populations remarked in the literature, a unique area of distribution seems to exist, at least from France to Greece, including the Carpathians, and that results to be not necessarily linked by the high region. The expansion in the Romanian Carpathians appears to have happened from the North to the South and we consider that the migratory birds, chiefly the immatures, played an important role in this spreading, because they probably acted as pioneers in the new territories.

2. Among the 18 dam basins arranged in the area, the goosander was found on 7 (Râșoru, Baci, Vâlsan, Vidraru, Pecineagu, Boia 1 and 3) and two rivers, though other few reservoirs are appropriate, while juveniles were found just on Râșoru, Vidraru, Baci and Pecineagu, 30-50 years after their construction. 918.25 m s.l.a. is their mean quota, which corresponds to the broadleaf and mixed forest levels. While the reservoirs are oligotrophic, their rocky banks are forested, a suitable habitat for nesting. At least, for the moment, the glacial lakes are not favourable to the species and we have no reports from here in no time of the year. The population of the rivers is probably very low, but we consider that the Olt River, rarely researched by us, is the most susceptible to host a few pairs.

3. Râșoru, Vidraru, Baci constitute the only places where individuals outside the breeding season have been seen and, practically, the birds can be considered present in the mountain region all year long. We do not know if some of the residents remain all time in the area in the proper years and, probably, they leave if the lakes freeze completely. After the melting, the birds return and, gradually, spread over the basins, toward the places of nesting. High strength was observed at the finish of the winter, the beginning of the spring, proving the migration through the area, many specimens being immatures. The numbers increased after the hatching of the juveniles, too.

4. While the breeding was first confirmed in 2007, on the Râșoru Dam Basin (7 juveniles, on June 6) and Baci (8 juveniles, on June 30 and 1 July), we suspect it happened in 2006 and even before, at least on Râșoru. The average number of chicks/brood was 5.3, a relatively low value caused, maybe, by the predation. The eggs started to be incubated the earliest in the first ten days of April, since the first observation of the family was on May 18, 2014. The maximum density was of ca. 0.50 pairs/km<sup>2</sup> of reservoir.

5. Despite the general negative impact on the biodiversity, the construction of the dam basins in the Făgăraș area proved to be favourable to the goosander. Currently, the species is not hunted, but, for a better protection, we recommend to the authorities the delimitation of sanctuaries as breeding spaces, mainly to the end of some reservoirs (at least Vidraru and Râșoru), in the condition of the tourism development, primarily with boats. The upcoming Romanian National Red Book should include this species.

6. Future researches on the species must be carried out, following in particular the birds that breed on rivers, including the mountain segment of Olt from the western extremity of the area.

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