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ECOLOGICAL RESEARCH ON THE BREEDING AVIFAUNA OF THE DÂMBOVNIC AND SUSENI LAKES AREA

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Abstract
Our research study was conducted in the area of the Dâmbovnic and Suseni lakes (a square of 2x2 km), two artificially created lakes. We identified 105 breeding species belonging to 13 orders, 39 families and 74 genera; 97 (92,4%) of them are confirmed breeding species and 8 (7,6 %) are probable breeding species. The results of the research on the Dâmbovnic and Suseni lakes area were compared and related to the data from the Atlas of the Romanian breeding species. By relating them to the Atlas data, we noted that 83 of the 100 breeding species cited in the Atlas were also recorded during our study; 22 new breeding species were identified (19 of them are confirmed breeding species and 3 are probable breeding species). The species that nest mainly in the reed beds (Ixobrychus minutus, Anas platyrhynchos, Fulica atra, Gallinula chloropus, Aythya ferina, Acrocephalus arundinaceus) and in the ecotones, marginal areas stand out among the wetland-dependent species through their higher numbers of individuals. Chroicocephalus ridibundus and Himantopus himantopus were observed to nest in the Argeş county for the first time. Most of them are constant and euconstant species (78 species), the results reflecting the abundance of resources in the area during the nesting period.
The species showing increasing trends in their breeding population had a significant share (57 %), because the attractiveness of these lakes for birds has continuously grown, being correlated with the ecological restoration of the degraded wetland areas and the emergenge of dense vegetation (thus creating new nesting places), the diversity of the habitat, the existence of ecotone areas, the diversification of the aquatic trophic resources and last but not least the reduced interaction between the local population and the bird communities in the lakes area. The anthropogenic influence is manifested through aggressive agriculture (the use of pesticides and fertilizers, etc.) and more recently through hunting, the existence of stray dogs, poor waste management, felling of old trees, all these in addition to some deficiencies of the water supply system, level fluctuations, etc. Strong eutrophication (hipereutrophication) can decrease food availability for waterbirds, which may lead to population decline in the future. Eighteen breeding species are listed in Annex I of the Birds Directive. There are no protection measures for the bird species in the area, because there is a lack of interest in this issue.

Keywords: breeding birds, lakes, pollution, eutrophication.

1. INTRODUCTION

The Neajlov River is among the rivers with the largest hydrographic networks (3,720 km) in Romania (Fig.1). Being the second order branch of the Arges basin and the first order branch of the Neajlov River, the Dâmbovnic River forms a meandering valley of 129 km in length, with a NW-SE direction of flow. It has a catchment area of 641.5 km² with altitudes reaching 350 m in the north of the basin and 70 m in the south, and stretches across the territories of the Argeş,

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Dâmbovița, Teleorman and Giurgiu counties. The Dâmbovnic and Suseni lakes are located in the Argeş county, on the territory of the commune of Suseni. These lakes were artificially created between 1965 and 1969 to collect the wastewater discharge from the Arpechim refinery.

Nutrient and heavy-metal pollution of the aquatic ecosystems is a topical issue. The effects of these excess nutrients are felt at all the environmental levels, threatening air and water quality and affecting the condition of the aquatic and terrestrial ecosystems. Life in the aquatic environment is largely governed by the physico-chemical characteristics and their stability. Fresh water is essential for agriculture, industry, human existence, and energy production, but it is still a limited resource of the Earth (Deaconu, 2016).

The analysis of the socio-economic system is very important because it allows us to evaluate the main anthropogenic emission sources of nutrients and heavy metals at the level of the Dâmbovnic River basin. Even though the ARPECHIM Piteşti – PETROM OMV chemical plant is located outside the limits of the above-mentioned hydrographic basin, it has been the main source of pollution with petroleum products and heavy metals of the aquatic ecosystems located in the area under research. The site conditions have been improved through bioremediation, combining ex-situ remediation of contaminated sediments using a bio-battery, with in-situ water bioremediation.

The disruption in the natural balance of an ecosystem can have unpredictable consequences on its evolution (Deaconu, 2012). Important links in the food chains, birds have been proved to be sensitive indicators of the ecosystem health. Birds feel and react promptly to the changes in their environment, that is why it was absolutely necessary to conduct an ornithological research study in the area of these polluted lakes.

Thus, the problem of protecting bird populations, especially in wetlands, becomes more and more critical, spreading across the country's borders and forcing us to take further steps, accordingly. The decline in the number of wild birds in Europe is a direct result of the degradation of their habitats, the destruction of their nesting places and the reduction in their natural food resources. These facts imposed special conservation measures (Munteanu, 2009).

The tailing ponds, initially built for another purpose, as those on the Argeş River (Mătieş, 1969; Munteanu and Mătieş, 1983; Gava, 1997; Conete, 2011; Conete, 2015), had a great impact on the landscape and influenced the population structure as well as the spatial and temporal dynamics of the bird species in the region. The high number of passage bird species, and also that of rare nesting species identified in the region confirm the importance of these lakes as regards their avifauna; they offer food resources, nesting and resting places. When the hunters are not around (they usually come in the evening or on weekends), the area is quiet and it is not affected by the daily activities in the region. Our research greatly contributes to the knowledge on the bird species in the region, especially on the nesting bird species.

2. MATERIALS AND METHODS

The hydrographic network is part of the Argeş River basin and drains off the area stretching to the watershed toward Teleorman (Barco, 1978). In the past, the dumping of the industrial waste from the petrochemical plant in Piteşti contributed to increased pollution levels on this river and to the destruction of the vegetation and fauna of the river and of its meadow. The Dâmbovnic River has its springs in the second terrace of the Argeş county, on the territory of the commune of Bradu, more precisely in the Geamăna village and flows into the Neajlov River, towards north-west of the commune of Clejani. The Dâmbovnic Lake is located at about 6 km south of Arpechim and connected with the Suseni Lake through an offtake of 5.8 km (Fig.1; Fig. 2). Solid suspensions and deposits of fine mineral particles have accumulated in these lakes (located in the upper section of the Dâmbovnic river), both owned by Petrom.

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The diversification of the pollution sources located in the hydrographic basin of the Dâmbovnic River, as well as the increase in the transfer rates of chemical compounds to the components of the natural capital have damaged the quality of the surface and groundwater through the accumulation of some macro-elements (nutrients) and the change in their biogeochemical cycles; eutrophication is one of the most important problems of the area; another major problem is the increased concentration of some compounds such as phenols, polycyclic aromatic hydrocarbons (PAH) in the sediments in the upper section of the basin, near Piteşti (Deaconu, 2012).

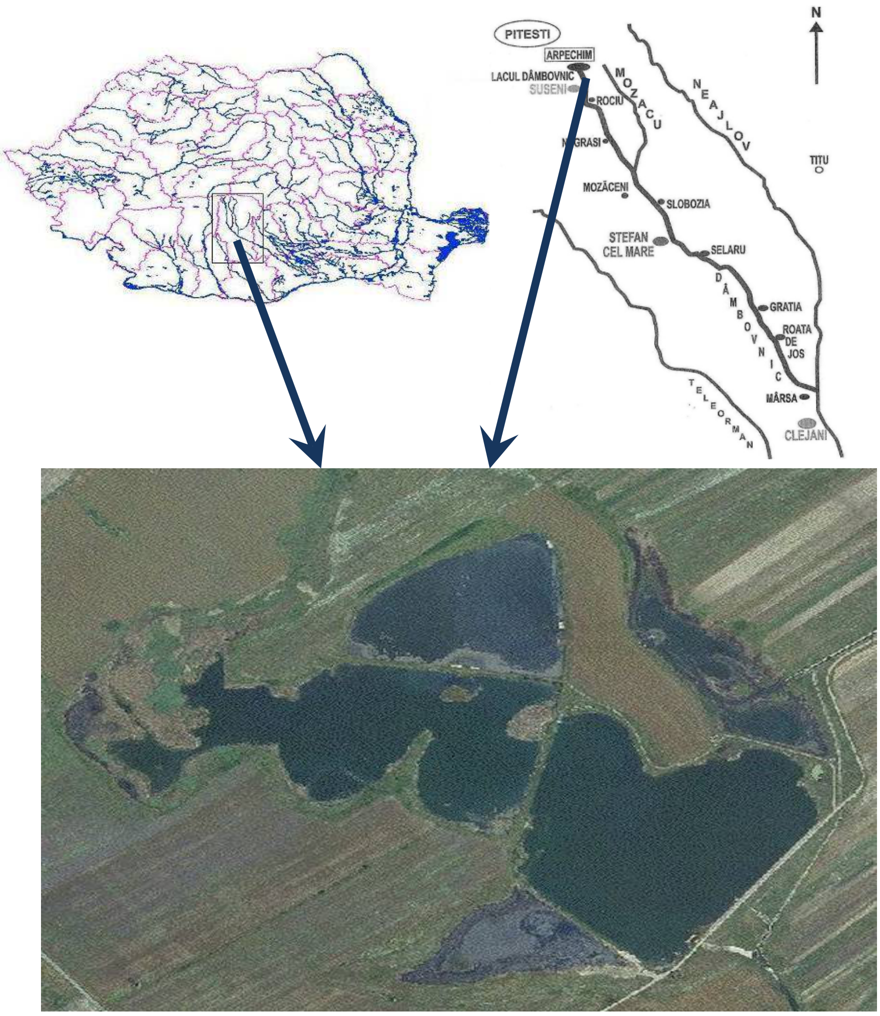

Figure 1. The map of the riparian area of the Dâmbovnic. The Neajlov River basin. The Dâmbovnic and Suseni lakes

The bioremediation method, used for improving the conditions in the area under research, employs aerobic bacteria, which have not been genetically modified and are not harmful to human beings. The contaminated sediments extracted from the Dâmbovnic Lake are arranged in stacks and aerated through perforated pipes; floating dams and aeration systems have been installed on the Dâmbovnic and Suseni lakes, and a wetland is being created in the western part of the Dâmbovnic Lake. Floating dams and aeration systems for water bioremediation were also installed in the compartments 3 and 4 of the Dâmbovnic Lake and in the Suseni Lake in 2010. The water supply is ensured by surface and underground sources, as well as by municipal water networks. The activities

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of Petrom Company have generated solid and liquid waste, including petroleum waste, dangerous waste, spent catalysts and building waste. Excess nitrogen and phosphorus are often considered to be the major causes of eutrophication. Eutrophication is one of the most serious environmental threats to aquatic ecosystems. Many problems, such as the reduced amount of oxygen, the problems related to taste and odour, the death of fish and loss of biodiversity occur as a result of eutrophication and algal blooms. With respect to nutrients, various sections of the river were classified into quality classes, ranging from II (good) to V (bad). Upstream sections (Dambovnic and Suseni lakes) are placed in Class V due to their ammonia and nitrite levels (Deaconu, 2016).

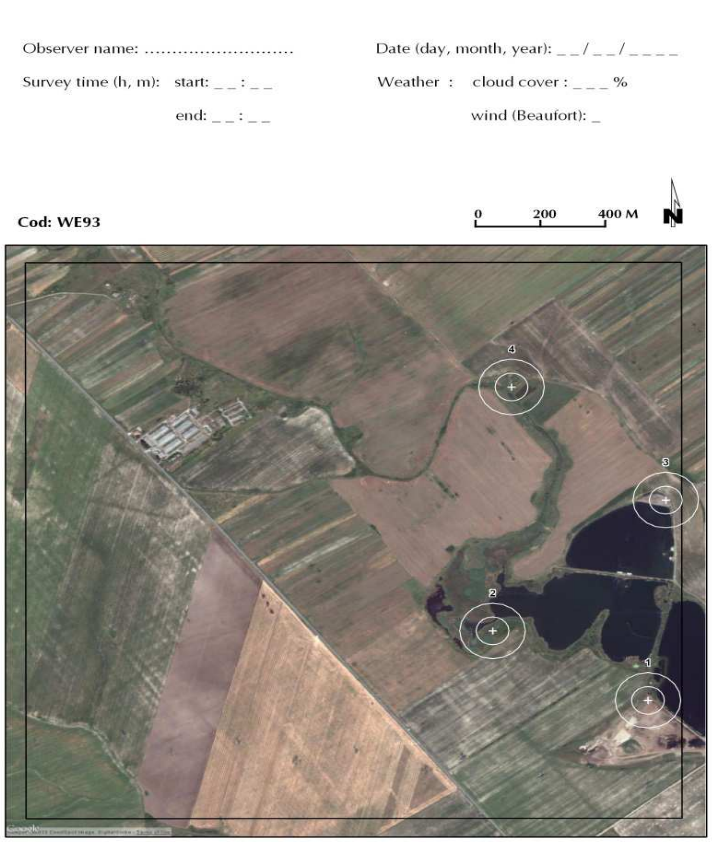

Figure 2. Square with pre-established points on the Dâmbovnic and Suseni Lake

In 2010, close to the Petrobrazi and Arpechim refineries, Petrom contractors installed modern facilities for waste treatment and began to process the waste from the collecting pits for waste minerals. These facilities provide an integrated approach in which the remediation of the site is combined with waste and water management, helping to restore the vegetation and subsequently, the fauna in the region.

The vegetation is specific to the wetlands from the southern part of Romania, which is a typical swamp vegetation (*Phragmites sp.*, *Typha sp.*, *Juncus sp.*), but covering only small areas, and there are few places burnt by petroleum waste. The shrubs and trees on the shore of the lake are very well developed (*Crataegus sp.*, *Salix sp.*, *Rosa canina*, *Rubus sp*, *Populus sp etc*) (Voicu, 2005; Deaconu, 2012). Invertebrates are also well developed in the area, especially insects. Vertebrates are represented here by a few species of fish, amphibians (*Hyla arborea*, *Pelophylax ridibundus*, *etc.*), reptiles (*Emys orbicularis*, *Natrix natrix*, *Lacerta viridis*, *etc*) and mammals (*Talpa europaea*,

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Lepus europaeus, Capreolus capreolus, Vulpes vulpes, etc). The lakes are surrounded by agricultural lands and they are important to the vulnerable bird species, which used to live on these lands.

The research on the nesting avifauna in the area of the Dâmbovnic and Suseni lakes (Fig.2) was conducted in the period April – July, between 2013 and 2016. Other phenological aspects were also observed during the period 2013-2016.

The species were identified with the naked eye, by listening for bird sounds or by using a camera. The counting was done using a terrestrial telescope (10 x 45) and binoculars (10 x 50), with the help of the illustrated *"Hamlyn Guide"* to the Birds of Romania and Europe (Bruun-Delin-Svensson, 1999) and *"Collins Bird Guide"* (Svensson et al., 2009). To observe the species, we travelled to the site every month, at around 5 a.m., following the guidelines of the *General monitoring programme for acquatic and lake-nesting species* (http://monitorizareapasarilor.cndd.ro). We used the itinerary and the fixed point observation methods. We walked on the shores of the lakes in order to watch the avifauna of the entire water surface and the avifauna in their neighbourhoods. Observation and counting were difficult in some areas, because the birds were hidden in the reed beds and tall crops; listening for their sounds was the main means of recognition. Furthermore, we also recorded their track in the square and at the established points with a GPS device.

The ecological assessment area, which includes the Dâmbovnic and Suseni lakes, is a square of 2x2 km (Fig. 2), inevitably comprising moist sites – wet areas and wetlands (rivers, lakes, swamps, wet farmland, etc.). We used four field notebooks with four maps (one for each of the four travels/ year), and a colour map of the square (Project). The main targets of this method are the birds characteristic of wetlands. The points we selected were necessarily located in moist sites or in their vicinity (*Carex sp.*, *Phragmites sp.*, *Typha sp.*, lakes, river, etc.).

3. RESULTS AND DISCUSSIONS

In the area under research, during the prevernal, vernal and estival period we identified 105 breeding species belonging to 13 orders, 39 families and 74 genera, representing a relatively high level of biodiversity (Table 1).

Table 1. List of breeding birds identified in the area under research

No.	Species	The Atlas of the breeding birds of Romania	Personal research	The minimum and the maximum of the estimated number (pairs)	Constancy during the breeding	Birds Directive	Breeding bird population trends
1.	*Tachybaptus ruficollis**	CB	CB	2-5	C3		+
2.	*Podiceps cristatus**	CB	CB	2-4	C4		-
3.	*Ixobrychus minutus**	PB	CB	5-8	C3	AI	+
4.	*Nycticorax nycticorax**		CB	4-8	C4	AI	+
5.	*Ciconia ciconia**	CB	CB	1-1	C4	AI	-
6.	*Cygnus olor**		CB	1-1	C4	AII\2	+
7.	*Anas platyrhynchos**	CB	CB	12-16	C4	AII\1, AIII\1	+
8.	*Anas querquedula**	PB	PB	1-2	C2	AII\1	-

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9.	*Aythya ferina**	PB	CB	5-7	C4	AII\1, AIII\2	+
10.	*Aythya nyroca**		PB	0-1	C3	AI	+
11.	*Accipiter gentilis*	PB	PB	0-1	C2		-
12.	*Accipiter nisus*		CB	1-1	C3		+
13.	*Accipiter brevipes*	PB					
14.	*Circus aeruginosus**		CB	1-1	C4	AI	+
15.	*Buteo buteo*	CB	CB	1-1	C3		-
16.	*Falco tinnunculus*	PB	CB	1-1	C4		+
17.	*Falco vespertinus*	PB					
18.	*Falco subbuteo*		CB	1-1	C3		+
19.	*Perdix perdix*	CB	CB	1-4	C2	AII\1, AIII\1	-
20.	*Coturnix coturnix*	PB	CB	5-10	C3	AII\2	\
21.	*Phasianus colchicus*	CB	CB	7-14	C4	AII\1, AIII\1	-
22.	*Rallus aquaticus**	PB	CB	1-2	C2	AII\2	+
23.	*Crex crex*	PB					
24.	*Gallinula chloropus**	CB	CB	4-8	C4	AII\2	-
25.	*Fulica atra**	CB	CB	10-20	C4	AII\1, AIII\2	+
26.	*Charadrius dubius**	CB	CB	1-3	C3		+
27.	*Vanellus vanellus **	PB	CB	6-16	C4	AII\2	+
28.	*Tringa totanus **		PB	0-1	C3	AII\2	+
29.	*Himantopus himantopus**		CB	1-2	C4	AI	+
30.	*Chroicocephalus ridibundus**		CB	2-4	C4	AII\2	+
31.	*Sterna hirundo**		CB	1-2	C3	AI	+
32.	*Chlidonias hybridus**		CB	2-2	C4	AI	+
33.	*Chlidonias niger**		CB	1-3	C4	AI	+
34.	*Columba palumbus*	CB	PB	0-1	C2	AII\1	\
35.	*Columba oenas*	CB					
36.	*Streptopelia decaocto*	CB	CB	8-20	C4	AII\2	+
37.	*Streptopelia turtur*	CB	CB	1-2	C3	AII\2	-
38.	*Cuculus canorus*	CB	CB	1-2	C4		-
39.	*Otus scops*	PB	PB	1-2	C1		-
40.	*Athene noctua*	CB	CB	2-4	C3		-
41.	*Strix aluco*	PB					
42.	*Asio otus*	PB	CB	1-1	C3		+
43.	*Caprimulgus europaeus*	CB					
44.	*Alcedo atthis**	CB	CB	2-3	C3	AI	+
45.	*Merops apiaster*	PB	CB	3-6	C3		+
46.	*Coracias garrulus*	CB	CB	1-1	C2	AI	\
47.	*Upupa epops*	CB	CB	1-2	C2		-
48.	*Jynx torquilla*	CB					
49.	*Picus canus*	CB					
50.	*Picus viridis*	CB	CB	2-3	C4		-
51.	*Dendrocopos major*	CB	CB	1-3	C2		-
52.	*Dendrocopos syriacus*	CB	CB	4-6	C4	AI	+
53.	*Dendrocopos medius*	CB					
54.	*Dendrocopos minor*	CB	CB	1-2	C2		\

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55.	*Galerida cristata*	CB	CB	6-12	C4		-
56.	*Lullula arborea*	CB	CB	1-2	C2	AI	-
57.	*Alauda arvensis*	CB	CB	10-20	C4	AII\2	+
58.	*Riparia riparia*	CB	CB	6-10	C3		+
59.	*Hirundo rustica*	CB	CB	2-4	C4		\
60.	*Delichon urbica*	CB	CB	9-18	C4		+
61.	*Anthus campestris*		CB	1-2	C2	AI	+
62.	*Anthus trivialis*	PB	PB	1-2	C2		-
63.	*Motacilla flava*	CB	CB	10-22	C4		+
64.	*Motacilla alba*	CB	CB	8-12	C4		-
65.	*Troglodytes troglodytes*	PB	CB	1-1	C2		+
66.	*Erithacus rubecula*	CB	CB	2-3	C3		-
67.	*Luscinia luscinia*	PB	CB	1-2	C2		+
68.	*Luscinia megarhynchos*	CB	CB	3-6	C4		-
69.	*Phoenichurus phoenichurus*	PB					
70.	*Phoenichurus ochruros*	CB	CB	2-4	C3		+
71.	*Saxicola rubetra*	PB	CB	1-2	C2		+
72.	*Saxicola torquata*	PB	CB	2-5	C3		+
73.	*Oenanthe oenanthe*	PB	CB	1-2	C2		+
74.	*Turdus merula*	CB	CB	3-7	C3	AII\2	-
75.	*Turdus philomelos*	CB	CB	1-2	C2	AII\2	-
76.	*Locustella fluviatilis**	CB	CB	1-1	C1		-
77.	*Locustella naevia**		CB	1-1	C2		+
78.	*Locustella luscinioides**		CB	2-3	C3		+
79.	*Acrocephalus schoenobaenus**	CB	CB	1-2	C2		+
80.	*Acrocephalus scirpaceus**	CB	CB	2-4	C4		+
81.	*Acrocephalus arundinaceus**	CB	CB	6-10	C4		+
82.	*Acrocephalus palustris**		CB	10-16	C4		+
83.	*Hippolais icterina*	CB					
84.	*Sylvia nisoria*	PB	CB	1-3	C2	AI	+
85.	*Sylvia curruca*	CB	CB	4-8	C4		+
86.	*Sylvia communis*	CB	CB	5-12	C4		-
87.	*Sylvia borin*		PB	1-1	C1		+
88.	*Sylvia atricapilla*	CB	CB	2-3	C4		-
89.	*Phylloscopus collybita*	CB	CB	3-6	C4		+
90.	*Muscicapa striata*	CB	CB	1-2	C2		\
91.	*Ficedula albicollis*		CB	1-2	C3	AI	+
92.	*Aegithalos caudatus*	CB	CB	1-3	C2		-
93.	*Parus palustris*	PB	CB	2-4	C3		+
94.	*Parus lugubris*	CB					
95.	*Cyanistes caeruleus*	CB	CB	3-6	C4		+
96.	*Parus major*	CB	CB	6-16	C4		-
97.	*Sitta europaea*	CB	CB	1-2	C2		\
98.	*Remiz pendulinus**		CB	1-1	C3		+
99.	*Oriolus oriolus*	CB	CB	3-6	C4		-
100.	*Lanius collurio*	CB	CB	6-12	C4	AI	+
101.	*Lanius minor*		CB	1-2	C2	AI	+
102.	*Lanius excubitor*	PB					
103.	*Garrulus glandarius*	CB	CB	2-3	C3	AII\2	+
104.	*Pica pica*	CB	CB	9-18	C4	AII\2	+

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105.	*Corvus monedula*	CB	CB	10-30	C4	AII\2	-
106.	*Corvus frugilegus*		CB	20-40	C4	AII\2	+
107.	*Corvus corone cornix*	CB	CB	3-6	C3	AII\2	-
108.	*Corvus corax*	CB	CB	1-1	C3		-
109.	*Sturnus vulgaris*	CB	CB	6-14	C4	AII\2	+
110.	*Passer domesticus*	CB	CB	14-28	C4		\
111.	*Passer montanus*	CB	CB	18-40	C4		+
112.	*Fringilla coelebs*	CB	CB	2-3	C3		-
113.	*Serinus serinus*	CB					
114.	*Carduelis chloris*	CB	CB	2-4	C4		-
115.	*Carduelis carduelis*	CB	CB	6-12	C4		+
116.	*Carduelis cannabina*	CB	CB	3-6	C3		-
117.	*Pyrrhula pyrrhula*	PB					
118.	*Coccothraustes coccothraustes*	CB					
119.	*Emberiza cirlus*	PB					
120.	*Emberiza citrinella*	CB	CB	4-10	C3		\
121.	*Miliaria calandra*	CB	CB	6-16	C4		-
122.	*Emberiza schoeniclus**		CB	2-3	C4		+

Note:
Breeding: CB - certain breeding species; PB – probable breeding species; C1 – accidental species, C2 – accessory species, C3 – constant species, C4 – euconstant species; Birds Directive: AI – Annex I; AII/1 – annex II, part 1; AII/2 – annex II, part 2; AIII/1 – annex III, part 1; AIII/2 – annex III, part 2;
Population trends: - – stable; + – increasing; \ – decreasing.
* - water dependent species.

Of the 166 species identified (in all the phenological aspects) in the area of the Dâmbovnic and Suseni lakes, 105 are breeding species (representing 63 %), and 61 species (37 %) are non-breeding species, which did not find favourable conditions to breed in this area (Fig. 3). The results emphasize the dominance of breeding species and are similar to the results obtained in the area of the Bascov reservoir (recorded in a similar 2X2 Km square), where we identified 185 bird species, of which 102 were breeding species, representing 55% of the local avifauna; the Bascov Lake is subjected to a permanent and aggressive anthropogenic pressure, which is much higher than in the case presented in our current study, except for the hunting which is not practiced in this area (Conete, 2015).

Of the breeding species (105), 97 (92,4 %) are confirmed breeding species, and 8 species (7,6%) are probable breeding species; 32 breeding species are wetland-dependent (Table 1). The dominance of breeding species in the area is due to the availability of food resources, and good nesting and resting places.

The research results obtained in the area of the Dâmbovnic and Suseni lakes were compared and related (the KX 2 square with the side of 50 km, according to the U.T.M. system) to the data from the Atlas of the Breeding Birds of Romania (Munteanu et al., 2002).

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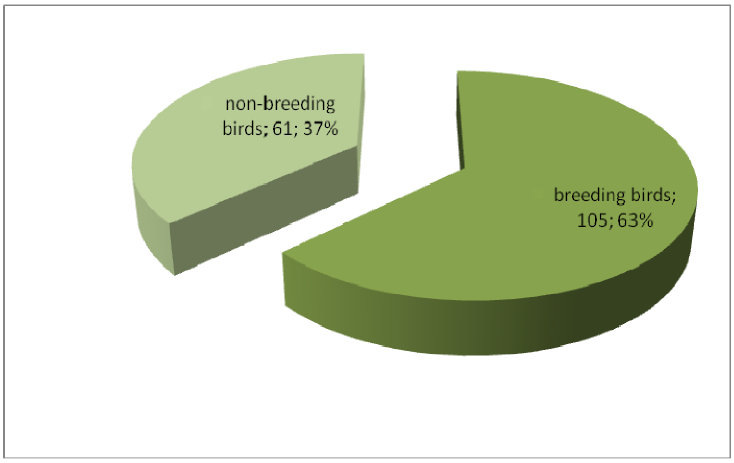

Figure 3. The percentage representation of breeding and non-breeding bird species

By comparing our data with those in the Atlas, we observed that we found only 83 out of the 100 breeding species (73 confirmed breeding and 27 probable breeding species)) cited in the Atlas, but we also identified 22 new breeding species, of which **19 are confirmed breeding species** (*Nycticorax nycticorax, Cygnus olor, Accipiter nisus, Circus aeruginosus, Sterna hirundo, Chlidonias niger*, *Himantopus himantopus*, *Chroicocephalus ridibundus*, *Remiz pendulinus*, *Anthus campestris* etc.) and **3 probable breeding species** *(Aythya nyroca, Tringa totanus, Sylvia borin)*. It should also be noted that the species *Ixobrychus minutus, Aythya ferina, Falco tinnunculus, Rallus aquaticus*, *Coturnix coturnix*, *Vanellus vanellus*, *Asio otus*, *Merops apiaster*, *Saxicola torquata, Oenanthe oenanthe, Parus palustris, etc.*, which are recorded in the Atlas of the Breeding Birds of Romania as probable breeding species, were proved to be confirmed breeding species (Table 1).
We estimated the number of breeding individuals for each nesting species. Those species nesting mostly in the reed beds (*Ixobrychus minutus, Anas platyrhynchos, Fulica atra, Gallinula chloropus, Aythya ferina*, *Acrocephalus arundinaceus*) are prominent among the wetland-dependent species due to their high number of individuals. Some species nest on the sandy (*Charadrius dubius*), or muddy (*Vanellus vanellus*) shores of the lakes, in the low wetland vegetation (*Sterna hirundo*), on the artificial islets created on abandoned floating dams (*Chroicocephalus ridibundus, Himantopus himantopus, Fulica atra, etc.* - Fig.4), in the river shore holes (*Alcedo atthis, Riparia riparia, etc*) or on the floating vegetation (*Podiceps cristatus, Chlidonias hybridus*, *Chlidonias niger*), while others nest in the aspen stands, in the grey willows close to the lakes (*Nycticorax nycticorax*), or on utility poles (*Ciconia ciconia*). *Acrocephalus palustris* nests in the tall grasses and high agricultural crops, in the shrubbery on the sides of the canals, and also in the agricultural crops and on the edge of reed beds. Other species nest on agricultural lands, on cereal fields or on farmlands *(Vanellus vanellus, Coturnix coturnix, Alauda arvensis, Motacilla flava, Miliaria calandra, etc.)* and also in built-up areas *(Hirundo rustica, Delichon urbica, Athene noctua, Otus scops, Streptopelia decaocto, Dendrocopos syriacus, Passer domesticus, etc.).*
Extreme weather conditions, climate change, habitat loss, changes in agricultural practice, pesticides use, environmental pollution and eutrophication, increased anthropogenic pressure on isolated (hunting, poaching, etc.) and rural areas, and other negative factors have been responsible for some fluctuations in the number of nesting species.

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Figure 4. Aspects of the vernal season. Chroicocephalus ridibundus and Himantopus himantopus nesting

Regarding the constancy (ecological indices), 48 breeding species, representing 46 % of the breeding avifauna (*Podiceps cristatus*, *Nycticorax nycticorax*, *Ciconia ciconia*, *Cygnus olor*, *Anas platyrhynchos*, *Aythya ferina*, *Circus aeruginosus*, *Fulica atra*, *Vanellus vanellus*, *Himantopus himantopus*, *Chroicocephalus ridibundus*, *Chlidonias niger*, *Cuculus canorus*, *Dendrocopos syriacus*, *Motacilla flava*, *Acrocephalus palustris*, *Lanius collurio*, *Miliaria calandra*, *Emberiza schoeniclus*, etc.) were euconstant (C4), 30 species (28 %, *Ixobrychus minutus*, *Aythya nyroca*, *Falco subbuteo*, *Coturnix coturnix*, *Sterna hirundo*, *Tringa totanus*, *Streptopelia turtur*, *Alcedo atthis*, *Saxicola torquata*, *Turdus merula*, *Locustella luscinioides*, *Remiz pendulinus*, *Corvus corax*, *Carduelis cannabina*, etc.) were constant (C3), 24 species (23 %, *Accipiter gentilis*, *Columba palumbus*, *Coracias garrulus*, *Dendrocopos minor*, *Anthus campestris*, *Aegithalos caudatus*, *Lanius minor*, etc.) were accessory species (C2) and 3 species (3 %, *Otus scops*, *Locustella fluviatilis*, *Sylvia borin*.) were accidental species (C1) (Table 1, Fig. 5).

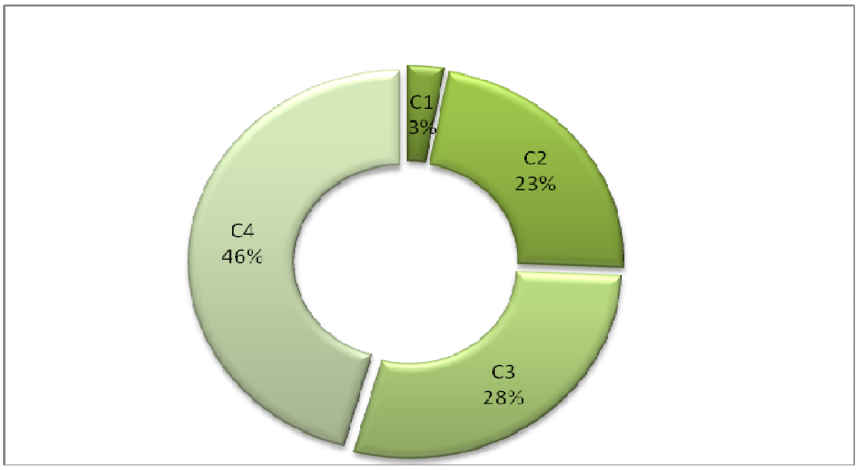

Figure 5. Distribution of bird species by their constancy: C1 – accidental species, C2 – accessory species, C3 – constant species, and C4 – euconstant species

The high number of euconstant and constant species (78), especially of wetland-dependent species indicates the wealth of the food resources in the area during the nesting period. Furthermore, the area offers suitable and quiet nesting places as the lakes are somewhat isolated/ far from human settlements and covered with vegetation; recently this year, nesting was affected by hunters/ poachers and fishermen. In relation to the degree of availability of the trophic resources (the abundance of aquatic and terrestrial insects in the area, in addition to the resources found on the

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cultivated fields surrounding these lakes) and nesting places, as well as the presence of stray dogs and anthropogenic disturbance (agricultural works, poaching, environmental works, pollution, etc.), the specific richness of breeding bird species in the area under research is relatively high. The benefits provided by the abundance of trophic resources and the existence of suitable breeding and resting places (favourable factors for the avifauna) attract a high level of biodiversity in the area of the artificial lakes (Primack, 2008; Conete, 2011).
Eighteen breeding species (17.14 % - Table 1) are listed in Annex I of the Birds Directive (http://eur-lex.europa.eu).
As regards the evolution trend in the number of individuals breeding in the area of the Dâmbovnic and Suseni lakes, we noticed that a part of these species – 36 (34 %) did not have significant variations throughout the observation period. Numerous species (60) exhibited increasing trends in the number of breeding individuals (57%), due to the growing attractiveness of the area, resulting from the silting of the lakes and the emergence and growth of hard vegetation (rush and reed areas), while the species exhibiting decreasing trends in the number of breeding individuals were underrepresented (9% of the total), as a consequence of anthropogenic influence (Table 1, Fig. 6).

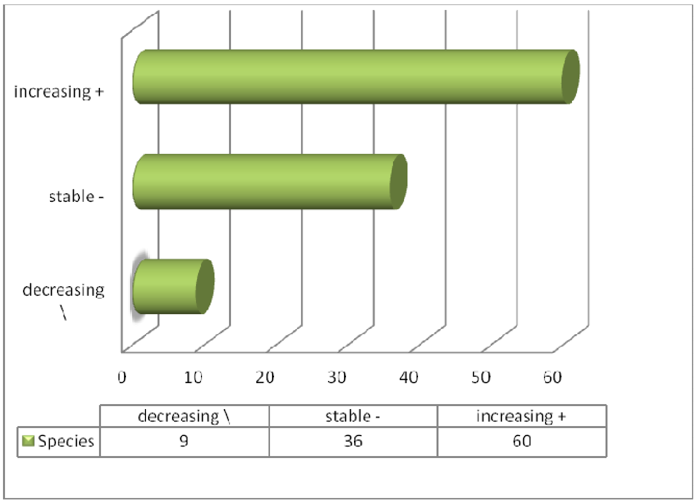

Figure 6. Distribution of species according to the evolution trend in the number of breeding individuals: - – stable (36); + – in creasing (60); \ – decreasing (9)

Among the many factors influencing these trends, the most important, with a positive effect on the avifauna are: the ecological restoration of the degraded areas (of the two lakes), which determined the emergence of a dense vegetation, new nesting and feeding places for birds, and the diversification of the aquatic trophic resources; in addition to these factors, we should also mention the reduced level of interaction between the local inhabitants and the bird populations as this is a secluded area, where fishing, watering and grazing of animals are banned. The conditions in the polluted area have considerably improved in the last 15 years by a series of measures meant to reduce or completely stop pollution through repeated evacuation of petroleum products from Arpechim and through the bioremediation method, which combined ex-situ remediation of contaminated sediments by means of a *bio-battery*, with in-situ water bioremediation.
Thus, the high number of species with an increasing number of breeding individuals in the area under research is due to its variety of habitats, the existence of ecotones (there is an uncultivated band of land with a width of more than 1.5 m between the cultivated terrains and the wetlands), the interleaving of agricultural lands and shrubbery, groves and wetlands (with rush and reed beds and

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willow stands) – a mosaic-like landscape, the existence of canals bordered by shrubbery, and a clearings bordered by old trees (on the farmland); unfortunately some of these trees were cut down in the last years. We should also add that there is an old forest plot nearby.

We noticed that the species breeding mainly in eutrophic lakes (*Podiceps cristatus*, *Anas querquedula Aythya ferina*, *Fulica atra*, etc) showed increasing or stable trends of breeding populations in the area, but according to some studies, they can be affected by eutrophication (nutrient inputs from agriculture – excess use of fertilizers, or from industrial pollution, etc). We should take into account the threats posed by hunting (which is a recent practice in the area), predators (stray dogs, herding dogs, etc.), the poor waste management and also the deficiencies in the water supply system, which have led to an excess growth of aquatic vegetation and the reduction of the water surface.

After serious silting problems, the Suseni Lake has recently been subjected to some desilting works with beneficial effects on the populations of breeding birds (*Aythya ferina*, *Chroicocephalus ridibundus*, *Chlidonias niger*, *Fulica atra*, *etc.*).

Eutrophication was proved to cause increases in phytoplankton, turbidity and cyprinid populations; it can also affect negatively the abundance of invertebrates and underwater vegetation. For this reason, strong eutrophication can decrease food availability for waterbirds, which may lead to population decline (Pöysä et al., 2013). Food abundance has been shown to be the key factor determining the species number of waterfowl communities in Northern Europe (Elmberg et al., 1993). Contrariwise, eutrophication of nutrient-poor oligothrophic lakes may improve breeding opportunities for dabbling ducks, such as the mallard (*Anas platyrhynchos*), which prefer moderately eutrophic wetlands. It is necessary to notice that climate change may enhance eutrophication. In Europe the general declining trend of most breeding waterbirds during the last 15 years was most severe in species that prefer eutrophic lakes for breeding. One potential reason for this is over-eutrophication of naturally nutrient-rich lakes, but the pattern should be studied in more detail (investigation into the effects of exploitation on population sizes of quarry species and into the connection between water quality and waterbird populations) (Pöysä et al., 2013). Birds, especially aquatic species, are valuable biological indicators for monitoring the health of some aquatic ecosystems.

The causes that led to the decrease in the nesting populations of some species include felling of old and dry trees from the clearing located at the back of the farmland (*Columba palumbus*, *Coracias garrulus, Dendrocopos minor, Sitta europaea, etc.*), and the closing in 2016 of a working point of the company, whose role was to ensure the protection and surveillance of the lakes (*Hirundo rustica, Passer domesticus, etc*). We should also consider here the yearly decline of those bird species that feed or nest mainly on agricultural lands.

Regarding the evolution trends in the number of individuals of the key breeding species (listed in Annex I of the Birds Directive) we can notice that the species *Ixobrychus minutus*, *Nycticorax nycticorax, Aythya nyroca, Circus aeruginosus, Himantopus himantopus, Sterna hirundo, Chlidonias hybridus, Alcedo atthis, Dendrocopos syriacus, Ficedula albicollis, Lanius collurio, etc.* recorded an increasing trend, while the species *Ciconia ciconia, Lullula arborea* exhibited a steady number throughout the observation period, and the species *Coracias garrulus* recorded a decreasing trend strictly related to the disappearance of old trees in the area.

It is necessary to monitor the evolution trends of the populations of breeding species at least in the case of key species to take real and effective measures for the conservation of the avifaunal diversity. In order to reduce and eliminate the effects caused by anthropogenic factors we need to protect not only those areas that are already acknowledged as breeding areas, but also those that are

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potential breeding areas. The measures should be accompanied by some codes of good practice at both scientific and economic levels (Munteanu et al., 2015).

4. CONCLUSIONS

During the nesting season we recorded 105 (63% of the local avifauna) breeding species belonging to 13 orders, 39 families and 74 genera, representing a relatively high level of biodiversity. Of these species, 97 (92,4%) are confirmed breeding species, and 8 species (7.6 %) are probable breeding species; the high number of breeding species is correlated with the ecological restoration of the degraded wetland areas and the emergence of the dense vegetation (which in turn, creates new nesting places), with diversity of the habitat, the existence of ecotones, the diversification of the aquatic trophic resources and last but not least the reduced level of interaction between the local inhabitants and the bird populations in the area of the Dâmbovnic and Suseni lakes. Among the identified nesting species, 32 are wetland-dependent species.

The results of the research conducted in the Dâmbovnic and Suseni lakes area were compared and related to the data from the Atlas. Thus, we identified **22 new breeding species of which 19 are confirmed breeding species and 3 are probable breeding species. *Chroicocephalus ridibundus, Himantopus himantopus* were observed to nest in the Argeş county for the first time.**

Most of them are constant and euconstant species (78 species), the results reflecting the abundance of resources in the area during the nesting period. The birds nesting in the reed beds and in the ecotones or marginal areas stand out through their relatively high number of individuals. Eighteen breeding species are listed in Annex I of the Birds Directive.

The birds showing an increasing trend in their breeding population (57 %) had a significant share in the total number of species, due to the growing attractiveness of these lakes as a result of bioremediation (after the Arpechim refinery ceased operations), silting, eutrophication, the emergence of solid vegetation (rush and reed beds), and willow stands; however, the anthropogenic influence has permanently affected the area through aggressive agriculture (the use of pesticides and fertilizers, etc.) and more recently through hunting, the presence of stray dogs, poor waste management and also through some deficiencies in the water supply system, level fluctuations, etc.

Extremes in weather conditions, climate change, habitat loss, changes in agricultural practices, pesticides use, environmental pollution and eutrophication (hipereutrophication), increased pressure of humans on isolated (hunting) and rural areas (felling of old trees and the disappearance of some shelterbelts), and other factors have been responsible for some fluctuations in the number of nesting individuals.

Eutrophication of nutrient-poor oligothrophic lakes may improve breeding opportunities for dabbling ducks (*Anas platyrhynchos),* which prefer moderately eutrophic wetlands. In Europe the general declining trend of most breeding waterbirds during the last 15 years was most severe in species that prefer eutrophic lakes for breeding. Strong eutrophication (hipereutrophication) can decrease food availability for waterbirds, which may lead to population decline in future.

The reduced number of breeding species showing a decreasing trend in their population is encouraging, as it is the proof of the effects of ecological restoration. Unfortunately, there are no protection measures for bird species in the area, because there is a lack of interest in this environmental issue.

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It is necessary to monitor the evolution trends of the populations of breeding species, at least for the key species, to make sure that we take real and effective conservation measures to ensure avifaunal diversity, as a reference point and an instrument for the regional biodiversity conservation measures. The high number of key breeding bird species identified in the area under research confirm the regional avifaunal importance of these lakes and must be interpreted as a powerful argument for the necessity of adequate protection in the area. The lakes are located close to the reservoirs of the Arges River (a Natura 2000 site) - real migration corridors and they gain a more and more important avifaunal value in the context of the disappearance of natural wetland areas.
In the future it is imperative to discuss and implement a series of protection measures for the local avifauna. These measures should be treated with much resonsibility and supported by local authorities. Thus, it is required to inform the local community on their responsibility to maintain and protect this area and its biodiversity for the future generations, especially the bird communities and their habitats.

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*** Google Earth Satellite Database.