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BIRDS' DIVERSITY AND THE ANTHROPOGENIC IMPACT IN PREAJBA-FĂCĂI WETLANDS (DOLJ, ROMANIA)

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Abstract. The investigated wetland area is represented by one natural reserve from the central part of Dolj County, Lacustrine Complex Preajba-Făcăi and it 'surroundings. Our field study was done during the period 2014 – 2016. We recorded 33 aquatic and semi-aquatic bird species in the area. From these, 14 bird species appear in the Annexe 1 of Birds' Directive. There were identified 16 breeding species, all presenting small effectives; between these, we notice the presence of *Aythya nyroca* – globally threatened species and of some species included in the Romanian Red Book of Vertebrates (*Nycticorax nycticorax*, *Himantopus himantopus* and *Egretta garzetta*, breeding species in the area). During the passage time, we met another protected bird species, like *Microcarbo pygmeus*, *Ardeola ralloides*, *Ardea purpurea*, *Ardea alba* or *Alcedo atthis* on the wetland territory. We analyse also the impact of identified risk factors on the birds' presence in the area: habitats' degradation, agricultural practices and grazing, hunting, fishing practices.

Keywords: Preajba-Făcăi, wetland, bird fauna, anthropogenic impact.

Rezumat. Diversitatea păsărilor și impactul antropic din zona umedă Preajba-Făcăi (Dolj, România). Zona umedă investigată este o arie naturală protejată situată în partea centrală a județului Dolj, Complexul lacustru Preajba-Făcăi și împrejurimile sale. Studiul nostru s-a desfășurat în perioada 2014 – 2016. Am inventariat 33 de specii de păsări acavtice și semiacvatice. Dintre acestea, 14 sunt specii incluse in Anexa 1 a Directivei Păsări. Am identificat 16 specii clocitoare, toate cu efective mici; printre acestea, subliniem prezența speciei *Aythya nyroca*, amenințată pe plan global și a unor specii incluse în Cartea Roșie a Vertebratelor din România (*Nycticorax nycticorax*, *Himantopus himantopus* și *Egretta garzetta*). În perioada migrației, pe teritoriul zonei umede, am întâlnit și alte specii protejate, cum sunt *Microcarbo pygmeus*, *Ardeola ralloides*, *Ardea purpurea*, *Ardea alba* sau *Alcedo atthis*. Analizăm și impactul factorilor de risc identificați asupra prezenței păsărilor: degradarea habitatelor, extinderea terenurilor cultivate și folosirea pesticidelor, pășunatul, vânătoarea, activitățile de pescuit.

Cuvinte cheie: Preajba-Făcăi, zonă umedă, avifauna, impact antropic.

Introduction

The Lacustrine Complex Preajba-Făcăi is situated about 6 kilometres (km) in the south-eastern side of Craiova, on the administrative territory Malu Mare settlement. There are ten ponds that are result of one dam built on the Preajba River and Valea Bătrâna River, in the north of Preajba village and present a total length about 4 km (Figure 1). The source of water is permanent, with constant debit, being supplied by 50 springs. The depth of ponds is between 1 and 2.8 metres (m); the ponds have eutrophic waters (Cioboiu 2014). The area is part of Oltenia Plain and the climate is temperate-continental, with obvious Mediterranean influences.

Vegetation is rich and present great diversity, from phytoplankton and phytobenthos to various groups of macrophyte species. The reed beds are surrounding the ponds forming strips about 1 – 3 m wide, but also compact surfaces on the tail of ponds. In some sectors of ponds, there are clusters of poplars (*Populus nigra*, *Populus canadensis*) and willows (*Salix*

fragilis, *Salix alba*), clumps of bushes and shrubs (*Prunus spinosa*, *Rosa canina*, *Rubus fruticosus* etc.). In the proximity of ponds, there are slopes covered by dry grasslands and agricultural lands, too.

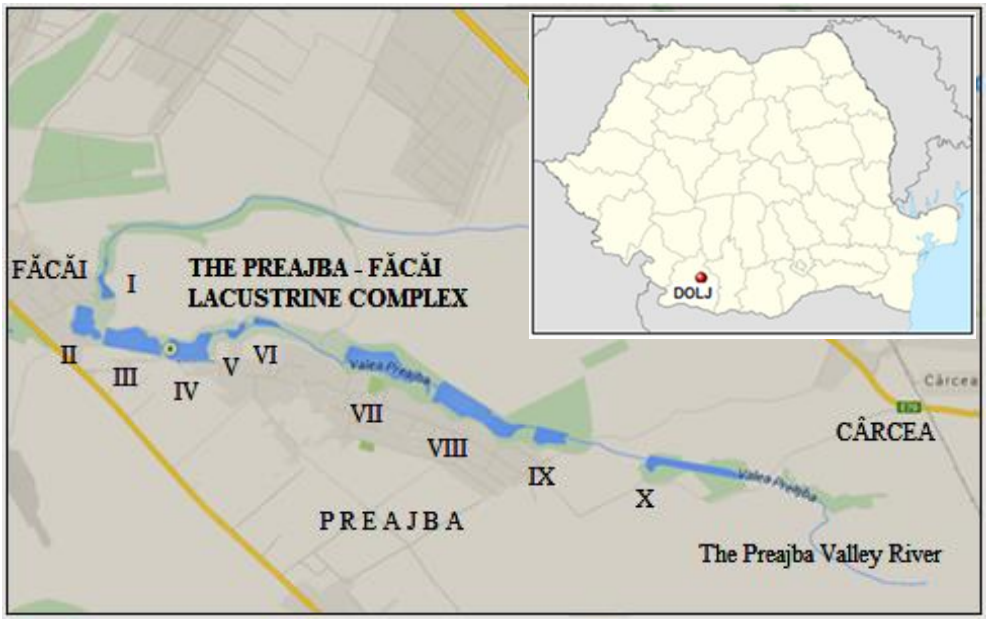

Figure 1. Location of the study area: Lacustrine Complex Preajba-Făcăi (processed after https://www.google.ro/maps/).

The Lacustrine Complex Preajba-Făcăi is natural protected area (code 2394, Law no. 5/2000, covering 28 hectares. Despite this status, there nobody is caretaker of the protected area and no management plan exists yet.

Our studies are the first ornithological ones done in the area and we already published some preliminary aspects (Bălescu 2015), presenting data about 84 bird species recorded in the area. In the present paper, we focused on the bird fauna related to the wetland habitats and the impact of various human activities on the birds' presence in the area.

Methods of Study

Our field study was done starting from the early spring of 2014 (March) till the May of 2016. We visited the wetland area monthly using transects monitoring and fixed-point survey methods, along the ponds. We used binoculars (Buchnell 12x40), one Canon Sx40HS digital camera and one Panasonic SDR-H20 camera, but also one GPS (Garmin eTrex 30x) in order to establish some coordinates. During the field works, we used guides to identify the birds (Bruun & co 1999) and eggs (Tălpeanu 1969). In the present paper, we use the taxonomy of birds presented in the volume "Atlas of bird species of community interest in Romania" (2015).

Results and Discussion

Our bird fauna's list for the Lacustrine Complex Preajba-Făcăi's perimeter and its vicinities includes 33 bird species related to the wetland habitats (table 1). We included some passerine species that are related to the wetland habitats – reed tickets and humid grasslands during their breeding season, but also for feeding activities. The given effectives represent the minimum and maximum breeding pairs recorded during the years, respectively, the minimum and the maximum effective recorded in one day of fieldwork observation during the migration or wintering time.

Table 1. List of recorded aquatic and semi-aquatic bird species in the Lacustrine Complex Preajba-Făcăi.

No.	Species & taxonomy	Phenology Preajba-Făcăi	Breeding (pairs)	Effectives (individuals)	Birds' Directive Annexe 1	Romanian Red Book of Vertebrates
	1. Order Anseriformes Family Anatidae					
1.	*Cygnus olor*	S, PM	1 – 3	2 - 10	-	-
2.	*Anas crecca*	WV	–	5 - 8	-	-
3.	*Anas plathyrhynchos*	S, PM	10 - 15	4 - 180	-	-
4.	*Anas querquedula*	P	-	8 - 16	-	-
5.	*Anas clypeata*	P	–	3 - 7	-	-
6.	*Aythya ferina*	SV	1 - 2	2 - 8	-	-
7.	*Aythya nyroca*	SV	3 - 4	4 - 10	+	V
	2. Order Podicipediformes Family Podicipedidae					
8.	*Tachybaptus ruficollis*	P, WV	–	4 - 5	-	-
9.	*Podiceps cristatus*	SV	2 - 3	12 - 18	-	-
	3. Order Suliformes Family Phalacrocoracidae					
10.	*Phalacrocorax carbo*	SV, WV	–	2 - 17	-	-
11.	*Microcarbo pygmeus*	SV, WV	–	3 - 42	+	V
	4. Order Pelecaniformes Family Ardeidae					
12.	*Ixobrychus minutus*	SV	8 - 14	27 - 38	+	-
13.	*Nycticorax nycticorax*	SV	1 - 2	8 - 10	+	V
14.	*Ardeola ralloides*	P	–	2 - 3	+	V
15.	*Egretta garzetta*	SV	1 - 2	3 - 15	+	E
16.	*Ardea alba*	WV	–	2 - 4	+	E
17.	*Ardea cinerea*	SV, WV	–	1 - 5	-	-
18.	*Ardea purpurea*	SV, P	–	2 - 4	+	E
	5. Order Ciconiiformes Family Ciconiidae					
19.	*Ciconia ciconia*	P	–	2	+	V
	6. Order Accipitriformes Family Accipitridae					
20.	*Circus aeruginosus*	P	–	1	+	
	7. Order Gruiformes Family Rallidae					
21.	*Gallinula chloropus*	S, PM	9 - 12	8 - 50	-	-
22.	*Fulica atra*	S, PM	12 - 15	15 - 100	-	-
	8. Order Charadriiformes Family Recurvirostridae					

No.	Species & taxonomy	Phenology Preajba-Făcăi	Breeding (pairs)	Effectives (individuals)	Birds' Directive Annexe 1	Romanian Red Book of Vertebrates
23.	*Himantopus himantopus*	SV, P	0 - 1	4 - 6	+	E
	Fam. Scolopacidae					
24	*Tringa ochropus*	P	-	2	-	-
	Family Laridae					
25.	*Larus cachinnans*	SV, WV	–	2 - 17	-	-
26.	*Chroicocephalus ridibundus*	SV, WV	–	2 - 10	-	-
	Family Sternidae					
27.	*Sterna hirundo*	SV, P	1 - 2	2 - 10	+	-
28.	*Chlidonias hybrida*	SV	6 - 9	6 - 30	+	-
	9. Order Coraciiformes					
	Family Alcedinidae					
29.	*Alcedo atthis*	WV	–	1 - 2	+	-
	10. Ord. Passeriformes					
	Family Motacillidae					
30.	*Motacilla alba*	SV	4 - 7	4 – 18	-	-
31	*Motacilla flava*	P	-	4 - 8	-	-
	Family Sylviidae					
32.	*Acrocephalus scirpaceus*	SV	5 - 6	x	-	-
33.	*Acrocephalus arundinaceus*	SV	9 – 15	x	-	-
34.	*Acrocephalus schoenobaenus*	P	-	x	-	-
	Family Emberizidae					
35.	*Emberiza schoeniclus*	WV	–	2 - 4	-	-

Legend

Phenological type: S – sedentary species; PM – partially migratory species, P – passage visitors; SV – summer visitors, WV – winter visitors.

Protected status: E – endangered, V - vulnerable.

Our study covered two very different winter, one very cold and one really mild winter. The mostly aquatic bird species are migratory in the perimeter of ponds and for those that are constant presence during the wintering period (*Cygnus olor*, *Anas platyrhynchos*, *Gallinula chloropus* or *Fulica atra*), we assess that the recorded individuals are belonging to northern populations that replace the breeding populations in the area. The ponds were completed frozen between December 2014 and end of February 2015, but we recorded wintering populations for these species, cormorants (*Phalacrocorax carbo* and *Microcarbo pygmeus*), grey heron (*Ardea cinerea*), gulls (*Larus cachinnans* and *Chroicocephalus ridibundus*) and little grebe (*Tachybaptus ruficollis*) during the period November 2015 – February 2016. During the wintering time, we recorded 15 bird species related to the wetland habitats. Like effectives, we mention the mallard (*Anas platyrhynchos*) with population about 80 – 110 individuals, coot (*Fulica atra*) with 75 – 92 individuals and pygmy cormorant (*Microcarbo pygmeus*) with 30 – 38 individuals in the area.

Normally, the spring migration begins in the middle February in the area, but the mostly birds have very short stop-overs, going on to the northern breeding areas, while during the autumn migration the birds' movement is very slowly and they are using the rich feeding resources and suitable resting habitats from the ponds' perimeter. The greatest diversity was recorded in September – October (30 bird species), when we met also the biggest effectives of aquatic birds in the area, the mostly species presenting populations of tens or hundreds of individuals.

The breeding bird fauna consist of 16 species, mostly of them using the reed beds in order to build their nests. Between the exceptions, we mention the terns (*Sterna hirundo* and *Chlidonias hybrida*) and the black-winged stilt (*Himantopus himantopus*). The terns were breeding on the floating vegetation near the compact reed beds from the ponds VI, VII and IX (Fig. 1), forming small colonies consisting from 6 to 9 pairs, each of it with 2 – 3 chicks, while the black-winged stilt was present with one breeding pair in 2014 with two chicks, on the marshes area from the ponds V. Unfortunately, starting from February 2015, in the vicinity of this pond, one sheepfold was installed on the meadow; the constant presence of sheep and dogs in the area, forced the birds to move on, so, we did not meet *Himantopus himantopus* like breeding species during the 2015 and 2016 breeding season.

The herons are breeding in the compact reed tickets, excepting the night heron (*Nycticorax nycticorax*) that was recorded with two nests in the willows from the pond II. Between the anseriforms, the mute swan (*Cygnus olor*) is long-term monogamous species and very territorial one, reusing and consolidating the same nest every year. In 2014, we recorded just one pair, with eight chicken, on the pond IX (the juvenile birds leaved the area just in early spring of 2015), during the spring of 2015, we met another one pair with only one juvenile on the pond III (maybe, a pair in first breeding season), while in May 2016, we recorded another pair on the pond IV, with eight cygnets.

The birds represent one very important bio-indicator of the environment’s quality through their absence or presence inside one territory. Their impressive mobility by the ability of flight allows the birds to leave immediately a territory when the level of disturbance increase or the suitable habitats and ecological resources disappear.

The Lacustrine Complex Preajba-Făcăi is natural protected area, but has no custodian or caretaker and nobody elaborated one plan of management for the area. In practice, it seems to be one territory of nobody, so, the people feeling free do take any natural resource from the area, to enjoy the territory for fishing, hunting or picnic activities. The presence of local community and different human activities are constant in the perimeter and vicinity of Lacustrine Complex Preajba-Făcăi, through its position near Preajba village and agricultural lands. Moreover, there one hotel and restaurant, Lotus, is situated in front of pond 4 and host different social events (different ceremonies and parties), especially during the week-end.

The stronger influence on the bird fauna from the area is due to agricultural and grazing practices. The excessive use of pesticides and the vicinity of agricultural lands with the ponds’ perimeter, especially, in the northern and eastern side influence the quality of waters, the composition and structure of aquatic biocoenosis. By other side the practice of monocultures in the area seems to extend in the area and the use of treated seeds represent a great risk for some bird species (especially, wild grouse species, but also for geese and ducks that can stop and feed on the agricultural lands). In the same time, we must mention that especially in spring and fall, during the plough working, some bird species like storks (*Ciconia ciconia*) and gulls (*Larus cachinnans* and *Chroicocephalus ridibundus*) use to search for food on the agricultural lands.

The grazing activity has no high influence through itself but by the dogs that are going free everywhere, including inside the reed tickets and on the swampy areas eating eggs and chicks of birds. We met also a big number of abandoned savagery dogs in the area.

The fishery is the constant human activity in the perimeter of Lacustrine Complex Preajba-Făcăi, but is not intensive one. In fact, the fishing and hunting are completely

uncontrolled inside this territory, becoming one important disturbing factor for the birds' presence and a source of abandoned waste in the perimeter of ponds.

The exploitation of reed and trees is, also, completely uncontrolled in the area; if the reed tickets are growing up every year and its exploitation by cutting has good influence for birds' presence, the extraction of trees that are not numerous in this perimeter can reduce more the suitable habitats for the breeding of some species, including protected ones.

As we can see in the table 1, 9 of the identified bird species appear in the Red Book of Vertebrates from Romania (Botnariuc & Tatole 2005): 4 endangered species (*Egretta garzetta*, *Ardea alba*, *Ardea purpurea*, and *Himantopus himantopus*) and 5 vulnerable species (*Aythya nyroca*, *Microcarbo pygmeus*, *Nycticorax nycticorax*, *Ardeola ralloides*, and *Ciconia ciconia*). Most of these species use to feed the investigated area during the breeding season, migration or winter time and just 4 of them are regular or irregular breeding species with small populations in the perimeter of Lacustrine Complex Preajba-Făcăi - *Aythya nyroca*, *Nycticorax nycticorax*, *Egretta garzetta* and *Himantopus himantopus*.

We notice also the presence of 14 bird species that are included in the Annexe 1 of Birds' Directive (2009/147/EC), like species that need special conservation measures concerning their habitats in order to ensure their survival and the reproduction in their distribution range. From these, 7 are breeding species in the investigated area, while the others use it like feeding territory appearing during the migration or in the wintering time.

On the base of our field observation, we believe that it is necessary to implement at least some minimal measures of conservation on the perimeter of protected area Lacustrine Complex Preajba-Făcăi and its vicinities. First of all, the decision-makers must inform the local community on the protection status of the territory, including by information panels and active campaigns (regarding not only to the importance of the area, but to the agricultural and other practices, too). The schools from the nearest villages can develop extracurricular learning activities in the area – for example, during the *Otherwise School* week – with the support of specialists from University from Craiova, Oltenia Museum and Environmental Protection Agency. It is necessary to control the grazing, fishing and hunting activities, but also to limit the presence of free savagery dogs in the area. The extraction of trees (as firewood or other aims) must be completed prohibit, while the reed extraction will be allowed just by cutting and not during the breeding season of birds.

Conclusions

We identified 33 bird species related to the wetland habitats in the perimeters Lacustrine Complex Preajba-Făcăi.

From these, 16 bird species are regular or irregular breeding ones.

The diversity and populations of birds present low values. Some human activities in the area represent disturbing factors for the bird fauna: agricultural and grazing practices, extraction of reed and trees, abandoned savagery dogs, fishing and hunting.

We met 9 bird species that were included in the Red Book of Vertebrates from Romania: 4 endangered species and 5 vulnerable ones.

We recorded 14 bird species that appear in the Annexe 1 of Birds' Directive, 7 of them being breeding species in the area.

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AVIFAUNA ALONG URBAN GRADIENT OF SUCEAVA CITY

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Abstract. The aim of the paper is to find out if we could identify an ecological model regarding the distribution of the breeding pairs in the urban area of Suceava city. In this context we have checked if the birds are influenced by the degree of urbanization. The birds of Suceava city are more abundant in the centre of the city, but the diversity is greater in the periphery. The abundance of birds is greater in the anthropic areas than in the natural ones. Regarding the groups' association of ecological birds with certain types of land use in urban area, it can be noted that the birds could be seen also in habitats less common for their ecological preferences in the condition of Suceava city. The urbanization gradient could represent actually a direct consequence on the abundance and the diversity of birds' species present in the city, as it is considered in the case of Suceava. In the meantime, the continuous increase of the city's degree of development does not affect dramatically the presence of the birds' species, having in view the fact that they have an increased adaptability in the urban areas, with the condition that the areas having natural vegetation in the city are maintained.

Keywords: bird's distribution, urban gradient

Rezumat. Avifauna în lungul unui gradient urban din oraşul Suceava. Scopul lucrării constă în identificarea unui model ecologic al distribuţiei perechilor clocitoare în zona urbană a Sucevei. În acest sens, am verificat dacă păsările sunt influenţate de gradul de urbanizare. Păsările din Suceava sunt mai abundente în centrul oraşului, dar diversitatea specifică este mai ridicată la periferie. Abundenţa speciilor este mai mare în zonele antropice, decât în cele naturale. În privinţa asocierii grupelor ecologice de păsări cu anumite tipuri de utilizare a terenurilor din zona urbană, se observă că speciile de păsări sunt prezente şi în habitate mai puţin caracteristice. Gradientul de urbanizare ar putea avea consecinţe directe asupra abundenţei şi diversităţii speciilor din oraş, aşa cum rezultă în cazul Sucevei. Dezvoltarea continuă a oraşului, din ultimul timp, nu afectează dramatic prezenţa speciilor de păsări, datorită capacităţii ridicate de adaptare la condiţiile mediului urban, cu condiţia menţinerii unor perimetre cu vegetaţie naturală.

Cuvinte cheie: distribuţia păsărilor, gradient urban

Introduction

The birds in the cities have been studied along time in many papers (Grimm et al, 2000); Croitoru, 2009), proving the existence of numerous species of birds, which can adapt to the conditions of the urban landscape. In general, cities are preferred for nesting and raising the nestlings of omnivores, granivores or those birds which use hollows for nesting (Chace & Walsh, 2004). To these, there are added the birds which eat the corpses of animals dead in car crash or constructions or those birds which hunt other species of birds, such as day or night predators. Besides, the more the degree of urbanization increases, the more the number of bird individuals are, but the number of species decreases (Chace & Walsh, 2004; Savard et al., 2000).

Furthermore, most species of birds breed in urban green spaces, especially parks and gardens. (Melles et al., 2003). For instance, the presence of forest bodies is essential for the presence of bird species in the urban areas (DeGraaf & Wentworth, 1996, Hedblom & Söderström, 2010). At the same time, the species of birds are present in a big number in those areas in which the socio-economic development is greater (Melles, 2005). Although you might assume that the human impact is very increased in built up areas and can affect the

presence of birds. In reality, birds accommodate near buildings or in them. Thus, they can find many leftovers to eat among the buildings. In the same time, in some built up areas, where there is a high density of birds, the chance to hunt other species is bigger.

Although species of birds could be a common presence in the urban spaces, only a few papers describe the avifauna from cities (Lancaster & Rees, 1979, Croitoru, 2009). Moreover, in the conditions of a more and more accelerated urbanization, the populations of birds seem to be more and more affected (Fuller et al., 2009), hence resides the importance of the ornithological studies, which could bring new arguments for the preservation of nature, closely related to the continuous development of cities. At the same time, birds are an environmental bioindicator for the biologic models, which could be easily observed (Clergeau et al., 2001). So, the presence of a great number of birds from different species would show an ecological balance. In this context, inside cities there is the need to create some spaces which are populated by birds and which are as close as possible to those in the natural environment.

Regarding Romania, there are few references to the avifauna inside the cities (Papadopol, 1975; Croitoru, 2009), which include information about the inhabited areas. This is the reason for which we presented, using Geographical Informational System (GIS), a current image of the distribution of breeding species in Suceava (Romania).

The general aim of the paper is to find out if in our study is an ecological model regarding the distribution of the nesting pairs from the urban area of Suceava city. In this context, we have analysed if the birds are influenced by the degree of urbanization. Starting from this idea we wanted to verify if there is a difference between the presence of the species of birds and their abundance among the centre, peri-central and peri-urban areas. In the conditions of restraining the polluting industrial activities in the cities of Romania, can birds occupy the imperviousness spaces in a bigger number than the green areas? Do birds respect their general ecological preference inside the city?

Material and Methods

Study Area. The study area is represented by Suceava city and its surroundings. Suceava is situated in the north-east of Romania, on Suceava Plateau, a subunit of the Moldavian Plateau. Hydrographically, it is laid in the Basin of Siret River. The river Suceava flows through the area. The minimum altitude in the area is of 270 m in the meadow of Suceava river and the maximum altitude is of 435 m.

Following the analysis of urbanization degree, there were delimited 3 areas: central, peri-central and peri-urban areas. The centre (downtown) is dominated by buildings, especially administrative. In the peri-central area there are both buildings and green spaces, but the imperviousness areas are dominant. The peri-urban area presents many compact green areas, especially forests, but also areas with housing constructions. However, the green areas are dominant in peri-urban.

Birds count. During 2011-2012, in the breeding period, May - June, we estimated the presence of bird species using two types of transects. In bird surveying we used line transects and point transects (Gregory & Baillie, 2004). We established the transects and point transects regarding our previous information. The line transect involves traveling on a predetermined route and recording birds on either side of the observer. The birds are seen or heard from the transect line, at the distance of maximum 100 m. The walking speed was almost the same. Each season, the same persons did a minimum of two visits to a transect.

The data were also collected within plots using the point count method (Gibbons and Gregory, 2006). The point count sampling design consisted of a series of points at which birds were counted within a defined radius. Birds that are seen flying over the census area (aerial species) are recorded separately because they cannot be included in the standard estimation. We could identify passerines and non-passerine species, in open areas, forests areas, riparian, aquatic or built-up areas. Each plot was visited several times for a ten-minute observation period (Bibby et al, 2000). Visits to each plot were done early in the morning (6:30–11.00) or in the evening (15:00–18:30). As the weather can influence the occurrence of some bird species, working during rain or strong wind was avoided (Bibby et al, 2000).

A 10 × 50 resolution binocular (Olympus mark) and a field guide book were also used to identify the species of birds observed (Svensson et al., 2010). Five minutes after the plot was located, we started to observe birds. This time delay was in place to allow birds to return to their natural behaviour or to nest in order to minimize potential impacts of human presence on the survey. The following variables were recorded during each 10 min observation period: the type of micro landscape, the name of the bird species observed, the number of observed individuals from each bird species. The birds encountered outside our study plots were recorded only when it was a local new species that had never been observed in the area before. These records were only considered for compiling a bird checklist of Suceava city.

We avoided double counting the same individual birds at a point count or within a transect section. We used careful observation and common sense as suggested by Gregory & Baillie, 2004. For the centre, peri-central and peri-urban areas there was quantified the number of species, their abundance and the diversity index Shannon-Winner (Krebs, 1989) was calculated.

GIS Analysis. During the breeding period birds are restricted to some specific areas. We mapped with GPS the nest position of the species (Gregory & Baillie, 2004). For bird - habitat geodatabase, the projection system used was Stereo 70, using ESRI ArcGis v.9.3 software. The geodatabase for habitats was generated based on Urban Atlas, 2012 (Figure 1).

The principal habitats that are delimitated: continuous urban fabric (S.L. : > 80%); discontinuous dense urban fabric (S.L. : 50% - 80%); discontinuous medium density urban fabric (S.L. : 30% - 50%); discontinuous low density urban fabric (S.L. : 10% - 30%); discontinuous very low density urban fabric (S.L. : < 10%); isolated structures; industrial, commercial, public, military and private units; mineral extraction and dump sites; construction sites; land without current use; green urban areas; sports and leisure facilities; arable land (annual crops); pastures; complex and mixed cultivation patterns; forests; open spaces with little or no vegetation (beaches, dunes, bare rocks, glaciers); water; railways and associated land; other roads and associated land. Some species of bird’s nest in isolated trees or groups of trees or shrubs which are differently identified in Urban Atlas, 2012. This is the reason for which we have separated some compact areas with trees or shrubs where bird species breed.

We built up the maps for all ecological groups identified: aquatic, built-up, open area, forest and riparian birds. Nesting guild should provide useful information about habitat restrictions and should allow more powerful statistical tests than when considering each species separately (Melles et al 2003a). We excluded the data referring to Jackdaw (*Corvus monedula*), because the individuals are too dispersed in the urban area. We chose to build up separated maps for analysis, depending on the type of habitat preferred during the breeding

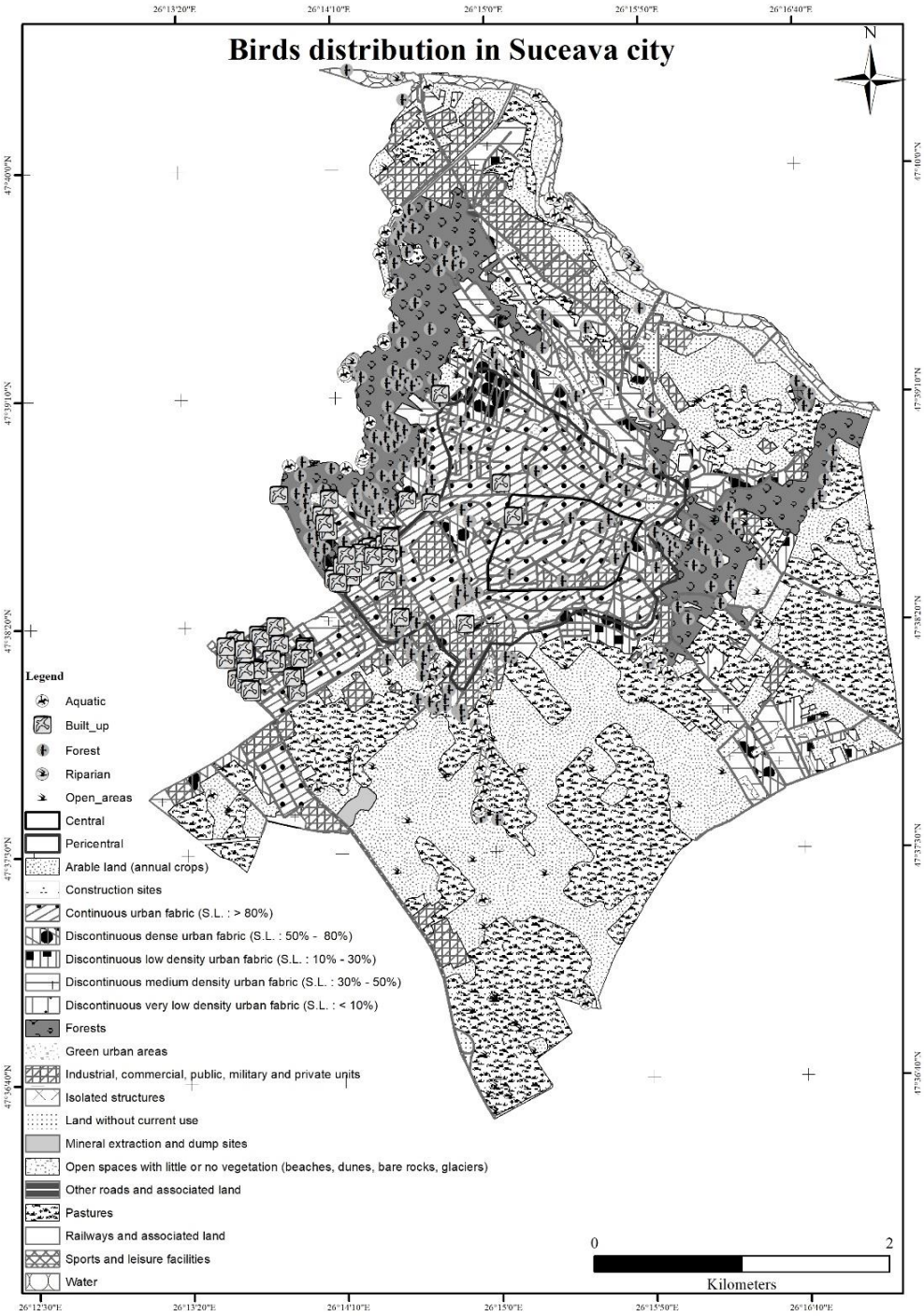

Figure 1. Birds distribution and land use in Suceava city.

period by the bird species we identified in the field and not to overcharge the maps. For every nesting place there was applied a buffer with a radius of 100 m, considered as a minimum area in which the identified birds carry out their activities. Within the buffer, there were identified the number and types of habitat in which the nesting birds carry out their activities.

Statistical analyses. We have compared the diversity, the evenness and the abundance of birds in the central, peri-central and peri-urban areas through Kruskal-Wallis to see if the number of species and the abundance decreases at the same time with the degree of urbanization. The p-value has been computed using 10000 Monte Carlo simulations.

We have applied the same type of tests to see if birds prefer more the spaces which include natural green spaces or the anthropic ones built, with houses or blocks. We have applied the same tests on each ecological group of birds. We have not taken into account the year effect, as we have made average ratings on the populations of birds overall on the two years.

We have applied a Correspondence analysis (CA) to see the connection between the types of habitat and the bird ecological groups. MultiVariate Statistical Package (MVSP) was used to calculate diversity of birds. We have used R-statistics, XLSTAT and Microsoft Excel for the statistical analysis of data (tests and CA).

Results and Discussion

There were identified 88 species (Table 1).

Table 1. Birds species from peri-urban, peri-central and centre of Suceava city.

No.	Peri-urban		No.	Peri-urban	
	Name	abundance		Name	abundance
1.	Accipiter gentilis	6	35.	Erithacus rubecula	52
2.	Accipiter nisus	6	36.	Falco subbuteo	7
3.	Acrocephalus arundinaceus	19	37.	Falco tinnunculus	23
4.	Acrocephalus scirpaceus	5	38.	Fringilla coelebs	8
5.	Aegithalus caudatus	14	39.	Fulica atra	89
6.	Alauda arvensis	47	40.	Gallinula chloropus	36
7.	Alcedo atthis	6	41.	Galerida cristata	26
8.	Anas platyrhynchos	72	42.	Garrulus glandarius	6
9.	Apus apus	1019	43.	Hippolais icterina	2
10.	Ardea cinerea	62	44.	Ixobrichus minutus	28
11.	Ardea purpurea	2	45.	Jynx torquilla	5
12.	Asio otus	18	46.	Lanius collurio	50
13.	Athene noctua	7	47.	Lanius excubitor	7
14.	Buteo buteo	4	48.	Merops apiaster	54
15.	Linnaria cannabina	4	49.	Motacilla alba	23
16.	Carduelis carduelis	8	50.	Motacilla cinerea	3
17.	Chloris chloris	26	51.	Motacilla flava	43
18.	Certhia familiaris	4	52.	Oenanthe oenanthe	11
19.	Ciconia ciconia	9	53.	Oriolus oriolus	42
20.	Circus aeruginosus	2	54.	Panurus biarmicus	30
21.	Columba livia f.domestica	990	55.	Pariparus ater	4
22.	Columba oenas	12	56.	Cyanistes caeruleus	18
23.	Columba palumbus	12	57.	Parus major	16
24.	Corvus frugilegus	1090	58.	Passer montanus	168
25.	Corvus cornix	60	59.	Perdix perdix	28
26.	Corvus corax	10	60.	Phasianus colchicus	3

No.	Peri-urban	
	Name	abundance
27.	Coturnix coturnix	7
28.	Cuculus canorus	48
29.	Cygnus olor	5
30.	Delichon urbicum	2216
31.	Dendrocopos major	14
32.	Dendrocopos syriacus	6
33.	Emberiza citrinella	9
34.	Emberiza schoeniculus	2

No.	Peri-urban	
	Name	abundance
61.	Phylloscopus collybita	28
62.	Picus canus	7
63.	Pica pica	22
64.	Picus viridis	3
65.	Podiceps cristatus	10
66.	Rallus aquaticus	12
67.	Remiz pendulinus	3

No.	Peri-central	
	Name	abundance
1.	Apus apus	121
2.	Apus melba	12
3.	Asio otus	4
4.	Athene noctua	4
5.	Linaria cannabina	6
6.	Chloris chloris	4
7.	Certhia familiaris	6
8.	Coccothraustes coccothraustes	4
9.	Columba livia f. domestica	1980
10.	Corvus frugilegus	275
11.	Delichin urbicum	360
12.	Dendrocopos major	6
13.	Erithacus rubecula	4
14.	Fringilla coelebs	16
15.	Hippolais icterina	6
16.	Parus major	52
17.	Passer montanus	2
18.	Phylloscopus collybita	14
19.	Sitta europae	8
20.	Strptopelia decaocto	50
21.	Sylvia communis	16

No.	Centre	
	Name	abundance
1.	Asio otus	8
2.	Columba livia f._domestica	1270
3.	Delichin urbicum	160
4.	Dendrocopos major	3
5.	Parus major	14
6.	Phylloscopus collybita	6
7.	Sylvia communis	12

Between peri-urban, peri-central and centre area are significant statistical differences concerning birds' presence (Table 2). The results of the z-test show that there are significant differences among the three areas which compose the city (p=0.002). The number of species increases from the centre to the periphery, and the highest number of individuals is in the central area.

Table 2. Diversity, evenness, species richness and abundance of bird species in peri-urban, peri-central and centre areas of Suceava city.

	Peri-urban	**Peri-central**	**Centre**
Index	1,202	0,538	0,224
Evenness	0,609	0,401	0,265
No. of Sp.	67	16	7
Abundance	1473	2950	7887

Between the green areas and the anthropic ones there are significant statistical differences (p=0.008) concerning birds' presence. The abundance of birds is greater in the anthropic areas than in the natural ones. If we look at the diversity and the number of species the situation is reversed (Table 3).

Table 3. Diversity, evenness, species richness and abundance of bird species in green and built-up areas of Suceava city.

	Diversity index	Evenness	Species Richness	Abundance
Green	1.582	0.816	87	1577
Built-up	0.881	0.463	80	13055

The most numerous groups of species is the one of forest birds with 44 species (33%), also the most abundant group (44%). The fewest species (4,54%) belong to the riparian birds.

Forest birds prefer most types of habitat and most types of patches which delimit and are met especially to the periphery. Built-up birds are more numerous in the centre than to the periphery. Open area birds are more numerous to the periphery and the riparian and aquatic birds prefer the restricted areas with clay shores or respectively with water, found to the periphery (all results $p<0,05$).

CA shows that through some groups of ecological birds with a less common habitat if we have in view their biological preference for certain habitats. Forest birds prefer, beside forests, more green urban areas, discontinuous dense urban fabric, industrial, commercial, public, military and private units. Built-up birds could nest in imperviousness areas with continuous urban fabric, other roads and associated land. Taking into account that aquatic passerines prefer for breeding the habitats from the edge of the aquatic areas, associate with discontinuous very low-density urban fabric, discontinuous medium density urban fabric and arable land. The same association is observed also for the open area birds. Riparian birds associate with open spaces with little or no vegetation and isolated structures. The least preferred habitat is mineral extraction and dump sites, being also the type of field with the smallest share in Suceava city.

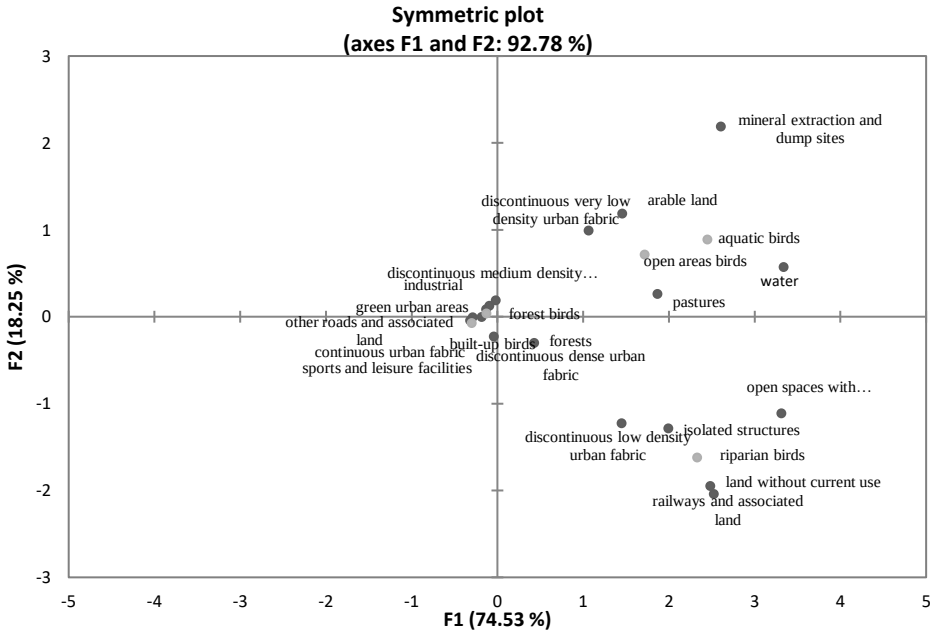

Figure 2. CA among ecological group of birds and habitats from Suceava city.

Regarding the fact that the abundance of birds differ between the centre and the periphery, contrary to what has been said by (Lancaster & Rees 1979), who stated that birds' density does not change along the urban gradient and the birds' diversity is greater in the areas in which habitats' diversity is lower. On the other hand, Blair, 2004, revealed that the species richness and the bird diversity is higher at intermediate levels of urbanization.

Afterwards, the results regarding a more numerous presence of the bird species in green spaces, wooded, from the periphery are in concordance with those specified by (Lancaster and Rees 1979) (Sandström et al 2006) that the number of species is smaller in the centre and it increases to the periphery (Chace & Walsh 2006). Also, at peri-urban region, sometime, birds stay in old abandoned industrial areas, where they are not disturbed, taking into account that Suceava's industry from that areas have been in a dramatic decline for more than 20 years (Tomasciuc, 2016).

Furthermore, in central and peri-central areas, most often, birds prefer in high number to have nests on high camouflaged supports (especially building or high electricity poles) with visibility to the feeding fields (open areas), but also to the surroundings, to see the appearance of some predators. The results chime with those specified by (Gatesire et al., 2014) (Lancaster & Rees, 1979) (Chace & Walsh, 2006), who affirm that in the urban areas with constructions the birds' abundance is greater. The buildings' conformation facilitates the birds' presence in a big number, adapted to the urban environment (e. g. pigeons, crows, sparrows). In this case the buildings represent either nesting places, either they create together with the surrounding natural vegetation, a shield against the wind or a screen against the sun. However, the number of species is small towards the centre of the city and in the urban areas it is still preferable to maintain a great diversity of birds, which is also a good clue of people's quality life (Savard et al, 2000) (McKinney, 2002) (Clergeau et al, 2001).

Indeed, maintaining a continuous monitoring of the avifauna and an increase of the percentage of green spaces through buildings is desirable for the city of Suceava, situation similar for other cities in the West of Europe, which do not fulfil the surface of parks or alignments of trees that have to exist in a city, according to the things specified by the recommendations of the European Community, 2017.

Regarding the groups' association of ecological birds with certain types of land use, birds can be seen also in habitats less common for ecological preferences due to the lack of places suitable for nesting in some preferred habitats. The density of individuals could be very high or the structure of buildings could not present possible niches to nest. At the same time, the biogeographical origin, the density of bird communities, the habitat of origin determines the versatility of bird species in choosing also another type of habitat for nesting than the one usually occupied in the urban areas (Conole, 2014).

In addition, in Suceava city non-passerines aquatic birds populate most flowing and standing streams mostly in the areas surrounding the city, where the anthropic impact is less invasive and where the ecological conditions permit the different species to populate these areas, either the entire year or just for breeding, feeding or wintering. The species less sensitive to the human disturbance like the big duck (*Anas platyrhynchos* - Mallard) make the most of any water eye, especially in the industrial area, where after the closing of some industrial facilities (Tomasciuc, 2016), there remained many water basins, which represent a refuge for many species of water birds.

As respects storks, they are poorly represented on the territory of Suceava city: first, because of the lack of nesting places; and second, due to the agriculture intensification within

the periphery of Suceava city. During this study there was identified a small number of nesting pairs (4), all being located in the periurban area of the city, where they nest either on the chimney of some houses (Șcheia, Lipoveni), or on decommissioned buildings (Iţcani).

Regarding aquatic and semi-aquatic passerines, they are widely spread in the studied area, occupying most palustrian habitats. The most significant populations can be met in the peri-urban areas, where the conditions are more favourable. Among the areas with a pronounced importance for this group of birds there are: lakes Icar, stream Scheia, lake Lipoveni and Suceava river (the location of the areas can be seen in Tomasciuc, 2016). These territories include a gathering of lacustrine, forestry habitats and open spaces, where birds can nest and feed themselves safely during breeding period.

Afterwards, built-up area birds are represented among others by Common swift (*Apus apus*) and House martin (*Delichon urbicum*). There are well-represented on the radius of Suceava city, being strongly represented numerically in the neighbourhoods: Obcini, George Enescu, Mărășești and Burdujeni. These neighbourhoods own a series of architectural particularities which offer places favourable for built up birds' species to nest. As particularities, these buildings are older, containing different cracks and the windows' carpentry is made of wood (most windows do no open, so that birds are not disturbed). For example, the area George Enescu (Tomasciuc, 2016), populated by some bird species, has a particular feature. It was once a huge swamp, and most blocks are flooded in the basement because of the underground springs. The accumulations of water in the basement serve as real nurseries for mosquitoes, aspect which can favour the occupancy of the area by the birds which feed themselves directly or indirectly with them.

For instance, Common swift occupies in a greater number the areas where the blocks have bridge and the access to it is blocked for human beings. In the same way, House martins occupy especially schools and other big buildings which provide nesting places.

Also, Domestic pigeons (*Columba livia* forma *domestica*) and Eurasian Collared Dove (*Streptopelia decaocto*) are a common appearance in Suceava city. Besides, in the studied area, these birds constitute large colonies, especially in the old buildings and in the neighbourhoods: Obcini, George Enescu, Center, Burdujeni and the industrial area. They nest in inaccessible places like terraces, building bridges, cracks in walls and less often in hollows (in Central Park). Particularly, the most important populations are in the central area, where they nest in the bridge of the prefecture and the catholic cathedral. Moreover, the population of pigeons and Collared doves from the centre of the city is protected by the community police and the mayor's office has entrusted a civil servant to feed the birds daily with a bag of grain.

Concerning open-area birds, they are well-represented as a number of species and individuals on the entire peri-urban area of Suceava city. For exemplification, more important populations can be met in the Icar, Burdujeni, Iţcani and Șcheia neighbourhood.

Next, forest birds are distributed on the radius of the city. Such as, the biggest concentrations can be found to the periphery of the city, in the small forest George Enescu – Zamca, where birds find favourable life conditions.

In the same way, some more antropofile species (e.g. woodpeckers) occupy green spaces in the city, especially the parks and yards of the institutions which have trees (the County Hospital, the Agricultural and Development Research, the area the Citadel of Chair and the parks of the city).

Afterwards, diurnal predators nest mostly in the peri-urban areas. Anyway, they are poorly represented in number the peripheral area than other bird species, because of the strong persecution of people. Also, they are few inside the urban area because of the lack of ecological conditions. Generally, diurnal birds of prey nest in the forests or on buildings, but on the edge of some open-spaces (del Hoyo et al., 1994). For instance, the peri-urban areas are nevertheless the most accessed by these birds, as they embody the minimum of ecological conditions for diurnal predators, forests and buildings are surrounded by some open spaces.

On the other hand, regarding, nocturnal predators, cities can be an attractive place for a series of species like some owls, because urban habitats include a great number of rodents and also the old buildings are good places for nesting, as it is the case in Suceava. TSuch as, the species which accept better the anthropic impact are Little owl (*Athene noctua*), Tawny owl (*Strix aluco*) and Long-eared Owl (*Asio otus*), species which live in the city throughout the year. In the peripheral areas of the city, as it is the small forest George Enescu – Zamca nest both as well as Long Eared Owl and as Ural Owl – *Strix uralensis*).

Concerning woodpeckers such as Syrian woodpecker (*Dendrocopus syriacus*) and Great Spotted Woodpecker (*Dendrocopus major*) are present in a relatively great number on the radius of Suceava. For instance, they nest especially in parks, like the University Park or the one within Suceava Municipal Hospital, but also sporadically in trees from different places in the city. Moreover, the species which support less the human disturbance are the woodpecker (*Picus* sp.), which stay in the periurban areas, in the woods of this area.

Last but not least, riparian birds occupy a limited area at the edge of the city, where they can find favourable ecological conditions. Especially, the most important areas for these species in Suceava city are: Suceava River, lakes Icar, Lake Lipoveni and Șcheia stream.

In the view of results, the more numerous presences towards the centre of the city and the abandoned industrial areas can be the effect of a lack of threats or of the nest's position, which is often away from the sun, wind, being situated in places well-hidden from buildings or trees. At the same time, the easier access to the leftovers nearby can be one of the causes of the increased abundance of the birds towards the centre. As consequence, the urbanization gradient can represent actually a direct consequence on the abundance and the diversity of birds' species present in the city, as it is considered in the case of Suceava. In the addition to, the continuous increase of the city's degree of development does not affect dramatically the presence of the birds' species, having in view the fact that they have an increased adaptability in the urban areas (Bonier et al, 2007), with the condition that the areas having natural vegetation in the city are maintained (Melles, 2005) (Melles et al, 2003b). However, the diversity of birds is preferred instead of a high abundance of a small number of species. For this goal it is necessary to increase the percentage of green spaces in the central areas and protect them in the peri-urban areas.

At the same time, this paper can be useful for the following plans of territorial arranging closely aligned with the conservation of the green spaces and of the places where species of birds live, which beside the ecological importance, are charismatic and can represent touristic attractions and good indicator for quality life of the inhabitants (Savard et al, 2000) (McKinney, 2002) (Clergeau et al, 2001).

Conclusions

The birds in Suceava city are more abundant in the centre of the city, but the diversity is greater in the periphery.

The abundance of birds is greater in the anthropic areas than in the natural ones.

Regarding the groups' association of ecological birds with certain types of land use, it can be noted that the birds can also be seen in urban area in habitats less common for ecological preferences.

The urbanization gradient can represent actually a direct consequence on the abundance and the diversity of birds' species present in the city, as it is considered in the case of Suceava.

The continuous increase of the city's degree of development does not affect dramatically the presence of the birds' species, having in view the fact that they have an increased adaptability in the urban areas, with the condition that the areas having natural vegetation in the city are maintained.

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ETHOLOGICAL OBSERVATIONS ON ROOKS (*CORVUS FRUGILEGUS* L.) UNDER NATURAL CONDITIONS OF REHABILITATION

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Abstract. In the breeding season of the rook (*Corvus frugilegus* L.) in 2013 we made observations in rookeries established in two neighbourhoods in Iaşi city, Tătăraşi and Copou. The rookery from Tătăraşi neighbourhood is made up of four subdivisions, three of which are situated in Vasile Lupu Street and the fourth in Ciurchi Street. Two of the subdivisions of the rookery "Tătăraşi" also serve as roosts for rooks, towards the end of the breeding season. The object of our research has been rook behaviour at the stage of chick development subsequent of leaving the parental nest. In order to obtain ethological data, we captured six individuals that we hand-reared in Tătăraşi neighbourhood.

Keywords: rookery, juveniles, food, flight, rehabilitation

Rezumat. Observaţii etologice la cioara de semănătură (*Corvus frugilegus* L.) în condiţiile reabilitării în natură. În sezonul reproductiv al ciorii de semănătură (*Corvus frugilegus* L.) din anul 2013 am făcut observaţii în colonii stabilite în două cartiere din municipiul Iaşi, Tătăraşi şi Copou. Colonia din cartierul Tătăraşi este alcătuită din patru subdiviziuni, dintre care trei se situează la strada Vasile Lupu iar a patra, la strada Ciurchi. Două dintre subdiviziunile coloniei „Tătăraşi” servesc şi ca locuri de înnoptare pentru ciori, spre finalul perioadei de cuibărit. Obiectul cercetării noastre l-a făcut comportamentul la cioara de semănătură, în etapa din dezvoltarea puiului subsecventă părăsirii cuibului părintesc. Pentru a obţine date etologice am capturat 6 indivizi pe care i-am crescut la mână, în cartierul Tătăraşi.

Cuvinte cheie: colonie, juvenili, hrană, zbor, reabilitare

Introduction

The present study is based on ethological observations on the rook, carried out in a plantation of trees functioning as a nesting habitat in which we experimented the rehabilitation of some juveniles. Our experiment enabled us to highlight some aspects of social life in the studied corvid species, especially those related to feeding. We aimed to investigate the behaviour of rehabilitated juveniles in a place as familiar as possible, the rookery, taming being an essential condition for the continuity of the observation of some ethological aspects.

In the case of rooks, pair-bonding within the nesting place occurs at the beginning of March. During this period the mates join for courtship-display and for mating, the male giving the female regurgitated food. Subsequently the couples start preparing the nest for laying eggs. The laying period differs from one couple to another, depending on the moment the nest building ends and on the female physiology. In the circumstances of 2013, in the rookeries studied by us in Iaşi, the nest building lasted, in some cases, until the beginning of April. The clutch can consist of 2 - 6 eggs. The incubation duration (the embryo development) is 16 - 18 days (Røskaft, 1983). The chick-rearing at the nest lasts from April to June and sometimes, in the case of the couples that lay eggs in May, it reaches July. At the

age of 30 - 36 days the chicks are full-fledged and can start the flying activity, in the surroundings of the nest (Perrins & Cramp, 1998). The postembryonic development ends at about 40 days but the parents go on feeding their fledglings for another five to six weeks after leaving the nest (Røskaft & Slagsvold, 1985).

Material and Methods

We made visits to nesting areas starting with 10 May until 26 June 2013. During this time, we caught chicks at different growth stages, some with developing plumage, others with fully completed moult. We took from nature six individuals, all of them fledglings, five belonging to the rookery of Tătărași neighbourhood and one belonging to Copou neighbourhood, which we hand reared. We used a bait net in order to capture them. The study was carried out for 54 days between 21 May and 24 July. The juveniles from Tătărași neighbourhood were released in the area of the parental nests. The specimen captured from Copou neighbourhood was brought to the rookery of Tătărași in order to rehabilitate it. The subjects were fed raw meat, boiled eggs, vegetables, seeds and grains, insects (orthopterous) four times a day: in the morning, at noon, in the afternoon and at sunset. We gave them water to drink by means of a 2 ml syringe. We reared the subjects of the experiment in a fenced green space, close to a rook roost which gave them a relative sense of security (Fig. 1).

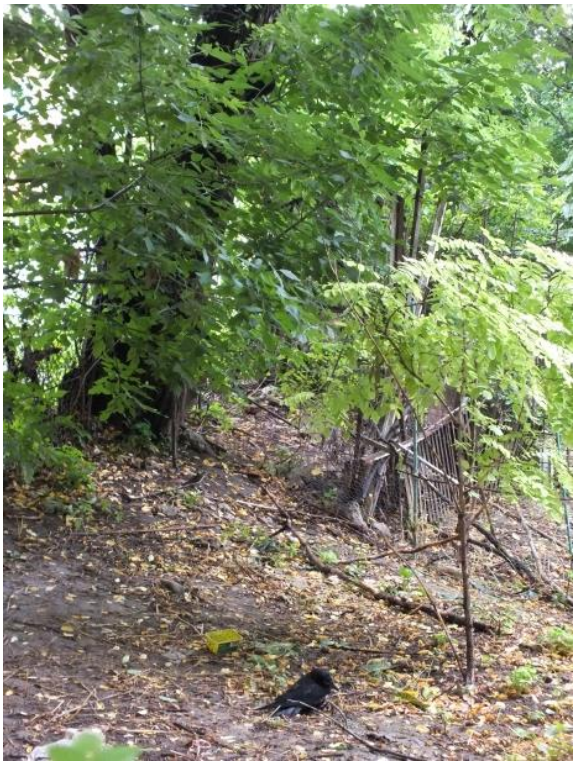

Figure 1. Rook nesting and roosting habitat in Tătărași neighbourhood.

The methods we have applied in our ethological study are the direct observation, photography and filming. For taking still images and for making movies we have used a digital camera Fujifilm FinePix HS20EXR (30 × optical zoom, 16-megapixel effective resolution, maximum resolution 4608 × 3456, 1920 × 1080 resolution video, SDHC external memory, 46 MB internal memory and image stabilizer), together with a Photo tripod T NB FTDC034880.

Results and Discussion

In the rookery of Tătărași neighbourhood, we found the first fledglings in the second decade of May. Subsequently fledglings were found by the end of spring and in early June. In the rookery of Copou neighbourhood we witnessed the flight out of the nest as late as the end of June. We estimated the age of the individuals was approx. 30 days, by comparing them with other individuals that were the subject of a personal study, effected in 2011, regarding the succession of phases in rook life cycle.

It took three days for each individual to become familiar with the experimenter. Taking into account the omnivorous feeding regime we introduced in the subjects' diet meat, egg yolk, cheese, sunflower seeds, cereals (wheat / corn), vegetables and fruits. Meat was the most requested food. Their preferences went to vegetables such as cabbage or lettuce leaves, fruits (mulberries), seeds (sunflower seeds) and grains (wheat).

As food-related behaviour we registered the food-begging calls when meeting the caretaker, on the one hand, and on the other the consumption of food from a bowl or directly from the ground. However, the subjects didn't use drinkers, begging water from a syringe. In the wild, as we could notice, the rehabilitated juveniles do not learn how to drink on their own. However they consume with pleasure the juicy fruit of the mulberry tree. This fact indicates their thirst, especially on a warm weather. In a confined space (aviary), in time, the juveniles learn the drinking behaviour. We deduced this fact from another experiment of ours, carried out in 2010, in a private garden (from Ciric street).

The flights of the subjects in the canopy were registered at different heights, mainly in its middle part, or on the basal branches, associated with the food-begging call. Unlike the subjects of the experiment carried out in 2010, which, growing in semi-captivity, had got tamed, those we refer to in this study maintained their fear of humans. As a result during our visits in the rookery they manifested, in addition to food-call, the tendency to avoid meeting the caretaker. Obviously, once the flight exercises in the canopy started, the anti-predator response prevailed. Perhaps it would have been necessary to launch the subjects from a high building, located close to the rookery, in order to facilitate their flight in the upper part of the canopy, at the moment of roosting. A terrestrial predator attack hindered in the end our efforts to rehabilitate one of the juveniles. We noticed the presence of wounds to the head and neck of the bird in question, which indicated it had been killed by a carnivorous mammal.

It is preferable to raise the rook in captivity in the process of taming, at least at the beginning of their taking from the wild. One must consider that maintaining several individuals in an aviary makes them get gradually accustomed to the accessories, to the aviary and to the landmarks of the aviary surroundings, in case of release. Distress is quite high as long as several individuals live close together. In these conditions, the agitation manifested by calls becomes unbearable for humans. Once in the surrounding nature, though, they will easily orientate towards the aviary roof, where they learn to receive food from the caretaker's hand. This way the distress will be replaced by the harmony of "cohabitation" of the bird with

man. The juveniles we reared in 2010 by Ciric used short trees as landmarks while returning to the aviary (27 July 2010). The land where the aviary was placed was not, however, a nesting habitat, so their flights were directed towards the aviary, where the individuals had formed habits of group cohabitation.

Going back to the case of the juveniles rehabilitated in 2013, from the very beginning each individual was placed on a low tree branch in an active rookery, where it was found by its kind, and thus, the adaptation of its responses to the care taking situation was highlighted only to a small extent.

An indisputable fact is that the species we have been studying prefers group association on branches to staying alone. We found that the begging manner becomes more insistent and food consumption is done avidly when rehabilitated juveniles establish close contact with each other on the branches. We also registered food-begging calls at the subjects when meeting the members of the rookery. Signal exchanges with their kind were frequent, which denotes the dominance of the gregarious component of rook behaviour.

Conclusions

We have noticed social behaviours in subjects expressed both through mutual interaction and through interaction with their kind in nature. Unlike the situation of rearing rooks in semi-captivity, in nature the conditions are less favourable for taming juveniles. What seems to be valid for both rearing methods (in semi-captivity and in nature) is the importance of relations within the group as far as learning food consumption by juveniles is concerned.

With regard to feeding, we have found that juveniles prefer meat and other animal protein-based foods. In their diet there can also be successfully introduced plant-based foods (vegetables, fruits and seeds), but basic food remains, however, the animal source, to meet the needs of the growing body.

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ETHOLOGICAL STUDY ON THE RAVEN (*CORVUS CORAX* L.) DURING THE BREEDING SEASON

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Abstract. The present study is based on observations on the raven (*Corvus corax* L.) carried out in the city of Iaşi (Romania), during the breeding season. The research took place in two forest areas, Ciric and Galata, located in the north-eastern and western city limits. In each of the study areas we monitored a pair of ravens: one in 2008 and the other in 2014. From an ecological point of view these areas are tied to the raven's preferences insofar as they are covered by tall trees stretching along the rivers in the proximity. Each pairs of ravens built their nests in the area of one river valley, namely Ciric or Bahlui. The interaction between the mates could be noticed both during their flight and while perched in trees. Although manifest, territorial behaviour does not generate conflicts between adults and immatures in the nest surroundings. As a matter of fact, the latter are involved in the nesting process, during hatching and brooding. The cooperation between the couple of adults and an immature as helper in nesting was recorded during two breeding seasons (in 2008 and 2010) at Ciric forest. The occurrence of trios as a form of cooperative breeding in raven was reported by Ratcliffe in 1962 (Kilham, 1989). According to the trophic preference for meat, the ravens prey on small mammals from their territory which are also fed to the chicks. First-hatched chicks benefit from the main parental feeding offer throughout their development. Hatching asynchrony is a common feature of several species of corvids, encountered in the raven too, as an adaptive response to the trophic resource limitation.

Keywords: calls, territory, nesting, forest, tree, food

Rezumat. Studiu etologic despre corb (*Corvus corax* L.) în sezonul de cuibărit. Prezentul studiu se bazează pe observaţii la corb (*Corvus corax* L.) efectuate în raza municipiului Iaşi (România), în sezonul de cuibărit. Cercetatările au avut loc în două zone împădurite, Ciric şi Galata, localizate la marginile nord-estică respectiv vestică ale oraşului. În fiecare din zonele de studiu am monitorizat câte o pereche de corbi, unul în anul 2008, celălalt, în anul 2014. Ele corespund din punct de vedere ecologic preferinţelor corbului, prin existenţa arborilor înalţi şi prin faptul că au cursuri de apă în proximitate. Ambele cupluri de corbi au stabilit teritoriul pe traseul câte unui râu, Ciricul, respectiv Bahluiul. La corb, interacţiunea între membri cuplului se observă atât în zbor, cât şi în cursul escalelor pe arbori. Deşi manifest, comportamentul teritorial nu generează conflicte în zona cuibului, între adulţi şi imaturi. De altfel aceştia din urmă se implică în cuibărit, pe durata incubaţiei şi chiar mai târziu, după ecloziunea puilor, oferindu-le protecţie. Cooperarea dintre adulţii unui cuplu şi un imatur ajutor de cuibărit a fost înregistrată doi ani la rând (2008 şi 2010) la Ciric. Apariţia trio-urilor ca formă de reproducere prin cooperare a fost semnalată de Ratcliffe în anul 1962 (Kilham, 1989). Potrivit preferinţei trofice pentru carne, corbii îşi procură din teritoriu prăzi din rândul micromamiferelor, care servesc inclusiv la creşterea puilor. Principala ofertă parentală de hrană revine puilor eclozaţi primii. Ecloziunea nesincronizată este o trăsătură comună mai multor specii de corvide, întâlnită şi la corb, ca răspuns adaptativ la limitarea resurselor trofice.

Cuvinte cheie: strigăte, teritoriu, cuibărit, pădure, arbore, hrană

Introduction

Our study presents the nesting behaviour of the raven and the succession of the life-cycle stages. The raven lives mainly in the mountain forests, especially in the cliffy areas – suitable nest sites. It builds the nest also in trees inside small forests of the hilly regions, such as those encountered on the southern slope of Bahlui valley, in Iasi. In February the ravens display the pair bonding and begin the nesting activities. The partners remain together for

several years, an aspect met also in other species of corvids. Usually the courtship calls and mating take place at nest or in its surroundings.

The clutch usually consists of 5 – 6 eggs (after our own data only of five eggs). The male provides food for the female during the incubation and after hatching, until the chicks grow up and develop their plumage. After leaving the nest, the parents keep feeding their young a prolonged period until June inclusive. The pair of ravens monitored at Ciric tended five chicks viable while the pair from Galata had two egg failures in the clutch of five eggs. The raven has a omnivorous diet and life habits similar to those of related species. The aspects we refer to in our study such as feeding, resting, defending the territory and vocalizations are part of the general way of behaving in corvids.

Material and Methods

Our observations started on 17 February 2008, concomitant to the nest preparations for laying the eggs, and continued throughout the biological cycle until the end of April, when the chicks begin to move on the branches. We analysed the general appearance of the raven chicks in detail in 2014, starting from the second decade of March, soon after hatching. The field study was supported by images and movies taken with a digital camera Fujifilm FinePix HS20EXR (30 × optical zoom, 16 megapixels effective resolution, maximum resolution 4608 × 3456, 1920 × 1080 video resolution, SDHC external memory, internal memory 46 MB and image stabilizer) together with a tripod Photo T nB FTDC034880.

For the recording of the particularities related to age in chicks (Fig. 1 and Fig. 2) we used climber equipment and techniques as well as a special device for tree climbing with stability and safety spikes. In the ethological studies we focused on the social displays of the raven in the nesting territory, the territory surveillance, the feeding behaviour, the calls of the families of birds studied and the exploration of the nest in the last phase of the young development.

Results and Discussion

At the beginning of the field trips we analysed the characters of distinction between the sexes respectively the size and the beak length, both greater in male. We also made estimates of the ravens age after the plumage coloration, which is lighter in the immature in comparison with the adults. The pink coloration of the gap is another particular feature of the immature common to the juveniles (Bugnyar, 2002).

The ravens build their nest at the basis of the principal branches near the tree trunk axis, where the stability is ensured. The nest tree species used by the raven were in one of the cases studied locust tree (*Robinia pseudacacia*), in the other the ash (*Fraxinus excelsior*). Inside the nesting territory we recorded the flapping wing sound, lower in intensity in the immature than in the adults and also the calls of those birds.

The sound emissions are corroborated with certain expressions of the raven corresponding to courtship behaviour, aggressive and territorial behaviour. The birds' behaviour consists of successive gestures involving different parts of the body (neck, wings, tail etc.) plus the tonal variety of the voice. The territorial behaviour is made up of alternating bending and returning to the normal position, with the contour feathers ruffled and the eyes covered by the nictitating membrane. The ravens display their territorial behaviour also by low-intensity sounds.

The ethological aspects related to mating were recorded on 30.09.2007 in Ciric forest. Our observations confirm what has been written in the literature on this subject (Perrins & Cramp, 1998) mentioning that they were made out of the breeding season. The female solicitation-display consists of raising its head and drooping wings, trembling the tail and using the voice at a low intensity.

The partners emit intense calls both during their movements and while coming back to the nest-site. The calls lower in intensity starting with the second decade of February once the eggs are laid. The male comes occasionally to replace the female at the nest during its foraging movements. At dusk the partners carry out aerial plays above the forest while catching each other's bill in a remarkable synchronization.

In the nest-site the ravens bring periodically food, some of which they eat and the rest they store. According to our observations, the raven food is based mainly on meat. The indigestible parts of the food, hair for example, serve to the pellet casting.

In the breeding ground the raven does not allow the goshawk (*Accipiter gentilis*) access. When the encounter between the two species of birds takes place, the raven simulates at nest attacks towards the raptor and emits warning calls to flush it away. We recorded this behaviour in the immature individual, during the flight of a goshawk over its nest (24.02.2008).

The incubation takes about three weeks. Both the female and the immature took part in incubating the eggs. Their cooperation was recorded even later at the moment of hatching in the second decade of March (16.03.2008), then in the first phases of nestlings development until the apparition of the pin feathers (at 13 days). Subsequently the immature left the nest.

The chicks growth rate varies significantly depending on the individual hereditary dowry. The differences between siblings are also determined by the hatching asynchrony, those who hatch the first receiving more food from their parents (Radu, 1970). The rest of the siblings can develop properly mostly after the plumage formation when the juvenile traits are outlined. In this age stage both the female and the male will feed them in turn.

Over the first two weeks of postnatal development, the female protects the chicks against meteorological factors, the chicks not being fully developed either morphologically or physiologically (Fig. 1 and Fig. 2).

Figure 1. Small chicks with down (original photo).

Figure 2. Chicks with pin feathers (original photo).

As long as the chicks are small, it fragments and softens the food with its saliva before feeding them. Gradually, the portions of food for chicks increase, including the indigestible parts too that will be regurgitated as pellets later. In addition to feeding and sanitation, the female displays the allo-preening behaviour of the chicks. At the same time, it arranges the nest material to expand the space necessary for the chicks according to their growth in size. The male supervises the territory, chasing any intruders, even the red squirrel (*Sciurus vulgaris*), which is normally a prey species for the raven. Typically, the branches from the upper canopy serve as nest defence sites.

The chicks begin to make movements and exercise flying at the nest at the age of about four weeks, when the development of the plumage is advanced (Fig. 3).

Figure 3. A brood of large young found in Mârzesti Forest, Iasi County, (original photo).

At this age they emit calls at the arrival of their parents in the nesting territory for the first time. This indicates both the development of their nervous system and of their sense organs. In the next ten days the chicks gain the coordination necessary for standing on the edge of the nest where the parents come to feed them. The siblings display in a synchronized way almost all activities at the nest: begging, nest exploration, preening and allopreening, flight training etc. They interact playfully with their parents by catching their beaks. The relaxation of the family group is noticed especially in sunny weather when the ravens extend their wings to the nest substrate. The growth of the beak and tarsi reaches the peak after the first month of postnatal development.

Before starting to fly at the age of about 40 days (Perrins & Cramp, 1998), the juveniles show more vigorousness, play and stand up resting. Leaving the parental nest is gradual the juvenile using at first the tree branches the most easily reached from the nest for flight training. While ready to fledge, the chicks start begging by trembling their wings and emit feeding calls during the food transfer, the same way as the adult female does during the food dependency of its partner. The vigorous chicks that can move to meet their parents on branches have priority at feeding. The parental support of the young whose chances of survival prove to be good is a natural selection mechanism typical of corvids and of birds in general.

Conclusions

In the breeding season of the raven one can notice a significant tonal variation and numerous interactions between partners while exploring the territory. The cooperative breeding involves the replacement of the female during incubation and young brooding by an immature helper. We base this statement on the observation of two cases in Ciric, in 2009 and 2010 and in the forest Uricani in 2014. We noticed helpers at nests also in one of the related species, the rook (*Corvus frugilegus*).

Under the circumstances of hatching asynchrony, the nestlings develop at different rates, since their parents get more food to the first-hatched nestling. The food transfer display in juveniles is similar to that of the female while begging at meeting its partner. The family group cohabitate in a playful way suggested by the prehension of the parents beaks, by the chicks. At the same time there is a synchrony of each behaviour displayed in the family. The life cycle aspects in the raven are essentially similar to those related to other species of corvids. The spontaneity and elegancy of the movements inside the breeding ground is a trait particular for the raven.

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MEDIEVAL HUMAN BONES DISCOVERED AT THE *PALACE OF CULTURE* IN IAŞI (IAŞI COUNTY, ROMANIA): ANTHROPOLOGICAL REPORT

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Abstract. The human osteological material that makes the subject of the current study was discovered and exhumed in 2011 archaeological excavations, at the Palace of Culture in Iaşi (Iaşi County, Romania). We have identified 10 inhumation skeletons from individual graves, and fragments from reinhumations that belonged to six subjects. According to the information provided by the archaeologists, the skeletons were dated to the 13th century. The orientation of the deceased was according to the Christian ritual. The preservation status of the skeletons is satisfactory. From the total of 16 skeletons, three didn’t live past the age of 20 (two women and one man), three subjects were between 35 and 40 years old (two men and one woman) and the other 10 subjects (seven men and three women) lived past the age of 40. Biometric and morphological characteristics were revealed to estimate the anthropological type. Pathologies and abnormalities were identified and analysed.

Keywords: *Palace of Culture* - Iaşi, medieval necropolis, anthropological data.

Rezumat. Oase umane medievale descoperite la Palatul Culturii din Iaşi (judeţul Iaşi, România): raport antropologic. Materialul osteologic uman, la care ne referim în prezentul studiu, a fost descoperit şi deshumat în campania arheologică din 2011, de la Palatului Culturii din Iaşi. Conform informaţiilor oferite de către arheologi, scheletele au fost datate ca aparţinând secolului al XIII-lea. Au fost identificate 10 morminte individuale de înhumaţie, precum şi fragmente provenite din reînhumari care au aparţinut la şase subiecţi. Orientarea defuncţilor era conform ritualului creştin. Starea de conservare a scheletelor este satisfăcătoare. Din totalul celor 16 schelete, trei nu au depăşit vârsta de 20 de ani (doua femei şi un bărbat), trei subiecţi se încadrează în intervalul de vârstă 35-40 de ani (doi bărbaţi şi o femeie) iar ceilalţi 10 subiecţi (şapte bărbaţi şi trei femei) au trecut de vârsta de 40 de ani. Pe baza unor caractere biometrice şi morfologice au fost estimate tipuri antropologice. Au fost identificate şi analizate patologiile şi anormalităţile.

Cuvinte cheie: Palatul Culturii din Iaşi, necropola medievală, date antropologice.

Introduction

The archaeological researches carried out in 2011 at the Palace of Culture in Iaşi (Iaşi County, Romania), in the context of consolidation and rehabilitation of the edifice, revealed 10 individual inhumation tombs. Alongside the skeleton found in the M3 tomb, we also discovered fragments originated from reinhumations that belonged to six subjects. The orientation of the deceased coincides with the west-east axis, facing east, laid on the back, according to the Christian ritual. Based on the information provided by the archaeologists coordinated by Stela Cheptea PhD., the skeletons were dated to the13th century. Of the total 16 skeletons, three belong to men and eight to women. We mention that the skeletons originated from reinhumations are very fragmented, offering only the possibility to evaluate

the age at death and the sex. Following the analysis of each skeleton according to the methodology used in the paleoanthropological research, a series of biometric and morphological characteristics were revealed that lead to estimate the anthropological type.

Material and Methods

In the present paper we describe the bones of 16 skeletons (10 from individual inhumation tombs and six from reinhumations). Of the total of 16 skeletons, three belonged to adolescents (two women and one man) and the other 13 belonged to adults (nine men and four women).

The anthropological analysis started with the cleaning, marking and restoration of skeletal remains, followed by a morphoscopic analysis, recording of biometric data, estimation of the age at death, sex evaluation, as well as a paleopathological analysis. The age at death for subjects less than 20 years old (*infans I*, *infans II* and *juvenis*) was established based on the primary and permanent tooth eruption, according to the methods suggested by Ubelaker (1979), Moores *et al*. (1963), Schaefer *et al*. (2009), as well as by analyzing the ossification level of the long bone epiphyses and their respective classification within age categories (Maresh, 1970; Scheuer & Black, 2000). The age at death for 20-x years (*adultus*, *maturus* and *senilis)* was established based on the following criteria: pubic symphyseal morphology, dental erosion, degenerative transformations of the sacroiliac joints, transformations of the spongy long bone tissue, cranial suture obliteration, the rib heads shape, *intra vitam* tooth loss. The sex was determined for the subjects supassing 14 years old based on the following aspects: pelvis characteristics, the skeleton's massiveness and robustness, joints and muscle insertions development level, skull and mandible features, shape and size of teeth. The sex (14-x ani) and the age at death for the subjects surpassing 20 years old was established based on the methods recommended by Stradalova (1975), Ubelaker (1979), Ferembach *et al.* (1979), Brothwell (1981), Bruzek (2002), Walrath *et al.* (2004), White & Folkens (2005), Schmitt (2005), Latham & Finnegan (2010). The anthropometric and conformational study of each skeleton was based on the Martin & Saller techniques (1956-1966), whereas for size evaluation we used the dimorphic scales of Alexeev & Debeţ (1964). The morphoscopic observations were recorded and analyzed based on the methods suggested by Eickstedt (1934) and Olivier (1969). The stature was calculated using the dimensional scales proposed by Manouvrier (1893), Bach (1965), Breitinger (1938) and Trotter & Glesser (1952). Pathologies and abnormalities were identified and classified based on the methods recommended by Aufderheide & Rodriguez-Martin (1998), Cox & Mays (2000), Waldron (2009), Barnes (2012).

We used a series of abbreviations as follows:

1: g-op (maximum cranial length);
8: eu-eu (maximum cranial breadth);
9: ft-ft (minimum frontal breadth);
10: co-co (maximum frontal breadth);
12: ast-ast (maximum occipital breadth);
17: ba-b (cranial height);
20: po-b (height of the calotte);
43: fmt-fmt (upper facial breadth);
45: zy-zy (maximum face diameter);
48: n-pr (the height of the facial massif);

47: n-gn (total face height);
51: mf-ek (the orbit's breadth);
52: height of the orbit;
54: al-al (nasal breadth);
55: n-ns (the height of the nose);
62: ol-st (the length of the palatal vault);
63: enm_2-enm_2 (internal palatal breadth);
68: mandibular lenght;
69: id-gn (chin height);
69(1): height of the mandibular;
69(3): breadth of the mandibular;
70: maximum ramus height;
71: minimum ramus breadth;
8/1: cranial index;
20/1: auricular-longitudinal index;
20/8: auricular-transversal index;
9/10: frontal-transversal index;
9/8: frontal- parietal index;
12/8: parietal-occipital index;
47/45: total facial index;
48/45: facial superior index;
52/51: orbitary index;
54/55: nazal index;
45/8: cranial-facial transversal index;
69(3)/69(1): mandibular robustness index.

Results and Discussion

In the present paper we describe the bones of 16 skeletons (10 from individual inhumation tombs and six from reinhumations). Of the total of 16 skeletons, three belonged to adolescents (two women and one man) and the other 13 belonged to adults (nine men and four women).

Skeleton M1 is well preserved and relatively complete; it belonged to a woman aged between adolescence and adulthood (18-20 years), based on the degree of ossification for the long bones and the pelvis, with below-average height (150.69 cm).

The skull (Fig. 1), sphenoid shaped in norma verticalis and house shaped in norma occipitalis, offers medium or large metric values, characterized as medium long (1: 170 mm), wide (8: 141 mm) and high by vertical diameter (17: 132 mm); in terms of shape, the skullcap appears brachycephalic (8/1: 82.94 i.u.), hypsicephalic (by the height to length ratio – 17/1: 77.64 i.u.) and metriocephalic (by the height to width ratio – 17/8: 93.61 i.u.), with a medium wide forehead (9: 93.5 mm), metriometope (9/8: 66.31 i.u.) and a medium wide occipital bone by metric value (12: 107 mm) and medium by width (12/8: 75.88 i.u.); the sagittal profile has an arched, slightly sloped line of the head, which becomes almost flat posteriorly (corresponding to the occipital), displaying a slightly bulging occipital; the bone surface is generally poorly delineated (glabellar: gr. I→II; supraorbital – gr. I, occipital protuberance – gr. II).

The face, by metric values – total (47: 99 mm) and upper (48: 60.50 mm), belongs to the small and very small categories; the orbits, medium and very small by absolute values, give an orbital index of the hypsiconc type (52/51: 104.54 i.u.); the nose belongs to the mesorrhine category (54/55: 48.86 i.u.) – based on the small dimensional values (length – 44 mm; width – 21.5 mm); the upper jaw, mesognathic (40/5: 102.53 i.u.), has a deep palate, brachystaphyline (63/62: 88.31 i.u.), with a paraboloid-divergent dental arch.

The teeth from the upper jaw have a low abrasion degree of the mastication surface (gr. I); central incisors, premolars, and molars 1 and 2 – from the right side are present; the M3 molars are unerupted. The mandible appears medium-wide, both by intercondylar (65: 110 mm) and intergonial (66: 93.50 mm) diameter, with a high ($69_{(1)}$: 28 mm) and thick horizontal ramus ($69_{(3)}$: 13 mm), high robustness index ($69_{(3)}/69_{(1)}$: 46.42 i.u.); the mentum, with a pyramidal shape, is slightly marked, the gonions, slightly outlined, are in the same plane as the ramus; dentition is complete except for third molars (non-erupted).

Postcranial skeleton is gracile, with a poorly delineated muscular insertion surface; by sectional indexes (slightly different: 81.08 i.u. and respectively 80.55 i.u.), the humeri belong to the eurycnemic category; the femurs, with pilaster, are flattened, with a difference of about 3 i.u. (82.14 u.i for the right bone and 85.45 i.u. for the left bone); however, the tibiae belong to the same category – platycnemic (59.23 i.u.).

Anthropological type: Mediterranid with Alpine influences.

Dental abnormalities/pathologies: the dentition doesn't display caries. On the vestibular side of the mandibular teeth (right central incisor and left side incisor), supragingival dental calculus is deposited in a moderate layer. Increased prevalence of dental tartar was identified for the populations involved in agriculture and hunting, the causes being the lack of oral hygiene, the local food preparation techniques, the diet or certain cultural activities.

Skeleton M2 is very well preserved; it can be attributed, without any doubts, to a mature man (35-40 years old) of above-average height (168.20 cm).

The skull (Fig. 2) has a short (1: 180 mm), wide (8: 149.50 mm) and tall skullcap (by both vertical diameters – 17: 142 mm; 20: 120 mm), dimensions that indicate a pronounced brachycephalic conformation (8/1: 83.05 i.u.), hypsicephalic (by the vertical-longitudinal indexes – 17/1: 78.88 i.u. and 20/1: 66.66 i.u.), metriocephalic (by the vertical-transversal indexes – 17/8: 94.98 i.u., respectivelly 20/8: 80.26 i.u.); the forehead, straight, without bossae, but with prominent glabella (gr. III-IV), is in accordance with the width of the skullcap, stenometopic (9/8: 64.88 i.u.), with the crests disposed intermediary; the occipital, moderately curved, with a well-outlined bone surface (occipital protuberance – gr. III), is wide both by the metric value (12: 119 mm) and in relation to the width of the skullcap (12/8: 79.59 i.u.); the mastoid apophyses are moderate (gr. II→III), but the supramastoidian surface appears emphasized.

As rare dispositions, we note the presence of a Wormian bone on the lambdoid suture path. The Wormian bones or the sutural bones are small bones that can be found at the cranial sutures level. The number and the shape of the Wormian bones ranges from one person to another and they are present in the frontal and occipital bones, in some cases leading to errors in the diagnosis of cranial fractures. Bergman *et al.* (1988) mentioned that about 40% of the skulls contain sutural bones on the lambdoid suture path; the next sutural bone, frequently encountered, is the epipteric bone (the pterion point) found near the antero-lateral

fontanelle. It was found that there are no prior reports confirming the presence of a Wormian bone at the level of the bregmatic suture. Wormian bones may appear on a regular basis and seem to be genetically conditioned for certain populations. Although the mechanisms responsible for Wormian bones are not known, some studies indicated that their presence may serve at identifying cranial and central nervous system abnormalities with various consequences (Pryles & Khan, 1979; Das *et al.*, 2005; Barberini *et al.*, 2008).

The mandible, gracile ($69_{(3)}/69_{(1)}$: 35 i.u.), is very wide by intercondylar (65: 132.5 mm) and intergonial diameter (66: 111 mm), having a very tall horizontal ramus ($69_{(1)}$: 40 mm) with the mental protuberance pronouncedly pyramidal and slightly developed gonions.

The dentition of the mandible is slightly eroded. The molars on the left side of the upper maxillary have supragingival dental calculus.

Postcranial skeleton (incomplete), very robust, shows eurybrach humeri (76.92 i.u. and 77.35 i.u.), on which the muscle impressions are accentuated (deltoid V).

Anthropological type: Dinarric with East-Europoid influences.

Skeleton M3 is well preserved and belongs to a mature man of 35-40 years old, with above-average height (168.53 cm).

The skull (Fig. 3), ovoid shaped in norma verticalis, has a short (1: 177 mm), high (by both vertical diameters – 17: 139 mm; 20: 116 mm) and medium wide skullcap (8: 140.5 mm), dimensions that show a mesocephalic conformation (8/1: 79.37 i.u.), hypsicephalic (17/1: 78.53 i.u. and 20/1: 65.53 i.u.), acrocephalic and metriocephalic (17/8: 98.93 i.u. and 20/8: 82.56 i.u.); the forehead, with a pronounced glabella (gr. III), is medium wide, both by dimensional values (9: 96 mm; 10: 122 mm) and also in relation to the width of the skull – metriometope (9/8: 68.32 i.u.); the occipital bone, high and moderately curved, belongs, both by metric value (12: 107 mm) and by the width index, in the middle category.

The face has absolute and relative values placed, on the dimorphic scale, in the middle category: total height – 47: 116 mm, height of the upper level – 48: 70 mm, maximum width – 45: 138.50 mm (large category); the facial indexes – total and upper: euryprosope (47/45: 83.75 i.u.) and mesene (48/45: 50.54 i.u.); the orbits, almost round, with small and medium size (width: 39 mm; height: 34.5 mm) are hypsiconch – high (52/51: 88.46 i.u.); camerrhine nose (54/55: 57.14 i.u.) has a straight line and a pyriform aperture with a slight prenasal fossa; the dental arch has a divergent paraboloid form, brachystaphyline (63/62 – 92.22 i.u.), on which the dentition (intact at the time of death) has, in general, a low abrasion (the first molars having a slightly higher abrasion degree); morphoscopic, we also add, the moderate development of the malar bone, its middle disposition and the slight development of the canines (gr. II).

The mandible is characterized by high values, pertaining to the large category (65: 123 mm; inter-gonal width – 66: 130 mm – very large; high horizontal ramus – $69_{(1)}$: 33 mm –middle; high thickness of the ramus – $69_{(3)}$: 14 mm – very large) and a high robustness index ($69_{(3)}$ /$69_{(1)}$: 46.87 i.u.); morphoscopic, we notice the pyramidal shape of the mental tubercle and a slight widening of the gonions.

Postcranial skeleton is very robust: the humeri, based on the section indexes, belong to the eurybrachic type (83.50 i.u.); the femurs appear flattened (76.05 i.u. and 77.14 i.u.), without pilaster - the right femur (96.77 i.u.) and with pilaster – the left femur (101.66 i.u.) and with attenuated muscular surface; the tibiae – are eurycnemic based on the flattening degree of the diaphysis in the upper area (75.75 i.u. – right, and respectively 78.46 i.u.- left).

Anthropological type: Dinarric East-Europoid.

Postcranial abnormalities/pathologies: the fibulas are connected in the upper side with the tibias; the hip bones have osteophytes; the sacrum bone presents *spina bifida occulta* in the S4-S5 segment. The origin of *spina bifida* is generally considered to be multifactorial, involving genetic predisposition and environmental factors with a triggering role, but the exact cause has yet to be determined. In the last decade, it was found that the deficiency of folic acid, zinc and selenium in maternal metabolism can cause neural tube defects in the embryo. All three nutrients are needed to establish the genetic control of the cell growth during the morphogenesis process (Barnes, 1994). Thus, maternal nutritional status, exposure to teratogenic factors and genetic predisposition may act together and cause spinal dysraphism.

Skeleton M4. The bones belonged to a male subject, 55-60 years old. Postcranial skeleton is represented by only five cervical vertebrae.

The skull (Fig. 4), well preserved, of ovoid shape in norma verticalis – brachycephalic (8/1: 80.79 i.u.) by the ratio between the width (8: 143 mm – middle) and the length of the skullcap (1: 177 mm – small), hypsicephalic, based on its middle height (20: 115 mm, and 17: 136 mm) relative to length (17/1: 76.83 i.u., and 20/1: 64.97 i.u.), and metriocephalic relative to width (17/8: 95.10 i.u., and 20/8: 80.42 i.u.), with the occipital medium wide (12/8: 76.57 i.u.) and curved and with a slightly sloping forehead, metriometope (9/8: 67.13 i.u.); the bone surface is diffused (gr. I or II).

The face is narrow (45: 130 mm) and low (47: 111 mm; 48: 67 mm), with a mesoprosopic and mesene conformation, (facial indexes – 47/45: 87.69 i.u. and 48/45: 51.53 i.u.) and an orthognathic profile (40/5: 95.26 i.u.); the orbits are medium (52: 34 mm; 51: 37 mm), slightly rectangular, hypsiconch - high (52/51: 91.89 i.u.); the short (55: 45 mm) and narrow nose (54: 22.5 mm) appears mesorrhine (54/55: 50 i.u.), with a pyriform aperture; the malar bones are gracile, with deep canine fossae; the deep, short (62: 39 mm) and narrow palate (63: 36 mm) – brachystaphyline (63/62: 92.30 i.u.) has a paraboloid dental arch.

The mandible is narrow (in correlation with the small width of the face), of very low depth, gracile ($69_{(3)}/69_{(1)}$: 30.30 i.u.), with a pyramidal mentum and shrouded gonions.

Anthropological type: East-Europoid.

Dental abnormalities/pathologies: the dentition is eroded (III^{rd}-IV^{th} degree) and shows supragingival dental calculus.

Skeleton M5 is represented by few postcranial bones; the skeleton belonged to a young male (18-20 years old) of middle stature (164.46 cm).

From the skull we only identified a fragment of the left temporal bone and isolated teeth (very slightly eroded) from the mandible and the upper jaw.

Postcranial skeleton appears gracile (especially in the upper limbs bones), with moderate joint surfaces and diffused muscle impressions; the humeri are eurybrachic (66.66 u.i, 67.24 i.u.); the right femur is stenomeric (107.40 i.u.) with pilaster, while the left tibia is eurycnemic (73.68 i.u.).

Anthropological type: couldn't be determined.

Skeleton M6. The skull is represented by an incomplete skullcap, the left malar bone, the upper maxillary and the mandible – incomplete.

Postcranial skeleton is relatively better represented; the long bones collected (only from the upper limbs), as well as those from the pelvis, allow the estimation of the age and sex: woman about 16-18 years old of average stature (154.23 cm).

In the skull fragments, we notice the minimum and the maximum size of the forehead fall under the very wide category (9: 102 mm; 10: 134 mm) and the appreciable height of the malar bone. In the postcranial skeleton we used for measurements, the upper limbs bones were preserved and belong to the eurybrachic category (97.50 i.u.).

Anthropological type: couldn’t be determined.

Cranial abnormalities/pathologies: on the lambdoid suture, Wormian bones are present.

Skeleton M7. We emphasize the incompleteness and poor conservation.

From the skull we recovered: the right temporal squama, a fragment from the occipital bone, a fragment from the right parietal bone, the mandible – incomplete, and a fragment from the right side of the upper maxillary.

In the postcranial skeleton we identified the bones from the upper and lower limbs (some incomplete), fragments from the hip bones, the sacrum bone – incomplete, the astragals, the heels, two thoracic vertebrae, the phalanges, the metacarpals, the metatarsals.

We attribute these fragments to a mature woman (35-40 years old) of average stature (154.10 cm).

The mandible has a high ($69_{(1)}$: 31.50 mm) and gracile ($69_{(3)}$: 10 mm) horizontal ramus, the vertical one being relatively short (70: 62.50 mm); the gonions are well marked, being placed in the same plane as the ramus; the dentition is well preserved (a few teeth were lost post-mortem), offering an abrasion of IInd-IIIrd degree.

Skeleton M8. The well-preserved skull belonged to a mature man (50-55 years old).

The skull (Fig. 5), of medium height (17:133 mm; 20: 114 mm) and length (1: 180 mm), but also considering its horizontal diameters (8: 140 mm; 9: 96 mm; 10: 118 mm; 12: 119 mm) is mesocephalic (8/1: 77.77 u.i), orthocephalic and hypsicephalic by the vertical-longitudinal height indexes (17/1: 73.88 u.i; 20/1: 63.33 i.u.) and metriocephalic by the vertical-transversal indexes(17/8: 95 i.u. and 20/8: 81.42 i.u.); the forehead, in relation to the width of the skullcap is metriometope (9/8: 68.57 u.i) and by the ratio between its minimum and maximum diameters appears to have an oval shape (9/10: 81.35 i.u.); the occipital is wide (12/8: 85 u.i) compared to the width of the skullcap, and moderately curved; norma verticalis indicates an ovoid contour of the skullcap and norma occipitalis is house shaped; the bone surface is generally flattened (supraorbital: gr. II; glabellar: gr. I→II; occipital protuberance: gr. II); however, the mastoid apophyses appear large (gr. IV), also displaying a pronounced supramastoidian surface.

The face, orthognathic (40/5: 95.83 i.u.), is low (both in terms of upper floor – 48: 50 mm and taken together with the mandible – 47: 95 mm) and wide (45: 141.5 mm), values which determine a hypereuriprosopic (47/45: 67.13 i.u.) and hypereurine conformation– low (48/45: 35.33 i.u.); the orbits, slightly rectangular, are hypsiconch (52/51: 92.30 i.u.) due to their considerable height (52: 36 mm) and moderate width (51: 39 mm); the nose appears short (55: 45 mm) and narrow (54: 23 mm) respectively chamerrhine (54/55: 51.11 i.u.), with a straight line of the nose, an antropine pyriform aperture and a nasal spine of IInd degree; the

malar bones have a moderate-to-wide development, an intermediary disposition and relatively deep canine fossae (gr. III).

The mandible, with slightly marked gonions, is short ($69_{(1)}$: 27 mm) and thick ($69_{(3)}$: 16.50 mm) and has a vertical ramus of large height and width (70: 73 mm and 71: 33.50 mm) obliquely positioned; the mental tubercle, slightly marked, has a round shape. The teeth on the mandible show an abrasion of IIIrd degree.

The palate is short (62: 41 mm) and moderately deep, with a paraboloid-divergent dental arch, which lacks dentition (most of the teeth fell post-mortem).

Postcranial skeleton is represented only by a few bones: the upper epiphysis and a fragment of the left femur diaphysis, a fragment from the diaphysis and the upper epiphysis of the right humerus, manubrium, left clavicle, left shoulder blade, three dorsal vertebrae and 10 rib fragments.

Anthropological type: East-Europoid elements + Mongolian elements.

Cranial abnormalities/pathologies: we notice the presence of an indentation (probably, because of a hit) on the frontal bone.

Skeleton M9. The cranial skeleton is represented only by the right temporal bone and a fragment of the front bone.

Postcranial skeleton (fragmented and incomplete) provides reliable indications of gender and age: man (according to the pelvis characteristics), 40-45 years old.

In the lower limbs area, we mention that the upper area of the right femur diaphysis is eurymere (93.75 i.u.) and the right tibia is mesocnemic (63.01 i.u.).

Postcranial abnormalities/pathologies: two cervical vertebrae and the sternal body present signs of degenerative osteoarthritis, a characteristic disease of the older age. Degenerative osteoarthritis, a joint disease characterized by loss of the cartilage that protects the joint surfaces. The bones, not being separated anymore by interbone cartilage, get in contact with each other by friction, a phenomenon that causes damage of the underlying bone. Osteoarthritis often affects the joints of the spine and of the upper and lower limbs and it is the main cause of pain and disability among the elderly. Osteoarthritis progresses slowly, the cartilage is gradually destroyed until the articular bone surfaces get into direct contact. As osteoarthritis becomes severe, it may end up with total loss of the joint function (Aufderheide & Rodriguez-Martin, 1998). Among the factors responsible for the development of osteoarthritis we count genetic predisposition, obesity, trauma and movement. Movement is a prerequisite condition for the development of osteoarthritis. The incidence of disease increases with age, so that at an advanced mature age, it is almost impossible to find an individual that hasn't been affected by osteoarthritis.

Skeleton M10. Poorly preserved, the skeleton belonged to a mature man (40-45 years old).

The cranial skeleton is incomplete and fragmented – six fragments of the parietal bones, four fragments of the occipital bone and six fragments of the temporal bones.

Postcranial skeleton is represented by humeri, radius, right cubitus and a fragment from the right tibia, two fragments of fibulas, one fragment of hip bone, two sacral vertebrae, axis and an atlas fragment, 15 fragments of ribs. The postcranial skeleton dispalys an average to high robustness; the humeri show a moderate deltoidian surface and provide diaphysical section indexes which are fall under the eurybrachic category (76.74 i.u. and 77.27 i.u.);

The stature, calculated by considering the length of the humeri and the right cubitus, indicates an average of 167.96 cm, value that falls under the above-average category for male statures.

Anthropological type: couldn't be determined.

Cranial abnormalities/pathologies: on the exocranial bone plate of a fragment from the parietal bone we notice a depth – probably caused by a hit.

Postcranial abnormalities/pathologies: the lower epiphyses of the humerus present supratrohlear perforation.

Reinhumated skeletons. The skeleton remains derived from reinhumations are very fragmented offering only the possibility to evaluate the age at death and sex. We estimated six individuals: three males aged between 40 and 60 years old, and three females aged between 45 and 60 years old.

Conclusions

Following the general analysis of the human bones discovered in 2011 at the Palace of Culture in Iasi (dated to the 13th century), we identified 16 subjects, whereof 10 men (one man of 18-20 years old, five men of 35-45 years old, four men of 50-60 years old) and six women (two women of 14-20 years old, one woman of 35-40 years old, three women of 45-50 years old).

The anthropological type could be determined only for five subjects and shows a mixture of characters.

We note that the presence of abnormalities and pathologies reported for these 16 skeletons is moderate: cranial trauma – two cases, dental tartar – three cases, Wormian bones – one case, olecranon perforation – one case, osteoarthritis – two cases.

a. **b.**

Figure 1. Skull of the **s**keleton M1: ♀, 18-20 years: a. facial norm; b. right lateral norm.

a. **b.**

Figure 2. Skull of the **s**keleton M2: ♂, 35-40 years: a. facial norm; b. right lateral norm.

a. **b.**

Figure 3. Skull of the **s**keleton M3: ♂, 35-40 years: a. facial norm; b. right lateral norm.

a. **b.**

Figure 4. Skull of the **s**keleton M2: ♂, 55-60 years: a. facial norm; b. right lateral norm.

a. **b.**

Figure 5. Skull of the **s**keleton M8: ♂, 50-55 years: a. facial norm; b. right lateral norm.

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DEMOGRAPHIC STRUCTURE IN LATE-MEDIEVAL POPULATION OF IASI (IAŞI COUNTY, ROMANIA): NECROPOLIS OF ARONEANU MONASTERY, 16th-19th CENTURIES

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Abstract. This article presents a demographic study on the skeletal series (79 skeletons) discovered in 2014, in the necropolis of Aroneanu Monastery of Iasi (Iași County, Romania). According to the information given by the archaeologists, the necropolis was used between the 16th and 19th centuries. Both general and infant mortality were analyzed, by age and by sex, and the mean lifespan was estimated by calculating the mean age at death. We identified an increased mortality rate during childhood (0-14 years: 21.52%), which along with the mortality rate during adolescence (14-20 years: 2.53%) indicates that nearly a quarter of the studied population died before reaching adulthood. For the period of 20-x years, the highest mortality rate is recorded among matures (30-60 years – 59.49%); the incidence of deaths among adults (20-30 years), as well as among subjects over 60 years is lower (11.39% and respectively 5.06%). The average lifespan for the whole series (0-x years) and also by sex (20-x years) is in accordance with the late medieval populations studied in Iași.

Keywords: necropolis, 16th-19th centuries, demography, Aroneanu Monastery of Iași

Rezumat. Structura demografică a populației de ev mediu tîrziu din Iași: necropola Mănăstirii Aroneanu, secolele XVI-XIX. În prezentul articol este realizat un studiu demografic al unei serii scheletice (79 de schelete) descoperită în anul 2014 în necropola Mănăstirii Aroneanu din Iași (județul Iași, România). Conform informațiilor oferite de arheologi, limitele în timp de folosire a necropolei ar fi situate între secolele XVI-XIX. S-a analizat mortalitatea generală și infantilă, pe vârste și sexe, precum și durata medie de viață prin calcularea vârstei medii la deces. S-a constatat o mortalitate crescută în etapa copilăriei (0-14 ani: 21,52%), care împreună cu cea din perioada adolescenței (14-20 ani: 2,53%) indică faptul că aproape un sfert din populația studiată a decedat înainte de a atinge vârsta adultă. Pentru etapa de vârstă 20-x ani, mortalitatea cea mai ridicată este înregistrată în rândul maturilor (30-60 ani – 59,49%), ponderea deceselor în rândul adulților (20-30 ani), ca și în cel al subiecților de peste 60 de ani, fiind mai scăzută (11,39% și respectiv 5,06%). Durata medie de viață, atât pe întreaga serie (0-x ani), cât și pe sexe (20-x ani), se înscrie în contextul populațiilor medievale târzii din Iași.

Cuvinte cheie: necropolă, secolele XVI-XIX, demografie, Mănăstirea Aroneanu din Iași

Introduction

The archaeological diggings carried out in 2014 at the Aroneanu Monastery of Iasi (Iași County, Romania) as part of a rehabilitation project for this monument, led to the discovery of a necropolis with 79 inhumation skeletons originated from individual tombs, double tombs and reburials. Regarding the dating of the necropolis, the authors of the diggings, coordinated by archaeologist Stela Cheptea, Ph.D., established its period of use between the 16th century and the beginning of the 19th century, according to the archaeological inventory. The bones discovered both inside and outside of the Aroneanu

Monastery were entrusted to the "Olga Necrasov" Centre of Anthropological Research for bioanthropological study, as a part of the urban population from medieval Iasi.

Aroneanu Monastery, also known in medieval documents as "the monastery of Aron Vodă", "Sf. Nicolae" monastery of Iaşi or the Greek monastery of the Earthly "Sf. Nicolae", was built in 1594 by Aron Vodă in the northeastern part of Iasi. The greed of the Greek monks and the poor administration repeatedly led the monastery complex to ruins. Nowadays, from the old monastery complex, only the church of "Sf. Nicolae" remained, which was restored (1907) and became the parish church of the Aroneanu village (Iași County) and it is known nowadays under this name (Bădărău & Caproșu, 2007).

The medieval period, as a period of foundation and progressive development of the Romanian states, is less known from an anthropological point of view, more specifically for the last centuries of the second millennium. The historic evolution of Iași (located in the center of Moldavia, at equal distance between the Eastern Carpathians and Nistru River), was achieved under the circumstances of permanent misfortunes, often suffering after the Tatar-Turkish and Polish invasions (Cloșcă, 2008). In the medieval period, the absence of hygiene and effective measures in this area led to the outbreak of many diseases and implicitly to an increase in the number of deaths among the population (Cihodaru *et al*., 1980). The paleodemographic studies provide important insights into the life patterns of the ancient populations, as well as an understanding of the population dynamics in historical and prehistoric times (Nagaoka, 2006). By paleodemographic analysis of various human communities, we can estimate on the number and the density of people from a particular settlement, the general mortality and infant mortality, the distribution of deaths by age and by sex, and life expectancy.

Material and Methods

The analyzed series includes a total of 79 skeletons (originated from inhumation tombs and reburials) exhumed in 2014 from the late-medieval necropolis (16^{th}-19^{th} centuries) of the Aroneanu Monastery in Iași (Iași County, Romania). From the total skeletons, 17 belonged to children (0-14 years), two to adolescents (one male and one female), nine to adults (four males and five females), 47 to matures (36 males and 11 females) and only four to elderly (one male and three females).

The estimation of the age at death and of the sex (for the segment 20-x years) was done using the methods and techniques recommended by Brothwell (1981), Mays (1998), Bruzek (2002), Walrath *et al.* (2004), White & Folkens (2005) and Schmitt (2005). In respect of estimating the age at death in the case of sub-adults, this has been achieved on the basis of the eruption of the temporary and definitive dentition, according to the methodology established by Ubelaker (1979), Moores *et al.* (1963) and Schaefer *et al.* (2009), as well as through the analysis of the degree of ossification of the epiphysis of the long bones and their positioning in the corresponding age categories (Maresh, 1970; Scheuer & Black, 2000). The anthropometric and conformational study on each skeleton has been completed by using the techniques of R. Martin and K. Saller (1956-1966) for the evaluation of dimensions by using the dimorphic scales of Alexeev & Debeţ (1964). For the somatoscopical and typological characterization, we have used the methods and scales of Eickstedt (1937-1943).

The waist has been calculated by using the dimensional scales proposed by Manouvrier (1983), Bach (1965), Breitinger (1938), Trotter & Glesser (1958). The absolute and relative values, resulted from the direct measurement and from the conformational

indices, have been positioned in the scales proposed by Olivier (1969). After evaluating the age and sex of each skeleton, we proceeded to the demographical analysis of the population represented by the 79 skeletons, studying the mortality rates by age and by sex and the average lifespan estimated by calculating the life expectancy both at birth (0-x years) and at the age of 20 years (20-x years). The average life expectancy at birth, associated with the average lifespan, is the most accurate evaluation of the mortality level and it represents the average number of years a person is expected to live from the moment of birth to the age limit (Ţarcă, 2008). The life expectancy at birth was estimated using the mortality tables (Acsádi & Nemeskeri, 1970). Based on the mortality by age and by sex, these tables represent significant demographic models in the evaluation of the probabilities of death (qx) or survival (lx). The mortality table features the life history of a population, which usually begins at birth and ends with the extinction of the last exponent (Brothwell, 1981). The mortality tables include several mathematical indices associated with the number of deaths grouped by specific age intervals (half decades), based on which we established in the end the life expectancy for the entire population (0-x years) and for the adult population (20-x years):

- % dx = the number of deceased subjects, by age intervals, and the associated percentage;
- lx = the number of survivors;
- qx = the death probability
- Lx, Tx = mathematical calculations based on the previous indices;
- e˚x = the life expectancy.

The lx survival rate, established for each age group, is defined as the probability that an individual from the intended group will be still alive at the beginning of the age group (Chamberlain, 2006).

Results and Discussion

The series of 79 skeletons, exhumed from the necropolis of Aroneanu Monastery in Iaşi, dating from the late-medieval period (16^{th}-19^{th} centuries), presents a satisfactory preservation status, being suitable for a demographic study in terms of distribution by age and sex (Table 1).

Table 1. Distribution of age and sex in the skeletal series from Aroneanu Monastery of Iaşi (16^{th}–19^{th} centuries).

Sex	Male		Female		Indeterminable		Total	
Age (years)	N	%	N	%	N	%	N	%
Infans I (0-7)	-	-	-	-	12	15.19	12	15.19
Infans II (7-14)	-	-	-	-	5	6.33	5	6.33
Juvenis (14-20)	1	1.27	1	1.27	-	-	2	2.53
Adultus (20-30)	4	5.06	5	6.33	-	-	9	11.39
Maturus (30-60)	36	45.57	11	13.92	-	-	47	59.49
Senilis (60-x)	1	1.27	3	3.80	-	-	4	5.06
Total	**42**	53.16	**20**	25.32	**17**	21.52	**79**	100

It was found that the child mortality rate (*infans* I and II) reaches a percentage value of approximately 22%, with the highest rate being recorded amongst children aged between 0 and 7 years (approximately 15%). During adolescence (14-20 years), the incidence of death is significantly lower, with only two cases reported (one female – 1.27%, and one male – 1.27%). The frequency of adolescent deaths, cumulated with child deaths (0-14 years), indicates a mortality rate of about 23%, which shows that nearly one-fourth of the population buried in this necropolis died before reaching adulthood. For the group of 20-x years old, the highest mortality rate is recorded among matures (30-60 years – 59%), whereas the incidence of death among adults (20-30 years) and subjects over 60 is lower (approximately 11%, and respectively 5%).

With regards to the distribution of death by sex, for the segment of 20-x years old, represented by 60 subjects, we notice that the number of male skeletons is much higher compared to that of female skeletons (41 male skeletons and 19 female skeletons).

Based on the distribution of subjects by age at death, we calculated the life expectancy at birth for the entire studied series (0-x years) and for individuals over 20 years, separately for each sex, indicators that reflect the longevity of this population. Thus, the life expectancy at birth for the entire sample studied (0-x years) is 36.61 years (Table 2) and by sex (for 20-x years) it is 27.38 years for men (Table 3) and approximately five years lower for women – 21.97 years (Table 4). The average lifespan for the adult population segment (individuals over 20 years) is 47.38 years for men and 41.97 years for women.

Table 2. Mortality and life expectancy for the assemblage exhumed from the necropolis of Aroneanu Monastery (0-x years).

Age class	N (Dx)	% (dx)	Survivors (1x)	Probability of death (qx)	Life expectancy (e^0x)
0-4	7	8.86	100.00	0.0886	**36.61**
5-9	5	6.33	91.14	0.0694	34.93
10-14	5	6.33	84.81	0.0746	32.35
15-19	2	2.53	78.48	0.0323	29.76
20-24	3	3.80	75.95	0.0500	25.67
25-29	6	7.59	72.15	0.1053	21.89
30-34	5	6.33	64.56	0.0980	19.17
35-39	2	2.53	58.23	0.0435	15.98
40-44	9	11.39	55.70	0.2045	11.59
45-49	10	12.66	44.30	0.2857	8.93
50-54	9	11.39	31.65	0.3600	6.50
55-59	12	15.19	20.25	0.7500	3.75
60-64	4	5.06	5.06	1.0000	2.50

Table 3. Mortality and life expectancy for the males exhumed from the necropolis of Aroneanu Monastery (20-x years).

Age class	N (Dx)	% (dx)	Survivors (1x)	Probability of death (qx)	Lx	Tx	Life expectancy (e^0x)
20-24	0	0.00	100.00	0.0000	500.00	2737.80	**27.38**
25-29	4	9.76	100.00	0.0976	475.61	2237.80	22.38
30-34	3	7.32	90.24	0.0811	432.93	1762.20	19.53
35-39	1	2.44	82.93	0.0294	408.54	1329.27	16.03
40-44	5	12.20	80.49	0.1515	371.95	920.73	11.44
45-49	9	21.95	68.29	0.3214	286.59	548.78	8.04
50-54	8	19.51	46.34	0.4211	182.93	262.20	5.66
55-59	10	24.39	26.83	0.9091	73.17	79.27	2.95
60-64	1	2.44	2.44	1.0000	6.10	6.10	2.50

Table 4. Mortality and life expectancy for the females exhumed from the necropolis of Aroneanu Monastery (20-x years).

Age class	N (Dx)	% (dx)	Survivors (1x)	Probability of death (qx)	Lx	Tx	Life expectancy (e^0x)
20-24	3	15.79	100.00	0.1579	460.53	2197.37	**21.97**
25-29	2	10.53	84.21	0.1250	394.74	1736.84	20.63
30-34	2	10.53	73.68	0.1429	342.11	1342.11	18.21
35-39	1	5.26	63.16	0.0833	302.63	1000.00	15.83
40-44	4	21.05	57.89	0.3636	236.84	697.37	12.05
45-49	1	5.26	36.84	0.1429	171.05	460.53	12.50
50-54	1	5.26	31.58	0.1667	144.74	289.47	9.17
55-59	2	10.53	26.32	0.4000	105.26	144.74	5.50
60-64	3	15.79	15.79	1.0000	39.47	39.47	2.50

Compared to other synchronous populations who inhabited in Iași, the population buried in the Aroneanu necropolis presents a wider lifespan compared to that of the reference series: 36.61 years – necropolis of the Aroneanu Monastery – Iași; 35.92 – the "Curtea Domnească" (Groza *et al*, 2012); 35.63 years – "Banu" Church (Groza *et al*, 2013); 34.06 – "Sf. Nicolae-Ciurchi" (Simalcsik *et al*., 2012); and 25.63 years – necropolis of Piatra Neamț-Dărmănești (Groza *et al.*, 2015) (Fig. 1).

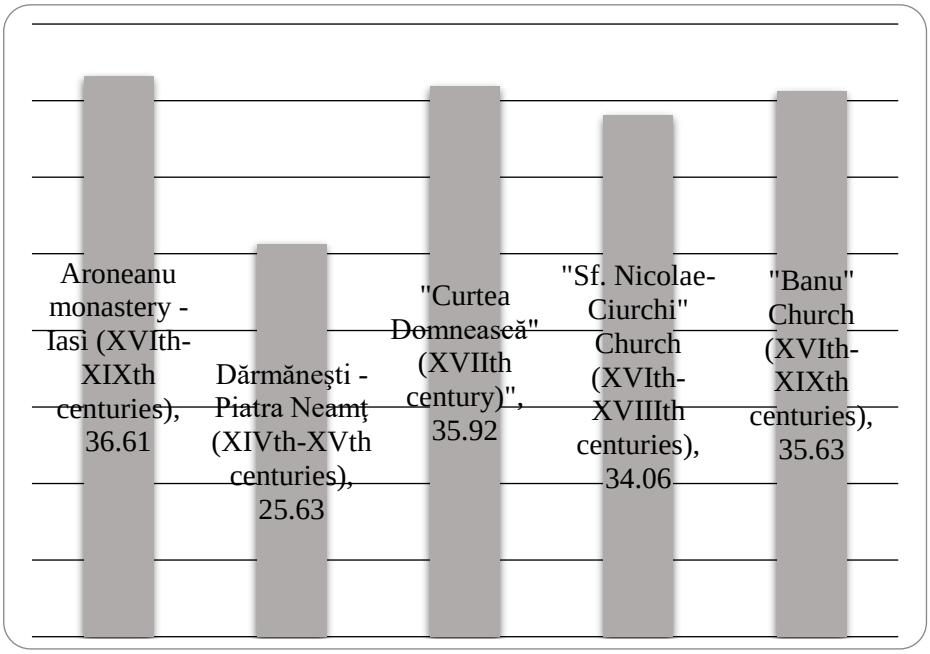

Figure 1. The average lifespan for the investigated series, compared to other synchronous series (0–x years).

Conclusions

The demographic analysis carried out on the 79 skeletons (16^{th} - 19^{th} centuries), exhumed in 2014 from the necropolis of the Aroneanu Monastery in Iasi, indicates a relatively high mortality rate among children (0-14 years: approximately 21.52%), with the highest rate being recorded among deceased children aged between 0 and 7 years old (15.19%). Thus, the frequency of adolescent deaths (2.53%), cumulated with children deaths (0-14 years), indicates a mortality rate of approximately 24%, which shows that nearly one-fourth of the population buried in this necropolis died before reaching adulthood. The incidence of death among adults (20-30 years) is approximately 12%, while among matures (30-60 years) it reaches the value of 59.49%. The survival rate after the age of 60 amounts to just 5.06%. With regards to the distribution of deaths by sex for the 20-x years age segment, represented by 41 subjects, we notice that the number of male skeletons is higher compared to that of female skeletons. Life expectancy at birth for the total population we analyzed (0-x years) is 36.61 years, whereas in the 20-x years segment, it is 27.38 years for males and 21.97 years for females.

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MORPHOMETRIC VARIABILITY OF THE MOLAR TOOTH M2 IN THE SKELETAL SERIES DISCOVERED IN THE 17TH CENTURY NECROPOLIS FROM IASI (IASI COUNTY, ROMANIA)

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Abstract. M2 tooth is particularly important for paleoanthropological research. The molar tooth M2 is generally well preserved *in situ* compared to other molar teeth (M1 wears out early and therefore its form becomes with flattened cusps and unclear pattern, and M3 does not appear constantly). This particularly molar, M2, is used in the study of health and diet providing information on dental wear based on food. The 17th century necropolis of Iași was discovered in 2008, in the rescue archaeological excavations from the *Palas Mall* complex. 60 individual and collective burial tombs were excavated, from which 111 skeletons were recovered (80 males and 31 females). Dating skeletons was made based on the archaeological inventory. In the present study, 234 M2 teeth from 77 skeletons were analysed. For each tooth, the following dimensions were taken: cusps height, mesio-distal and bucco-lingual crown diameters. Morphometric variability was analysed depending on various factors such as: sex, age, laterality and position in the skull. The molar teeth M2 morphometrically analysed will be the subject of a further study concerning the dental microwear as a marker of the paleodiet.

Keywords: M2 molar, tooth, morphometry, necropolis, 17th century, Iasi.

Rezumat. Dintele M2 este deosebit de important pentru cercetarea paleoantropologică. Dintele molar M2 este în general bine conservat *in situ* comparativ cu alți dinți molari (molarul M1 se uzează devreme, prin urmare forma sa devine cu cuspizi aplatizați, cu un model neclar, iar molarul M3 nu apare în mod constant). Molarul M2 este utilizat pentru studiul sănătății și al dietei, oferind informații despre uzura dentară bazată pe alimentație. Necropola de secol XVII din Iași a fost descoperită în anul 2008, cu ocazia săpăturile arheologice de salvare de la complexul Palas Mall. Au fost excavate 60 de morminte individuale și colective, din care au fost recuperate 111 schelete (80 de bărbați și 31 de femei). Datarea scheletelor a fost făcută pe baza inventarului arheologic. În studiul de față, au fost analizați 234 de dinți M2 de la 77 de schelete. Pentru fiecare dinte au fost luate următoarele dimensiuni: înălțimea cuspizilor și diametrele coroanei mezio-distal și buco-lingual. Variabilitatea morfometrică a fost analizată în funcție de diferiți factori, precum: sex, vârstă, lateralitate și poziția în craniu. Dinții M2 analizați morfometric vor fi obiectul unui studiu ulterior privind micro-uzura dentară ca marker al paleodietei.

Cuvinte cheie: molar M2, dinte, morfometrie, necropolă, secol XVII, Iași.

Introduction

Teeth are a valuable and durable source of information for paleoanthropological research based on their hard tissues: the enamel, dentine and cementum (Gomez-Robles *et al*., 2007; Guatelli-Steinberg & Huffman, 2012). Traces of somatic development, life history and significant biological phenomena are preserved in teeth and can offer a wealth of information about the individuals of whom they were once a part (Grine, 2007). Dental crown size variations have been reported between different populations due to numerous factors such as: genetic, epigenetic and environmental influences (Brook *et al*., 2009).

The human molars are permanent teeth and they consist of three pairs in each jaw, located distal of the premolars (maxillary – M^1, M^2, M^3; mandibular – M_1, M_2, M_3). In the studies of dental morphometry, the M1 and M3 molars are avoided because M1 has a variable morphology, usually with flattened cusps and unclear pattern, and M3 does not appear constantly – congenitally missing (Moreno-Gómez, 2013; Scott, 2008).

Studies of morphometry and evolutionary relationships have been based on non-metric crown traits (marginal ridge complex, cingulum derivative, supernumerary coronal structure, cervical enamel line, variation in major cusps, supernumerary cusps) and root traits (root number, dictated by some combination of inter-radicular projections and fusion, and supernumerary roots) (Scott *et al*., 2015). Techniques based on distance measurements and indexes constructed from them (crown index) are also used to describe the tooth form (Bernal, 2007). The most common measurements used today are the maximum crown diameters taken in the mesio-distal (M-D) and bucco-lingual (B-L) planes (Takahashi *et al*., 2007; Hemphill, 2015).

This preliminary study aims to compare dental crown size of the molar tooth M2 in the skeletal series discovered in the 17th century necropolis from Iasi (Iasi County, Romania), depending on various factors such as: sex, age, laterality and position in the skull.

The necropolis of "Curtea Domnească" at Iaşi (Iaşi County, Romania) was discovered in 2008, in the rescue archaeological excavations from the *Palas Mall* complex. 60 individual and collective burial tombs were excavated, from which 111 skeletons were recovered (80 males and 31 females). Dating skeletons (17th century) was made on the archaeological inventory. Estimation of age at death and sex was done using criteria recommended by Bruzek (2002), Schmitt (2005), and White & Folkens (2000). The anthropometric and conformational study of each skeleton has been completed according to methods of Martin & Saller (1956-1966).

Material and Methods

In the present study, 234 crowns of molar tooth M2, belonging to 77 skeletons from the necropolis of "Curtea Domnească" at Iaşi, were analysed (Table 1).

Table 1. Selected teeth, belonging to 77 adult skeletons from "Curtea Domnească" necropolis.

Sex	Molar tooth M2	N
Men	Right inferior	57
	Left inferior	47
	Right superior	41
	Left superior	38
Women	Right inferior	16
	Left inferior	12
	Right superior	12
	Left superior	11

According to Hillson *et al*. (2005), the maximum crown diameters were taken with an electronic caliper: mesio-distal (the largest mesial-to-distal dimension taken parallel to the occlusal surface), and bucco-lingual (the greatest distance between the buccal and lingual

surfaces, perpendicular to the mesio-distal diameter) (Fig. 1). For each cusp, height was calculated by measuring the perpendicular distance between the maximum tip point and the cervical plane (Fiorenza *et al*., 2011) (Fig. 2). The relationships between measurements were investigated through scatterplots, correlations, column and radar type charts. The statistical evaluation of the results was carried out by one-way ANOVA (Analysis of Variance) followed by *t* – test. Differences between groups were considered significant when $p<0.05$.

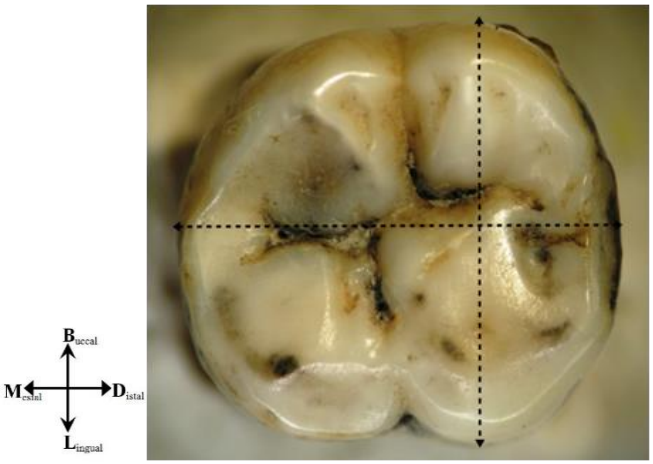

Figure 1. Occlusal view of M_2 inferior molar: mesio-distal and bucco-lingual crown diameters.

Figure 2. Lingual view of M_2 inferior molar, high cusps: 1 – paraconid; 2 – metaconid; 3 – protoconid; 4 – hypoconid.

Results and Discussion

Table 2 provides summary statistics for measurements of the M2 molars. The coefficient of variation (CV%) was used to describe variability and it has values for the M^2 and M_2 bucco-lingual crown diameter between 0.08% (in man) and 0.09% (in women), respectively 0.06% and 0.05%. The mean of the mesio-distal crown diameter of M^2 in women is smaller (mean = 9.34, n = 23) than that of men (mean = 9.42, n = 79), but bucco-lingual crown diameter is higher (mean = 11.27 in women and 11.19 in man). The highest cusp of the M^2 in man is the hypocone (H^4 maximum hight = 8.10 mm, H^4 minimum hight = 3.80 mm) and lowest is the paracone (H^1 maximum hight = 7.24 mm, H^1 minimum hight = 1.05 mm). In women, the protocone is the highest cusp (H^3 maximum hight = 7.28 mm, H^3 minimum hight = 4.15 mm) and the lowest is the paracone (H^1 maximum hight = 6.65 mm, H^1 minimum hight = 3.46 mm). The lowest cusp of the M_2 is the protoconid (in women H_3 maximum hight = 6.77 mm, in man H_3 maximum hight = 6.68 mm) and the highest is the metaconid in women (H_2 maximum high = 7.40) and hypoconid in man (H_4 maximum high = 7.51 mm).

Table 2. Summary statistics for measurements of M2 molars. Abbreviations: B-L D. – bucco-lingual maximum crown diameter; M-D D. – mesio-distal maximum crown diameter; H^1/H_1 – paracone/paraconid hight; H^2/H_2 – metacone/metaconid hight; H^3/H_3 – protocone/protoconid hight; H^4/H_4 – hypocone/hypoconid hight; N – number of examined molars; Min. – Minimum; Max. – Maximum; SD – standard deviation; CV – coefficient of variation (%); CL – confidence level.

Anatomical element	Variable	Sex	N	Mean (mm)	Min. (mm)	Max. (mm)	SD	CL (95%)	CV (%)
M^2	B-L D.	Man	79	11.19	7.18	13.45	0.94	0.21	0.08
		Women	23	11.27	9.32	13.13	1.04	0.44	0.09
	M-D D.	Man	79	9.42	5.93	12.52	0.89	0.20	0.09
		Women	23	9.34	7.76	10.72	0.83	0.36	0.08
	H^1	Man	79	4.51	1.05	7.24	1.26	0.28	0.27
		Women	23	4.93	3.46	6.65	0.85	0.37	0.17
	H^2	Man	79	4.71	1.73	7.24	1.22	0.27	0.25
		Women	23	5.19	3.80	7.03	0.87	0.37	0.16
	H^3	Man	79	5.73	3.67	7.61	0.95	0.21	0.16
		Women	23	5.90	4.15	7.28	0.77	0.33	0.13
	H^4	Man	79	5.82	3.80	8.10	0.91	0.20	0.15
		Women	23	5.83	3.46	7.10	0.84	0.36	0.14
M_2	B-L D.	Man	104	10.09	8.96	12.04	0.64	0.12	0.06
		Women	28	9.83	8.95	11.35	0.57	0.22	0.05
	M-D D.	Man	104	10.63	8.87	12.97	0.77	0.15	0.07
		Women	28	10.68	9.34	12.67	0.71	0.27	0.06
	H_1	Man	104	4.99	1.57	7.01	1.00	0.19	0.20
		Women	28	5.27	2.84	6.95	0.88	0.34	0.16
	H_2	Man	104	5.15	2.44	7.38	0.95	0.18	0.18
		Women	28	5.53	4.06	7.40	0.81	0.30	0.14
	H_3	Man	104	4.81	1.25	6.68	1.10	0.21	0.22
		Women	28	5.33	3.27	6.77	0.96	0.37	0.18
	H_4	Man	104	4.82	2.35	7.51	1.06	0.20	0.21
		Women	28	5.38	3.69	6.88	0.85	0.33	0.15

The correlations of the dimensional variability (bucco-lingual and mesio-distal diameters) of the M_2 inferior (Fig. 3) and M^2 superior (Fig. 4) tooth are positive in men, showing a weak (r = 0.22) and moderate (r = 0.6) sample correlation coefficients. A scattered moderate correlation (r = 0,62) (Fig. 7) and no correlation (r = -0,6) (Fig. 8) were recorded in the dimensional variability (bucco-lingual and mesio-distal diameters) of the M_2 inferior tooth, respectively M^2 superior tooth, in women.

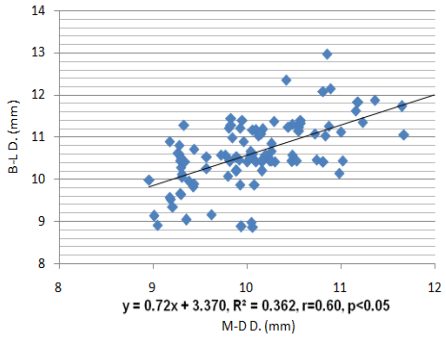

Figure 3. Dimensional variability of the M_2 inferior tooth, in men.

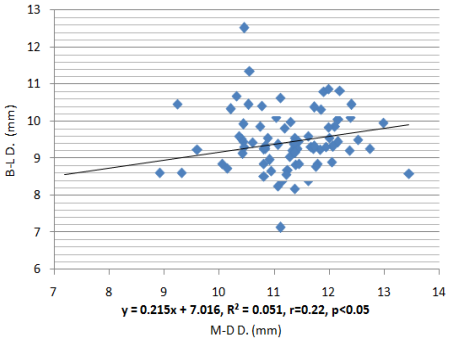

Figure 4. Dimensional variability of the M^2 superior tooth, in men.

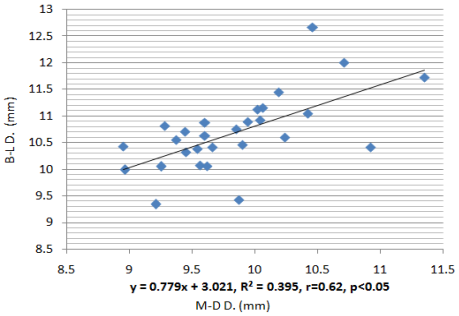

Figure 5. Dimensional variability of the M_2 inferior tooth, in women

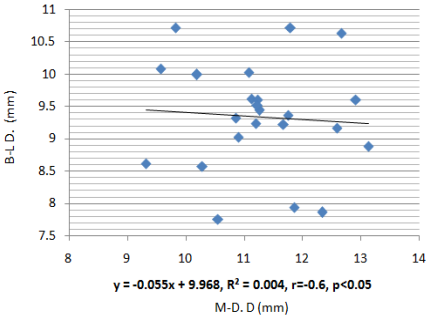

Figure 6. Dimensional variability of the M^2 superior tooth, in women.

The shape of the occlusal surface can be characterized by a crown shape index B-L diameter x 100/M-D diameter. The crown shape index of the M_2 inferior tooth shows a low variability in both women and men (Fig. 7); instead, the M^2 superior tooth crown shape has a greater variability, especially in women compared to men (Fig. 8).

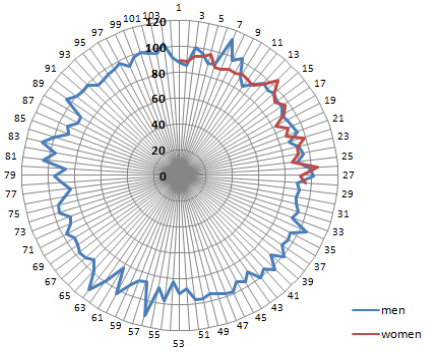

Figure 7. Variability of the crown shape index of the M_2 inferior tooth, by sex.

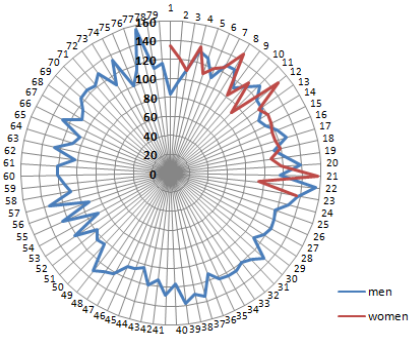

Figure 8. Variability of the crown shape index of the M^2 superior tooth, by sex.

Considering the height of the dental crown of the M2 molar, it decreases with age due to dental wear, with different rhythm depending on sex and dental position. The decrease rhythm is greater in men compared to women, especially in the case of the M^2 superior (Figs. 10-11).

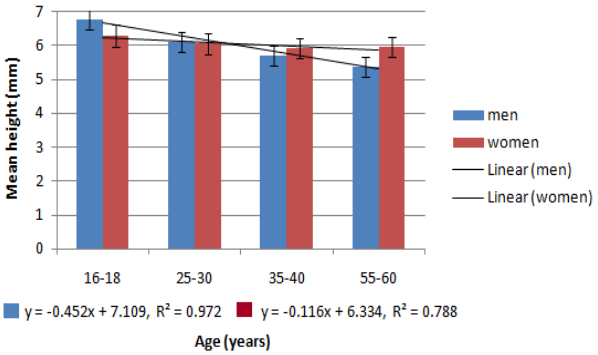

Figure 9. Variability of the mean height,
dental crow of the M^2 superior molar, depending on sex.

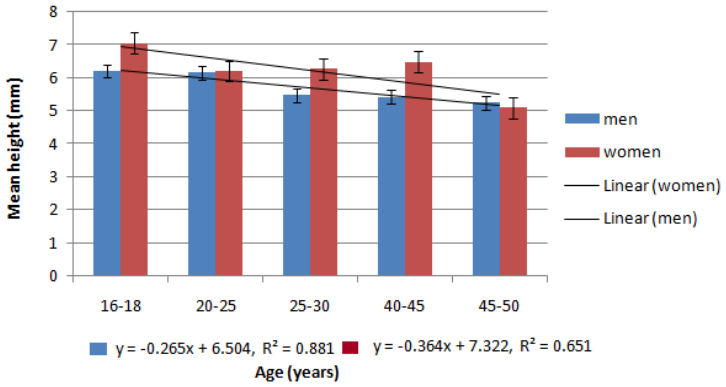

Figure 10. Variability of the mean height,
dental crow of the M_2 inferior molar, depending on sex.

Conclusions

The morphometry of the molar tooth M2, analysed in the skeletal series discovered in the 17th century necropolis from Iasi, shows a variability depending on the tooth position, sex and age. According to the data obtained in our study, the most stable shape of the dental crown appears in the case of the inferior M_2 tooth in men, and the most variable form at the upper M^2 tooth in women. The height of the dental crown decreases with age due to dental wear, but with a different rhythm depending on the position of the tooth and the sex.

The molar tooth M2 is the subject of the study concerning the dental macro- and micro-wear as a marker of the paleodiet. Thus, such research is started, based on electron microscopy techniques, image analysis and geometric morphometrics (Mahoney, 2006).

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DARWINISM IN ROMANIA, BETWEEN SCIENCE AND IDEOLOGY

Ion COJOCARU

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Abstract. The motivation of this work starts from the following five considerations: i) Theories of science are often exploited ideologically; ii) The evolutionary theory of Charles Darwin (1859) was and still is the most ideologized scientific theory; iii) The consequences of Darwinism ideologization have always had negative effects on Darwinism as a scientific theory (unlike, for example, by the ideologization of Lamarck's theory, which has increased its image, more precisely, the idea of the tendency towards perfection, suggested by Lamarckism, conforms to the older theories of progress, suggesting the idea of a sense of the existence of the world and man, much appreciated also by the religious ideology); iv) Data from the literature shows the transition from totalitarian political regimes to political relaxation regimes on freedom of expression is generally associated with an increase in public confidence in untrue, unscientific facts (pseudoscience, esotericism, religion, occult practices etc.), to the detriment of science and critical thinking. v) Currently, in Romania Darwinism and evolutionary biology are eliminated, without any scientific or didactic justification, from school curricula, and in some biology textbooks there are accredited creationist theses. The paper has a working hypothesis the process of ideologization of Darwinism in Romania, as a phenomenon associated with the changes of the political regime in this country, starting with 1859 to the present.

Keywords: darwinism, evolutionary biology, darwinism ideologization, political regime, Romania.

Rezumat. **Darwinismul în România, între știință și ideologie.** Motivația acestei lucrări pornește de la următoarele cinci considerente: i) Teoriile din știință sunt adesea exploatate ideologic; ii) Teoria evoluționistă a lui Charles Darwin (1859) a fost și este încă cea mai ideologizată teorie științifică; iii) Consecințele ideologizării darwinismului au avut întotdeauna efecte negative pentru darwinism, ca teorie științifică (spre deosebire, de exemplu, de ideologizarea teoriei lui Lamarck, care i-a sporit imaginea, mai exact, ideea tendinței spre perfecțiune, sugerată de lamarckism, concorda cu mai vechile teorii ale progresului, sugerând ideea de sens al existenței lumii și omului, mult apreciată și de ideologia religioasă); iv) Date din literatură arată că trecerea de la regimuri politice totalitare la regimuri politice de relaxare privind libertatea de expresie este asociată, în general, cu o creștere a încrederii populației în fapte neadevărate, neștiințifice (pseudoștiințe, ezoterism, religie, practici oculte etc.), în detrimentul științei și gândirii critice. v) În prezent, în România darwinismul și biologia evoluționistă sunt eliminate, fără vreo justificare științifică sau didactica, din programele școlare, iar în unele manuale de biologie sunt acreditate teze creaționiste. Lucrarea are ca ipoteză de lucru procesul de ideologizare a darwinismului în România, ca fenomen asociat schimbărilor de regim politic din această țară, începând cu anul 1859 până în prezent.

Cuvinte cheie: darwinism, biologie evoluționistă, ideologizarea darwinismului, regim politic, România.

Introduction

The evolutionist conception of biology is based on the theory of Charles Darwin on the origin of species by natural selection published in 1859. Darwinism has had a major impact on science, but also on the extra-scientific domain: philosophical, ideological, political, religious. The evolutionary theory developed by Charles Darwin represented a revolution in the way to study nature, also in thought (Barnett, 1995; Smocovitis, 2005, Ruse, 2009). "Darwin gave the death blow to uncritical vitalism in biology, to occultism in psychology, and to mysticism and formalism in philosophy" states US evolutionist J. M. Baldwin, 50 years after the publication of *The Origin of Species* (Baldwin, 2015). Two

aspects here retain attention. First, the fact that Darwinist evolution based on natural selection offers the only mechanism of adaptation and the most important mechanism for evolution accepted by science at present, more than 150 years after the publication of *The Origin of Species*. Second, Darwinian theory of evolution is the most ideologized and politicized scientific concept, with different cultural, social and political effects. Ernst Mayr, one of the most prominent evolutionists of the twentieth century, has shown that no scientific theory has faced such a fierce and long-standing opposition (Mayr, 1982, Flonta, 2010). We point out that the ideologization of certain aspects of science is inevitable (Young, 1971); here we want to denounce the abuse of ideologization in terms of culture, education, social life and political action, which ultimately undermine science.

Darwinism had such a profound impact on the mentality of its age that its principles, understood or misunderstood, were used for or against various ideas and ideologies. George Bernard Shaw (a Socialist) once remarked that Darwin "was lucky enough to thank everyone who had a personal interest". Evolutionism "has been used to support virtually any kind of "imaginary «ism»". (Alexander, 2010). In *Autobiography*, speaking of the languages in which *the Origin of Species* was translated, Darwin specified that an essay about this book also appeared in Hebrew "wishing to show that the theory is contained in the Old Testament" (Darwin, 1962 [1887]). What has generated and still generates most of the comments, interpretations or even hostile reactions to the theory of evolution through natural selection is that for the first time a scientific explanation has been given to the finality in nature, without the need for imagining a supernatural creator. Since Darwin, our static and sufficient vision of the world, imposed by authority such as that of the Church, has been demolished; it has been replaced by a dynamic vision, free of any omniscient authority, always subject to criticism and renewed, through the contribution of science. It is amazing how a simple observation of an obvious fact in nature - differentiated survival (at the same time - differentiated reproduction), could generate so many extra-scientific interpretations. Receiving a metaphorical name, which was almost personified by some, differentiated survival was a source of ideological manipulation and could cause harm to both science and society (Dennett, 1995). Differential survival can be found by anyone, there is no need for a scientific method. But the scientific analysis of this finding involves explaining why some individuals leave offspring, and others do not, why not all individuals have the same qualitative traits. Differential survival, continued for a long time, produces irreversible biological changes. Darwin called this process *natural selection*, and its result in time - descent with modification and character divergence; we today designate these two findings with a single term - *evolution*.

Natural selection, a blind but creative essence, take over the creative role of God, therefore it is the opposite of divinity, it is diabolical. Differential survival status or natural selection is often designated by the words driving force, cause, factor, mechanism, fundamental principle, agent, thus creating conditions for personification of nature. As a result, this "force" appears to be the ultimate danger of mankind: it leads to man's approach to animal and leads to the animal's approach to man, leads to instability and the destruction of social order, interethnic discord, cultural disorientation, atheism, the biologisation of society, the ruin of traditional religious morality, sexual revolution, ethical nihilism, the disappearance of humanism and the governance of animal laws in society, to the idea that the world would be governed by a law of conflict and war and not of peace and harmony, to the

disappearance of the sense of life, to the activation of hidden forces in the individual's psychology: selfishness, violence, shamelessness, disobedience, discrimination of others, etc.

Acceptance of Darwinism, of the idea of evolution in general, is directly related to the freedom of critical thinking and the political regime. There are observations that show that when a political regime changes with a more relaxed regime in terms of freedom of expression and opinion, most people tend to use this freedom rather towards occult beliefs, untrue facts, marginalization of science, rather than approach the recognized values of science. Carl Sagan (1996) (citing situations in Russia, China, Germany, USA) shows that in countries with these political changes, the phenomena of mysticism, esotericism, astrology, religion, intellectual imposture, etc. have grown to the detriment of culture based on science, logic and critical thinking. These phenomena become truly dangerous when formalize and become a norm of education. A phenomenon of this kind can be seen in the post-totalitarian Romania. As in other countries, in Romania, the attitude towards Darwinist evolution has experienced in time oscillations and accents, depending on the cultural and political environment of the moment.

1. Darwinism as science subjected to ideologization

The differentiated survival of living beings is intuitively perceived by anyone as a result of natural processes, arising from self; if we say that this survival is the result of a "competition" and a "selection", then obviously we used some indispensable metaphors of our way of communication. Darwin has been always bounded of the biologizant interpretation of human society. "A man can by an act of sacrifice, by the example he give so, to do more good his tribe than giving birth to descendants" he said in his *Descent of Man* (Darwin, 1967 [1881]). Ideologisation of Darwinism was applied, over time, in philosophy (social Darwinism), religion (Darwinism theological evolutionism theist), social doctrines politics, eugenics, racism, colonialism, territorial expansionism, militarism, serving interests that are unrelated to science with biological evolution, thus contributing to misinterpretation of the concept of Darwinian.

In philosophy, the Darwinian evolutionism has been exploited ideologically even in the Darwin's time. The philosopher Herbert Spencer (1820-1903) expanded the notion of "struggle for life" on economic and social life, and of the phrase "survival of the more apt" (formulated by him and also used by the Darwin), gave him even a moral connotation („more” = better capable, superior), although the expression refers to the reproductive success (*fitness*, in current terms). Darwin later said that Spencer's ideas "have been of no use to me" and "his deductive manner of treating a subject is quite opposed to the structure of my thinking ... my fundamental generalizations do not seem to me to be of any strictly scientific utility". Erroneous ideas of H. Spencer have considerably damaged the correct understanding and acceptance of evolution by natural selection and led to the doctrine, falsely titled, social Darwinism (Ayala, 2008). Hodgson and Knudsen shows that social evolution is not *analogous* to evolution in the natural world, but, at a high level of abstraction, social and biological evolution share general principles – complex population systems been found in both nature and the human social world. In this sense, social evolution *is* Darwinian (Hodgson & Knudsen, 2006). The idea of free evolution through natural selection has created fear, even during Darwin's life, that nature is left to chance and society can be subjected to disorder at any time. The fear of indeterminism that has arisen since Darwin's life (at Duke of Argyll, 1867) (White & Gribbin, 2004) will persist later and will generate the fear of fatalism, the

fact that man is not fully responsible of his actions (at Bernard Shaw) (Flonta, 2015). In an opposite, strictly deterministic view, evolution based on selection seemed to abduct the freedom of events in nature, that everything is reduced to a mechanical sorting and elimination process. J.M. Baldwin points out that the first objection to Darwinism was that natural selection leaves no room for freedom, but reduces the whole succession of nature to cause and effect (Baldwin, 2015). Friedrich Engels used Darwinism to lay the foundations for an ideology of the state - dialectical materialism, and a new philosophy - the dialectics of nature, which attempted to encompass in general laws, matched with left-wing political ideology, processes in nature, society, thinking (Flonta, 2010). When the principles of Darwinism, applied to the living world, were associated with human society, they were used to justify political goals or actions.

Darwinism was used in political interest (acceptance or denial) in different political regimes: in societies under the left dictatorship (Lysenkoism - anti-capitalist pseudoscience of the unique party in the USSR), dictatorship of the Right (Nazism) or as a subject of propaganda of sectoral, anti-evolutionist, creationist dictatorships, of religious lobbying structures in democratic states (in the US). Darwin's principles will be praised or denied by interest in both different political or religious entities (political regimes, political parties, religious worship institutions) and within the same entity as dictated by political or religious ideology. The ideologization of the Darwinist selectionist principle was to serve both the right-wing Western Capitalist policy (nobility elites, entrepreneurs, capital holders) and left-wing Communist politicians (the proletariat as a profile of the newly evolved social man) (Alexander, 2010). Darwinism could be exploited by personal political ideologies (electoral campaign type) (Buican, 1994, Flonta, 2010) or state policies (soviet creative Darwinism) (Buican, 1994). Darwin's conception of evolution through natural selection also links abusively the ideas of eugenics, racism and social Darwinism (Alexander, 2010). Darwinism was used as a weapon against bigotry (in England) or as an ideology for hegemony (in Germany) (Mârza, 1957). Darwinism was used as a fighting weapon, both by the materialists, as well as by the idealists, both revolutionary and reactionary parties (Mârza, 1957).

Darwinism has been extensively processed ideological and also in the field of religion. In general, religious ideology has disapproved and ridiculed Darwinism over time due to its atheistic and materialist consequences. What draws attention, however, is that from doctrinal interest, theology has sympathized in three situations with Darwinism. First, even during Darwin's life, when the mentality of the natural theology of the age suggested that science is only a tool to study Creation and to confirm the Creator's plan. Darwin's theory had to be received with understanding because it revealed, in this optics, the way the Creator works in the living world. The second most recent situation is that theology strategically approved Darwinism, when the validity of Darwinian evolution had already been confirmed by all sciences. In this case, the cultivated, faithful world, including many well-known biologists, imagined a theological evolution or "theological darwinism" to remain faithful to both the principles of science and personal religious dogmatic sentimentality. The third is the situation where theology sought to respond to a secular problem, which made it logical to the difficult test and affected its credibility in the eyes of believers - *the theodicy* or why there is suffering, cruelty if God is a benevolent, and especially how evil often touches children, innocents, innocent people, valuable people or even believers. The saving solution was Darwinism. The Creator did not plan the evil, Darwinian laws of evolution are responsible for the free actions and attributes of individuals, so Darwinist science is, as Francisco Ayala

says, a great believer biologist in the title of a book written by him, a gift for both science and religion. "Evolution is a disguised friend of theology, not her enemy", and Darwinism "is also the solution to the thorny problem of evil" (Ayala, 2008: 18-19). About the new quality of Darwinism as a "friend of theology" in Romania does not seem to have been taken into account because Darwinism, or evolutionism, has completely disappeared from the biology textbooks, and in the textbooks of religion (Muha, 2012) it is qualified, without being explained, as a source of evil in society, a tool of the communist and atheistic ideology that marked the national history.

It is obvious that these ideological interpretations of Darwinism are associated, most often with the defense of immediate interests: political, military or the defense of an ideological *statu quo*, such as the religious one. On the other hand, the ideologization of Darwinism has led to the emergence of pseudosciences (social Darwinism, soviet creative Darwinism), which have and still have yet to complicate the public's understanding of strictly scientific evolutionary conception. The accusation that Darwinism was the basis of criminal ideologies (racism, colonialism, nazism, etc.) not only is it unfounded, but it also induces a logical error called *reductio ad absurdum*, which has the purpose of exonerate the culprits. In this sense it must be said that a scientific theory can not be held responsible for its use for antisocial or inhuman purposes, based on extra-scientific analogies. Darwinian evolutionism, once validated by science, he belongs not only to Darwin, but to universal science. Contemporary evolutionism is even more Darwinian than Darwin's theory, because it excludes any Lamarckist-type means that Darwin, from caution, continued to take into account.

2. Darwinism ideologisation in Romania

A detailed presentation of how penetrated and was perceived Darwin's theory of evolution in Romania was achieved in particular by Mârza (1957), Pop (1958) and Stugren (1969). In this paper we propose to highlight in the current perspective image of Darwinism in Romania, past and present. To analyze how Darwinism was perceived in Romania, we will demarcate three historical stages since 1859, the official birth year of Darwinism. These stages correspond to three political regimes in Romania: First, the period from 1859-1947, with democratic regime; second, the period from 1948 to 1989, with the left-wing totalitarian regime; the third, the post-totalitarian period, 1990-present, with developing democratic regime.

The period 1859 - 1947 corresponds, generally, to a democratic political regime in Romania. During this time, Darwinism will be victorious in confronting with other theories of evolution (mutationism, neo-lamarckism, orthogenesis, neovitalism, various finalist theories) (Pop, 1958) and will, along with genetics, stand at the basis of the synthetic theory of evolution. In Romania, the evolutionist idea quickly penetrated, a decade after the publication of *The Origin of Species*, as a subject of study for naturalists and philosophers. The first articles favorable to Darwinism were published by C. Grigorovici (1869), Gr. Ştefănescu (1870), A.D. Xenopol (1870), E. Şuţu, (1874), A.P. Alexi (1875), P. Vasici (1878) (Botnariuc, 1961). Darwinism was accepted by most of the Romanian naturalists after 1870, but a distinct approach between evolutionism in general and purely scientific Darwinian evolution was made. In general, Darwinism, as a scientific theory, is accepted except its materialistic character - I. Baraş, 1862; I. Ghica, 1866 (Botnariuc, 1961). On the contrary, there were convinced Darwinists, such as Julius Römer (1876), who appreciated the

materialistic character of Darwin's theory (Heltmann, 1968). The presentation of Darwinism is usually critical but honest. Thus, Xenopol accepts the Darwinian vision of the origin of species and man, admits the influence of the environment on organisms, admits the concept of struggle for existence and overpopulation in nature, but rejects it in society, arguing that man has multiple possibilities to increase his means of existence. The rejection of Darwinism during this period was made either in the name of idealistic, spiritualist orientations (B. Haşdeu, 1873) or fixist and creationists (D. Ananescu, C. Exarcu) or political reasons (G. Bariţiu). G. Bariţiu feared that the theory of the struggle for existence and the survival of the most apt to be used as justification in the policy of denationalization of the Romanians in Transylvania (Botnariuc, 1961). At the end of the nineteenth century the socialist movement in Romania worked in two directions: the struggle for Marxism and fight for Darwinism. The combination of Darwinism with a certain political doctrine was the first form of ideologization with political goal of Darwin's theory of evolution (Mârza, 1957). Between 1881 and 1891, the magazine "Contemporanul", of socialist orientation, publishes numerous articles on Darwinism (Mârza, 1957). In the political life of 1880s, the socialist Constantin Dobrogeanu Gherea detest the "brutally introduction" by Herbert Spencer of "Darwin's law" in human society (Gherea, 1976). It is interesting to note that the first Romanian scientist who accepted Darwinism, Gr. Ştefănescu, admitted this theory with all its materialistic consequences. In the „Archaeopteryx" article, published in 1870 in the „Revista Ştiinţifică", he points out that paleontology offered the intermediate forms predicted by Darwin's theory of evolution, and called for "to tell the truth in all frankness," and without preconceived ideas (Ştefănescu, 1876). Beginning with the twentieth century, although Darwinism was in its eclipse, in Romania this conception is imposed among scientists and begins to be integrated into the university courses of natural sciences and philosophy. Officially, Darwinism is not censored, but is not included in the curricula (Mârza, 1957). Professors naturalists from universities (N. Leon, P. Bujor) or philosophers (P. P. Negulescu) promoted the evolution of the chair (Stugren, 1969). The evolutionist conceptions of the Romanian authors of this period are also loaded with a dose of lamarckism and neo-lamarckism (eg E. Racoviță, 1929), an excusable fact given that the synthesis theory of evolution that would reconcile Mendelian genetics with the theory of natural selection in Darwin's original theory had not yet been elaborated. On the other hand, there were also reasonable suspicions about the involvement of natural selection in all kinds of evolutionary processes. Thus, L. Blaga considered that the theory of natural selection of mutations would explain evolution as a whole only if it would prove that the mutagenic process is carried out in several directions. "... nowhere in nature do we observe this supposed explosive variability, in infinitely many directions and every step of life" (Blaga, 1948). The same type of suspicion will be raised over a quarter of a century by the authors of the punctuated equilibrium theory (Flonta, 2010), which, referring to macroevolution, were not convinced that all the evolutionary changes are based on small and continuous changes of each particular feature of a body, under natural selection, for a long time. A categorical opponent of Darwinism, in this period is physiologist Nicolae Paulescu, who denied Darwin's whole conception, trying to introduce the notions of "soul" and "God" into science. Professors N. Leon and D. Voinov reacted against him, publishing several articles in "Convorbiri Literare". Against idealistic attitudes C. Fedeleş affirmed in 1911 that "scientific research never uses hidden powers" (Fedeleş, 1911).

As a conclusion it is noted that initially Darwinism was accepted by a number of Romanian scholars, although the theory was strongly criticized in the epoch. The fact that

Darwinian interpretations were often mixed with the Lamarckist ones is due to the persistent divergence between geneticists and Darwinists, until the synthesis theory of evolution was developed, and that Darwin himself left some lamarckist theses acceptable. Attitude to Darwinism depends on the authors' free opinion and not on the state policy. Withholding against Darwinism has generally two main reasons: the materialistic and atheistic conclusions of the theory, and the fact that it was not yet achieved the synthesis of genetics and natural selection theory. In these circumstances, some lamarckist explanations seemed even more scientific than Weismann's speculation (suggesting preformism) - which was self-defined as a neo-Darwinist (Delage & Goldsmith, 2016 [1920]). At the First Congress of Naturalists in Romania, held in Cluj in 1928, long before Romania's evolutionism became an object of educational policy, it was stated: "The naturalist, especially the modern biologist, can not be anything other than evolutionary" (Bologa, 1930).

In the period 1948-1989, although some concurrent evolutionary concepts (neutral theory, punctuated equilibrium) appear, the evolutionist explanation remains in the Darwinian paradigm. In Romania, this period corresponds politically to a totalitarian left-wing, socialist regime. The state is declared secular. Now two historical stages can be delimited: one of direct Soviet influence, between 1948-1964, and another of socialism of a national character, from 1965 to 1989. These stages of political regime will also influence the way in which Darwinism is presented and ideologized in Romania. When the left dictatorship begins in Romania, after the end of the Second World War, evolutionism already marks the triumph of classical Darwinism, the theory of natural selection, within the synthetic theory of evolution. In these circumstances, it was easier to adopt the Darwinist evolutionist conception in its purely scientific form, without deformations and ideological manipulations. In reality, Romania's political life will impose an unprecedented ideology of all biology in the early years of the new political regime. At the end of the 1940s and in the 1950s, the Romanian biology supported the Soviet ideological influence. "Does not exist and can not exist a science detached from politics" says a quote from the Soviet Academic Letter to American Professor Müller (Romania Liberă of 15. XII. 1948: Mârza, 1949). Darwinian evolutionism will be used as an argument and instrument of the political ideology of the new regime, which we will call here *socialism of direct soviet influence*. In the scientific papers of „proletarian biology” (Buican, 2009), published in these years in Romania, it will be spoken of a capitalist, bourgeois and idealistic, reactionary biology and a progressive, materialistic science of socialist society (Mârza, 1949; Prezent, 1949; Munteanu, 1951; Stănescu, 1951; Munteanu, 1955; Ghiță, 1959). Since 1948, evolutionary biology is taught in the school under the title "The Basics of Darwinism"; in the early 1960s it will be called *General Biology*, having a wider contents (Mârza & Zaharia, 1966; Stugren, 1966). Between 1949 and 1977, Darwin's main books were translated and published (Mârza, 1977). *The Origin of Species* was published in 1957 (Darwin, 1957). The Darwinian evolutionism will be popularized, but distorted in certain aspects, denied or distorted in others, because it also contained, in the concept of time, elements of bourgeois thought, reactionary and idealistic (Lepeltier, 2009). Although this ideologization is not a romanian creation, it marked the scientific life of Romania and it is appropriate to be discussed. What we want to emphasize here is the potential for ideological manipulation of a scientific theory.

Soviet biology, which various Romanian authors will make popular in the 1950s and early 1960s, will consider Darwinism as a weapon of class struggle. The fact that the Darwinian mechanism of evolution is materialistic is appreciated, but it has been used

excessively to support the political atheism of the regime. At the same time, ideologically, certain aspects of Darwinism are denied, without a critical scientific analysis. Behold, in short, what aspects of Darwinism were uncomfortable for the Soviet biology promoted then in Romania (Mârza, 1949): the evolution of Darwin is too slow, without leaps, that is without "revolution"; the explanation given is that the bourgeoisie had a repulsion to the idea of revolution and this is felt in the work of Darwin. The Russian agronomist I.V. Miciurin, "the founder of the biology of the age of socialism" (Munteanu, 1955), took from Darwin the essence of theory (selection, variation, hereditary transmission of body variations through sexual cells), but did not take "reactionary theses" as: the struggle for existence and overpopulation, derived from Malthus's conception, the idea that evolution is made by small variations. In addition, "man can cause great variation to ensure a qualitative leap in a single generation". Malthus's concept of overpopulation is typically bourgeois, reactionary because it proposes the solution that the poor population, which is the fastest growing population, should be limited by abortion. Miciurin has shown that man can transform nature. As a result, Darwin took on an inhumane economic theory as the "bourgeois theory of competition" (Engels), which is unacceptable. These ideas are a weakness of Darwin's theory. It is shown that neither the "sexual selection theory" has been imposed. The scientific concepts of Lamarck and Darwin "were imposed by battle." *creative soviet Darwinism* was imposed by the struggle, and Trofim Lysenko, the brightest student of Miciurin, raised the battle flag (Mârza, 1949). Soviet creative Darwinism was a mixture of Darwinian and neo-lamackist ideas arranged in accordance with party ideology and class struggle, maintained by serious experimental tricks (Buican, 2004, 2009). This pseudoscience was invented by the soviet agronomist Trofim Lysenko, using as a basis the argumentation of Miciurin's agronomic activity. The part of Darwinism that suggested the exclusive creative role of natural selection was denied (Preda, 1952); also, has been denied the role of chance in evolution, the struggle for existence, especially the intraspecific one. According to Miciurin, the genotype, a variation factor, is not entirely determined at the formation of the zygote, as morganists say, but evolves with the stages of development of the organism. Thus he concludes that by crossing individuals - in which the degree of maturity of the variation has reached a rather advanced stage - and considering their degree of development, we can not only obtain new species but also anticipate the characters of these species (Present, 1949). After Miciurin, the struggle for existence, intraspecific, is replaced by the cooperative relationship (a continuation of P. Kropotkin's mutual aid thesis of 1902). Lysenkoism tended, ultimately, to a new communist man, compatible with the dogmas of communist ideology. If social Darwinism started the selection to improve human heredity and ultimately society, Lysenkoist neo-lamarckism considered that the social environment (reformed by the socialist revolution) could change both heredity and human society. Soviet post-war evolutionism criticized a series of scholars who played a leading role in the triumph of the synthetic theory of evolution and thus of original Darwinism, such as Mendel, Morgan, Weismann on the grounds that they are idealists and promote a bourgeois, reactionary ideology. In Nicolae Botnariuc's extensive work on the history of general biology (Botnariuc, 1961), the Darwinian evolutionary thinking is broadly detailed, but the work devotes a separate chapter to Miciurin’s theory (more exactly lysenkoism). It is obvious that Botnariuc's work had to respond to the country's ideology and political status, namely Soviet-type socialism.

Separation from Soviet biology was made in the early 1960s. We will refer in this regard to the appearance in 1965 of the book *Science of Evolution* by Bogdan Stugren, a fully

depolitized book written in consensus with the valid data available in Western science. This rupture is also marked by political declarations of the new President of Romania, Nicolae Ceaușescu: „A series of discoveries in the natural sciences, in biology and especially in genetics, from cybernetics and other fields have long been treated as pseudosciences, as reactionary ideological manifestations" (Bobeică & Kolassovits, 1966). Bogdan Stugren published in 1969 the book *Evolutionism of the 20th century*, a valuable synthesis on the history of evolutionary thought, with reference to Romania (Stugren, 1969). These works are elaborated in rigorous scientific manner, without reference to T. Lysenko's pseudoscience, they belong to the "national" type socialism, which characterized the political life of Romania. During this period, the evolutionism is studied in high school and Darwin's conception is extensively explained, without being attached extra-scientific, unnecessary comments, with political or religious connotations. The chapter "Evolutionism" in the General Biology manual taught in class XII (Raicu et al., 1986) is placed correctly after chapter "Genetics", offering students the basis understanding of variability and heredity, essential concepts of Darwinian mechanism of evolution. It should be emphasized that, in this period, evolutionary biology is used as an argument "in the formation of atheistic-scientific conceptions." School biology must contribute to the rejection of religious concepts, which now claim to have a "scientific" character, which would logically flow from the interpretation of science data (Mărcuș, 1980).

In period 1990 – present, the synthetic theory of evolution or neo-Darwinism contemporary develops based on studies of genetics, molecular biology and developmental biology. The explanation of evolution remains in the Darwinian logic, such as Ernst Mayr said, the most important evolutionary theorist of the twentieth century (Mayr, 2004). Ideologically, the evolutionism is strongly attacked by various extra-scientific and anti-scientific doctrines - creationist, of religious essence and others pseudoscientific and mystical (such as the intelligent design, the theological Darwinism, the theistic evolutionism, the anthropic principle) (Cojocaru, 2015). The political regime in Romania, since 1989, is democratic. Is no longer stipulated laic character of the state. Today, Darwinism is promoted in Romania by only certain specialists biologists and philosophers (among which Buican, 1994; Flonta, 2010; Derevenco, 2011). No paper with antidarwinist message published by prominent Romanian biologists is known. Although creative messages dominate the media, an anti-evolutionist attitude has not been officially assumed. In bookshops can find many books of evolutionary biology translated from other languages. An official anti-evolutionary attitude is seen only in educational policy and we refer to the content of curricula. After 1989, only a few notable works on the evolution or importance of the Darwinian conception were published in Romania, except for university courses. The book of P. Derevenco, *Darwin and Darwinism* (2011) appeared as a reaction to the formal abandonment of this subject in Romania. Instead, the influence of anti-evolutionary literature has increased and the one dedicated to pseudoscience or religious propaganda, according to the socio-cultural model presented by Sagan (Sagan 1996). Darwin's fundamental work, *The Origin of Species*, published in Romanian in 1957, at the Romanian Academy Publishing House, is not reproduced, although improvements are required in the form of the presentation. The year 2009 was a good opportunity for reprinting this grandiose works, but Romanian Academy did not propose this.

The evolutionism has been removed from the biology curriculum, în 2006, by decision of the Minister. Instead, religious doctrine is presented during the entire period of

basic education and secondary education (12 years). In religion textbooks is contained anti-evolutionist propaganda (the evolutionism is presented as a philosophy of atheists and communists). The academic environment has not officially reacted to this action. In some science textbooks (such as Dumitrache et al., 2006), the scientific explanation regarding the evolution is placed on the same plane with Biblical mythology, the latter being presented as been plausible and as an alternative explanatory science. In Romania today, creationism has entered science textbooks. The internal (Derevenco, 2011 Cojocaru, 2015) and external reactions to this situation were isolated and without visible effect.

Romanian Academy has not signed the 2006 statement of the Global Network of Science Academies ("IAP Statement on the Teaching of Evolution"), which requested that scientific evidence, data, and testable theories about the origins and evolution of life on Earth not be *concealed*, *denied*, or *confused* with theories not testable by science (http://www.interacademies.net). Romania also has not signed Resolution 1580 (in 2007) of the Parliamentary Assembly of the Council of Europe „The dangers of creationism in education" (http://www.contributors.ro). The statistical data show that a quarter of Romanians reject evolution (Blancke et al., 2014); in the school situation is even more worrying, a study showed that 86% of students of classes VII-XII did not accept the concept of evolution (Derevenco, 2011).

Conclusions

Darwinism ideologisation was achieved for political reasons or philosophical, always with negative effects for understanding the scientific content of this theory among the most people. The censorship of Darwinism can be assumed (in totalitarian political systems, sectoral organizations) or can not be assumed (associated with self-censorship in democratic political systems, such as Romania). Darwinism ideologization in Romania, as in other countries, was closely linked to the political factor - the type of regime and political ideology. Darwinism has rapidly penetrated the Romanian intellectual environment, a decade after the publication of *The Origin of Species*, being perceived generally favorable, as a scientific theory. Over the next seven decades after the publication of *The Origin of Species*, Darwin's concept is known especially in the sphere of cultural elites, who accepts, in whole or with reserves, or reject it. Officially, Darwinism is not censored, but is not included in the curricula. There is no state policy pro-Darwinian or anti-Darwinian. Until the appearance of the synthetic theory of evolution, which coincides with the installation of communist power in Romania, in the mid twentieth century, Darwinism was critically judged on strict scientific positions and did not amount object of state policy or party politics, concerning science or education. The communist regime in Romania did not distort Darwinism (as in the USSR, for example), Darwin's evolutionary concept being presented in the education system just as a biological science. During this period is first translated and presented extensively to the Romanian public Darwin's scientific work.

With the post-communist democratic regime in Romania, installed after 1989, evolutionary biology is gradually removed completely from public school (2006). The censorship of Darwinism in the public schools is now confused with the censorship of the entire evolutionary conception about nature. From this point of view there is a return to a century ago, except that in the past, the theory of evolution on Darwinian base had no scientific support that it has today. Evolutionary biology is now treated not as a true science, *but as an ideology that can be rejected under the pretext of the freedom of conscience* -

freedom respected by any genuine democracy. At the same time, the religion (more exactly theological dogma) is introduced at all levels of the school education (elementary, secondary, high school). The elimination of evolutionary biology has not received any scientific or pedagogical justification, being simply a way of educational policy. It seems plausible that in a public school that guarantees the seriousness of the religious point, Darwinism, with its extra-scientific interpretations, must be regarded as an inconvenient doctrine. In addition, in the program of religion is approved the discrediting of evolutionary biology (as in Muha, 2012).

The ideologisation of Darwinism and of evolutionary biology in Romania today is an expression of the policy practiced also in other countries, to unite with force the science and the miracle (under the slogan "the dialogue and harmony between religion and science"), if this brings social or political benefits. Epistemologically the science paradigm is going to be compromised in the sense that whether there can be an "theistic evolutionism", then we can talk about any science as "theistic", therefore the science is placed in a relationship of subordination to theology (in the sense supported by Thomas Aquinas in the thirteenth century). Currently, by corrupting the scientific paradigm by anti-evolutionists, the main ideological opponent of Darwinism is no longer the religion or creationism, but the „theological Darwinism”, also called "theistic evolutionism". And this fact is the supreme ideological manipulation of evolutionary biology, of science in general.

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AQUAPONICS AWARENESS: A MODERN APPROACH FOR LIMITING THE AQUACULTURE ENVIRONMENTAL IMPACT AND IMPROVING THE PRODUCTIVITY

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Abstract. Aquaponics integrates two farming methods: aquaculture, which involves the cultivation of aquatic animals, and hydroponics, which involves the production of vegetable crops based on nutritive solutions. In this system both cultured biomasses benefit from the principles of water recycling and nutrients utilization, since the last are excreted by aquatic animals and used by plants grown in hydroponic systems. The plants grown from the aquaculture waste constitute an outstanding advantage of the aquaponics, since reduce the contamination and increase the efficiency of water use, and also limit the environmental impact. Aquaponics can reduce production costs by making more efficient the use of resources, can be established at different production scales, increases economic profitability and diversifies the origin of financial income. The current paper aims to make a general overview on the aquaponics efficiency, by following four main key aspects: technological, waste management, water management and land management aspects.

Keywords: aquaponics, food production, sustainability, smart food.

Rezumat: Conştientizare asupra acvaponiei: o abordare modernă pentru limitarea impactului acvaculturii asupra mediului şi îmbunătăţirea productivităţii. Acvaponia integrează două metode de cultivare: acvacultura, care implică creşterea de animale acvatice şi hidroponia, care implică producerea de culturi vegetale pe bază de soluţii nutritive. În acest sistem, ambele biomase cultivate beneficiază de principiile reciclării apei şi utilizării nutrienţilor, deoarece aceştia din urmă sunt excretaţi de animalele acvatice şi folosiţi de plantele cultivate în sistemele hidroponice. Utilizarea suplimentară a deşeurilor din acvacultură de către plante constituie un avantaj deosebit al acvaponiei, deoarece reduce contaminarea şi creşte eficienţa utilizării apei, limitând astfel impactul asupra mediului. Acvaponia poate reduce costurile de producţie prin utilizarea mai eficientă a resurselor, poate fi stabilită la diferite scări de producţie, creşte rentabilitatea economică şi diversifică originea veniturilor financiare. Scopul lucrării este de a face o prezentare generală a eficienţei acvaponiei, urmărind patru aspecte-cheie: aspectele tehnologice, managementul deşeurilor, managementul apei şi managementul terenurilor.

Cuvinte cheie: acvaponie, producţie hrană, sustenabilitate, hrană smart.

Introduction

A major global trend nowadays is urbanization and its degree reached 70% in various European countries (dos Santos, 2016). The main challenges brought by this trend include population rise, food insecurity, climate change, water and fossil fuel scarcity and soil degradation (dos Santos 2016; Suhl *et al.*, 2016). The current annual population increase is more than 80 million and there is an expected increase from the current 7.5 billion people

to approximately 9.5 billion people by 2050, therefore the world population will require 50% more food by 2050 (Pinstrup-Andersen, 2017). According to FAO (2014) aquaculture is one of the fastest-growing food production sectors, which provides approximately 50% of fish and fish products for human consumption. Also, as part of the European Union's Blue Growth Strategy to create sustainable growth and employment in the marine economy, aquaculture has been identified as a sector with high growth potential (Grealis *et al.*, 2017). Nowadays, aquaculture is considered more important than fisheries due to the depletion of wild fish populations and the importance of maintaining the supply of protein for human diets (Nadarajah & Flateen, 2017; Ismail *et al.*, 2017). However, traditional aquaculture production in natural ponds causes significant negative environmental impacts through the use of high amounts of freshwater and the hazard brought by the high nutrient load in the waste water (Suhl *et al.*, 2016). Shrimp farms destroy coastal mangrove habitats, salmon farms can release genetic anomalies into local fish populations, farms of high-value fish species use wild-caught forage fish stocks for feed inputs and farms of fed species can pollute local waters (Froehlich *et al.*, 2017). Excessive and unrestricted use of antibiotics, pesticides and fertilizers is a general problem in the aquaculture sector, particularly in developing countries (Ottinger *et al.*, 2016). Potential increased pressure on water resources (shortages in freshwater availability) and water quality (eutrophication) could lead to the decline of aquaculture production and affect food security (Ottinger *et al.*, 2016). Nevertheless, advances in the technology, practices, and siting of aquaculture have allowed significant mitigation of these environmental risks and harms (Froehlich *et al.*, 2017). Aquaculture integrated systems, such as aquaponics, can address and relieve environmental pressure caused by traditional food production techniques. Aquaponics is the merger of two profitable and well-established food production technologies – aquaculture and hydroponics (Ginkel *et al.*, 2017). Aquaponics is the fusion of recirculating aquaculture and soilless vegetable production, within a complex closed-loop system (Cerozi & Fitzsimmons, 2017). It integrates and synergistically combines aquaculture and hydroponic techniques in one merged system (Wongkiew *et al.*, 2017). According to dos Santos (2016) aquaponics could represent a new integrated agricultural system from producers to consumers, in an integrated manner, due to the short supply chains and organic fresh food. Also, due to its double purpose, aquaponics might be a sustainable solution to the low provision of fish and vegetables in some countries (Bosma *et al.*, 2017). This technological method has the potential to produce protein with less labor, less land, fewer chemicals and a fraction of the water usage (FAO, 2016). Aquaponics offers a complete food diet that covers both vegetable and meat products (Addy *et al.*, 2017). The aim of this paper is to make a general overview about aquaponic systems, by following four main key aspects that characterize the efficiency of this concept, as follows: technical and technological aspects, waste management, water management and land management aspects. As a result, this study must identify the utility of integrating aquaponics and also, proposals must be made in order to assure a future development of this concept.

Management of technical and technological aspects

FAO guidelines confirmed that the most common aquaponic production techniques are: the deep-water culture (DWC), the nutrient film technique (NFT) and the media bed method (FAO, 2016). The media bed technique is the most popular design for small-scale aquaponics due to its relatively low initial cost and its beginning friendliness. For the construction of the media bed, different substrates are used such as gravel, sand, mineral

wool, clay balls (hydroton), coconut shells (Lacheta, 2010; Wahome *et al.*, 2011). From the hydraulic criteria point of view, the media bed technique is divided into two subcategories: permanent submersion regime (PSR) and intermittent submersion regime (ISR). Petrea (2014) pointed out that indicators such as the hydraulic loading rate (HLR) and hydraulic retention time (HRT) are frequently used to control the physical filtration process more efficient in the aquaponic units, in case of the media bed technique. The NFT technique consists of using horizontal pipes for the vegetable biomass, each with a continuous shallow stream of nutrient-rich aquaponic water (Timmons *et al.*, 2002). Plants are placed within holes in the top of the pipes, and are able to use the thin film of nutrient-rich water (FAO, 2016). The DWC method involves suspending plants in polystyrene sheets, with their roots hanging down into the water. Both the NFT and DWC are popular methods for commercial operations as both are financially more viable than media bed units when scaled up (FAO, 2016). Many fish and vegetable species are potentially suitable for the aquaponic system (Forchino *et al.*, 2017). The most common fish species reared are *Oreochromis niloticus* (Nile tilapia), *Onchorynchus mykiss* (rainbow trout), *Cyprinus carpio* (common carp) and *Clarias gariepinus* (African catfish). However, more valuable species are reported suitable for the aquaponic system, such as *Acipenseridae* species (sturgeons) (Petrea *et al.*, 2016; Forchino *et al.*, 2017). Other aquatic organisms such as shrimps, prawns and crayfish can be reared in the system (Love *et al.*, 2015). In terms of plant selection, leafy vegetables such as *Lactuca sativa* (lettuce), *Ocimum basilicum* (basil), *Spinacia oleracea* (spinach), *Ipomoea aquatic* (water spinach), *Mentha piperita* (mint), *Artemisa dracunculus* (tarragon), *Brassica oleracea* (kale), *Brassica rapa* var. *chinensis* (pok choy), *Brassica rapa* var. *parachinensis* (choy sum) have been reported suitable but also fruity plants such as *Cucumis sativus* (cucumber), *Capsicum annuum* (bell pepper), *Solanum lycopersicum* (tomato), *Solanum melongena* (eggplant) and root crops such as *Daucus carota* (carrot) (Trang *et al.*, 2010; Endut *et al.*, 2009; Love *et al.*, 2015; Petrea *et al.*, 2016; Shete *et al.*, 2016; Forchino *et al.*, 2017; Bosma *et al.*, 2017). Regarding the growth performance of the vegetable biomass under aquaponic conditions, data from a series of scientific articles are centralized in Table 1., aiming to create an overall picture of the influence of different technical and technological conditions upon the productivity of aquaponic systems.

Table 1 Vegetable biomass growth performance under different aquaponic techniques and conditions.

References	Researched plant-fish species	Details related to experimental conditions	Plants growth performance
Licamele, (2009)	**Lettuce** (*Lactuca sativa)* –**Nile tilapia** (*Oreochromis niloticus*).	**Different stocking densities of fish biomass:** A: 2 kg m^{-3}; B: 5 kg m^{-3}; C: 8 kg m^{-3}.	**Lettuce growth rate:** A – 4.32 kg; B – 4.65 kg; C – 3.09 kg.
Endut *et al.*, (2009)	**Water spinach** (*Ipomoea aquatica*) - **African catfish** (*Clarias gariepinus).*	**Testing of different hydraulic regimes:** HRT_1=0.64 m day^{-1}; HRT_2=1.28 m day^{-1}; HRT_3=1.92 m day^{-1}; HRT_4=2.56 m day^{-1}.	**Daily plants growth rate (height):** 1.70 cm day^{-1} (HRT_1); 2.11 cm day^{-1} (HRT_2); 1.75 cm day^{-1} (HRT_3); 1.59 cm day^{-1} (HRT_4).
Endut *et al.*, (2010)	**Water spinach** (*Ipomoea aquatica*) –**African catfish** (*Clarias gariepinus).*	**Application of different hydraulic regimes:** HRT_1=0.64 m day^{-1}; HRT_2=1.28 m day^{-1};	**Daily plants growth rate (height):** 1.75 cm day^{-1} (HRT_1); 2.50 cm day^{-1} (HRT_2);

References	Researched plant-fish species	Details related to experimental conditions	Plants growth performance
		HRT_3=1.92 m day^{-1}; HRT_4=2.56 m day^{-1}; HRT_5=3.20 m day^{-1}.	2.06 cm day^{-1} (HRT_3); 1.90 cm day^{-1} (HRT_4); 1.90 cm day^{-1} (HRT_5).
Trang *et al.*, (2010)	**Lettuce** (*Lactuca sativa)*; **Water spinach** (*Ipomoea aquatica*); **Pok choy** (*Brassica rapa* var. *chinensis*); **Choy sum** (*Brassica rapa* var. *parachinensis).*	Application of different biomass culture technologies: • Fully immersed plant root (FI); • Half immersed plant root (HI);	Leaves surface: **Lettuce**: FI: 251 cm^2; HI: 830 cm^2; **Water spinach**: FI: 251 cm^2; HI: 830 cm^2; **Pok choy**: FI: 251 cm^2; HI: 830 cm^2; **Choy sum:** FI: 251 cm^2; HI: 830 cm^2.
Lennard & Leonard, (2004)	**Lettuce** (*Lactuca sativa)* –**Murray Cod** (*Maccullochella peelii peelii*).	Application of different submersion regimes: • permanent submersion regime (PSR); • intermittent submersion regime (ISR).	**Lettuce growth rate:** PSR: 129 g $plant^{-1}$ – 4.97 kg m^{-2}; ISR: 113.45 g $plant^{-1}$ – 4.34 kg m^{-2}.
AL–Hafedh *et al.*, (2008)	**Lettuce** (*Lactuca sativa)* –**Nile tilapia** (*Oreochromis niloticus*).	Application of different reports between feed input: culture surface of vegetable biomass: A: 169; B: 113; C: 56.	**Lettuce final individual biomass:** A: 289 g $plant^{-1}$; B: 212 g $plant^{-1}$; C: 157 g $plant^{-1}$.
Sikawa & Yakupitiya ge, (2010)	**Lettuce** (*Lactuca sativa)* –**Catfish hibrid** (*Clarias macrocephalus* x *Clarias gariepinus*).	Application of aquaponic technique on sand/gravel substrate to perform a comparative analysis of treated unfiltered technological water (UTW) and filtered water (FW).	Lettuce growth rate for UTW: **Substrate gravel:** 14 g $plant^{-1}$; 165.87 g m^{-2}; **Substrate sand:** 23.13 g $plant^{-1}$; 277.53 g m^{-2}; Lettuce growth rate for FW: **Substrate gravel:** 22.59 g $plant^{-1}$; 271.13 g m^{-2}: **Substrate sand:** 35.28 g $plant^{-1}$; 423.4 g m^{-2}.
Dediu *et al.*, (2012)	**Lettuce** (*Lactuca sativa)* **- Sturgeon hybrid** *(Huso huso* x *Acipenser ruthenus).*	Application of different hydraulic regimes: A: HRT_1 = 5.4 min; Water $flow_1$ = 8 L min^{-1}; B: HRT_2 = 2.7 min; Water $flow_2$ = 12 L min^{-1}.	**Lettuce growth rate:** A: 75 g $plant^{-1}$; 3.77 kg m^{-2}; B: 66.02 g $plant^{-1}$; 3.37 kg m^{-2}.
Rafiee & Saad, (2006)	**Lettuce** (*Lactuca sativa* var. *longifolia)* **-Nile tilapia** (*Oreochromis niloticus*).	Evaluation of the influence of zeolite utilization as growth substrate under aquaponic conditions.	**Lettuce growth rate:** With zeolite: 6.54 g $plant^{-1}$; Without zeolite: 35.88 g $unite^{-1}$.
Graber & Junge, (2009)	A. **Tomatoes** (*Solanum lycopersicum*) and **cucumbers** (*Cucumis sativus*) – **Perch** (*Perca fluviatilis*) B. **Eggplant** (*Solanum melongena*) –**Nile tilapia** (*Oreochromis niloticus*).	Application of different combinations of fish-plant species.	**Plants growth rate:** A. tomatoes: 355 g m^{-2} day^{-1}; cucumbers: 80 g m^{-2} day^{-1}; B. eggplants: 90 g m^{-2} day^{-1}.

Waste management

The human production of nitrogen and phosphorous compounds dramatically increased, especially during the second half of the twentieth century through the use of fertilizers or as a by-product of the combustion of fossil fuels (Simionov *et al.*, 2017). Aquaculture effluents are rich in nitrogen and phosphorus, thus being a worldwide concern for potential environmental pollution (Cerozi & Fitzsimmons, 2017). Aquaculture effluents are known to be rich in dissolved and suspended solids that contain mainly phosphorus and nitrogen generated from fish excretion, feces and uneaten feed (Cerozi & Fitzsimmons, 2017). Effective water filtration to remove waste material is critical to development of land-based aquaculture systems (Little & Bunting, 2016). Elevated concentrations of these substances, which also constitute plant nutrients, led to the development of aquaponics systems (Little & Bunting, 2016). Aquaponic systems function by symbiotic relationships as follows: the waste produced by fish in the water tanks (which are toxic to fish development and growth if not removed from the technological water) is directly used or converted by bacteria into nutrients useful for plants (Bosma *et al.*, 2017). In the aquaponic systems the ammonia nitrogen-rich aquaculture effluent is converted to nitrate (NO_3^-) via nitrification and the NO_3^- is recycled as a fertilizer for plant growth in the hydroponic grow bed (Wongkiew *et al.*, 2017). All four forms of nitrogen (NH_3, NH_4^+, NO_2^{-}, NO_3^-) can be used by plants and stimulate growth, however the form faster absorbed by plants is nitrate. In the fish waste, ammonia nitrogen is the main form of nitrogen pollutant (90%) in the exit water (Addy *et al.*, 2017). Thus, the exit water from the fish tanks should be firstly directed into the biological filters, so that the *“Nitrosomonas”* bacteria genus can oxidize the ammonia into nitrite (NO_2^-) and then nitrite-oxidizing bacteria, represented by the *“Nitrobacter”* genus, converts nitrite further to nitrates (NO_3^-) (Fig. 1). Further on, the water is directed to the plant growing units where plants assimilate these nutrients, the water becomes clean and is recycled back to the fish tank (Bosma *et al.*, 2017). The nutrient balance focuses on nitrogen because this is the most needed nutrient for both plants and fish (Bosma *et al.*, 2017). If the biological filters are somehow inefficient in converting ammonia nitrogen into the less toxic nitrate, as an alternative aquaponics vegetable crop is algae, which can utilize both nitrate and ammonia nitrogen (Addy *et al.*, 2017). As well, another study pointed out that aquaponics can maximize phosphorus utilization to 71.7% of total phosphorus input, hence there is potential for aquaponics systems to become an alternative way of recycling P and enhancing overall P utilization (Cerozi & Fitzsimmons, 2017). In aquaponic systems, emissions are mainly constituted by nitrogen and phosphorous released in the environment due to suspended solids and dead plants removal and disposal (Forchino *et al.*, 2017). However, these wastes can be easily recycled within the farm because dead vegetables can be used for the production of humus through their mineralization by earthworms. Therefore, aquaponics, the integration of aquaculture and agriculture, can have the ability to enhance nutrient efficiency and environmental sustainability (Cerozi & Fitzsimmons, 2017).

Water management

Water is the basic natural resource for the development of human society and for the survival of ecosystems (Zeng *et al.*, 2013). Freshwater is a fundamental resource for human well-being and the natural environment (Liu *et al.*, 2016). Due to rapid socio-economic development conflicts between water demand and supply have become more intense (Zeng *et al.*, 2013).

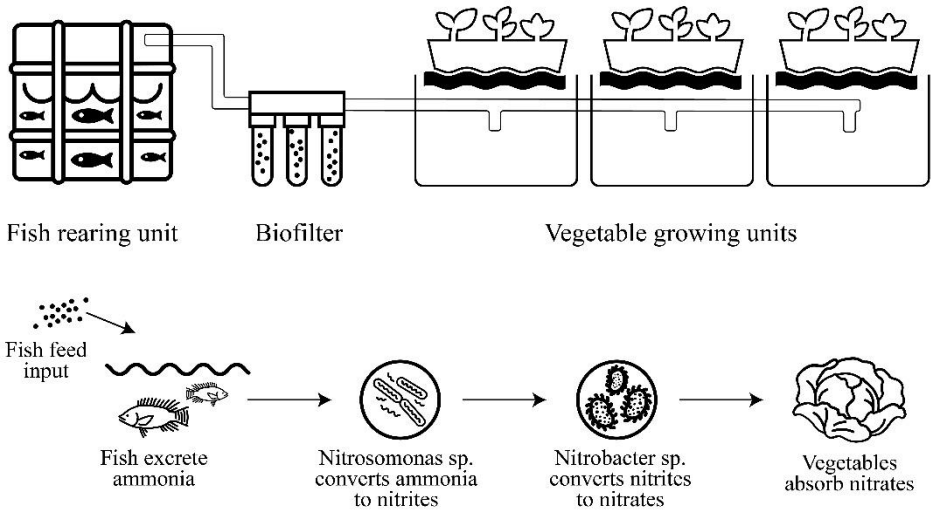

Figure 1. General principle of aquaponics function.

Many of the new cities to be built by 2050 will be in areas with little or no freshwater supply (Kiss *et al.*, 2015). Freshwater is the main source for the cultivation of aquatic organisms (FAO, 2015). Only 3% of the Earth's water is freshwater and 0.3% of that is found in surface waters such as lakes, rivers or swamps (Ottinger *et al.*, 2016). Water scarcity is a widespread problem in many parts of the world (Liu *et al.*, 2016). A critical challenge for the 21st century is the increasing scarcity and the quality of water, with less water available for agriculture, including aquaculture (Edwards, 2015). The aquaculture sector affects water quality and water quantity thus having negative impact on aquatic biodiversity and the planet's natural resources (Ottinger *et al.*, 2016). High amounts of water are used in aquaculture systems in order to replenish oxygen, balance water loss from evaporation and to remove wastes (Ottinger *et al.*, 2016). Worldwide, the total surface of aquaculture ponds accounts for more than 110.000 km^2, with most ponds (87,500 km^2) used for freshwater production (Ottinger *et al.*, 2016). Fish in an integrated recirculating aquaponic system can be reared in 8 times higher densities than the recommended fish stocking density (Diem *et al.*, 2017). Irrigated agriculture is globally the largest user of water and 40% of global agricultural production is from irrigated croplands (Winter *et al.*, 2017). Aquaponics has many advantages such as water use efficiency and environmental sustainability (Cerozi & Fitzsimmons, 2017). Growing the same quantity of vegetables in an aquaponic system will require only 5% of water use compared with the open field agriculture (Pinstrup-Andersen, 2017). Also, irrigated agricultural areas are typically located in arid and semi-arid regions, with abundant sunlight but low precipitations (Winter *et al.*, 2017). These areas are the most susceptible to water stress and aquaponics can resolve issues such as water scarcity by minimizing water exchange and sustain an adequate water quality (Winter *et al.*, 2017; Wongkiew *et al.*, 2017; Shete *et al.*, 2016; Cerozi & Fitzsimmons, 2017). Another study reported that aquaponics consumes only 1/7 of conventional agriculture water usage (Addy *et al.*, 2017). Cutting water use by 95% is extremely important at a time with increased water scarcity (Pinstrup-Andersen, 2017). After assessing the environmental impact of a micro-

scale aquaponic system by using the life cycle assessment method, Maucieri *et al.* (2017) concluded that the water consumption scored the lowest values which represented less than 1% of the total contributions from all the impact researched categories.

Land management

For the first time in history, in 2008 the human society became primarily urban (Kiss *et al.*, 2015). For the foreseeable future the world's population will continue to move to cities so that by 2050 almost 70% of the human population will be city dwellers (Kiss *et al.*, 2015). The expansion of aquaculture activities leads to increased demand for natural resources such as land (Ottinger *et al.*, 2016). Aquaculture is in increasing competition with primarily existing agricultural areas and in many coastal regions land is already a scarce resource (Ottinger *et al.*, 2016). As the urbanization rate is rapidly increasing, aquaponic systems could offer solutions to produce marketable vegetable crops and fish meat close to urban centers (Forchino *et al.*, 2017). Aquaponics can be set up almost everywhere and has the potential to urbanize food production (dos Santos, 2016). This food production technique could be implemented in old industrial neglected buildings, with the advantage of re-establishing a sustainable activity without increasing urbanization pressure on land (dos Santos, 2016). Since there is no soil involved in the system, the problems associated with soil contamination and soil degradation are eliminated (Addy *et al.*, 2017). In their study Ginkel *et al.* (2017) found that aquaponically grown vegetables have areal productivities 10 times higher than the field grown vegetables. The production of vegetables in open fields is associated with large risks and uncertainties from different biotic and abiotic stresses (Pinstrup-Andersen, 2017). Pest attacks, droughts, floods and strong winds are some of the possible threats that may occur in the traditional agriculture system. Also, traditional agriculture and aquaculture are both seasoned conditioned, while aquaponic production is continuous through the year, due to the indoors practices. The agriculture food system footprint is more than 67 times larger than the area of the city it serves. Therefore, shifting crop and animal food production to aquaponic greenhouses, combined with other efficiency improvements, reduces the food system footprint to approximately 3.5 times the city area (Kiss *et al.*, 2015). There is growing interest in locally produced food that is commercialized to consumers directly, and aquaponics is a growing form of aqua-agriculture that can ensure a local and regional food system model practiced in or near large population centers (Love *et al.*, 2015).

Conclusion

Aquaponic systems are widely researched in the scientific communities, endorsed by many commercial producers and supported through specific guidelines by FAO. However, the lack of a certain legislation regarding the integration of those systems in the already existing fish farms is required. Also, the integration of aquaponics concept must be sustained by a know-how sharing platform. Future research must be made regarding the implementation of aquaponics vertical systems in order to determine their productivity and cost-effectiveness. The specialists from both fisheries and aquaculture, and agriculture domains must work together in order to share their knowledge, sustain and develop this eco-friendly production systems. In the aquaponics systems, both production and water treatment efficiency were widely demonstrated. Aquaponics are able to assure the water treatment process by both bio- and phytoremediation. The aquaponics concept has a high degree of

technical aspects that gives its engineering absolute character. It is recommended that future socio-economic studies to be made in order to rise the popularity of this concept world-wide.

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A STUDY REGARDING THE POLLUTION OF SEDIMENTS FROM ROMANIAN BLACK SEA COAST WITH MICROPLASTIC FIBERS

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Abstract. The aim of the study was to quantify the microplastic fibers from the sand of the Romanian Black Sea coast, a harmful pollutant for the marine ecosystems spread all over the world. Market demand for plastic products globally increases every year, increasing the marine environment pollution with plastic fibers. Numerous studies on marine pollutants have been conducted over the years, the microplastic fibers having a recent interest, this one being among the first studies conducted in our country. Pollution with microplastics may harm human health due to their structure and chemical composition, reaching into the body through the consumption of marine animals that come in contact with the microplastic fibers which have a high degree of remanence, both in the environment and into the body.

Keywords: microplastic fibers, marine pollution, Black Sea

Rezumat. Studiu privind poluarea sedimentelor de la litoralul românesc al Mării Negre cu fibre de microplastic. Scopul acestui studiu îl reprezintă cuantificarea fibrelor de microplastic din nisipul de pe litoralul românesc al Mării Negre, un poluant dăunător ecosistemelor marine, răspândit peste tot în lume. Cererea pe piață a produselor din plastic crește de la an la an la nivel global, atrăgând după sine intensificarea poluării mediului marin cu fibre de plastic. De-a lungul anilor s-au efectuat numeroase studii privind poluanții marini, fibrele de microplastic prezentând un recent interes, acesta fiind printre primele studii efectuate în țara noastră. Poluarea cu microplastice poate dăuna sănătății umane datorită structurii și compoziției lor chimice, ajungând în corp prin consumul de animale marine care vin în contact cu fibrele de microplastic ce au un grad ridicat de remanență, atât în mediu cât și la nivelul organismului.

Cuvinte cheie: fibre de microplastic, poluare marină, Marea Neagră

Introduction

Plastics have high molecular weight; they are non-biodegradable materials and therefore highly persistent in the environment. Thus, the aquatic environment pollution with microplastics is considered a subject of scientific interest because of the negative effects measured in the last decade (Shim and Thompson, 2015). Since the middle of the 20th century the increasing of global plastics production is accompanied by an accumulation of plastic litter in the marine environment. The persistent plastics, whether deliberately dumped or accidentally lost, are dispersed by the marine currents and wind, rarely being degraded and becoming fragmented over the time. Besides the primary plastic litter resulted from consumption products, these degraded secondary micro-fragments lead to an increasing amount of small plastic particles, so called “microplastics” (Roch and Brinker, 2017). Due to their long resilience in the marine environment, microplastics can be transported over long distances and marine organisms can be primarily affected either by immobilization or by digestive system damage (Gregory, 2009; Thompson, Moore *et al*., 2009; Van Franeker *et*

al., 2011). The uptake of microplastics by various marine organisms is reported by the researchers worldwide. Ingestion of microplastics may lead to potentially fatal injuries such as blockages of the digestive system or abrasions. The ecological implications could be more severe as microplastics can release in water toxic additives that degrade and accumulating as persistent organic pollutants. Microplastic fibers are very small sized and can easily be ingested by the marine animals and thus, reach in human consumption (Renske e al. 2017). In high amounts certain chemicals from plastic composition can affect the endocrine system, which could lead to adverse effects upon the reproductive and developmental system, causing testicular or prostate cancer, menstrual cycle disorder or cervical cancer, followed by long-term infertility in both genders. Diseases such as asthma, cardiovascular diseases, liver enzyme abnormalities, allergy or diabetes - because of the influence on insulin secretion by bisphenol A (BPA) present in the plastics - are not excluded (Anisha et al. 2016; Ayelet Ziv-Gal and Jodi Flaws 2016; Jackye Peretz *et al*. 2012; Rinku Verma *et al.* 2016).

Material and Methods

Four sampling sites were selected: 3 sites with high touristic potential (Mamaia, Eforie Nord and Costinești) and 1 less frequented by tourists, not being included in the touristic circuit (Agigea), (Figure 1). A sampling sites distribution map was produced in ArcGIS Online.

Figure 1. The map of sampling sites distribution.

The sampling was run using non-plastic sampling tools (tablespoon, trowel or small shovel) and glass container to store the samples. 5 replicates of 500 g of sand each were collected at every sampling site from the littoral area**.**

In the laboratory a mass of 100 g of sand was weighted with an electronic balance and introduced in a 400 ml Berzelius beaker. A volume of 150 ml of saturated NaCl solution was added. This increased the water density and allowed the plastics to float. The supernatant was transferred to an Erlenmeyer flask and 10 ml of HCl Fumans was added. The plastic fibers are resistant to acid activity and they are not dissolved. After this process all the liquid

was pipetted to a Petri dish and analyzed using a Zeiss optic stereomicroscope at 40x magnification, in blue and yellow light source.

Results and Discussion

The analyzes of the samples collected from 4 different sites from littoral area of the Romanian Black Sea coast attested the presence of a high amounts of microplastic fibers in the sediments. The largest amount of microplastic fibers was recorded at Costinești sampling site (6.4 microfibers·100 g sediment^{-1}), followed by Eforie Nord with 5 microfibers·100 g sediment^{-1}, Mamaia with 4.6 microfibers·100 g sediment^{-1} and Agigea with 3.6 microfibers·100 g sediment^{-1}) (Figure 2). Microplastic fibers observed have different lengths and colors (green, red, black, blue), in many cases being possible to identify their origin (Figure 3). The One way ANOVA test showed no difference between sampling sites regarding the microplastic fibers.

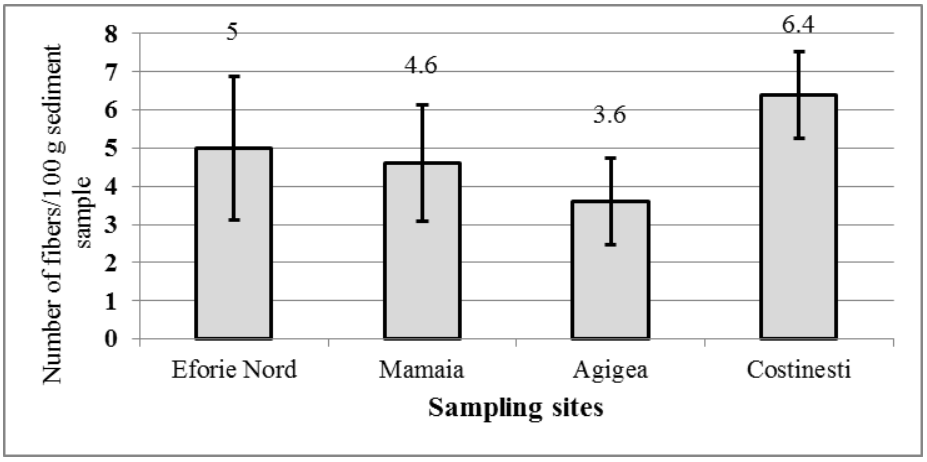

Figure 2. Number of the fibers observed and counted in the sediment samples (average±SD).

In the last decades, numerous studies proved the presence of microplastics in the marine environment (Shim and Thompson, 2015; Magnusson and Norén 2014; Ojaveer *et al*., 2013; Claessens *et al*., 2011). The massive accumulation in the ocean of microplastics has been attested by the worldwide scientists that demonstrated through their studies the ubiquitous character of these materials (Browne *et al*. 2010; Claessens *et al.* 2011; Hidalgo-Ruz and Thiel 2013; Ng and Obbard 2006; Van Cauwenberghe *et al.* 2013; Vianello *et al.* 2013).

EU Technical Subgroup on Marine Litter tried to propose a standardized monitoring strategy for microplastics (Hanke *et al*. 2013). Microplastics uptake has been reported for various marine organisms (*Centropages typicus,* herring, gray gurnard, whiting, horse mackerel, haddock, Atlantic mackerel, cod, *Nephrops norvegicus, Talitrus saltator*) (Cole *et al*. 2013; Foekema *et al.* 2013; Murray and Cowie 2011; Ugolini *et al*. 2013). Ingestion of microplastics may lead to „potentially fatal injuries such as blockages throughout the digestive system or abrasions from sharp objects” (Wright *et al*. 2013) which, comparatively to macroplastics, mainly affect microorganisms, smaller invertebrates or larvae.

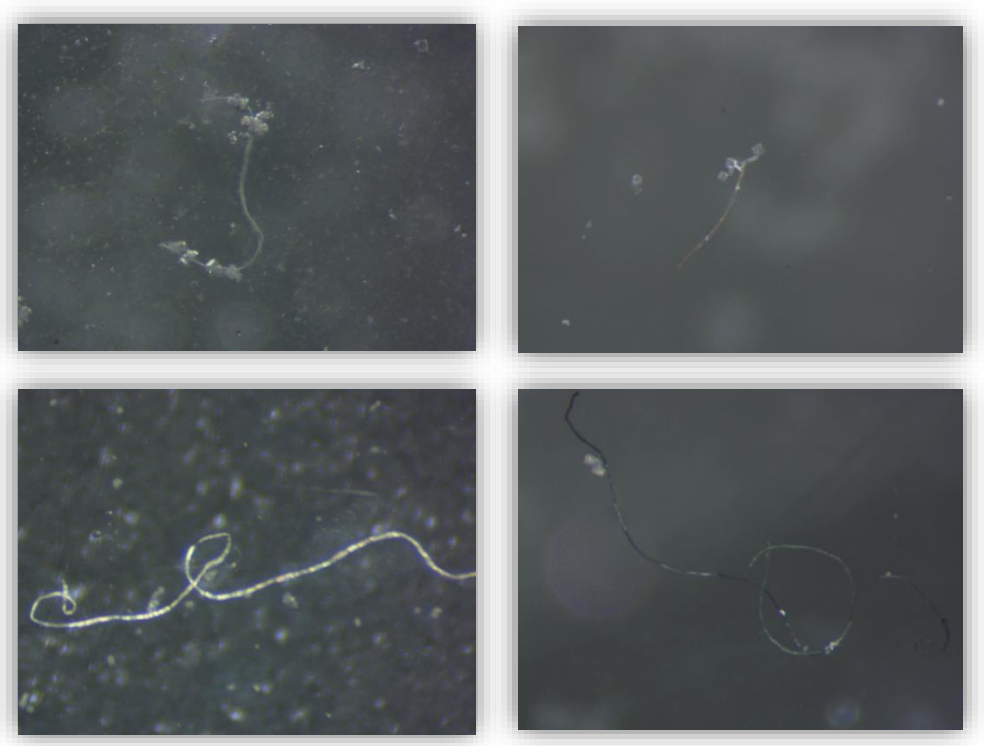

Figure 3. Microplastic fibers observed with stereomicroscope at 40x magnification.

The studies regarding the microplastics in the coastal waters of the Baltic Sea showed an average concentration of 4 fibres·100 ml^{-1} (Magnusson and Norén 2014), data reported later by Ojaveer *et al*., 2013.

In the littoral area sediments, along the German Baltic Sea coast, were found microplastic concentrations of 0–7 particles·kg dry $sediments^{-1}$ and 2–11 fibers·100 g dry $sediments^{-1}$ (Andrea Stolte *et al*. 2015), much less compared to present study: 2-8 fibers·100 g $sediment^{-1}$.

In 1997 Goldberg affirmed that the microplastics will fall into the seabed via a process so called "marine snow" and will be ingested by bottom-dwelling marine organisms that accumulate microplastics in their bodies. Currently, the reliability and comparability of the data on marine microplastics concentration is hampered by the huge variety of methodologies applied which lead to generation of data of extremely different quality (Hidalgo-Ruz *et al*. 2012).

Conclusion

This study represents one of the first studies in Romania regarding the quantitative analysis of microplastics from the Romanian Black Sea coast, investigating 4 different sites along the littoral area. Microplastic fibers represent a serious pollutant because of the

negative effects upon aquatic organisms and not only, being harmful for the human body in case of ingestion, via marine products. Plastics are useful due to their light weight, durability and safety; however, there is a drastic need to reduce the amount of waste entering the marine environment. More studies are necessary in the field of representative sampling design, in order to establish the damage impact upon the marine environment.

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AN OVERVIEW FOCUSED ON TOXICOLOGICAL EFFECTS OF THE NEONICOTINOID INSECTICIDE IMIDACLOPRID

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Abstract. The aim of this overview was to evaluate the toxicological effects of the neonicotinoid insecticide imidacloprid upon vertebrates, based on the data available from scientific publications. Eurostat database was used to extract the quantities of insecticides sold starting with the year 2009 until 2015 - the last reported year, with the last update on 11/28/2017. Imidacloprid is a new systemic compound with an innovative way of action. Today it is considered to be the best substitute for insecticides that are very toxic for vertebrates and human population.

Keywords: toxicity, imidacloprid, insecticides demand

Rezumat. Un comentariu critic asupra efectelor toxicologice ale insecticidului neonicotinoid imidacloprid. Scopul acestui comentariu a fost evaluarea efectelor toxicologice ale insecticidului neonicotinoid imidacloprid asupra vertebratelor pe baza datelor disponibile în literatura de specialitate. S-a utilizat baza de date Eurostat pentru a extrage cantitatea de insecticide vândute începând cu anul 2009 până în 2015 - ultimul an raportat, cu ultima actualizare la data de 28/11/2017. Imidaclopridul este un nou compus sistemic cu un mod inovator de acțiune. Este considerat astăzi a fi cel mai bun înlocuitor pentru insecticidele foarte toxice pentru vertebrate și populația umană.

Cuvinte cheie: toxicitate, imidaclorpid, cererea de insecticide

Introduction

Insecticides play an important role for the human society and food production. Many insect species are competing with human population for the food resources. Thus, human used their intelligence to find weapons to eliminate this threat and to have a higher productivity in order to satisfy the food demand. On the other hand, insecticides had a major role in eradication and control of the insect vectors responsible for many diseases like typhus transmitted by lice. In the beginning it was believed that insecticides have direct action upon insects only but, in time, it has been proved that they affect vertebrates and are dangerous to human population health as well. In this case were found other alternative compounds considered to be less toxic than the ones previously used.

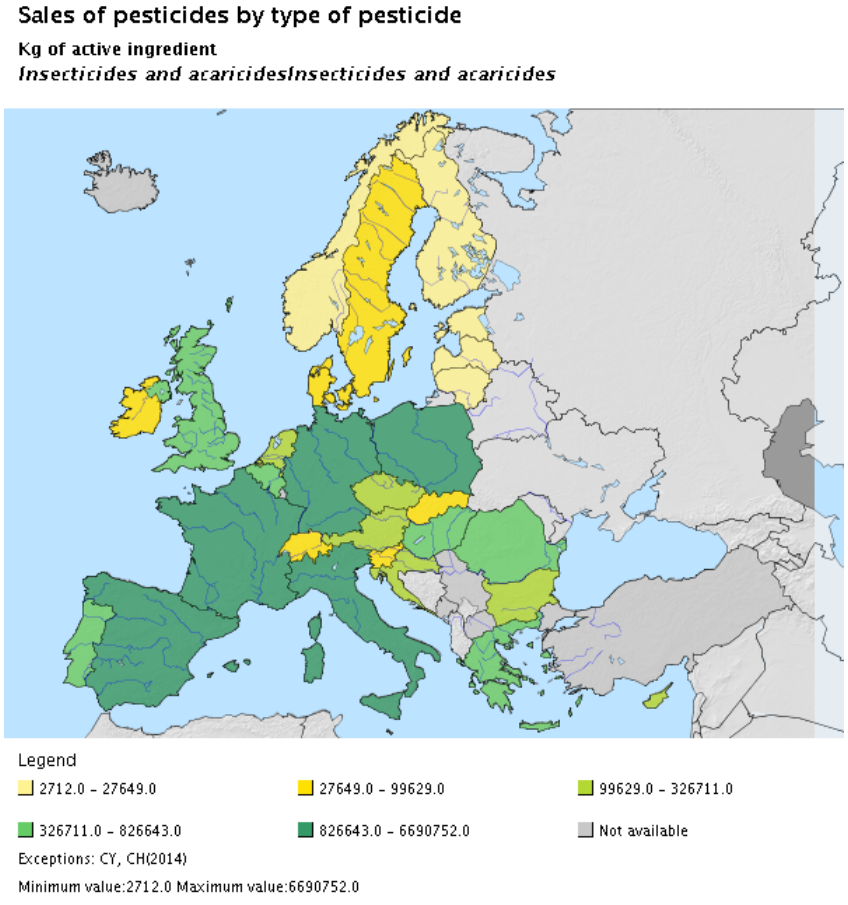
The nicotinoids are systemic insecticides that enter the body via ingestion and contact (Osterauer and Köhler, 2008). The action is concentrated on the central nervous system and they are mainly used in pest management against biting and sucking insects (Osterauer and

Köhler, 2008). In Europe, according to Eurostat (ec.europa.eu/eurostat), the highest amount of insecticides is used in agriculture.

The aim of the overview was to evaluate the toxicological effects of the neonicotinoid insecticide imidacloprid upon vertebrates, based on the data available from scientific publications.

The demand of insecticides in Europe

Eurostat data base was used to extract the quantities of insecticides sold starting with the year 2009 until 2015 - the last reported year, with the last update on 28/11/2017 (Fig. 1). Based on this data, an estimation of the demand and usage of insecticides in Europe can be done. Regarding the data, not all the countries contributed.



	Available data for the studied year						
European Countries	2009	2010	2011	2012	2013	2014	2015
BE:Belgium	x	x	658,820	563,187	616,676	555,844	576,381
BG:Bulgaria	x	x	c	83,058	110,152	163,439	286,100
CZ:Czech Republic	x	x	285,044	280,514	265,667	337,679	326,711
DK:Denmark	x	x	46,218	89,049	84,652	38,291	54,903
DE:Germany	1,035,222	933,442	875,344	1,029,492	894,975	977,198	954,384
EE:Estonia	x	x	19,382	20,607	19,544	25,283	27,633
IE:Ireland	x	x	48,280	42,414	53,554	51,430	59,791
EL:Greece	x	x	109,297	910,678	1,287,010*	588,794	694,354
ES:Spain	x	x	8,061,915	7,640,732	6,821,991	7,515,055	6,690,752
FR:France	x	x	2,149,732	2,327,347	2,244,126	2,610,867	2,466,333
HR:Croatia	x	x	x	x	135,128	143,090	139,197
IT:Italy	x	x	7,927,733	2,500,093	2,102,842	2,251,888	2,429,131
CY:Cyprus	x	x	c	c	c	180,623	c
LV:Latvia	x	x	34,164	44,516	43,892	63,998	16,782
LT:Lithuania	x	x	24,995	42,296	39,926	43,566	27,649
LU:Luxembourg	x	x	c	c	c	c	c
HU:Hungary	x	x	522,094	609,383	606,210	916,538	826,643
MT:Malta	x	x	2,994	3,313	3,387	2,946	2,712
NL:Netherlands	x	253,261	270,422	246,955	225,800	252,034	292,255
AT:Austria	x	x	241,938	244,026	238,196	240,220	195,564
PL:Poland	x	x	991,417	1,286,326	1,305,890	1,479,165	1,539,373
PT:Portugal	x	x	877,774	809,679	745,785	732,935	561,450
RO:Romania	x	x	807,802	827,576	626,348	569,046	676,494
SI:Slovenia	x	x	38,493	41,621	26,749	33,453	37,821
SK:Slovakia	x	x	63,693	65,157	90,226	106,509	99,629
FI:Finland	x	x	31,419	30,876	25,484	12,839	18,620
SE:Sweden	x	x	28,875	28,944	27,674	34,185	29,865
UK:United Kingdom	x	x	2,871,360	454,220	643,151	779,422	657,938
IS:Iceland	x	x	x	x	x	x	x
LI:Liechtenstein	x	x	x	x	x	x	x
NO:Norway	x	x	5,098	4,387	4,142	4,822	3,531
CH:Switzerland	x	x	95,300	69,300	64,518	83,063	:
ME:Montenegro	x	x	x	x	x	x	x
MK:Former Yugoslav Republic of Macedonia	x	x	x	x	x	x	x
AL:Albania	x	x	x	x	x	x	x
RS:Serbia	x	x	x	x	x	x	x

Figure 1. The distribution map for insecticides sales and reported values in Europe.

The not reported data are marked with “x” and with “c” the confidential data. Based on this, Germany was the only country constantly reporting these data, followed by the Netherlands. A ranking of the European countries with the highest demand of insecticides mainly used to treat the agriculture crops was possible based on these data. Spain came first with the highest demand and usage, the sales of total active ingredient being around 8,061,915 kg in 2011 and 6,690,752 kg in 2015. The second was Italy with 7,927,733 kg in 2011 and 2,492,131 kg in 2015. The third was France with 1,149,732 kg in 2011 and 2,466,333 kg in 2015. The distribution map of insecticides demand in Europe is presented in Figure 1 and is directly connected with the climate request for insect development, agricultural areas and industrial production.

What is imidacloprid?

Imidacloprid (1-(6-chloro-3-pyridylmethyl)-N-nitro imidazolidin-2-ylideneamine) is a new systemic compound with a novel mode of action (Sawasdee & Köhler, 2009) and it has been increasingly used since 1991 (Elbert *et al.*, 1991; Jemec *et al.*, 2017).

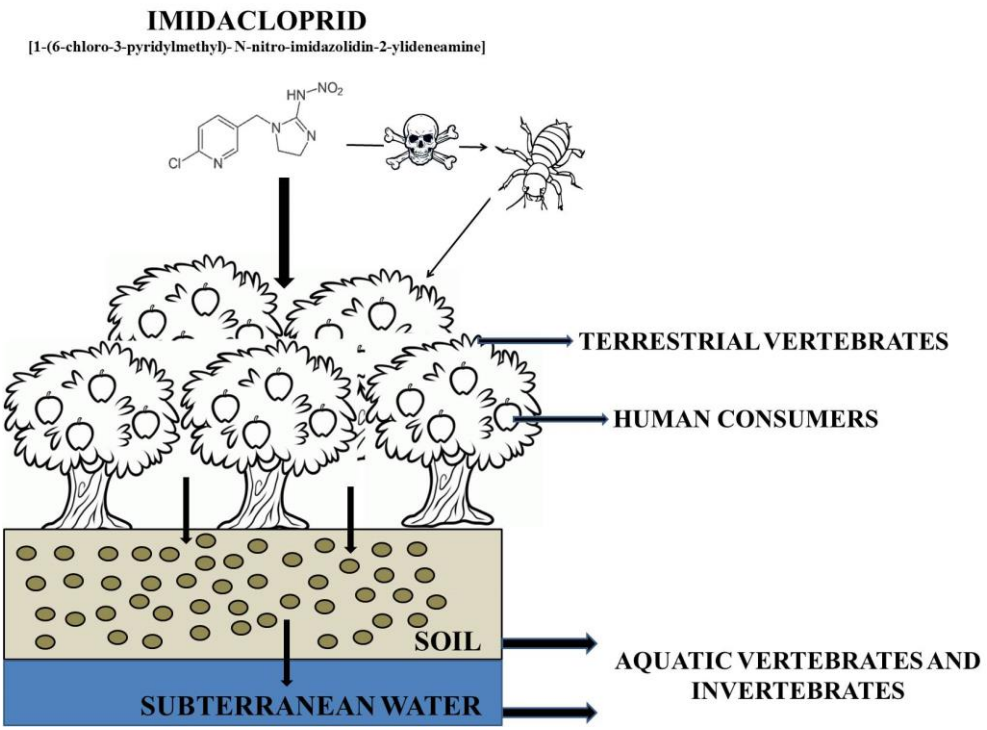


Figure 2. Imidacloprid in environment, its contamination of soil and subterranean water.

This insecticide is acting as a blocker of the nicotinergic acetylcholine receptor, resulting in the impairment of normal nerve function, and has applications in the control of pest insects (Matsuda *et al*., 2001; Sawasdee & Köhler, 2009). It is considered today one of the best replacers for insecticides very toxic for vertebrates and human population (Matsuda *et al*., 2001). Every manmade compound released in environment can create significant damages to life forms. Insecticides cannot differentiate between "good" insect and "bad" insect. Their toxicological targets are general. This leads to the decrease of species necessary for pollination and a significant reduction of fruits and vegetables production. Another problem is related to the persistence within environment. Cox (2001) reported that imidacloprid is persistent in soil, as the concentration in the tested soil samples did not decrease 1 year after application. In this case it may cause a real damage to vertebrate species and more than that to soil and subterranean water resource (Fig. 2)

Imidacloprid toxicity upon organisms other than insects

Mullins (1993) considered imidacloprid to have low to moderate toxicity in mammals and it was registered in U.S. as Category III. In acute test it showed no dermal or eye irritation and no mutagenic effects. In chronic experiments it was demonstrated (for that research period) that was not carcinogenic or teratogenic and had no primary reproductive toxicity. It was considered at that time to be a safer alternative for application in agriculture.

Tomizawa & Casida (2005) provided with a well elaborated study that described the toxicological profile of nicotine and neonicotinoids. In the case of mammals, the acute oral LD_{50} for imidacloprid is 450 mg/kg, NOAEL is 5.7 mg/kg/day and was not considered carcinogenic. In the case of birds, the acute oral LD_{50} is 31 mg/kg, and LC_{50} for fish is 211 ppm. In general, there are no specific antidotes for neonicotinoid poisoning in mammals. The neonicotinoidic compounds are considered therapeutic agents as analgesics and with applications for treatment of neurodegenerative diseases (Tomizawa and Casida 2005).

Sánchez-Bayo & Goka (2006) run a study on the ecological effects of the insecticide imidacloprid and the pollutant biocide Zpt from commercial shampoo formula upon arthropod communities. They concluded that because of the complexity of interactions within the food web it is almost impossible to predict the side effects that may result from toxicological disturbances, in this case the application of pesticides to agroecosystems or pollutants in the wider environment.

Jemec *et al.* (2007) studied the toxicity of imidacloprid and diazon. The imidacloprid was classified by WHO in Class II (moderately hazardous). In rainbow trout (*Oncorhynchus mykiss*) the toxicity was: LC_{50} (96h) =211 mg/L and LC_{50} (96h)>83 mg/L, LOLC (94 h)=64 mg/L and LOLC (94 h)=281 mg/L. In bluegill (*Lepomis machrochirus*) the toxicity was: LC_{50} (96h)>105 mg/L and LOLC (94 h) =42 mg/L. In zebrafish (*Danio rerio*) LC_{50} (96h) was 241 mg/L.

Mohamed *et al.* (2009) studied in Sri Lanka imidacloprid exposure in three hospitals. They investigated 68 patients (61 self-ingestions and 7 dermal exposures) poisoned with imidacloprid. The majority of patients had symptoms such nausea, vomiting, headache, dizziness, abdominal pain and diarrhoea. The fatal cases in these hospitals were 0%. Only two cases with severe symptoms required intensive care unit. This insecticide caused no major abnormalities of blood electrolytes, glucose level, renal function or liver function tests. Authors noticed that two seriously poisoned cases received treatment with pralidoxime. They suggested that the treatment with oximes such pralidoxime can be either ineffective or contraindicated. Authors concluded based on the studied cases that imidacloprid pesticides appeared to have low toxicity in humans causing mild symptoms. The ingestion of high dosage may lead to sedation and respiratory arrest. The authors agreed that more research on this topic is necessary.

Ge *et al.* (2015) conducted an experiment in zebrafish that studied chronic exposure to various imidacloprid doses. The treatment concentrations of imidacloprid were: 0.3, 1.25 and 5 mg/L. The experimental fish were sampled at 7, 14, 21, and 28 days during exposure and prepared for determination of DNA damage and oxidative stress (SOD, CAT, ROS and MDA). In case of DNA damage, all imidacloprid exposed fish were significantly different from the control group. This indicated that the insecticide caused a DNA damage in zebrafish liver that is dependent on dosage. It was also observed a time-response relationship under same exposure conditions. The results of this experiment indicated that a very high concentration of imidacloprid increased the ROS (reactive oxygen species) level in liver. The values of the other oxidative stress markers (SOD, CAT and GST) were elevated to scavenge the excess of ROS.

Conclusions

Based on the scientific literature, the acute exposure to imidacloprid can be tolerated to high concentrations compared with other insecticides used in the past. Data suggested that is far less toxic than the others. The main problems remain the long-term exposure that can

create damages to all life forms, the persistence in environment and reduction of insect biodiversity. Further studies are necessary to understand the toxicology of imidacloprid to human consumers and environmental health.

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AN OVERVIEW ON TOXICOLOGICAL EFFECTS OF PYRETHROID INSECTICIDE DELTAMETHRIN

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Abstract. The aim of this study was to identify the impact of pyrethroid-type insecticides upon organisms but also the negative influence upon the quality of people lives. Pyrethroids are synthetic chemical mixtures similar to pyrethrin - a compound from a *Chrysantemum* flowers extract. The degree of aggressiveness of pyrethroid insecticides depends on a number of factors such as dose, route of administration and exposure time. So, the nervous system is the most vulnerable to the toxicity of these compounds, especially to type II pyrethroids. Disturbances due to exposure to compounds of the pyrethroid range lead to disruption of essential functions of the nervous system mainly affecting locomotor coordination and activity of antioxidant enzymes. Deltamethrin (DLM) is a synthetic type II pyrethroid. In insects DLM poisoning may cause paralysis or death. Also, fish and rats have experienced malfunctions of the reproductive system. In humans, exposure to deltamethrin, depending on the amount taken, may lead to headache, nausea, dizziness, tremors, convulsions, fatigue and paralysis.

Keywords: insecticide, pyrethroid, deltamethrin, oxidative stress

Rezumat. Un comentariu despre efectele toxicologice ale insecticidului piretroid deltametrin. Scopul acestui studiu a fost de a identifica impactul insecticidelor de tip piretroid asupra organismelor, dar și influența negativă asupra calității vieții oamenilor. Piretroizii sunt amestecuri chimice sintetice similare unui compus din extractele vegetale ale florilor de crizantemă, mai exact, piretrina. Gradul de agresivitate al insecticidelor piretroide depinde de o serie de factori ca: doza, calea de administrare și timpul de expunere. Astfel, sistemul nervos este cel mai vulnerabil în ceea ce privește toxicitatea acestor compuși, cu precădere la cele piretroide de tip II. Perturbările care apar datorită expunerii la compușii din gama piretroizilor conduc la dereglarea unor funcții esențiale ale sistemului nervos afectând în principal coordonarea locomotorie și activitatea unor enzime antioxidante. Deltametrinul (DLM) este un piretroid sintetic de tip II. La insecte, intoxicarea cu deltametrin poate determina paralizia sau decesul acestora. De asemenea, la pești și șobolani s-au înregistrat dereglări ale funcționării aparatului reproducător. În cazul oamenilor, expunerea la deltametrin, în funcție de cantitatea preluată, poate conduce la dureri de cap, greață, amețeli, tremurături, convulsii, oboseală sau paralizie.

Cuvinte cheie: insecticid, piretroid, deltametrin, stres oxidativ

Introduction

In recent years, various methods and chemicals have been developed to protect plants against pests. Today, there is a wide range of chemicals that negatively act on insects and not only. Among the most well-known are: organochlorine, organophosphate, pyrethroid and neonicotinoid insecticides. The pyrethroids insecticides are synthetic substances similar to the natural active compound, pyrethrins, spread in the species of some chrysanthemum

flowers. Significant amounts of active substance are extracted from *Chrysanthemum cinerariaefolium*, but small quantities of pyrethrin are also found in other chrysanthemum flowers as well, such as: *Chrysantemum coccineum* and *Chrysantemum marshalli* (Polosky, 2015). *Chrysanthemum cinerariaefolium* is a member of Asteraceae family, known for their fruits named achenes which contains the seeds rich in the active principle - pyretrins (Bajaj, 1994). According to the Agency for Toxic Substances and Disease Registry (2003) pyrethrins are a complex consisting of 6 components which are formed following the esterification of the chrysanthemic acid (pyretrin I, cinerin I, jasmolin I) and pyrethric acid (pyrethrin II, cinerin II, jasmolin II). Taking into account that pyrethrin is rapidly degraded by light and plant material is an exhaustible source, specialists have experimentally developed other similar chemicals called pyrethroids (Matsuo & Mori, 2012). Pyrethroids were produced at Rothamsted Research in America in the 1960s and 1970s by Michael Elliot and colleagues (BBSRC, 2014). The new synthetic esters are formed from natural pyrethrin in combination with other chemical substances named synergistics. This new formula is much more aggressive than pyrethrin. Pyrethroids have many advantages and disadvantages compared to pyrethrin as illustrated in Figure 1.

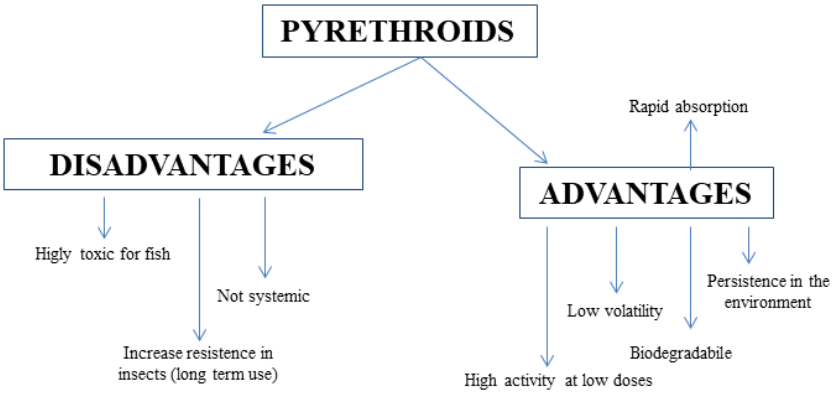

Figure 1. Advantages and disadvantages of pyrethroids (modified after Rehman *et al.*, 2014).

Despite the obvious advantages, the disadvantages weigh a lot more in this balance and that because the indirect actions of pyrethroids affect organisms much more. The principal target of insecticides is the nervous system according to a series of toxicological studies conducted on animal models (Rehman *et al.*, 2014). Pyrethroid insecticides have neurotoxic effects by disrupting the normal functioning of the sodium channels. Due to this fact the molecules of insecticide interfere with the transmission of nervous impulse, leading to repetitive nervous influxes or depolarization (Soderlund, 2012). The consequences are not delayed. Depending on dose or time of exposure, effects are even more pronounced. Tremors,

convulsions, nausea, locomotor deficits, paralysis or death are some symptoms of the pyrethroid insecticide poisoning (ATSDR, 2003, Soderlund, 2012, Rehman *et al.*, 2014).

Structures and properties of pyrethroids

Pyrethrine is the active substance which is found in the extract of several species of *Crysanthemum* and it has a powerful insecticide action. From all the natural extracts with insecticide effect, plant extracts of *Chrysanthemum* genus are most wanted. Today Australia is the second largest pyrethrin production centre after Kenya (Gilbert, 2010). Despite the massive production of natural pyrethrine extracts there are also similar synthetic compounds on the market called pyrethroids (Table 1). Pyrethroids have two forms associated with the presence/absence of an α-cyano group similar to pyrethrine.

Table 1. Examples of pyrethrine and pyrethroids insecticides (modified after Klaassen, 2008).

COMPOUND	SOURCE	EXAMPLES
Pyrethrine	Natural pyrethrum extract	Pyrethrium I, Pyrethrin II, Cinerin I, Cinerin II, Jasmolin I, Jasmolin II
Pyrethroids type I	Derivatives of pyrethrins that do not include a cyano group	Alletrin, Bifenthrim, Permethrin, Phenothrin, Resmethrin, Tefluthrin, Tetramethrin
Pyrethroids type II	Derivatives of pyrethrins that include a cyano group	Cyfluthrin, Cyhalothrin, Cypermethrin, Deltamethrin, Fenvalerate, Fenpropathrin, Flucythrinate, Flumethrin, Fluvalinate, Tralomethrin

Compared to pyrethrines, pyrethroids are more toxic and due to their lipophilicity are easier absorbed from the water column (Viran *et al*., 2003). Excess of type I pyrethroid leads to a poisoning named T syndrome, which is characterized by hyperexcitation, convulsions and tremors, while type II produce CS syndrome consisting of salivation, hypersensitivity, choreoathetosis and seizures (Soderlund *et al.*, 2002; Kim *et al*., 2008; Cao *et al*., 2010).

Both forms have insecticide function by attacking the nervous system of insects. The mechanism is not totally elucidated. It is known that the main target is the malfunction of the sodium channels in the nervous system, which causes hyperstimulation of nerve membrane (Miller & Salgado, 1985; Cox, 1998; Soderlund, 2012). Certain studies revealed that pyrethroids also act on the calcium channels (Clark & Symington, 2007; Neal *et al*., 2010).

Deltamethrin

One of the most popular type II pyrethroid insecticides is DLM. DLM was synthetized for the first time in 1974 and it is widely spread all over the world. Due to its effectiveness as insecticide is commonly used in agriculture to protect plant crops (Kumar *et al*., 2015). For example, in India DLM is used against pests of tea plantations and grain (Parvez & Raisuddin, 2006; Gurusubramanian *et al*., 2008) or to control mosquitoes responsible for the spread of malaria (Yadav *et al*., 2001). In China it is used as pesticide in the agricultural fields for pest control (Huang *et al*., 2014).

Despite its high effectiveness DLM is a potential source to induce negative consequences because humans and animals are exposed to it. Several studies demonstrated

the implications of DLM in the immune system perturbation. Occurrence of autoimmune diseases, immunosuppression and hypersensitivity reactions are some of immunotoxicity signs (Kumar *et al*., 2015). Toxic effects on spleen and thymus were observed by Kumar and his contributors (2017) in mice, when animals were exposed to 5 mg/Kg DLM for 7 days. Also, the team of Kumar has demonstrated the benefic action of piperine and curcumin against DLM poisoning. Some of its properties are summarized in Table 2.

Table 2. Properties of DLM (after NPIC, 2011).

PROPERTY	DLM
Molecular weight (g/mol)	505.2
Color	Colorless
Physical state	Crystals
Melting point (ºC)	101-102
Solubility in water (mg/L)	<0.002
Solubility in organic solvent	Soluble

How toxic is DELTAMETHRIN?

Most of experimental studies conducted *in vivo* or *in vitro* had the same results. DLM is toxic for insects and aquatic organisms and less toxic for birds, mammals or humans. Cases of pollution due to a large amount of DLM were reported. An ecocatastrophe occurred in Hungary in the Lake Balaton (1995): 30 tons of eel (*Anguilla anguilla*) died due to DLM toxicity (Nemcsók *et al.*, 1999). In order to identify the main effects of poisoning with DLM scientists have put the bases of animal models development. They intended to discover lethal and sub-lethal concentrations when the organisms show obvious effects. So, the organisms predominantly used in research are: insects, fish, mice and rats.

The farmworkers use insecticides in large amounts to protect plant crops and stored products, but they do not take into account the effects of the active substance. The study of Paudyal and contributors (2016) demonstrated the benefic effect of DLM upon three insect species: *Tribolium castaneum* (Herbst), *Sitophilus oryzae* (L.) and *Rhyzopertha dominica* (F.). These insects are known to be harmful. The concentrations of DLM were: 1, 25, 50, 100, 250, 500, 1,000 and 3,000 mg/L. 25 mg/L was the lethal concentration when the insects were knocked down after 4 hours of exposure. The producers of insecticides were interested to develop new formulas of DLM solutions. A surprising idea was to combine diatomaceous earth with DLM which has similar effects. This mixture was a perfect solution to combate *Sitophilus zeamais* in stored corn (Ceruti & Lazzari, 2005). The same mixture was used to fight against *Rhyzopertha dominica* and *Tribolium castaneum* (Korunic & Rozman, 2010). The molecules of DLM bind to sodium channels and the sodium ions can no longer pass into cell. At this moment occur repetitive nerve impulses which lead to a hyperstimulation of nervous function (Cao *et al.*, 2010). The mechanism of DLM action is illustrated in Figure 2.

After insects, fishes are the second group affected by the DLM exposure because they have a high compound absorption from the water which passes through gills (Srivastav *et al*., 1997; Sayeed *et al*., 2003).

Several studies demonstrated the impact of the insecticide upon the swimming behavior (Oliveira *et al*., 2012). In addition, the presence of oxidative stress is a marker of DLM influence. Oxidative stress is defined as imbalance between oxidants (ROS) and antioxidants. A large level of ROS leads to reduction of antioxidant enzymes activities (Sukla *et al*., 2011; Sies *et al*., 2017). The most used indicators to determine the presence of oxidative

stress are: catalase, superoxide dismutase, glutathione peroxidase and malondialdehyde (Gul *et al*., 2004). Evaluation of enzyme activities in fish is an important parameter to determine the presence of the compound in the aquatic environment.

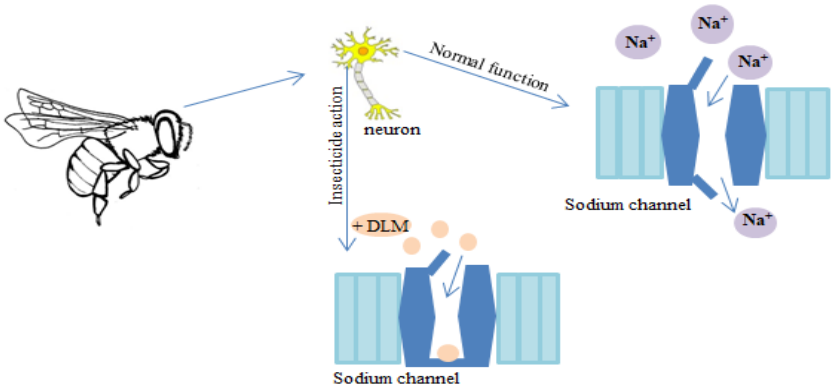

Figure 2. The action of DLM in the nervous system of insects.

Also, the biochemical activity is observed (Gul *et al*., 2004; Suvetha *et al*., 2015). For example, in snakehead (*Channa punctatus*) the activity of catalase is reduced and lipid peroxidation increases as a result of ROS action (Sayeed *et al*., 2003). The acute exposure of the zebrafish (*Danio rerio*) to different concentrations (0, 0.15, 1.5, 3.75, 7.5 and 15 µg/L) of DLM leads to locomotor deficits in 24 h. Rapid gill and opercular movement, swimming at the surface of water or swimming in a corkscrew manner were the main symptoms recorded (Huang *et al*., 2014). Same observations were made for tilapia species (*Oreochromis niloticus*) by Yildirim *et al*., (2006) and for guppies by Viran *et al*., (2003). The chronic exposure of zebrafish females (*Danio rerio*) for 5 days at two concentrations of DLM (0.5 and 1 µg/L) has determined degeneration of follicles, oogenesis delay and decreased number of primary oocyte (Yön et al., 2009). Eggs' hatching is affected too (Görge *et al*., 1990; Sharma & Ansari, 2010). Tthe effects of DLM can be observed due disrupting the intern metabolism. Low levels of plasma glucose and cholinesterase and high levels of hemoglobin content, proteins, ammonia and calcium were recorded in the case of rainbow trout (*Oncorhynchus mykiss*) at acute exposure (Velíšek *et al*., 2007).

Another study investigated the effect of DLM upon the Indian major carp (*Labeo rohita*) at acute exposure (0.438 mg/L). Fish manifested hyperactivity, loss of movement coordination, increased gill mucus secretion, increased cortisol and prolactin levels (Suvetha *et al.*, 2015).

Effects of DLM on nervous, respiratory, immune and hematological systems are reported in rats. Exposure of rats to different concentrations of insecticide and their effects are found in several papers. Locomotor activity and social interactions are reduced following the administration of 10 mg/kg DLM in rats (Ricci *et al.*, 2013; Habr *et al*., 2014). At low doses (0.08 mg/kg), the effect of DLM is reflected by the reduction of locomotor activity and increase of the rest period (Lazarini *et al*., 2001). Influence of the insecticide also can be observed in biochemical metabolism. The activity of enzymes superoxide dismutase and glutathione-S transferase was significantly low. Malondialdehyde which is a parameter of

lipid peroxidation showed high levels in different tissues (Mokhtar *et al*., 2006). After injection, DLM was rapidly distributed in the organism reaching approximately in all the tissues. Despite the fact that is very quickly absorbed, its excretion is low. Thus, small doses of DLM were recorded in brain and high doses in muscle, skin and fat (Kim *et al*., 2008). The cytotoxic effects can be diminished by adding vitamin E in the rats' diet. According to a study, the administration of DLM combined with vitamin E led to the reduction of oxidative stress (Galal *et al*., 2014).

Regarding human exposure there are several ways to be exposed to DLM poisoning. Substances can reach the skin surface, can get into the eyes, can be ingested or inhaled. The most common route is the dermal exposure. The effects can be observed by appearance of paraesthesia, erythema and desire to scratch the skin. The literature also reported several cases of suicide through ingestion of different solutions which contained DLM. After ingestion, most of the people have manifested dizziness, itching, nausea, fatigue, sweating, convulsions, tremors, facial paraesthesia and even coma (He *et al*., 1989; ATSDR, 2003, Watts, 2012).

Conclusions

The pyrethroid insecticides are an effective source of pest control, especially insects. High demands and the widespread use of these compounds in agriculture raised many questions among researchers. A part of their interest is focused on the effects produced by DLM upon organisms. Most of the experimental studies were run with model animals. Unfortunately, though little is known about poisoning symptoms, a cure for treating it was not found yet. An eventual perspective would be to find an appropriate treatment to fight against the toxicity of pyrethroid compounds without affecting other organisms.

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RECENZIE

D. MURARIU & O. POPESCU, ***Prefață*** la *Originea speciilor* de Charles Darwin, Editura Herald & Editura Academiei Române, 2017, 25 p.

Editura Herald și Editura Academiei Române au publicat, la începutul anului 2017, o ediție nouă a cărții lui Charles Darwin, *Originea speciilor prin selecție naturală sau păstrarea raselor favorizate în lupta pentru existență* (Darwin, 2017). Prima ediție în limba română a acestei lucrări de referință în domeniul științei a apărut în 1957 la Editura Academiei Populare Române, fiind tradusă din limba engleză de Ion E. Fuhn și confruntată cu traducerile din limba rusă (Nicolae Botnariuc), limba germană (Ion T. Tarnavschi) și limba franceză (Vasile D. Mârza), stilizator, Gellu Naum.

Noua ediție, din 2017, a *Originii speciilor* a fost publicată în baza traducerii lui Ion E. Fuhn, dar „revizuită", fiind „operate unele modificări necesare de ordin stilistic și conceptual". Lucrarea lui Darwin este precedată de o *Prefață* către cititor de 25 de pagini semnată de Dumitru Murariu (membru corespondent al Academiei Române) și Octavian Popescu (membru titular al Academiei Române). Salutând acest act editorial (așteptat de publicul de specialitate de mult timp) ne propunem în prezenta *Recenzie* să evidențiem, din perspectiva biologului evoluționist și a profesorului de biologie, modul în care *Prefața* aduce în fața noii generații de cititori din România, viziunea, mesajul și valorile perene ale gândirii științifice ale lui Charles Darwin, ce rezultă din opera mai sus citată a acestuia.

Prezenta recenzie critică a *Prefeței* actualei ediții publicată în limba română a *Originii speciilor* ține cont de următoarele criterii, pe care le considerăm relevante: (i) Modul de prezentare a esenței concepției lui Darwin; (ii) Implicațiile științifice și extra-științifice ale concepției darwiniste; (iii) Locul darwinismului în cadrul evoluționismului; (iv) Structura și alte observații privind conținutul *Prefeței*.

(i) Modul de prezentare a esenței concepției lui Darwin. Conform *Prefeței*, marea realizare a lui Darwin este ideea *originii speciilor dintr-un strămoș comun*, speciile neapărând separat, așa cum credea Lamarck, și faptul că, în plus, Darwin a reprezentat această idee printr-un *arbore filogenetic*. Aceast punct de vedere despre esența darwinismului este mărginit. Marea realizare a lui Darwin *nu a fost aceea că speciile se dezvoltă din strămoși comuni (și că a reprezentat evoluția prin arbori filogenetici)*, ci faptul că *a dat prima explicație științifică adaptării*. Deoarece în epoca sa adaptarea era privită ca un dar divin, o realizare născută din însăși actul creației divine, marea provocare a științei era să găsească o explicație a realizării *pe cale naturală* a adaptării, *înainte* de a pune problema transformării evolutive a speciilor. De aceea, Darwin avea să spună „m-au izbit întotdeauna acest fel de adaptări și până când au putut fi explicate mi s-a părut aproape inutil să mă silesc a dovedi cu probe indirecte că speciile s-au modificat" (Darwin, 1962 [1887]). Explicând adaptarea (adică de ce speciile sunt atât de potrivite mediului în care trăiesc), Darwin a putut explica și *originea* lor pe cale naturală (adică necreate de mâna vreunui zeu), și *evoluția* lor din *strămoși comuni*.

În ceea ce privește *contribuția și semnificația teoriei darwiniste în contextul științei vremii* este, în general, acceptat că darwinismul a avut un *caracter revoluționar* pentru faptul că a dat prima oară o explicație *finalității* în natură, că a exclus supranaturalul și miracolul din explicația lumii vii și a fundamentat o veritabilă *știință a vieții – biologia*. *Prefața* însă nu prezintă aceste fapte. În plus se observă că în nici un loc din *Prefață* nu apar cuvintele *creație, creator*, în contextul în care concepția creaționistă asupra lumii vii primise cea mai puternică lovitură de până atunci. De asemenea, *Prefața* nu face nicio referire la cadrul *materialist* al teoriei evoluționiste darwiniste, având în vedere faptul că Darwin a demitizat total explicațiile privind lumea vie, a pus capăt speculațiilor *idealiste* sau mistice despre natură, explicând fenomenele biologice numai prin cauze pur *materiale*.

Prefața sugerează faptul că în epoca lui Darwin se știa că evoluția este un proces natural, doar că unii autori credeau, precum înainte Lamarck, că speciile provin *separat*, iar alții, precum Darwin, suspectau că speciile provin din *strămoși comuni*. Deși Lamarck nu a sugerat cauze supranaturale pentru a explica evoluția speciilor, marea dispută în Anglia din timpul lui Darwin era dacă speciile au fost create, rămânând neschimbate până la eventuala lor dispariție (așa cum susținuse William Paley, profesorul de „teologie naturală" al lui Darwin) sau dacă ele au apărut prin cauze naturale și evoluează. În schimb, *Prefața* susține că marea întrebare a lui Darwin a fost, în special, de a se vedea dacă speciile au apărut separat sau din strămoși comuni, ceea ce reprezintă doar un aspect al revoluționarei ipoteze darwiniste. Dacă ținem cont de conjunctura ideologică actuală din școala publică românească (care a eliminat caracterul evoluționist al biologiei, promovând ca alternativă viziunea despre natură a dogmelor bisericești, neștiințifice), *Prefața* pare să ignore sau să ascundă conflictul cu teologia oficială pe care l-a generat *Originea speciilor*.

(ii) Implicațiile științifice și extra-științifice ale concepției darwiniste. Pentru implicațiile sale științifice și extra-științifice, concepția darwinistă a fost calificată, de istoricii științei, cu sintagma „revoluție darwinistă" (Baldwin, 2015 [1909]; Mayr, 2004 și alții). Prefața menționează următoarele merite principale ale operei lui Darwin: la pagina IX: „(Darwin) a avut inspirația schițării unui arbore filogenetic"; la paginile X-XI și următoarele: „prima descriere credibilă a evoluției biologice"; „[Darwin] a fost primul care a oferit o imagine logică pentru originea întregii diversități a lumii vii dintr-un singur strămoș comun" (și nu separat – precizare făcută pe coperta IV), spre deosebire de Lamarck care considera evoluția că se bazează pe tendința înnăscută spre perfecțiune a organismelor); „rolul selecției naturale în explicarea adaptării și în speciație (divergența caracterelor), a răspândirii geografice a viețuitoarelor", evoluția graduală, timp îndelungat, extincția speciilor (pagina XVIII), precizarea unor factori și un mecanism al evoluției bazat pe selecția naturală. La paginile X-XI se arată: „concepția sa despre evoluția lumii vii a fost îndeajuns de fundamentală și de completă pentru a influența decisiv gândirea majorității naturaliștilor, a oamenilor de știință precum și a publicului educat".

Aceste contribuții ale concepției darwiniste sunt, într-adevăr, relevante, dar ele sunt elemente de strictă specialitate, care nu depășesc sfera biologiei. De aici nu rezultă de ce darwinismul „a influențat practic întreaga gândire literară, filosofică și religioasă" (coperta IV). Înseamnă că ceva lipsește. Darwin a oferit o explicație naturală a evoluției, printr-o argumentație științifică vastă, bogată, verificabilă; a valorizat metodologia cercetării științifice (metoda ipotetico-deductivă sau a raționamentelor plauzibile). Mecanismul evoluției la Darwin poate fi discutat oricât și oricum, dar el *nu conține nimic neștiințific*.

Gândirea populaționistă, ianugurată de Darwin, a condus la revizuirea tuturor interpretărilor din biologie, renunțarea la esențialism și, chiar mai mult, să dea o nouă filozofie asupra naturii (Mayr, 1989 [1982]).

Pe linia inaugurată de Copernic, Galilei și Newton, Darwin a pus capăt definitiv pretenției seculare a Bisericii de deținătoare a monopolului adevărului în ceea ce privește natura și omul. Aceste concluzii au avut un impact imens în știință, filozofie, societate, cultură și asupra discursului religios în probleme ce depășesc dogma religioasă. De aici rezultă *caracterul revoluționar* al darwinismului. *Prefața* însă nu spune nimic de impactul darwinismului în afara științei și în special asupra viziunii teologice dominatoare în epocă, răspunzând, voit sau nevoit, iluziei pe care politica educațională din România vrea să o inducă în școala publică actuală, și anume că între știință și religie este armonie, ascunzând însă de elevi în programele școlare unele aspecte incomode pentru dogma religioasă, cum ar fi *biologia evoluționistă* (Derevenco, 2011, Cojocaru, 2015).

(iii) Locul darwinismului în cadrul evoluționismului. *Prefața* susține că teoria lui Darwin și cea a lui Lamarck fac parte din *aceeași etapă a dezvoltării concepției evoluționiste*, pe motiv că Darwin a păstrat în lucrările sale unele teze lamarckiste, precum legea întrebuințării și a neîntrebuințării, și ereditatea caracterelor dobândite. Astfel, la pagina XIX se afirmă: „cum Darwin a acceptat principiul lamarckian al moștenirii caracterelor dobândite ca o sursă de variabilitate biologică, această etapă ar putea fi numită și perioada «Lamarck – Darwin – Wallace»”.

A desemna o perioadă în istoria gândirii evoluționiste numită „Lamarck – Darwin – Wallace” înseamnă a nu ține cont de elementele definitorii, esențiale, ale teoriilor lui Lamarck, Darwin și Wallace, care au încercat să explice evoluția. Factorii lamarckiști: *efectul întrebuințării sau neîntrebuințării* și *transmiterea caracterelor dobândite*, admiși de Darwin ca explicație suplimentară pentru anumite adaptări, reprezintă un element *nesemnificativ* pentru esența teoriei darwiniste a evoluției, bazată pe *selecție naturală*. Trebuie făcută o distincție între *mecanismul darwinist al evoluției* (bazat exclusiv pe *selecție naturală*), pe de o parte, și discuțiile generale ale lui Darwin privind evoluția (ca și cum ar lua în considerare și *alte* mecanisme pe lângă mecanismul *său*, original), pe de altă parte. Ereditatea caracterelor dobândite este un element nesemnificativ pentru esența teoriei lui Darwin, deoarece mecanismul selecționist al evoluției nu implică această ipoteză lamarckistă.

Ar fi acceptabil să delimităm o perioadă „Lamarck – Darwin - Wallace” doar dacă teoriile lor ar descrie un mecanism al evoluției în termeni asemănători. Or, între teoria evoluționistă a lui Lamarck și cea a lui Darwin și Wallace nu există elemente de continuitate: mecanismul lamarckist al evoluției este non-selecționist, iar cel din teoria Darwin-Wallace selecționist. Mecanismul selecționist din teoria lui Darwin era *cu totul nou și original*, nederivat din vreo concepție lamarckistă, mai veche. De aceea, cu diferite ocazii, neodarwinismul (care nu acordă nicio importanță eredității caracterelor dobîndite) a fost, uneori calificat ca fiind mai „darwinist” decât teoria proprie a lui Darwin (Delage & Goldschimidt, 2016 [1920] și alții).

Lamarck, deși a publicat ideile care l-au făcut cunoscut la începutul secolului al XIX-lea (1809, 1815), el aparține etapei *transformismului* de tip secol XVIII, o expresie în științele naturii a iluminismului francez. Dacă ne-am raporta la conceptul lamarckist de ereditate a caracterelor dobândite am putea desemna un interval de timp care să înceapă cu Buffon și să se termine cu biologi de la jumătatea secolului al XX-lea. În ceea ce privește

mecanismul evoluției, Lamarck nu a oferit nicio explicație validă; pentru el evoluează *individul* sub influența directă sau indirectă a mediului. În cazul lui Darwin, unitatea de evoluție este *populația*, iar mecanismul este oferit de *selecția naturală* asupra variațiilor individuale întâmplătoare apărute în populație. Mecanismul evoluției pe baza selecției naturale este întreg, nu are nevoie de adăugarea tezelor lamarckiste. Într-o scrisoare din 1859 adresată lui Lyell, Darwin afirma că din opera lui Lamarck, el nu a rămas „cu nici un fapt sau idee" (Flonta, 2010). În concluzie, această periodizare a evoluției teoriilor evoluționiste, în care Darwin și Lamarck formează împreună o etapă a dezvoltării evoluționismului, este nerealistă și nedreaptă față de meritele și contribuțiile originale ale lui Charles Darwin.

O a doua observație se referă la supoziția că, dacă *teoria sintetică a evoluției* parcurge un proces de restructurare, în special prin aportul biologiei moleculare și biologiei dezvoltării, atunci darwinismul, care stă la baza ei, este și el depășit. În partea finală a *Prefeței* ni se prezintă o încercare de a pune față în față darwinismul clasic și teoria sintetică a evoluției, devenită acum clasică și ea, și unele direcții moderne ale biologiei, cum ar fi genomica. *Paradigma darwinistă*, cadrul conceptual în care Darwin a explicat evoluția, se reduce la trei piloni fundamentali: variabilitate individuală întâmplătoare și nedirecționată, selecție naturală, descendență cu modificări. Raportat la această paradigmă, autorii *Prefeței* opun o serie de teme care suscită dezbateri în biologia evoluționistă contemporană: evoluție neadaptativă a genomului, diminuarea rolului selecției naturale, modelul evoluției reticulate, ca urmare a transferului orizontal de gene, evoluție care „demolează" conceptul de arbore al vieții.

Cititorul nespecialist ar putea crede că prin aceste observații este demolată logica darwinistă asupra evoluției, eventual faptul că evoluționismul contemporan nu ar mai fi darwinist. Autorii *Prefeței* nu arată în ce constă paradigma darwinistă și nu subliniază faptul că nu există vreo teorie a evoluției acceptabilă, care să excludă principiul selecționist darwinist. Nu trebuie puse pe același plan evoluția genomurilor și evoluția speciilor ca proces macroevolutiv. Evoluția la nivel molecular poate depinde în mare măsură de hazard și să inițieze direcții inițial neadaptative, dar în cazul oricărei specii *echilibrul* dintre ea și mediul ei de viață, echilibru exprimat la vedere de adaptările fenotipului, este un rezultat al selecției naturale pe o perioadă mai lungă de timp. Progrese recente din cercetarea evoluției pot nuanța anumite aspecte din paradigma darwinistă, dar nicio realizare teoretică sau practică nu a reușit să o modifice în esența ei. Variabilitatea poate fi total întâmplătoare sau poate fi considerată mai puțin întâmplătoare (epigenetica, sinteza evoluționistă extinsă), dar rămâne întotdeauna neorientată față de direcția evoluției; sursă a evoluției pot fi variațiile mici apărute în populațiile de adulți (viziunea clasică a evoluției darwiniste graduale) sau variația radicală a stadiilor embrionare (evo-devo, sinteza evoluționistă extinsă), care poate orienta evoluția rapid și în direcții neașteptate (teoria echilibrului punctat). În toate aceste cazuri, *variabilitatea rămâne același factor darwinist* al evoluției. *Selecția naturală* poate fi mai puțin importantă în anumite etape (teoria neutralistă a evoluției moleculare, driftul genetic aleator, evo-devo), dar în final este singurul factor care aduce organismele în armonie cu mediul lor de viață.

Poate explica teoria neutralistă a evoluției moleculare apariția mimetismului sau adaptarea unor tetrapode terestre la viața acvatică? Dacă la nivel molecular evoluția are atât de multe inițiative aleatorii aparent non-darwiniste, atunci cum au apărut adaptările? Sau nu mai există adaptări? Selecția naturală poate acționa gradual și continuu în populații de adulți (viziunea darwinistă clasică) sau episodic, cu rate de evoluție variabile, (teoria echilibrului

punctat, etapele post-drift sau post-remanieri genetice importante în puține generații), dar rămâne același factor darwinist al evoluției. Darwin a sesizat aspecte ale evoluției care astăzi sunt în logica evo-devo sau a teoriei echilibrului punctat: „În multe cazuri, știm prea puțin pentru a putea să afirmăm că o parte sau un organ sunt atât de neimportante pentru buna stare a unei specii, încât modificările structurii lor nu au putut fi acumulate în mod lent pe calea selecției naturale. În multe alte cazuri, modificările sunt probabil rezultatul direct al legilor variației sau creșterii, fiind dobândite astfel independent de orice utilitate" (Darwin, 1957: 178).

Prefața sugerează cititorului că în prezent una din marile realizări ale lui Darwin, și anume conceptul de *arbore al vieții*, este nu doar subminat, ci practic „demolat". Argumentul înaintat de *Prefață* este transferul orizontal de gene, evidențiat mai ales la microorganismele procariote. Este adevărat că în două situații reprezentarea evoluției sub forma unui arbore este inaplicabilă: transferul lateral de gene (ereditatea pe „orizontală") și fuziunea de genomuri întregi. Dar ereditatea pe „verticală", de la genitori la descendenți, funcționează la marea majoritate a speciilor, inclusiv la microorganismele care schimbă gene pe „orizontală" și este, deci, exagerat și incorect să generalizăm că reprezentarea evoluției sub formă de arbore filogenetic a fost „demolată". În plus metoda cea mai modernă de construcție a filogeniilor – *cladistica*, care continuă să revoluționeze înțelegerea trecutului evolutiv al vieții, nu are oare ca principiu fundamental transferul vertical al caracterelor? A anunțat cineva „demolarea" cladisticii pentru că la bacterii există transfer orizintal de gene? Evident că nu, în biologie ca și în alte științe ale naturii excepțiile sunt puse în armonie cu regulile.

Cititorul poate rămâne cu impresia, lecturând partea finală a *Prefeței*, că principiul darwinist al selecției naturale este tot mai puțin important. Astăzi, rolul selecției naturale în adaptare și evoluție este nuanțat (Ridley, 2004): selecția naturală este singura explicație pentru adaptare, în timp ce evoluția în ansamblu poate să conțină factori non-selectivi, cum este driftul aleatoriu. Deci, evoluția, în viziunea acestor „soluții pluraliste", poate să conțină și procese non-adaptative, care au semnificație mai ales în analiza macroevoluției, însă rata de succes a speciilor în mediul lor de viață depinde în primul rând de gradul de adaptare a acestora, iar acest lucru se consolidează pe calea selecției naturale. Geneza speciilor poate conține elemente sau etape non-adaptative, dar supraviețuirea pe termen lung a speciilor presupune adaptare, deci selecție. Este evident, fără alte demonstrații, că evoluția, în ansamblul ei, este un proces adaptativ, sub aspectul finalității sale. Experimentele care au permis observarea evoluției la scară mică, „sub ochii noștri", au dovedit că schimbările evolutive au presupus o variabilitate naturală spontană și acțiunea selecției naturale. Dovezi în acest sens sunt creșterea ireversibilă a rezistenței microorganismelor la medicamente, selecția artificială, evoluția recentă a unor virusuri, experimentele lui John Endler pe peștii guppy sau celebrele experimente ale lui Richard Lenski pe *Escherichia coli*, în care a obținut o evoluție pe bază de selecție indusă, timp de peste douăzeci de ani, la aceste bacterii (Dawkins, 2016 [2009]). Toate aceste exemple confirmă validitatea principiului selecționist darwinist.

În schimb, *Prefața* pare că face o apologie a evoluției non-adaptative. Afirmația că evoluția poate avea, la un moment dat, un caracter non-adaptativ (mai ales la nivel molecular) este acceptabilă, dar a susține că, plecând de la „modele simple de evoluție, care nu implică adaptarea" (pagina XXV), s-ar putea elabora „o nouă sinteză a evoluționismului" este o mare exagerare. Este o mare exagerare pentru că o evoluție fără adaptare ar fi o evoluție fără selecție, fără finalitate, independentă pe termen lung de condițiile de mediu, ceea ce nici

teoretic, nici practic nu poate exista. De ce să punem problema evoluției fără adaptare, când adaptările există? Pe de altă parte, adaptarea evolutivă, generată de selecție de-a lungul generațiilor, nu trebuie confundată cu o mutație adaptativă întâmplătoare.

Să reamintim faptul că prima „sinteză" în cercetarea evoluției s-a făcut între teoria selecției naturale și genetica mendeliană, domenii de studiu profunde care păreau, inițial, că sunt în dezacord. Evoluția fără selecție nu are finalitate, nu generează adaptare, nu are perenitate. Istoria biologiei consemnează mai multe episoade în care genetica a fost folosită, fără succes însă, ca argument împotriva principiului selecționist darwinist: W. Bateson, H. de Vries (în primele decenii ale secolului XX), R. Goldschmidt (1940), interpretările pripite apărute în anii 1960-80 și ulterior, despre teoria neutralistă a evoluției moleculare a lui M. Kimura (numită în mod exagerat „non-darwinistă"). Kimura avea să declare ulterior: „teoria neutralistă nu neagă rolul selecției naturale în determinarea cursului adaptativ al evoluției" (Kimura, 1986). Față de aceste fapte E. Mayr afirma în 2004: „Mă izbește drept ceva aproape miraculos că Darwin a ajuns în 1859 atât de aproape de ceea ce va fi considerat drept valid 145 de ani mai târziu" (Mayr, 2004: 113). „Formula darwiniană de bază – evoluția este rezultatul variației genetice și a ordonării acesteia prin eliminare și selecție – este suficient de cuprinzătoare pentru a face față tuturor posibilităților din natură. A căuta o nouă teorie (paradigmă) a evoluției pare acum o întreprindere inutilă" (Mayr, 2004; 128). Trebuie subliniat aici că ceea ce numim frecvent „teoria sintetică a evoluției" nu trebuie înțeleasă ca o teorie distinctă de darwinism; ea reprezintă darwinismul dezvoltat în contextul biologiei prezentului, fiind numită și *darwinismul maturizat* (Mayr, 1989 [1982]), *darwinism sintetic* sau *a doua revoluție darwinistă* (Junker, 2007).

Trebuie însă să arătăm că unele din construcțiile evoluționiste ridicate peste fundamentul darwinist, adică ceea ce reprezintă *teoria sintetică a evoluției*, bazată inițial pe genetica de acum 60-90 de ani, este firesc să suporte anumite completări și corecții. Ca urmare, biologia moleculară, genomica, biologia sistemică, biologia sintetică, biologia dezvoltării evoluționistă (evo-devo) pot nuanța sau corecta anumite detalieri sau teze clasice ale teoriei sintetice a evoluției. Orientările actuale din cercetarea evoluționistă, popularizate prin sintagma „sinteza evoluționistă extinsă", care pun accentul mai ales pe procesele constructive din dezvoltarea ontogenetică (evo-devo) și epigenetică, precizează însă că „păstrează fundamentele teoriei evoluționiste" (Laland et al., 2015). Niciuna din aceste noi direcții de cercetare nu s-a hazardat să afirme că evoluția, în ansamblul ei, este neadaptativă, că selecția naturală nu este relevantă în apariția adaptării. Fundamentul darwinist, bazat pe principiul selecționist nu a putut nici măcar în teorie să fie înlocuit cu o altă paradigmă privind mecanismul evoluției. Eva Jablonka, genetician (și „epigenetician"), profesor de istoria științei, întrebată dacă vom vorbi mereu despre *darwinism*, răspunde: „da, pentru că ideile sale fundamentale sunt foarte puternice. Teoria sintetică a evoluției este în urma noastră, nu darwinismul" (Jablonka, 2008).

(iv) Structura și alte observații privind conținutul *Prefeței*. În afara obiecțiilor cu privire la modul de prezentare a esenței darwinismului, *Prefața* ne surprinde cu o serie de neajunsuri ce țin de: structură, claritatea ideilor, derutarea cititorului cu afirmații echivoce, prezentarea unor idei darwiniste în dezacord cu spiritul explicației darwiniste, erori științifice, o relativizare generală nejustificată a meritelor lui Darwin.

În ceea ce privește *structura Prefeței*, aceasta se limitează la un comentariu tematic al *capitolelor* și nu tratează *categorii de probleme* impuse de o teorie cu adevărat

revoluționară în știință. Prezentarea capitolelor se reduce, în general, la ideile rezumative pe care Darwin deja le scrisese după titlul fiecărui capitol. Această abordare nu aduce aproape nimic nou pentru cititor, cel mai mare neajuns fiind faptul că semnificațiile profunde ale teoriei și ale cărții sunt astfel eclipsate de o reluare mecanică, plată, a subiectelor tratate de Darwin în fiecare capitol. Dacă ne raportăm la *Prefața* primei ediții în limba română a *Originii speciilor*, cea din 1957, observăm că aceasta este structurată pe categorii de probleme: concepția lui Darwin, metodele de lucru, comentarii privind esența teoriei, caracterul ei revoluționar, conexiunile cu filosofia, ideologia politică, istoricul darwinismului la noi în țară. Dacă ar fi să comparăm exagerările din cele două prefețe, atunci trebuie spus că *Prefața* ediției din 1957 (Mârza, 1957) exagerează în ceea ce privește asocierea darwinismului cu ideologia regimului politic comunist din România și URSS, în timp ce *Prefața* actualei ediții (Murariu & Popescu, 2017) exagerează prin subestimarea și relativizarea teoriei lui Darwin în contextul evoluționismului contemporan, devierea atenției cititorului de la adevăratele și principalele noutăți pe care le-a adus teoria darwinistă în epocă (explicarea finalității în natură, un mecanism al evoluției bazat pe procese naturale observabile și demonstrabile, discreditarea definitivă a tezei creaționiste oficiale), relativizarea teoriei sintetice a evoluției fondată pe darwinism.

În ceea ce privește actuala ediție a *Originii speciilor* este de semnalat că nu prezintă un *index* de termeni, foarte util pentru o lucrare științifică de asemenea importanță, așa cum bine a prezentat ediția din 1957.

Prefața prezintă cititorului idei darwiniste în *dezacord* cu spiritul concepției darwiniste. Vom arăta în continuare două cazuri. Primul se referă la modul cum a fost tradusă sintagma „the survival of the fittest”; al doilea, la faptul dacă Darwin a vrut să-i dea teoriei sale științifice o conotație religioasă și, în plus, dacă teoria darwinistă sugerează, independent de Darwin, vreo viziune religioasă.

În ceea ce privește primul caz, în prezenta ediție a *Originii speciilor*, expresia „the survival of the fittest” a fost tradusă prin „supraviețuirea celui mai adaptat”. Această traducere nu este corectă. Expresia „the survival of the fittest” trebuie tradusă prin „supraviețuirea celui mai apt”. Nu numai faptul că „fittest”, conform dicționarului se traduce prin „potrivit, nimerit, capabil”, dar acesta este sensul ideii lui Darwin, de *apt* în mod spontan și pur întâmplător. În contextul unui text evoluționist este o diferență imensă între *apt* și *adaptat*. Termenul *adaptat* creează un cerc vicios pentru că *adaptarea* este un rezultat al acțiunii selecției naturale, *care nu este întâmplătoare*, fiind o trăsătură post-selecție. În logica darwinistă varietățile întâmplătoare utile ale *indivizilor* pot fi considerate apte, potrivite, bine nimerite; adaptările nu sunt trăsături individuale ci *supraindividuale*, ele caracterizează populațiile, subspeciile și bineînțeles speciile. Folosirea cuvântului „adaptat” în loc de „apt” creează, prin urmare, o logică circulară vicioasă binecunoscută: ce produce selecția naturală? Adaptări. Pe cine selecționează? Pe cei mai adaptați. Desigur, o asemenea traducere nefericită poate deruta cititorul care nu cunoaște bine opera lui Darwin. În ediția românească din 1957 a *Originii speciilor* (Darwin, 1957) este folosită corect sintagma „cel mai apt”, ca și în traducerile în limba franceză – „la persistance du plus apte” (de exemplu ediția tradusă de Edmond Barbier și publicată în 1906) (Darwin, 1906). De ce oare nu a fost tradusă corect această atât de bine cunoscută sintagmă darwinistă? Indiferent de motivație, această traducere subminează prezentarea și înțelegerea unui concept darwinist foarte important.

Pe de altă parte, trebuie spus că traducerea și caracterizarea unei opere sau teorii științifice trebuie să țină seama de *spiritul* acelor idei, nu doar de *litera* lor. Despre sintagmele

„selecție naturală" și „luptă pentru existență", Darwin a spus că sunt metafore, pentru că e mai ușor să ne exprimăm în acest fel, dar nimeni nu va trebui să creadă că pot fi comparate cu acțiunile conștiente și voluntare ale omului. Nimic din teoria lui Darwin, teorie care a explicat pentru prima dată științific și materialist *finalitatea* în natură, *nu are caracter teleologic,* finalist. Și totuși Darwin folosește deseori cuvântul *scop* în relație cu vreo utilitate sau acțiunea selecției naturale pentru că așa vorbea el, era doar un fel de a vorbi nu de a argumenta. Iată câteva exemple*:* „… la *Catasetum*, construcția florii este foarte diferită deși folosește pentru același scop;" (Darwin, 1957: 170); „… mijloacele atât de variate prin care se ajunge la același scop; "… prin urmare rezultatele obținute prin selecția naturală în vederea atingerii aceluiași scop general" … (Darwin, 1957: 171).

Să analizăm acum cel de al doilea caz, legat de posibilele conotații religioase ale operei lui Darwin, intenționate sau neintenționate. Am arătat mai sus (la punctul 1) că *Prefața* nu spune nimic despre principalul aport pe care l-a adus publicarea *Originii speciilor* în 1859, faptul că speciile nu sunt create, ci produsul unei evoluții naturale. De aici au venit majoritatea criticilor, vechi și mai noi, față de cartea lui Darwin, faptul că teoria lui materialistă ar conduce la ateism, fapt greu de suportat pentru o societate structurată pe autoritatea și supremația ideologică a „adevărului" dogmelor religioase. Cu toate acestea, ultimele rânduri din cartea lui Darwin prezintă o afirmație curioasă pentru litera și spiritul întregii sale teorii. Astfel, referindu-se la forțele care ar fi putut duce în trecut la apariția vieții „dintr-un început atât de simplu", Darwin scrie, în discordanță cu tot textul cărții sale, cuvintele: „însuflețite inițial de Creator în câteva forme sau numai în una singură". Despre această afirmație cititorul trebuie să știe că ea nu a fost scrisă în prima ediție din 1859 a *Originii speciilor*, unde era scris „însuflețite inițial în câteva forme sau numai în una singură". Aluzia la Creator a fost inserată de Darwin în ediția a II-a și următoarele (șase în total), ca urmare a presiunilor colosale venite asupra lui din toate direcțiile societății, privind implicațiile teoriei selecției naturale asupra credinței religioase.

În condițiile în care *Prefața* nu face nicio aluzie la caracterul materialist al teoriei darwiniste, la faptul că principalul merit al lui Darwin este acela că teoria sa explică adaptarea, diversitatea și evoluția prin *procese naturale*, discreditând definitiv ideea de plan al creației și creator responsabil de existența și adaptările speciilor, selectarea pe coperta a II-a a cărții, acum editate, tocmai a acestui text, ni se pare un fapt nepotrivit, chiar manipulator, și nereprezentativ pentru teoria lui Darwin. Textul de care vorbim nu aparține *Prefeței* și, deci, nu se reproșează ceva în această privință autorilor *Prefeței*, dar, pe de altă parte, nici *Prefața* nu spune nimic despre faptul că teoria lui Darwin este o alternativă științifică la vechea dogmă a creației speciilor. *Prefața* nu denunță teza creaționistă, cuvintele „creație", „creator" lipsind din textul *Prefeței*. Nu putem demonstra dacă, cu acest citat reprodus pe copertă, s-a urmărit transmiterea ideii că darwinismul nu este chiar atât de opus religiei, dar este în mod categoric un act în dezacord cu spiritul concepției materialiste a lui Darwin, act care se încadrează, întâmplător sau nu, în strategia de protecționism religios din școala publică românească, despre care am arătat mai sus.

O altă obiecție rezultă din modul cum autorii *Prefeței* justifică necesitatea republicării prezentei ediții a *Originii speciilor*; la pagina XVIII ei afirmă: „Ne putem întreba de ce mai este nevoie de o publicare a *Originii speciilor* în limba română, la aproape 160 de ani de la apariția primei ediții". Răspunsul dat la această problemă este că „marele public" și „elitele societății" nu cunosc suficient de bine teoria lui Darwin: „putem spune că subtilitățile teoriei sale au rămas practic necunoscute, nu doar la nivelul publicului larg, ci și în cercurile

de elită ale societății din România” (pagina IX); „cele mai mici nuanțe ale teoriei sunt încă necunoscute atât în rândul marelui public, cât și la nivelul elitelor societății” (pagina XVIII).

Referitor la aceste explicații ale autorilor facem două observații. Mai întâi faptul că în toată expunerea *Prefeței* nu se dă nici un exemplu de „subtilitate” care a rămas „necunoscută”, deși se sugerează că această afirmație este un argument important, care justifică republicarea acum a cărții lui Darwin. În al doilea rând observăm că autorii *Prefeței*, membri ai Academiei Române, își exprimă de două ori îngrijorarea că „marele public” și „elitele societății” nu cunosc suficient de bine teoria darwinistă, dar nu-și exprimă îngrijorarea că elevii din școlile publice românești nu-l cunosc pe Darwin, *evoluționismul fiind scos din programa școlară* de liceu. Ar fi fost acum un prilej bun ca Academia Română să-și exprime punctul de vedere față de decizia responsabililor din Educație de a priva biologia de explicarea în mod corespunzător a evoluției, și să recomande reintroducerea predării evoluționismului la liceu, odată cu studiul geneticii.

Un alt text pe acest subiect (al popularizării darwinismului) rămâne neclar pentru cititori: „Dacă din varii motive anul Darwin 2009 a trecut cu prea puține evenimente dedicate vieții și operei celui care încă din 1837 a avut inspirația schițării unui arbore filogenetic, o temă controversată (a programei școlare de biologie în țara noastră) a dominat numeroase emisiuni ale mediei audio-vizuale și tot atât de numeroase pagini ale mediei scrise” (pagina IX).

Ce pot înțelege cititorii neavizați din acest text, care sună ca o scuză? Trebuie arătat că în România, din anul 2006 s-a hotărât, prin hotărâre de ministru, eliminarea explicației evoluționiste din biologia școlară. În anul 2009, „Anul Darwin”, întreaga lume civilizată a celebrat bicentenarul nașterii lui Charles Darwin și 150 de ani de la publicarea lucrării sale capitale, *Originea speciilor*. Mulți cititori (printre care și Derevenco, 2011) s-au așteptat ca în acest an omagial să fie reeditată la noi în țară *Originea speciilor*, fapt care nu a avut loc. Totodată, cititorul se va putea întreba ce legătură există între „o temă controversată”, cea „a programei școlare de biologie în țara noastră”, și inițiativa Academiei Române de a republica, după 60 de ani, această lucrare de referință în știință. Se recunoaște discret că a fost introdusă o cenzură asupra biologiei evoluționiste în școlile publice românești?

O altă problemă de semnalat este aceea că *Prefața* conține idei preluate din cartea lui Darwin și insuficient explicate. Astfel, la pagina XI a *Prefeței* se afirmă că: „selecția naturală determină ca orice formă vie să devină cât mai adaptată condițiilor de viață, ca expresie a progresului organic”. Prezentarea nevoii de adaptare „ca expresie a progresului organic” reprezintă o denaturare în sens teleologic concepției darwiniste asupra selecției naturale, o „lamarckizare” a teoriei darwiniste. Mulți naturaliști de la sfârșitul secolului al XIX-lea și începutul secolului al XX-lea au acceptat teoria evoluției, dar au confundat-o cu o schimbare *automat* progresivă. Darwin face referire la progresul organizației, dar fără sens teleologic: „… fiecare ființă tinde să devină tot mai perfecționată în raport cu condițiile sale. Această perfecționare duce inevitabil la progresul treptat al organizației majorității organismelor vii din lume”; „… selecția naturală, sau supraviețuirea celor mai apți, nu include în mod necesar o dezvoltare progresivă…” (Darwin, 1957: 124-125). Este evident că relația de cauzalitate în textul lui Darwin este inversă față de ce susține *Prefața*: nu adaptarea este expresia progresului organic, cum pretinde *Prefața*, ci progresul organic este expresia adaptării, perfecționarea făcându-se „în raport cu condițiile” de viață ale ființelor. Deci miezul discuției în textul darwinist se referă la *adaptare*, ca rezultat al selecției naturale și nu la progresul organizației, care apare, în viziunea lui Darwin ca un subprodus al adaptării.

Alt exemplu de acest fel se referă la succesul evolutiv al organismelor „inferioare". *Prefața* susține (pagina XII) că Darwin explică persistența tipurilor „inferioare" prin „simplitatea structurii respective, care conferă o rezistență mai mare decât celor cu organizație mai complexă". Darwin, în schimb afirmă că selecția naturală este cea care favorizează persistența „organismelor inferioare" actuale, că „supraviețuirea celor mai apți, nu include în mod necesar o dezvoltare progresivă", dar chiar și așa „ar fi extrem de pripit să presupunem că cele mai multe din numeroasele forme inferioare existente nu au progresat cât de cât…" (Darwin, 1957: 125)". Rezultă clar că nu este vorba de o simplă diferență de „rezistență" între formele inferioare și cele superioare, ci „de avantajul acelor variații care se manifestă și sunt folositoare fiecărui organism în cadrul relațiilor sale complexe de viață" (Darwin, 1957: 125), indiferent de gradul de complexitate a organismelor.

La paginile XIV-XV se afirmă că Darwin a avut o „nedumerire" față de verigile lipsă, fapt lămurit abia de descoperirile din ultimii 30 de ani. Trebuie amintit însă că Darwin a avut ocazia să știe de existența unei faimoase verigi de legătură – fosila *Archaeopterxy*, formă de trecere între reptile și păsări, descoperită în anul 1861, despre care Darwin scrie în ultima ediție din *Originea speciilor*, tradusă și în limba română (Darwin, 1957: 272). Autorii *Prefeței* afirmă, în același context, că *Pederpes* este o formă de tranziție între amfibieni și tetrapode. Afirmația este dubioasă deoarece amfibienii sunt și ei tetrapode!

Prefața emite afirmații pe care le considerăm a fi nejuste față de importanța *teoriei sintetice a evoluției*, bazată pe darwinism. Astfel, la pagina XX se afirmă că „Dobzhansky și Simpson, prin prestigiul lor, au impus teoria sintetică a evoluției". Dobzhansky și Simpson au avut, este cert, un mare prestigiu în lumea științifică, dar teoria sintetică a evoluției s-a impus printr-un volum uriaș de argumente, venite succesiv de-a lungul anilor, din toate domeniile cercetării biologice. Nu este drept să se sugereze că teoria sintetică, validă și astăzi în structura ei generală, ar fi fost impusă prin *autoritate*. Un exemplu clasic de impunere a unei viziuni în știință prin autoritate este cel al teoriei catastrofelor impusă tardiv, în prima jumătate a secolului al XIX-lea, prin autoritatea lui Georges Cuvier. Ca urmare, unii discipoli ai lui Cuvier au fost chiar mai catastrofiști decât acesta, pentru că au crezut în autoritatea marelui savant francez mai mult decât în explicațiile științifice alternative.

Apreciere generală asupra *Prefeței* și actualei ediții în limba română a *Originii speciilor* de Charles Darwin. *Prefața* la actuala versiune în limba română a *Originii speciilor* înfățișează cititorului de azi mai degrabă o descriere a compoziției tematice a cărții lui Darwin, decât relevanța teoriei darwiniste în contextul științei și societății. Darwin este prezentat cititorilor mai curând ca un precursor al teoriilor moderne despre evoluție, decât ca *fondatorul* actualei paradigme în gândirea evoluționistă. Principala contribuție a lui Darwin, conform *Prefeței*, este teza despre originea speciilor dintr-un strămoș comun și reprezentarea evoluției printr-un arbore filogenetic. Aceste idei reflectă doar parțial esența și importanța perenă a darwinismului; în plus, spre finalul expunerii din *Prefață* se arată, în mod exagerat, că reprezentarea evoluției printr-un arbore filogenetic, una din principalele contribuții darwiniste, este astăzi practic „demolată".

Din *Prefață* nu rezultă impactul teoriei darwiniste în afara biologiei (gândire, știință, filozofie, societate), impact calificat de literatură drept „revoluție darwinistă". Coperta IV menționează că *Originea speciilor* „a influențat practic întreaga gândire literară, filosofică și religioasă", dar din *Prefață* nu rezultă de ce. Nu se spune nimic despre invalidarea dogmei creației și a proiectului divin, despre ruperea biologiei de religie, creaționism și mitologie.

Prefața nu menționează nici faptul că biologia evoluționistă contemporană se sprijină pe fundament darwinist, că evoluționismul contemporan este, în fapt, un *darwinism actualizat* (Junker, 2007). Importanța operei lui Darwin în biologia evoluționistă apare, prin urmare, evident relativizată.

Cititorul atent poate observa că *Prefața* pune o amprentă a incertitudinii pe toată opera lui Darwin, care pare în mare parte perimată, îngropată în istorie. Lipsa unui *index* de termeni limitează posibilitatea cititorului de a studia eficient argumentația științifică din textul prestigioasei lucrări. A rămas obscur ce legătură există între „controversata temă a programei școlare” din anul 2009 și importanța pentru republicare a operei lui Darwin. Este, de asemenea regretabil faptul că autorii *Prefeței* argumentează nevoia republicării cărții fundamentale a lui Darwin doar pentru că marele public și elitele societății nu-l cunosc suficient de bine pe Darwin, și faptul că s-au înregistrat progrese ulterioare în domeniu științelor naturii, fără a denunța, cu acest prilej, eliminarea explicației evoluționiste în biologia din școlile publice din România. Prin modul cum a fost concepută *Prefața*, una dintre cele mai strălucite cărți de știință scrise vreodată, *Originea speciilor* de Charles Darwin, este adusă într-o manieră neașteptat de modestă în fața publicului cititor actual.

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