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Studii comparative privind biodiversitatea habitatelor costiere, impactul antropic şi posibilitățile de conservare şi restaurare a habitatelor de importanță europeană dintre Capul Midia şi Capul Kaliakra

Volum cu lucrările Conferinței de la Constanța
(Mamaia, 26-28 septembrie 2008)

Proiect implementat de: Universitatea Ovidius Constanța
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MARIUS FĂGĂRAŞ (coord.)

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Prefață

Acest volum reuneşte o bună parte a lucrărilor ştiinţifice prezentate şi discutate în cadrul Conferinţei internaţionale organizată la Constanţa (Mamaia, 26-28 septembrie 2008) în cadrul proiectului transfrontalier Phare CBC Ro 2005/ 017-535.01.02.02, proiect implementat de Universitatea "Ovidius" Constanţa, în parteneriat cu Agenţia de Protecţie a Mediului Constanţa şi Getia Pontica Association, ONG din oraşul Kavarna, Bulgaria.

Scopul principal al Conferinţei a fost popularizarea activităţilor de cercetare desfăşurate pe teren de către membrii echipei de proiect în zona costieră transfrontalieră dintre Capul Midia (România) şi Capul Kaliakra (Bulgaria), cercetări care au vizat studiul habitatelor naturale şi al biodiversităţii costiere în complexitatea sa (floră, asociaţii vegetale, fauna de nevertebrate, herpetofauna şi avifauna). Au fost vizate de asemenea, aspecte legate de impactul antropic în zona costieră, urmărindu-se găsirea unor soluţii viabile pentru diminuarea efectelor negative ale activităţilor umane în regiunea litoralului vestic al Mării Negre, concomitent cu protecţia şi conservarea habitatelor naturale, a florei şi faunei tipice acestor habitate.

Studiul comparativ al biodiversităţii din zona sudică a litoralului românesc, intens antropizată şi zona nordică a litoralului bulgăresc, relativ bine conservată, au confirmat faptul că o mare parte a pierderilor de biodiversitate de la litoralul românesc al Mării Negre, semnalate în literatura de specialitate şi constatate pe teren, sunt consecinţa activităţilor antropice, mai ales a dezvoltării turistice explozive din cea de-a doua jumătate a secolului XX.

Situaţia actuală a biodiversităţii din zona costieră a Dobrogei sudice este bine reflectată în lucrările din acest volum, lucrări care aduc date ştiinţifice noi, dar şi confirmări sau infirmări ale cunoştinţelor din literatura de specialitate. Principalul merit al acestui volum este faptul că reuneşte informaţie ştiinţifică complexă cu privire la tipurile de habitate şi biodiversitatea costieră a Dobrogei româneşti şi bulgăreşti, începând cu zona infralitorală, continuând cu cea mediolitorală şi supralitorală şi terminând cu zonele umede din dreptul lacurilor paramarine, cu fâşiile de stepă din apropierea falezei sau cu pădurile şi tufărişurile submediteraneene ale falezelor terasate din zona bulgărească a Dobrogei. Sunt prezentate de asemenea în acest volum aspecte ale educaţiei ecologice desfăşurate de către ecologişti inimoşi, membrii ai unor ONG-uri din România şi Bulgaria, care au participat la Conferinţa noastră în calitate de invitaţi.

Sperăm ca acest volum să fie bine primit în lumea ştiinţifică din România şi Bulgaria, cu atât mai mult cu cât realizarea lui este rezultatul colaborării strânse dintre specialişti români şi bulgari din diferite domenii ale Biologiei şi Ecologiei.

Doresc să mulţumesc pe această cale atât membrilor echipei de proiect şi invitaţilor noştrii care au pregătit lucrări ştiinţifice, cât şi distinşilor referenţi ai volumului.

coordonatorul volumului
Dr. Marius Fagaras

Preface

This volume brings together most of the scientific papers presented and discussed during the International Conference organized in Constanta (Mamaia, September 26-28, 2008), within the trans-border project PHARE CBC Ro 2005/ 017-535.01.02.02, which was implemented by "Ovidius" University Constanta in partnership with the Environmental Protection Agency Constanta and Getia Pontica Association, NGO from Kavarna, Bulgaria.

The main purpose of the Conference was the popularization of the field research activities the project team members accomplished in the cross-border coastal area between Cape Midia (Romania) and Cape Kaliakra (Bulgaria). These researches targeted the study of the natural habitats and coastal biodiversity in its complexity (flora, plant associations, invertebrate fauna, herpetofauna and avifauna). The field studies also targeted aspects related to the anthropogenic impact on the littoral habitats, on their specific flora and fauna, looking for viable solution and the reduction of the negative effects caused by the human activities in the western part of the Black Sea littoral, together with the protection and preservation of the natural habitats, of the wild flora and fauna.

The comparative study of the biodiversity in the southern part of the Romanian littoral, intensely anthropic, and the northern part of the Bulgarian littoral, relatively well preserved, have confirmed that much of the biodiversity losses signaled in the specialized literature and noted on the field are the consequence of the anthropic activities, especially of the explosive touristic developments in the second part of the 20^{th} century.

The current situation of the coastal biodiversity of southern Dobrogea is well reflected in the papers in this volume, as they offer many new scientific data, but they also bring confirmations or contradictions of the specialty literature. The main merit of this volume is that is brings together complex scientific information regarding the coastal biodiversity of Romanian and Bulgarian Dobrogea, starting with the infra-littoral area and continuing with the mid-littoral and supra-littoral, and ending with the wetlands around the paramarine lakes, the steppe strips on and behind the seawall or the sub-Mediterranean forests and bushes of the terraced seawalls in the Bulgarian area of Dobrogea. The volume also includes aspects of ecological education accomplished by devoted ecologists, members of NGOs in Romania and Bulgaria, which participated in our Conference as guests.

We hope that this volume will be well received in the scientific community in Romania and Bulgaria, as its existence is the result of the strong collaboration between Romanian and Bulgarian specialists in different fields of biology and ecology.

I wish to thank the project members and the guests that prepared scientific papers for this volume, as well as the distinguished scientific reviewers of the volume.

volume coordinator
Marius Făgăraş, Ph.D.

GENERAL PRESENTATION OF THE PHARE CBC PROJECT RO 2005/017 – 535.01.02.02

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Abstract: This cross-border project took place over a period of 14 months through the program PHARE CBC, financed by the European Union and the Romanian Government. The project was based on the partnership between "Ovidius" University Constanta, The Environmental Protection Agency (EPA) and Getia Pontica Association of Kavarna. The aim of the project was to develop a durable partnership, to have joint activities for research and monitoring of the biodiversity in the Romanian and Bulgarian coastal area of Dobrogea, to estimate the anthropogenic impact on the natural habitats, on the wild flora and fauna, as well as to find common solutions for the preservation of the habitats that have not yet been affected by human activities or to restore those affected. The project results were presented in two Conferences organized in Constanta and Kavarna and they were also published in scientific books and papers.

Keywords: PHARE CBC project, coastal biodiversity, anthropogenic impact, conservation, habitats, Cape Midia, Cape Kaliakra.

Introduction

The aim of our cross-border project was to establish a durable partnership between "Ovidius" University Constanta (the Faculty of Natural and Agricultural Sciences), the Environmental Protection Agency (EPA) from Constanta and the "Getia Pontica Association for Ecology and Sustainable Developement" NGO from Kavarna, Bulgaria, with the purpose of organizing joint field research, information exchanges and monitoring activities of the coastal habitats and biodiversity (flora, plant communities, fauna, birds) in the terrestrial coastal area between Cape Midia (Romania) and Cape Kaliakra (Bulgaria) (Fig. 1), on a shore length of approximately 130 km.

Such a project is an interesting idea because the area between Cape Midia and Vama Veche is a touristic area, much affected by economical activities, while the area between Durankulak and Cape Kaliakra (Bulgarian Dobrogea) is relatively well preserved, with sand dune vegetation, steppe vegetation and wetlands. Our field research data, compared with that bibliographical information, will indicate the extent to which the biodiversity losses in the southern area of the Romanian Black Sea shore are due to anthropogenic factors.

As a result of our studies we wrote a common Strategy for the conservation of the coastal biodiversity of Dobrogea between Cape Midia and Cape Kaliakra. The implementation of this strategy by the environmental Authorities will lead to the improvement of the management plans in the Romanian and Bulgarian coastal areas of Dobrogea.

The increased involvement of local and central authorities, as well as the interest of the riverside residents in the problems of biodiversity preservation and of the conservation and restoration of natural habitats, was another objective of the project.

Our collaboration with the Bulgarian partners in this field will continue in the future through joint monitoring actions, in order to ascertain the way in which the results of our collaborative actions will lead to the improvement of the management of the coastal terrestrial territory, the protected areas or other zones that are remarkable through their biodiversity.

Fig. 1 – The studied coastal area between Cape Midia and Cape Kaliakra

Material and Methods

The inventory of biodiversity from the terrestrial coastal area between Cape Midia and Cape Kaliakra has been accomplished through numerous field trips both in Romania and Bulgaria, between April and August 2008.

For the determination of botanical and zoological material, the researchers used specific books such as: Flora Europaea [Tutin T.G. (eds.), vol. 1-5, 1964-1980], Flora of Romania, vol. 1-13 (Săvulescu Tr., 1952-1976), The Illustrated Flora of Romania (Ciocarlan V., 2000), The Romanian Fauna, Red Data Book of the People's Republic of Bulgaria, Volume 2- Animals (Botev et al., 1984), Red Data Book of the People's Republic of Bulgaria, Volume 1- Plants [Velchev V. (ed.) et al., 1984], Flora of Dobrudja (Kitanov, Penev, 1980), etc.

The botanical nomenclature is in accordance with the Romanian Flora and Flora Europaea.

The identification of plant communities was made by means of the phytocenological survey method, in accordance with west-European methodology (Zurich-Montpellier). The names of plant communities are in accordance with the International Code of Phytosociological Nomenclature (Weber et al, 2000).

In case of rare and endangered species, their threatening degree was established on the basis of Romanian Red Lists (Negrean G., 2001, Dihoru Gh., 1994, Oltean M. and al., 1994), the Red Data Book of the People's Republic of Bulgaria, IUCN Red List of Threatened Species (2008), The Annexes of Bern Convention, Bird Directive 79/409/EEC, etc.

For the identification and characterization of natural coastal habitats with conservative interest we used some scientific materials, such as: The Habitats of Romania (Donita N. and al., 2005), CORINE biotopes manual: Habitats of the European Communities, 1991, Habitats Directive 92/43/EEC, A classification of Palearctic habitats (Devillers, 1997), Manual for the Interpretation of Natura 2000 Habitats in Romania (Gafta, Owen, 2008), Biodiversity of Dobrudja (Skolka et al., 2005), Threaten and Rare Plant Communities in Bulgaria (Velchev, Bondev, 1984), etc.

The mapping of the coastal habitats with European conservative importance (according to the Habitats Directive) and also the rare and endangered plant populations was made by a cartographer.

For the fauna diversity analysis, samples from specific terrestrial ecosystems were collected, both from the beaches and the cliffs. Quantitative samples were taken using specific methods – the entomological net for flying insects and Barber traps for terrestrial fauna. Birds, reptiles and mammals were observed "in situ" and identified with specific methods – direct observation, field guides etc.

Results and Discussions

In the context of the adhesion of Romania and Bulgaria to the European Union and of environmental legislation uniformity, it is necessary to elaborate plans of cross-border management that are applicable to the entire coastal zone of Dobrogea (both Romanian and Bulgarian). To this purpose, a general evaluation of the coastal biodiversity of Dobrogea is necessary. Without a systematic inventory of the flora and fauna in the southern part of the Romanian littoral and northern part of the Bulgarian seacoast, the biodiversity losses will be neither correctly estimated nor limited.

There is an imperative need for a Red List of vascular plants in the littoral zone of the Romanian and Bulgarian Dobrogea, which should not take into account borders, but only the size of populations, of territory and also the risk factors. It is also necessary to identify and locate the habitats of European interest, in order to be able to impose adequate measures for conservation and restoration beyond the territorial limits of the two neighboring countries.

The implementation of the "Natura 2000" European network of protected areas but also of other environmental programs has encountered difficulties (at least in Romania) because of the lack of updated information regarding the coastal biodiversity, the distribution of habitats of European interest in the littoral zone and also the rare flora and fauna species.

A complete evaluation of the biodiversity in both zones of Dobrogea will permit the elaboration of a Strategy regarding the conservation of coastal biodiversity in the Romanian and Bulgarian coastal area of Dobrogea, valid on both sides of the common border. The management of the coastal zone, especially of the sites of European importance, could be much improved as a result of the books we realized.

In this context, our project had the following objectives:

a). The development of a durable partnership between the project partners with the purpose of realizing collaborative actions of research and monitoring of the coastal biodiversity between Cape Midia and Cape Kaliakra;

b). A better knowledge of the Romanian and Bulgarian coastal area and of the management applied for the protection of biodiversity and habitats of conservative interest;

c). The evaluation of the current biodiversity (flora, fauna) situation over the entire coastal area of Dobrogea, through cross-border research realized over the entire vegetation period;

d). The identification, mapping and monitoring of the natural habitats of European interest, of the plant communities, of the rare plant and animal populations (in accordance with the UNEP-WCMC database, IUCN Romanian and Bulgarian Red Lists, Bern Convention) and of those areas with remarkable biodiversity;

e). The identification of unprotected coastal areas with large plant and/or animal diversity and the mapping of those areas;

f). The evaluation of the anthropogenic impact over the natural coastal habitats and of the biodiversity losses determined by the economical activities.

g). The identification of solutions for the conservation and restoration of important habitats (according to the Habitats Directive) in the coastal areas that have been strongly affected by human activities.
h). The publishing of a Strategy regarding the conservation of coastal biodiversity in the Romanian and Bulgarian coastal zone of Dobrogea; this should help both the implementation of the European environmental programs in the western coastal area of the Black Sea and the improvement of the coastal management between Cape Midia and Cape Kaliakra.
i). The publication of a scientific book with our scientific results and a Volume containing scientific papers presented by lecturers within the Conferences;
j). the wide popularization of our joint activities and results both in Romania and Bulgaria within Conferences (organized in Constanta and Kavarna);
k). A wide dissemination of the research results, as scientific papers/reports and also materials (brochure, folders) that should be easily accessible to non-specialists and common citizens.
l). The Setting up of the Information Centre regarding the Dobrogea coastal biodiversity and a website (www.coastal-biodiv.ro);

All these ambitious objectives could not be realized without the consistent institutional partnership and established between the Faculty of Natural and Agricultural Sciences ("Ovidius" University Constanta), the Environmental Protection Agency (EPA) and "The Association for Ecology and Sustainable Development-Getia Pontica", NGO from Kavarna (Bulgaria).

Ovidius University Constanta is a public education institution, with competences in the field of scientific research. The Faculty of Natural and Agricultural Sciences has participated in numerous projects in the field of biodiversity protection and conservation, projects that materialized in the publication of scientific books and papers. Due to the experience accumulated over time, it took responsibility for the coordination of this project.

The Environmental Protection Agency Constanta is the most important local authority responsible for the implementation of environmental programs (for example, Natura 2000, Habitats Directive, etc.), of biodiversity monitoring and of administration of protected areas in Constanta district.

The Association for Ecology and Sustainable Developement "Getia Pontica", member of the environmental NGOs network in Bulgaria, is an NGO with experience in developing projects connected to sustainable development and biodiversity protection in Dobrich district. Through this NGO, the project activities included the participation of specialists from Shumen University, the Faculty of Natural Sciences.

The results of our research addressed certain target groups and final beneficiaries, with competences in implementing environment programs: The Local Environmental Authority, The National Environmental Agency, The Natural Monuments Commission within the Romanian Academy, the Regional legislative authorities (District Councils), the Dobrogea-Littoral Water Department Constanta, the Environmental Guard, environmental NGOs, the riverside residents.

The main activities of the project were:

- Meeting with all the partners in order to establish work groups, methodology and details of the activities according to the grant scheme (April 2008). Work visit to different points of the Romanian coastal area where research activities took place;
- Field research in the coastal zone between Cape Midia and Cape Kaliakra, between April and August 2008. Five field trips were organized in key points of the Romanian coastal zone between Cape Midia and Vama Veche and other five in the northern coastal area of Bulgaria between Durankulak and Cape Kaliakra (Fig. 1);
- The organization of a Conference and a round table in Constanta (September 2008), with three main objectives: the presentation of our field research results, discussions with institution participation about the draft of the Strategy for the conservation of coastal biodiversity of Dobrogea; the wide popularization and dissemination of our collaborative activities;
- The organization of a Conference and a round table in Kavarna (October 2008), together with our Bulgarian partners, with the purpose of popularizing and disseminating project activities and results in Bulgaria.

The project activities could be accomplished due to a large team of specialists from Romania and Bulgaria.

The Romanian project team

- Marius FĂGĂRAŞ, Ph.D. - Ovidius University of Constanta – project Manager and expert in botany, plant ecology, plant conservation;
- Marian-Traian GOMOIU, Ph.D. - Ovidius University of Constanta, member of the Romanian Academy, former Governor of the Danube Delta; expert in marine zoology, ecology, biodiversity conservation;
- Marius SKOLKA, Ph.D. - Ovidius University of Constanta; expert in zoology, marine invasive species, biodiversity conservation;
- Loreley Dana JIANU – Environmental Protection Agency Constanta, Biodiversity Conservation Department; expert in protected areas and environmental legislation;
- Dan COGĂLNICEANU, Ph.D. - Ovidius University of Constanta; expert in zoology, ecology, biodiversity;
- Paulina ANASTASIU, Ph.D. – University of Bucharest, Faculty of Natural Sciences; expert in botany, plant conservation, invasive plants;
- Lenuta BOBE - Ovidius University of Constanta; economist and expert in financial aspects;
- Olivia CHIROBOCEA - Ovidius University of Constanta; English-Romanian and Romanian-English translator/interpreter;
- Gavril NEGREAN - University of Bucharest, expert in botany (volunteer);
- Ciprian SAMOILĂ – Ph.D. student at Ovidius University of Constanta; IT specialist;
- Gabriel BĂNICĂ – Ph.D. student at Ovidius University of Constanta; ornithologist (volunteer);
- Marian TUDOR – Ph.D. student at Ovidius University of Constanta; zoologist (volunteer);

The Bulgarian project team

- Georgi Yordanov GEORGIEV – Getia Pontica Association – Bulgarian team coordinator; biologist;
- Galin GEORGIEV – manager of Getia Pontica Association; field guide;
- Zheni NANOVA – "Konstantin Preslavsky" University from Shumen (Bulgaria), Faculty of Natural Sciences; expert in botany;
- Alexander DOYCHINOV – "Konstantin Preslavsky" University from Shumen (Bulgaria), Faculty of Natural Sciences; expert in zoology, ecology;
- Lenutsa MARCEA – Getia Pontica Association; Bulgarian-Romanian and Romanian-Bulgarian translator/interpreter;

Conclusions

Through our inventories and monitoring of the coastal biodiversity between Cape Midia and Cape Kaliakra, our project has brought numerous new data presented in the scientific books and papers published by our team members;

Through its inter-human relations component, the project facilitated the cooperation between different institutions (Ovidius University of Constanta, the University of Bucharest, the University of Shumen, the Environmental Agency Constanta, etc.) and people with various specializations from Romania and Bulgaria, to the benefit of a better protected and managed environment in the cross-border area between Cape Midia and Cape Kaliakra.

Through the component of dissemination and popularization of information, the project permitted the exchange of information and experience with the Bulgarian partners but also with other organizations involved in the environmental protection problem in Bulgarian and Romania.

Through its strategy component, the project permitted the elaboration of a Strategy of conservation of the coastal biodiversity, as a first step towards the improvement of management plans for the western Black Sea coastal area;

The establishment of a website (www.coastal-biodiv.ro) and of an Information Center regarding the coastal biodiversity of Dobrogea, will facilitate the further dissemination of the environmental information through printed and 'on line' materials.

Since our initial objectives have been reached, we consider that our cross-border project has been a success, to which every team member has brought their contribution.

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TYPES OF HABITATS OF CONSERVATIVE INTEREST AND IMPORTANT PLANT ASSOCIATIONS ON THE SANDY BEACHES BETWEEN CAPE MIDIA AND CAPE KALIAKRA

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Abstract: This paper includes a characterization of all the main types of habitats of European interest, including the priority natural habitats referred to in Annex I of the Habitats Directive and identified in the area of sandy beaches between Cape Midia and Cape Kaliakra. Six types of habitats of conservative interest are characterized, as they are distributed especially in the broad sandy beaches in the proximity of the littoral lakes (Lake Corbu, Lake Siutghiol, Lake Techirghiol, Herghelie Marsh Mangalia, Lake Durankulaka and Lake Shabla). For each type of habitat, the following are specified: the characteristic plant associations, the distribution, the conservation state, the tendency in the conservation state and the main risk factors. The data in this paper are the result of field observations accomplished between April-August 2008, within the transborder project Phare CBC RO 2005/017-535.01.02.02.

Keywords: habitats, plantassociations, conservation, Black Sea shore, sandy beaches, Cape Midia (Romania), Cape Kaliakra (Bulgaria).

Introduction

The coastal area between Cape Midia and Cape Kaliakra, with a length of approximately 130 km, is heterogenous from the point of view of the physico-geographical conditions, with sandy beaches, wetlands, loess seawalls, limestone seawalls and limestone plateaus with steppe vegetation. The variety of the substrate and of the soil is reflected in the diversity of the natural habitats and in the large number of plant communities that populate them, many of them of European importance from the conservation point of view, according to the Directive 92/43/CEE (the Habitats Directive).

Due to the expansion of the touristic resorts, of the abusive construction in the beach area, but also to the lack of a coherent strategy for preservation and sustainable management, the coastal phytodiversity in the Romanian littoral area south of Cape Midia has known a strong decline over the past 15 years. The destruction or serious damage of the natural habitats has led to the disappearance of communities of typically littoral plants and of species of rare psamophile plants at national or European level (that were indicated in this area in bibliographical papers).

In the northern coastal part of Bulgaria, the anthropogenic influences are relatively reduced due to the large surfaces occupied by protected areas: the Lake Dunakulak Natural Complex, the Shabla Complex, the Yailata Natural Reserve and the Kaliakra Reserve. Consequently, the natural habitats are well preserved and they shelter a large diversity of plants, some of them floral rarities already extinct or critically endangered in the southern part of the Romanian littoral. We will mention among these species: *Silene thymifolia, Stachys maritima, Euphorbia paralias, Hypecoum procumbens, Ammophila arenaria ssp. arundinacea, Corispermum*

nitidum, Chamaesycae peplis, Cakile maritima ssp. euxina, etc. The important local populations of these species in the Durankulak Reservation (only 6-8 km south of Vama Veche) demonstrate that their decline in the Romanian littoral is mainly a consequence of the human activities that led to the degradation of the natural habitats.

In this paper, we wish to describe the main habitats of conservative interest in the sandy beaches between Cape Midia (Romania) and Cape Kaliakra (Bulgaria) (Fig. 1), to present their specific plant associations and the risk or potential factors that may determine a rapid degradation of the vegetal blanket in the studied coastal area. We also wish to draw the attention to some areas with high concentration of habitats of conservative interest at EU level (Corbu-Cape Midia, Durankulak, Shabla), where touristic resorts are being built, infringing thus upon their status of protected areas.

Fig. 1 – Sandy beaches with habitats of conservative interest between Cape Midia and Cape Kaliakra (the white points)

Material and Methods

Among the natural habitats inventoried in the coastal area between Cape Midia and Cape Kaliakra, those of conservative interest at EU level were selected. They require a designation as special conservation areas (ASC), according to Annex I of the Habitats Directive and to Annex II of OUG no. 57/2007. For all the described types of habitats, the Natura 2000 codes were specified (from the Habitats Directive) and the codes in the Palearctic Habitats classification system (Pal.Hab.) (Devillers et al., 1996). The conservation status of the habitat described was appreciated with one of the following qualifiers: very good, good, satisfactory and

unsatisfactory. The tendencies in the preservation state of the habitat were appreciated thus: strong decline, small decline, stable, small improvement, improvement.

The specification of the plant associations characteristic to each type of habitat, to the chorological data and to the conservation state were based on the specialized bibliography (Doniță et al., 2005, 2006; Gafta, Mountford et al., 2008; Tzonev et al, 2005, Velchev, Bondev, 1984; Tutin (ed.) et al., 1964-1980; Săvulescu (ed.) et al., 1952-1976; Ciocârlan, 2000; Kitanov, Penev, 1980; Meshinev et al., 1991; Sanda et al., 2001; Georgiev et al., 1998; Făgăraş, 2002, 2003; Skolka et al., 2005) but also on the personal observations and field experience of the paper authors.

The names of the plant associations are in accordance with the International Code of Phytosociological Nomenclature (Weber et al., 2000).

Results and Discussions

The following types of ecosystems are found in the cross-border coastal area between Cape Midia and Cape Kaliakra:

- Wide sandy beaches with psammophile vegetation in the place of former sea bays (Corbu beach) or in the area of the paramarine lakes (Tasaul, Siutghiol, Techirghiol, Belona, Herghelie Marsh Mangalia, Durankulak, Shabla, etc.);
- Large wetlands with mesophile and higrophile vegetation behind the dune strips or in the vicinity of the paramarine lakes (Hergheliei Marsh, Lake Techirghiol, Lake Durankulak, Lake Shabla);
- Narrow beaches with psammophile vegetation at the base of the high seawalls (Constanta, Tuzla-Costinesti, Vama Veche, Durankulak, Krapets);
- Low-height loess seawalls (maximum 30 m) with steppe vegetation between Cape Midia and Krapets;
- Steep or terraced limestone seawalls (heights of 70-80 m) with steppe vegetation and vest-pontic shrubs between Kamen Bryag and Cape Kaliakra;

Among the coastal ecosystems, we will refer only to the area of sandy beaches (supralittoral) covered by psamophile vegetation, where there are several types of natural habitats of conservative interest.

The largest part of the sandy beaches is covered by sand dunes and sandy belts, mobile, semifixed or stabilized by psamophile vegetation. Among the dunes and behind the dune strips, there are low areas, with stronger humitity and salinity, swampy in the heavy rain periods (especially in spring); the substrate turns into a swamp also because of the phreatic waters. Large wetlands with sandy substrate are also located in the vicinity of the littoral lakes, former river-marine lagoons (Lake Corbu, Lake Siutghiol, Lake Techirghiol, Herghelie Marsh, Lake Durankulak and Lake Shabla). The marine shore area, populated by specific vegetation, is located between the sand dunes and the sea.

In the southern Romanian coastal area (Cape Midia-Vama Veche), the dune habitats were mostly destroyed during the 1960s-1970s through the extension of the touristic resorts. This kind of habitats has remained in scattered fragments in the shape of “oases” between the resorts. The situation of these “natural vegetation oases” has worsened drastically since 1995. Currently, the habitats of European interest, some even priority, are endangered because of the building of residential complexes or touristinc points of interest exactly in the area of dune habitats, as it happens between Mamaia and Navodari, North Eforie and South Eforie, 2 Mai and Vama Veche. This is why the situation of beach biodiversity in the southern area of the Romanian littoral is currently disastrous, even after the implementation of the Natura 2000 program in Romania.

The dune habitats are well preserved only in the Agigea Marine Dunes Reservation, natural reserve with a surface of 8 ha. In the northern Bulgarian coastal area, the dune habitats are well represented on the large sandy beaches in front of the littoral Lakes Durankulak and Shabla. In the seawall areas, where the beaches narrow considerably, the presence of this kind of habitats is reduced.

In accordance with Directive 92/43 CEE and OUG 57/2007, the natural habitats of conservative interest are classified as follows:

1). *Natural habitats of European interest* – those types of habitats that:

- are endangered in their natural distribution area;
- have a reduced distribution surface;
- are representative samples for one or more of the five biogeographical regions specific to Romania: alpine, continental, Pannonial, steppe and Pontic (the Black Sea region).

2). *Priority natural habitats* – types of endangered natural habitats, for whose conservation, the European Community has a particular responsibility, due to the reduced proportion of their area on the European Union territory.

- these types of habitats are indicated by an asterisk (*) in Annex I of the Habitats Directive and in Annex II of OUG 57/2007 (OUG regarding the regime of the protected natural areas, the conservation of the natural habitats and of the wild flora and fauna).

In the sandy beaches (supralittoral) area between Cape Midia and Cape Kaliakra, six types of habitats of conservative interest have been identified (Tab. 1). According to the Habitats Directive (Directive 92/43 CEE), they require the designation of Special Conservation Areas (SAC) which must be include in the Natura 2000 European ecological network:

- Annual vegetation of drift lines (Code Natura 2000: 1210; code Pal. Hab: 17.2)
- Embryonic shifting dunes (Code Natura 2000: 2110; code Pal. Hab: 16.211)
- Shifting dunes along the shore line with *Ammophila arenaria* (white dunes) (Code Natura 2000: 2120; code Pal. Hab: 16.212);
- Fixed coastal dunes with herbaceous vegetation (grey dunes) (Code Natura 2000: * 2130; code Pal. Hab: 16.221-16.227, 16.22B);
- Humid dune slacks (Code Natura 2000: 2190; code Pal. Hab: 16.3);
- Mediterranean salty meadows (*Juncetalia maritimi*) (Code Natura 2000: 1410; code Pal. Hab: 15.5);

These types of habitats characteristic to the sandy beaches between Cape Midia and Cape Kaliakra will be described in what follows.

1210. Annual vegetation of drift lines

Characteristics: include plant communities which grow on coarse sand, slightly salty and rich in nitrate substances; they cover the space between the midlittoral and the first strip of dunes.

Distribution: over the entire shore length between Cape Midia and Cape Shabla, including the narrow beaches at the base of seawalls. North of Cape Shabla, the presence of this habitat type can be found only occasionally, on the narrow beaches from the bay area (Russalka, Bolata, Kavarna).

Conservation state: good (in Romania and Bulgaria);

Tendency in the conservation state of the habitat: stable (both in Romania and Bulgaria);

Risk factors: natural (big waves, strong winds) and anthropogenic;

Characteristic plant associations: it includes plant communities from the class *Cakiletea maritimae* R.Tx. et Prsg 1952, as well as *Cakilo euxinae-Salsoletum ruthenicae* Vicherek 1971, *Atripliceto hastatae-Cakiletum euxinae* Sanda *et* Popescu 1999; *Salsolo-Euphorbietum paralias* Pignatti 1952 ssp. *salsoletosum ruthenicae* Pop 1985; *Tournefortietum sibiricae* Popescu *et* Sanda 1975; *Lactuco tataricae-Glaucietum flavae* Dihoru *et* Negrean 1976.

2110. Embryonic shifting dunes

Characteristics: type of habitat made up of high, mobile dunes, partially or not at all fixed by vegetation; the solidification process is in its first stages. The microclimate is characterized by considerable thermal contrasts between night and day, intense solar radiation during the day and low humidity.

Distribution: in several points of the marine shore between Cape Midia and Cape Kaliakra, especially in areas with wide sandy beaches, lacking seawall or with a seawall far away from the sea; type of habitat present on the beaches of Corbu-Cape Midia, Năvodari, Mamaia, North Eforie, South Eforie, Durankulak, Shabla, Krapets, Bolata bay.

Conservation state: unsatisfactory in the Romanian southern coastal area, good in the northern Bulgarian area; seriously affected habitat in the beach area between Mamaia-Navodari, North Eforie and South Eforie and 2 Mai-Vama Veche by the construction of residences and touristic activities.

Trend in the conservation state of habitat: stable (both in Romania and Bulgaria);

Risk factors: natural (strong winds) and anthropogenic (buildings, sand extraction);

Characteristic plant associations: *Elymetum gigantei* Morariu 1957; *Leymo sabulosi-Elymetum farcti* Gehu et al. 1986, *Artemisietum tschernievianae (arenariae)* Popescu et Sanda 1977; *Secali sylvestris-Alyssetum borzeani* (Borza 1931) Morariu 1959; *Aperetum maritimae* Popescu et al. 1980; *Secali sylvestris-Brometum tectorum* Hargitai 1940; *Crambetum maritimae* (Şerbănescu 1965) Popescu et al. 1980, *Convolvuletum persici* (Borza 1931) Burduja 1968.

2120. Shifting dunes along the shoreline with Ammophila arenaria (white dunes)

Characteristics: Habitat of high, mobile or semi-fixed dunes, generally populated by psamophile species of the alliance *Ammophilion arenariae* J. M. et J. Gt. 1969 and *Elymion gigantei* Morariu 1957;

Distribution: only in the Bulgarian coastal area, between Durankulak and Shabla; they do not exist in the Romanian coastal area; the Durankulak beach (the Cosmos camp) is the northernmost point where *Ammophila arenaria* ssp. *arundinacea* was noticed;

Conservation state: very good, due to the small touristic developments in the northern coastal area of Bulgaria;

Trend in the conservation state of habitat: stable;

Risk factors: natural (strong winds) and anthropogenic (buildings, sand extraction);

Characteristic plant associations: *Ammophilo arundinaceae-Elymetum gigantei* Vicherek 1971, *Festucetum beckeri* Sanda, Popescu 1997;

2130. Fixed coastal dunes with herbaceous vegetation (grey dunes) (priority habitat)

Characteristics: coastal habitat made up of low dunes, stabilized and fixed by vegetation, located behind the strips of mobile dunes; the solidification process is advanced. In this habitat type grow usually plant associations of the class *Festucetea vaginatae* Soó 1968.

Distribution: only in the area of wide beaches in the vicinity of paramarine lakes (the beaches of Corbu-Cape Midia, Năvodari, Mamaia, Durankulak and Shabla). This type of habitat was completely destroyed by the extension of the resorts in the Romanian coastal area north of Mamaia.

Conservation state: good in the Bulgarian coastal area, unsatisfactory south of Cape Midia, except the Agigea Marine Dunes Reservation where is good.

Trend in the conservation state of habitat: stable (both in Romania and Bulgaria);

Risk factors: natural (strong winds) and anthropogenic (buildings, sand extraction; garbage disposal on the beach);

Characteristic plant associations: *Scabioso argenteae-Caricetum colchicae* (Simon 1960) Krausch 1965; *Ephedro-Caricetum colchicae* (Morariu 1959) Krausch 1965; *Caricetum colchicae* Simon 1960; *Scabioso argenteae-Artemisietetum campestris* Popescu *et* Sanda 1987; *Plantaginetum arenariae* (Buia *et al*. 1960) Popescu *et* Sanda 1987; *Stachyo atherocalici-Caricetum ligericae* Tzonev & al., 2005.

2190. Humid dune slacks

Characteristics: type of low habitat located located between dunes, with slightly salty soils and high humidity conditions; the solidification process is advanced.

Distribution: in the proximity of the wide beaches of the paramarine lakes (Corbu, Navodari, Mamaia, Herghelie Marsh, Durankulak and Schabla). This habitat does not exist in the coastal areas with seawall.

Conservation state: satisfactory in the Romanian southern coastal area and very good in the Bulgaria;

Trend in the conservation state of habitat: small decrease in Romania and stable in Bulgaria;

Risk factors: anthropogenic (buildings, garbage disposal on the beach);

Characteristic plant associations: *Orchio-Schoenetum nigricantis* Oberd. 1957, *Holoschoeno-Calamagrostietum epigeji* Popescu *et* Sanda 1978; *Lythro-Calamagrostidetum epigei* I.Pop 1968, *Caricetum distantis* Rapaics 1927.

1410. Mediterranean salt meadows (*Juncetalia maritimi*)

Characteristics: type of habitat populated by halophile species with sandy-clay or silty soils, low to medium salty, swamped in spring but dry during summer.

Distribution: in the wet, salty, depression areas of beach, behind the dune strips. Habitat present especially in the wet and salty areas in the vicinity of the littoral lakes (Corbu, Navodari, Mamaia, Herghelie Marsh, Durankulak and Shabla).

Conservation state: satisfactory in the Romanian coastal area and very good in the Bulgarian one. The habitat has been destroyed almost completely between Mamaia and Năvodari.

Trend in the conservation state of habitat: stable in Romania and Bulgaria;

Risk factors: anthropogenic**;**

Characteristic plant associations: *Juncetum littoralis-maritimi* Sanda *et al*. 1998; *Juncetum littoralis* Popescu *et al*. 1992; *Juncetum maritimi* (Rubel 1930) Pignatti 1953; *Teucrio-Schoenetum nigricantis* Sanda et Popescu 2002.

Conclussions

Six types of habitats of European conservative interest have been identified in the sandy beach area between Cape Midia and Cape Kaliakra. They could be easily identified especially by the plant communities that populate them.

On the southern Romanian littoral, the habitats of European importance are fragmented among the resorts and are well represented especially in the wide beaches nearby the paramarine lakes. On the northern Bulgarian littoral, they are well represented especially in the vicinity of Lakes Durankulak and Shabla.

The preservation state of the habitats nearby the sandy beaches is generally unsatisfactory in the southern Romanian coast and good and very good in the northern Bulgarian coast. In the Romanian coastal area south of Cape Midia, the conservation of the habitats of European interest is accomplished accordingly only in the Agigea Marine Dunes Reservation.

The tendencies in the conservation state of the habitats in the Romanian coastal area are negative (decline of habitats), while in the Bulgarian coastal area they are generally stable.

The favorable conservation state of the natural habitats, but also of the flora and fauna species in the vicinity of Lakes Durankulak and Shabla, is explained by their status as protected areas and thus by the reduced human activities in these areas.

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Tab. 1 - Coastal habitats from Cape Midia-Cape Kaliakra seashore area
and their specific plant associations

Code Natura 2000	**Coastal habitat type**	**Code Palearctic Habitats**	**Typical plant associations**
1210	Annual vegetation of drift lines	17.2	*Cakilo euxinae-Salsoletum ruthenicae* Vicherek 1971, *Atripliceto hastatae-Cakiletum euxinae* Sanda *et* Popescu 1999; *Salsolo-Euphorbietum paralias* Pignatti 1952 ssp. *salsoletosum ruthenicae* Pop 1985; *Tournefortietum sibiricae* Popescu *et* Sanda 1975; *Lactuco tataricae-Glaucietum flavae* Dihoru *et* Negrean 1976.
2110	Embryonic shifting dunes	16.211	*Elymetum gigantei* Morariu 1957; *Leymo sabulosi-Elymetum farcti* Gehu et al. 1986, *Artemisietum tschernievianae (arenariae)* Popescu et Sanda 1977; *Secali sylvestris-Alyssetum borzeani* (Borza 1931) Morariu 1959; *Aperetum maritimae* Popescu et al. 1980; *Secali sylvestris-Brometum tectorum* Hargitai 1940; *Crambetum maritimae* (Şerbănescu 1965) Popescu et al. 1980, *Convolvuletum persici* (Borza 1931) Burduja 1968.
2120	Shifting dunes along the shore line with *Ammophila arenaria* (white dunes)	16.212	*Ammophilo arundinaceae-Elymetum gigantei* Vicherek 1971, *Festucetum beckeri* Sanda, Popescu 1997;
* 2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)	16.221,16. 227, 16.22B	*Scabioso argenteae-Caricetum colchicae* (Simon 1960) Krausch 1965; *Ephedro-Caricetum colchicae* (Morariu 1959) Krausch 1965; *Caricetum colchicae* Simon 1960; *Scabioso argenteae-Artemisietetum campestris* Popescu *et* Sanda 1987; *Plantaginetum arenariae* (Buia *et al*. 1960) Popescu *et* Sanda 1987; *Stachyo atherocalici-Caricetum ligericae* Tzonev & al., 2005.
2190	Humid dune slacks	16.3	*Orchio-Schoenetum nigricantis* Oberd. 1957, *Holoschoeno-Calamagrostietum epigeji* Popescu *et* Sanda 1978; *Lythro-Calamagrostidetum epigei* I.Pop 1968, *Caricetum distantis* Rapaics 1927.
1410	Mediterranean salty meadows (*Juncetalia maritimi*)	15.5	*Juncetum littoralis-maritimi* Sanda *et al*. 1998; *Juncetum littoralis* Popescu *et al*. 1992; *Juncetum maritimi* (Rubel 1930) Pignatti 1953; *Teucrio-Schoenetum nigricantis* Sanda et Popescu 2002.

STUDIES CONCERNING FLORA OF LIMESTONE PLATEAU AND CLIFF FROM KAMEN BRYAG – YAILATA (BULGARIA)

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Abstract: During the field research carried out on Kamen Bryag – Yailata territory (NE Bulgaria), we inventoried 338 species and subspecies of vascular plants. Most of them are therophytes and hemicryptophytes, characteristic for grasses communities in area with dry climate. An important percent of flora is represented by Steppe elements and with southern origin (Mediterranean, sub-Mediterranean, Balkan), correlated with the climate of this region. The high number of rare and protected plants (37 taxa) makes this area valuable for conservation process.

Key words: vascular plants, life forms, geo-elements, protected species, Kamen Bryag – Yailata, NE Bulgaria.

Introduction

Kamen Bryag – Yailata area is situated at 18 km north-eastern of Kavarna city and is included into the natural geographic subregion of the Northern Bulgarian Black Sea Coast (Fig. 1). In geological terms this territory is part of the Moesian platform (Georgieva, Vladev, 2007; Geography of Bulgaria, 1982). Here mainly chalky sandstones and marls, middle Sarmatian marly clay and sands are disclosed (Geomorphological Map of Bulgaria) and separate areas with late sarmatian shellfish limestone. East of this territory is established one of the most typical shelves slides with submeridional direction (one of the most dangerous earthquake zones in Bulgaria). Landslides and underground niches are characteristic for cliffs. The soil on the seaside ledge is humus-calcareous. The climate is temperate-continental, but with significant humidity – Black Sea climatic region. The average air temperatures in January are positive, little higher than those inside the coastal Dobrudja. The average temperature amplitude is not high (the average annual air temperature is + 11 °C). The amount of the annual rainfall rarely exceeds 500 mm (rainfall maximum in February). The snow cover is not retained. Surface fluent waters missing due to the karstic terrain (Georgieva, Vladev, 2007; Geography of Bulgaria, 1982).

According to decree 822/2002, Yailata is a protected area. It covers 45.3 ha offering historical and natural attractions. Species of animal and plants, as well as their habitats are protected here. The habitats include communities of grasses with steppic character (Bondev, 1991), forests and shrub formations, coastal limestone cliffs and caves. On the territory of this protected area, according with the information from the reserve entrance, there are 19 rare and threatened plant species, including *Alyssum borzaeanum*, *Goniolimon besserianum*, *Goniolimon tataricum*, *Limonium latifolium*, *Limonium meyeri*, *Opopanax chironium* subsp. *bulgaricum* and also endemic plants *Silene caliacrae* and *Centaurea caliacrae*. To Yailata the biggest subpopulation of *Paeonia peregrina* in Bulgaria is also protected.

For Northern Bulgarian Black Sea Coast there are many botanical studies or information (Panțu, 1925; Prodan, 1935; Prodan, 1936; Prodan, 1939; Paşcovschi, 1938; Kitanov, Penev, 1980; Assyov, Petrova, 2006), but for Kamen Bryag – Yailata territory only few special references exist (Kozhuharov et al., 1997; Kozhuharov et al., 2001).

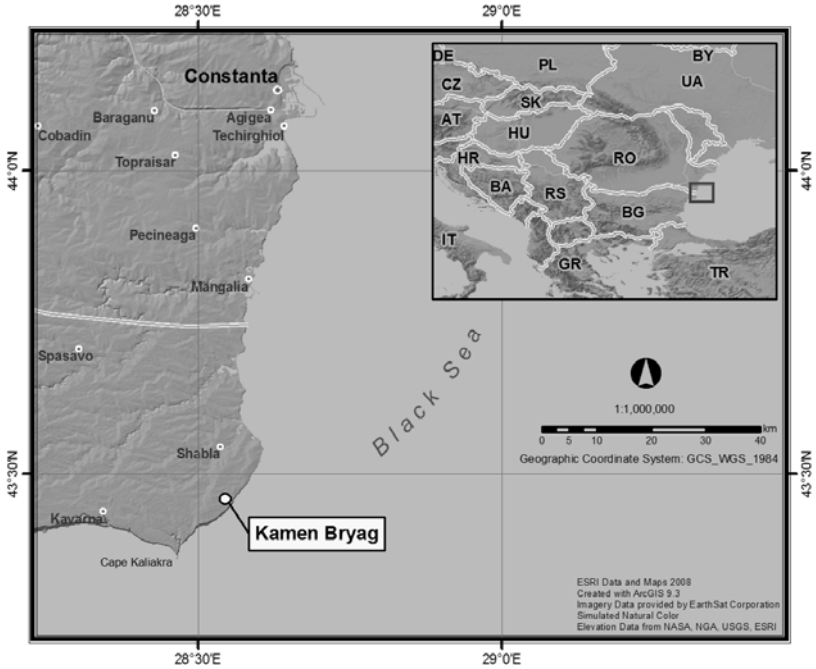

Fig. 1 – The geographic position of Kamen Bryag – Yailata region

Material and Methods

This study was carried out in the April – October 2008 period, using transects method. Transects were outlined so as to cover the maximum area. The length of researched seashore is about 5 km, between 43°27'59"N, 28°33'58"E and 43°25'35"N, 28°31'53"E. Various biotopes were studied: stony grassland from the plateau, vegetal formations of the rocky cliffs, forest and ruderal places too. For rare plants we registered the coordinates in WGS 84 system, using a GPS Garmin eTrex Legend C.

The nomenclature of taxa is according to Flora Europaea (Tutin et al., 1993 ; Tutin et al., 1964-1980). The floristic elements are according to Assyov & Petrova (2006) and Ciocârlan (2000). The life form for each taxon is given after Ciocârlan (2000). Rare and threatened species are according to Red Data Book of Bulgaria [Velchev (ed.), 1984], Biodiversity law and European legislation (The Bern Convention; Council Directive 92/43/EEC; IUCN Red List of Threatened Species, 2008)

Results and Discussions

On the research territory we recorded the next 327 taxa: *Acer campestre*, *Achillea clypeolata*, *Achillea setacea*, *Acinos arvensis*, *Adonis flammea*, *Aegilops cylindrica*, *Aegilops geniculata* [syn. Aegilops ovata], *Agrimonia eupatoria*, *Agropyron cristatum* subsp. *pectinatum*, *Ailanthus altissima*, *Ajuga chamaepytis*, *Ajuga laxmannii*, *Alliaria petiolata*, *Allium flavum* subsp. *flavum*, *Allium moschatum*, *Allium saxatile*, *Althaea cannabina*, *Alyssum desertorum*, *Alyssum hirsutum*, *Amaranthus crispus*, *Amaranthus retroflexus*, *Anthemis austriaca*, *Anthemis cotula*, *Anthemis tinctoria*, *Arabis hirsuta*, *Arctium lappa*, *Arenaria serpyllifolia*, *Artemisia absinthium*, *Artemisia austriaca*, *Artemisia pedemontana*, *Artemisia santonicum*, *Artemisia vulgaris*, *Arum orientale*, *Asparagus verticillatus*, *Asperugo procumbens*, *Asperula tenella*, *Asphodeline lutea*, *Asplenium ruta-muraria*, *Aster oleifolius*, *Astragalus hamosus*, *Atriplex oblongifolia*, *Atriplex tatarica*, *Ballota nigra* subsp. *nigra*, *Bassia prostrata* [syn. *Kochia prostrata*], *Beta trigyna*, *Bombycilaena erecta*, *Brassica juncea* s.l., *Bromus japonicus*, *Bromus squarrosus*, *Bromus sterilis*, *Bromus tectorum*, *Buglossoides arvensis* subsp. *sibthorpiana* [syn. *Lithospermum arvense* subsp. *sibthorpianum*], *Buglossoides purpurocaerulea* [syn.

Lithospermum purpurocaeruleum], *Camelina rumelica*, *Campanula rapunculus*, *Campanula sibirica*, *Cardaria draba* subsp. *draba*, *Carduus pycnocephalus*, *Carduus thoermeri*, *Carpinus orientalis*, *Carthamus lanatus*, *Celtis australis*, *Centaurea alba* subsp. *caliacrae*, *Centaurea diffusa*, *Centaurea napulifera* subsp. *thirkei*, *Centaurea salonitana*, *Centaurea solstitialis*, *Cephalaria transylvanica*, *Cephalaria uralensis*, *Cerastium glomeratum*, *Cerastium pumilum*, *Chamaecytisus jankae*, *Chenopodium album*, *Cichorium intybus*, *Clematis vitalba*, *Clypeola jonthlaspi*, *Conium maculatum*, *Consolida orientalis* [syn. *Delphinium orientale*], *Consolida regalis* s.l., *Convolvulus arvensis*, *Convolvulus cantabrica*, *Convolvulus lineatus*, *Conyza canadensis*, *Cornus mas*, *Corydalis solida*, *Crataegus monogyna*, *Crepis foetida* subsp. *rhoeadifolia*, *Crepis sancta*, *Crithmum maritimum*, *Crocus pallasii*, *Cruciata laevipes*, *Crupina vulgaris*, *Cynanchum acutum*, *Cynodon dactylon*, *Cynoglossum creticum*, *Cynoglossum officinale*, *Dactylis glomerata* s.l., *Datura stramonium*, *Descurainia sophia*, *Desmazeria rigida* [syn. Scleropoa rigida], *Dianthus giganteus*, *Dianthus leptopetalus*, *Dianthus pseudarmeria*, *Dichanthium ischaemum*, *Digitalis lanata*, *Echinochloa crus-galli*, *Echinops ritro* subsp. *ruthenicus*, *Echinops sphaerocephalus*, *Echium italicum*, *Echium vulgare*, *Elymus elongatus* [syn. *Agropyron elongatum*], *Elymus hispidus*, *Elymus repens* [syn. *Agropyron repens*], *Ephedra distachya* subsp. *monostachya*, *Erodium ciconium*, *Erodium cicutarium*, *Erophila verna* s.l., *Eryngium campestre*, *Erysimum cuspidatum*, *Erysimum diffusum*, *Eupatorium cannabinum*, *Euphorbia agraria*, *Euphorbia helioscopia*, *Euphorbia myrsinites*, *Euphorbia nicaeensis* s.l., *Euphorbia seguieriana*, *Falcaria vulgaris*, *Festuca arundinacea* subsp. *orientalis*, *Festuca valesiaca*, *Ficus carica*, *Filipendula vulgaris*, *Fragaria viridis*, *Fraxinus ornus*, *Fumaria kralikii*, *Fumaria rostellata*, *Galanthus elwesii*, *Galium album* subsp. *pycnotrichum*, *Galium aparine*, *Galium flavescens*, *Galium glaucum*, *Galium verticillatum*, *Geranium molle*, *Geranium pyrenaicum*, *Geranium robertianum*, *Geranium rotundifolium*, *Geum urbanum*, *Gleditsia triacanthos*, *Goniolimon besserianum*, *Gypsophila pallasii*, *Haplophyllum suaveolens*, *Hedera helix*, *Helianthemum salicifolium*, *Helianthus annuus*, *Heliotropium europaeum*, *Helminthotheca echioides*, *Herniaria incana*, *Hordeum bulbosum*, *Hordeum murinum*, *Hypericum elegans*, *Hypericum perforatum*, *Inula ensifolia*, *Inula oculus-christi*, *Iris pumila*, *Iris sintenisii*, *Jasminum fruticans*, *Jurinea consanguinea* subsp. *arachnoidea*, *Koeleria lobata* [syn. *Koeleria brevis*], *Koeleria nitidula*, *Lactuca quercina*, *Lactuca serriola*, *Lactuca viminea* s.l., *Lamium amplexicaule*, *Lamium purpureum*, *Lathyrus cicera*, *Legousia speculum-veneris* s.l., *Leonurus cardiaca*, *Ligustrum vulgare*, *Limonium latifolium*, *Limonium meyeri*, *Linaria genistifolia*, *Linum austriacum*, *Lolium perenne*, *Lolium rigidum* subsp. *lepturoides*, *Malva sylvestris*, *Marrubium peregrinum*, *Medicago arabica*, *Medicago minima*, *Medicago rigidula*, *Medicago sativa* subsp. *falcata*, *Melica ciliata*, *Milium vernale*, *Minuartia bilykiana*, *Minuartia glomerata*, *Minuartia setacea*, *Morus alba*, *Muscari racemosum*, *Myagrum perfoliatum*, *Myosotis arvensis* subsp. *arvensis*, *Myrrhoides nodosa*, *Nectaroscordum siculum*, *Onopordum acanthium*, *Onosma heterophylla*, *Opopanax chironium* subsp. *bulgaricum*, *Orlaya grandiflora*, *Ornithogalum comosum*, *Paeonia peregrina*, *Paeonia tenuifolia*, *Paliurus spina-christi*, *Papaver rhoeas*, *Parapholis incurva*, *Parietaria lusitanica* subsp. *serbica*, *Parietaria officinalis*, *Petrorhagia prolifera* [syn. *Tunica prolifera*], *Phleum paniculatum*, *Phleum subulatum*, *Phragmites australis*, *Pimpinella peregrina*, *Pisum sativum* subsp. *elatius*, *Plumbago europaea*, *Poa bulbosa*, *Poa nemoralis*, *Polygonum aviculare*, *Potentilla recta*, *Potentilla taurica*, *Prunus cerasifera*, *Prunus mahaleb*, *Prunus spinosa*, *Psilurus incurvus*, *Puccinelia limosa*, *Pyrus communis*, *Quercus pubescens*, *Ranunculus ficaria*, *Reseda lutea*, *Rhus coriaria*, *Robinia pseudacacia*, *Rubus caesius*, *Rumex patientia*, *Rumex tuberosus*, *Ruscus aculeatus*, *Salsola kali* subsp. *ruthenica*, *Salvia amplexicaulis*, *Salvia austriaca*, *Salvia nemorosa*, *Salvia nutans*, *Sambucus ebulus*, *Sanguisorba minor* s.l., *Satureja caerulea*, *Saxifraga tridactylites*, *Scabiosa ochroleuca*, *Scandix australis*, *Scandix pecten-veneris* s.l., *Scorzonera mollis*, *Sedum caespitosum*, *Sedum maximum*, *Sedum sexangulare*, *Sedum urvillei* subsp. *hillebrandtii*, *Senecio vernalis*, *Senecio vulgaris*, *Seseli campestre*, *Seseli rigidum*, *Setaria verticillata*, *Setaria viridis*, *Sherardia arvensis*, *Sideritis montana*, *Silene latifolia* subsp. *alba*, *Silene bupleuroides*, *Silene caliacrae*, *Silene conica*, *Silene dichotoma*, *Silene exaltata*, *Silybum marianum*, *Sinapis arvensis*, *Sisymbrium officinale*, *Sisymbrium orientale*, *Solanum dulcamara*, *Solanum nigrum*, *Sonchus oleraceus*, *Spergularia media*, *Stellaria media* s.l., *Sternbergia colchiciflora*, *Stipa capillata*, *Stipa lessingiana*, *Tagetes patula*, *Tamus communis*, *Tanacetum corymbosum*, *Tanacetum millefolium*, *Taraxacum officinale*, *Taraxacum serotinum*, *Teucrium chamaedrys*, *Teucrium polium* subsp. *capitatum*, *Thesium dollineri*, *Thlaspi*

perfoliatum, *Thymus pannonicus*, *Thymus zygioides*, *Tordylium maximum*, *Torilis arvensis*, *Torilis nodosa*, *Tragopogon dubius*, *Tragus racemosus*, *Tribulus terrestris*, *Trifolium echinatum*, *Trigonella gladiata*, *Trigonella monspeliaca*, *Triticum aestivum*, *Ulmus minor*, *Urtica dioica*, *Valeriana officinalis*, *Valerianella pumila*, *Verbascum banaticum*, *Verbascum ovalifolium* s.l., *Verbascum phoeniceum*, *Verbena officinalis*, *Veronica austriaca* subsp. *austriaca* [syn. *Veronica jaquinii*], *Veronica hederifolia* s.l., *Veronica orchidea*, *Viburnum lantana*, *Vicia narbonensis*, *Vicia pannonica*, *Vicia peregrina*, *Vicia sativa* subsp. *nigra*, *Vinca herbacea*, *Vincetoxicum hirundinaria*, *Viola kitaibeliana*, *Vulpia myuros*, *Xanthium italicum*, *Xanthium spinosum*, *Xeranthemum annuum*. Other 11 taxa are mentioned by literature (Kozhuharov et al., 1997; Kozhuharov et al., 2001) : *Adonis volgensis*, *Anemone sylvestris*, *Carduus uncinatus*, *Centaurium turcicum*, *Erodium hoefftianum*, *Gypsophila perfoliata*, *Hypecoum ponticum*, *Ruta graveolens*, *Sideritis syriaca*, *Thalictrum aquilegiifolium* s.l., *Verbascum purpureum*. These taxa belong to 62 families. Asteraceae prevails with 53 taxa (15.68%). This is followed by Poaceae with 40 taxa (11.83%), Caryophyllaceae with 21 taxa (6.21%), Lamiaceae with 19 taxa (5.62%), Brassicaceae with 17 taxa (5.02%), Fabaceae with 16 taxa (4.73%), Apiaceae with 15 taxa (4.43%), Rosaceae with 13 taxa (3.84%) and Scrophulariaceae with 10 taxa (2.95%) (Fig. 2). Other 30 families are represented by 9-2 taxa, while 24 families are represented by one taxa.

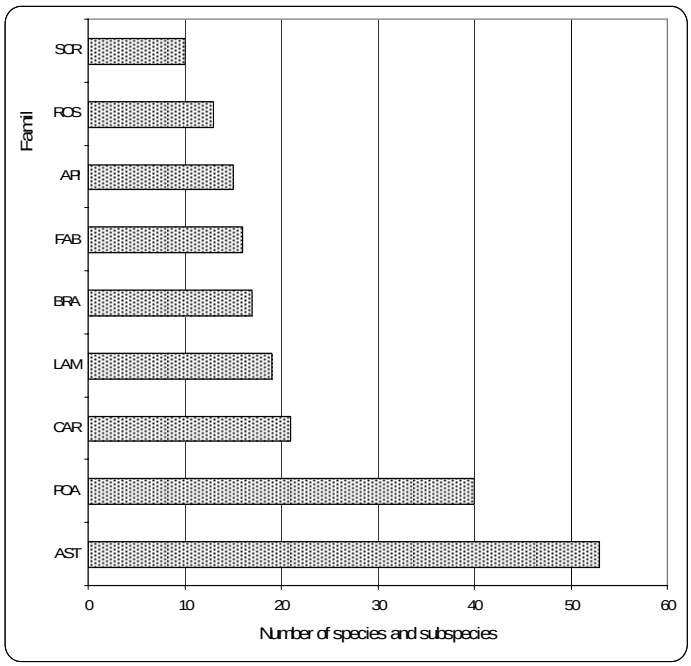

Fig. 2 – Spectrum of the main plant families from Kamen Bryag – Yailata

According to life forms, the flora from Kamen Bryag – Yailata has the following structure (Fig. 3): therophytes – 115 taxa (34.02%), hemicryptophytes – 108 taxa (31.95%), phanerophytes – 26 taxa (7.69%), geophytes – 23 taxa (6.80%), hemitherophytes – 23 taxa (6.80%), chamaephytes – 15 taxa (4.43%), therophytes–hemitherophytes – 13 taxa (3.84%), hemitherophytes–hemicryptophytes – 9 taxa (2.66%), hemicryptophytes–chamaephytes – 2 taxa (0.59%), therophytes - hemicryptophytes – 2 taxa (0.59%), chamaephyte–phanerophyte – 1 taxon (.29%), hemicryptophyte–geophyte – 1 taxon (0.29%). The high percent of therophytes is correlated with dry climate of this area, while the hemicryptophytes are characteristic for grasses communities, at Kamen Bryag – Yailata these dominating the limestone plateau.

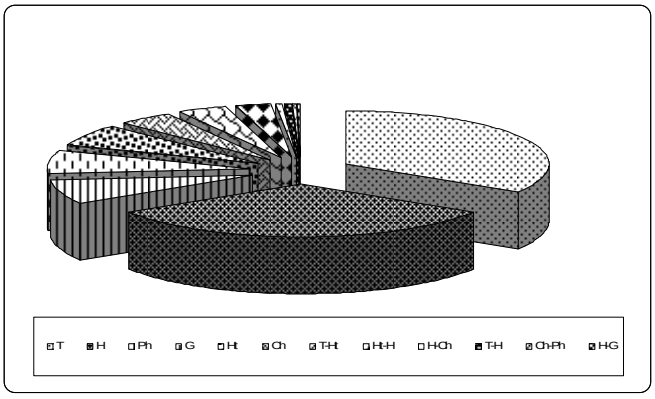

Fig. 3 – Spectrum of life forms of flora from Kamen Bryag – Yailata

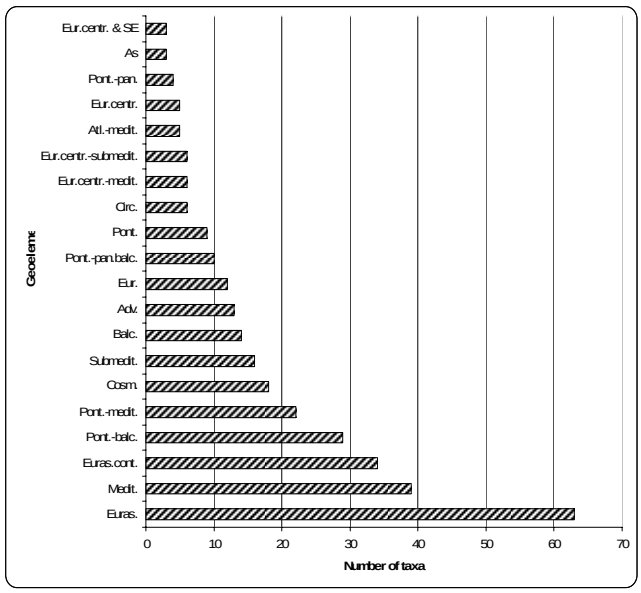

Fig. 4 – Spectrum of the main geographic elements of flora from Kamen Bryag - Yailata

The analysis of geographic elements of flora from Kamen Bryag – Yailata (Fig. 4) reveals the prevailing of Steppe elements (76 taxa – 22.48%): Ponto-Balkan – 29 taxa, Ponto-Mediterranean – 22 taxa, Ponto-Pannonian-Balkan – 10 taxa, Pontic – 9 taxa, Ponto-Pannonian – 4 taxa, Ponto-Caucasian – 1 taxon, Ponto-Mediterranean-Atlantic – 1 taxon. These are followed by Euro-Asian elements (63 taxa – 18.63%), Mediterranean – 39 (11.53%) and continental Euro-Asian elements (34 taxa – 10.05%). Sub-Mediterranean and Balkan elements are well represented too, with 16 taxa (4.73%) and, respectively, 14 taxa (4.14%). Among cosmopolite elements, we identified here 18 taxa (5.32%). Alien plants are represented by 13 taxa (3.84%), but they have only small populations, especially along the roads and pathways.

According with Red Data Book of Bulgaria [Velchev (ed.), 1984], the following rare species were recorded to Kamen Bryag – Yailata: *Adonis volgensis* (Kozhuharov et al., 1997, *Buglossoides arvensis* subsp. *sibthorpiana* – sporadic on limestone plateau, *Carduus uncinatus* (Kozhuharov et al., 1997), *Convolvulus lineatus* – rare on limestone plateau, *Crithmum maritimum* – rare on rocky cliff, *Ficus carica* – frequent on rocky cliff, *Goniolimon besserianum* – sporadic on limestone plateau, *Gypsophila perfoliata* (Kozhuharov et al., 1997),

Hypecoum ponticum (Kozhuharov et al., 1997), *Koeleria lobata* – sporadic on limestone plateau, *Onosma heterophylla* – sporadic on limestone plateau, *Opopanax chironium* subsp. *bulgaricum* – frequent on cliff, *Paeonia tenuifolia* – sporadic on limestone plateau, *Parapholis incurva* – rare in grassland (43°26'33"N, 28°32'55"E), *Scandix australis* – frequent on limestone plateau, *Sideritis syriaca* (Kozhuharov et al., 1997), *Silene caliacrae* – rare on rocky cliff (43°27'11"N, 28°33'31"E), *Stipa lessingiana* – frequent on limestone plateau, *Verbascum purpureum* (Kozhuharov et al., 1997). To these we add four endangered species: *Artemisia pedemontana* – rare on limestone plateau, *Limonium latifolium* and *Limonium meyeri* – rare on rocky cliff, *Ruta graveolens* (Kozhuharov et al., 1997). Among the species listed in Biodiversity Law we recorded on Kamen Bryag – Yailata area: *Paeonia tenuifolia* – sporadic on limestone plateau, *Artemisia pedemontana*, *Convolvulus lineatus*, *Galanthus elwesii* – in a forest at SW of Kamen Bryag (43°25'35"N, 28°31'53"E), *Goniolimon besserianum*, *Limonium latifolium*, *Limonium meyeri*, *Silene caliacrae* – endemic species for this region. *Paeonia tenuifolia* is also strictly protected species according to Bern Convention. Among species listed in Habitat Directive, only *Ruscus aculeatus* grows here. Its harvesting from the wild is forbidden. The conservation status of all these plants is favourable, the threats being almost absent.

Some inventoried plants to Kamen Bryag – Yailata are rare, although they are not included in Red Data Book of Bulgaria [Velchev (ed.), 1984]. They are represented here by only few individuals: *Centaurea alba* subsp. *caliacrae* – local endemic, on limestone plateau, *Centaurea napulifera* subsp. *thirkei* – Mediterranean element, rare on limestone plateau, *Cynoglossum creticum* – Mediterranean element, very rare on limestone plateau, *Dianthus leptopetalus* – Ponto-Balkan element, rare on limestone plateau, reported for the first time for this region, *Fumaria kralikii* – Mediterranean element, rare on rocky places, *Parietaria lusitanica* subsp. *serbica* – Ponto-Balkan element, rare on stony cliff, *Nectaroscordum siculum* – Ponto-Balkan element, very rare in forest, *Pisum sativum* subsp. *elatius* – Mediterranean species, rare in shrub formations at the border of forest, *Salvia amplexicaulis* – Daco-Balkan species, rare on stony grassland from the plateau.

We also mention the presence of some alien species: *Ailanthus altissima*, *Amaranthus crispus*, *Amaranthus retroflexus*, *Brassica juncea*, *Conyza canadensis*, *Datura stramonium*, *Gleditsia triacanthos*, *Morus alba*, *Robinia pseudacacia*, *Xanthium italicum*, *Xanthium spinosum*. These are spread especially along roads and pathways and don't seem to be a threat for the native flora. Occasionally *Triticum aestivum*, *Helianthus annuus*, *Tagetes patula* and *Pyrus communis* could be found as escaped from cultivation.

Conclusions

Taking into account the surface of researched territory (about 300 ha), we assert that the floristic diversity of Kamen Bryag – Yailata is high. Because our study was only a preliminary one, we suspect a higher number of taxa for this region.

Thermophile plants are dominating here, many of them being at the northern limit of their distribution.

Many rare plant species, protected at national or European level, occur to Kamen Bryag – Yailata having a favourable status and making this territory very important for conservation.

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STUDY OF THE HIGHER FLORA ON THE TERRITORY OF KALIAKRA RESERVE

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Abstract: field researches were carried out on the territory of Kaliakra reserve during the period April - August 2008. The purpose of the study is: Inventory of taxonomic diversity, analysis of floristic elements and life forms, establishment of endemic taxa and conservation status of taxa. As a result of the study 351 species of higher plants, referring to 222 genera and 62 families were found. Most of the species relate to two phytogeographic areas - Eastern Mediterranean and steppe-Pontic. 45 species with conservation status were established on the territory of the reserve.

Key words: taxonomic diversity, floristic elements, endemic plants, conservation status

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Introduction

"Kaliakra" is declared for a National Park in 25.09.1941 in 1966 it is categorized as a reserve. In 4.04.1980 its territory was expended and included part of the marine strip. Its main purpose is the conservation of the primary steppe vegetation, some bird species and natural habitats of monk seal (Monachus monachus). The reserve is the only one in Bulgaria that includes a sea aquatory. The total area of the reserve is 687.5 ha (287.5 ha of land part and 400 ha sea part). Kaliakra belongs to a group of the protected territories in the country, category I - strict nature reserve.

Kaliakra reserve is situated on the Cape Kaliakra and neighbouring aquatory. Cape Kaliakra is part of the eastern periphery of Dobrudja plateau and is included into the same name natural-geographic subregion of the Northern Black Sea coast. Cape Kaliakra is shaped into a well-developed rock ledge. In geological terms this territory is part of the Moesian platform (Georgieva et Vladev, 2007; Geography of Bulgaria, 1980). Here lower sarmatian clays, chalky sandstones and marls, middle sarmatian marly clays, chalky sandstones and sands and upper sarmatian shellfish limestone are disclosed (Soil map of Bulgaria, 1965). This is one of the most dangerous earthquake zones in Bulgaria with magnitude 7 (the highest of all regions). There is a serious danger of windstorms and lendslides throughout the region of Cape Kaliakra.The soils on the nose and in the surroundings are humus-calcareous type (Bondev, 1991).

The reserve belongs to the Black Sea climatic region. The climate is temperate continental, but with significant humidity. It features relatively mild, humid winter and dry, hot summer. The average annual air temperature in Kaliakra is 11 ^{o}C. August is the hottest month with average monthly temperatures of 22,5 ^{o}C and the coolest month is January, with average monthly temperature 0.8 ^{o}C. The multi-annual total of rainfalls in the region is 450-500 mm with rainfall maximum in February. In recent years there has been a reduction in the amount of rainfall and climate in the region has become increasingly arid in nature. River flow is irregular due to thekarst terrain (Georgieva et Vladev, 2007; Geography of Bulgaria, 1980).

The Kaliakra reserve occupies the eastern part of South Dobrudja, with vegetation belonging to the steppe and semisteppe communities (Delipavlov et al., 1969). In vegetation mainly grass phytocenoses dominates. The most frequent are found formations, with domination of cereals - *Poa bulbosa, Agropyron* sp., *Koeleria* sp. etc.

The formations of *Stipa pennata* and *Stipa capillata* are relatively widespread . Less distributed are the formations of *Stipa lessingiana, Artemisia pedemontana* and *Artemisia pontica. Iris sp., Adonis sp.* and *Paeonia sp*. develop together with cereal plants in spring. *Achillea sp., Salvia sp., Thymus sp*. etc. appear in June. Species diversity significantly reduced in August (Kozhukharov et al., 1979; Andreev et al., 1992).

Material and Methods

For establishing a floristic composition the route method was applied. The routes were matched so as to cover the most diverse habitats. Much of the identified locations were visited several times during the vegetation period of 2008 (at once in April, May, June, July and August), so the most complete inventory of species composition.

The following indicators were assessed in the floristic analysis: number of taxa by category, the richest in species and genera families, the richest in species genera, biological spectrum, floristic elements, endemic species and taxa with conservation status.

The determination of taxa were carried out with "Guide to the Vascular Plants in Bulgaria" (Andeev et al., 1992) and Flora of Bulgaria, volumes I-X (Yordanov (ed.), 1964-1995). The determination of floristic elements is on a basis of "Conspectus of the Bulgarian vascular flora. Distribution maps and floristic elements" (Assyov et al., 2006). The species with conservation status are associated with: Atlas of endemic plants in Bulgaria (Velchev et al., 1992); Red Book of P.R.Bulgaria, v. 1: Plants (Velchev (ed.), 1984); Biodiversity Law and Annex I of Bern Convention.

Results and Discussion

The flora of Kaliakra reserve includes 351 species of vascular plants, belonging to the 221 genera and 61 families (table 1). The established species constitute 9.84% of the flora of Bulgaria (3567 species) (Yordanov (ed.), 1964-1995) and 25.66% of the flora of Dobrudja (1368 species) (Kitanov, Penev, 1980). The families represented by the biggest number of species are : *Asteraceae* – 56, *Poaceae* – 38, *Fabaceae* – 25, *Lamiaceae* – 21, *Brassicaceae* – 19, *Caryophyllaceae* – 16, *Boraginaceae* – 15, *Apiaceae* – 11, *Scrophullariaceae* – 11, *Liliaceae* – 10, *Rosaceae* – 10.

Tab. 1 - Established in the reserve families with number of genera and species

No.	Family	Number of genera	Number of species
1	*Asteraceae*	31	56
2	*Poaceae*	24	38
3	*Fabaceae*	14	25
4	*Lamiaceae*	12	21
5	*Brassicaceae*	13	19
6	*Caryophyllaceae*	9	16
7	*Boraginaceae*	10	15
8	*Apiaceae*	10	11
9	*Scrophullariaceae*	5	11
10	*Liliaceae*	6	10
11	*Rosaceae*	8	10
12	*Rubiaceae*	4	9
13	*Ranunculaceae*	7	8

14	*Chenopodiaceae*	5	7
15	*Geraniaceae*	2	7
16	*Euphorbiaceae*	2	6
17	*Papaveraceae*	3	6
18	*Dipsaceaea*	2	5
19	*Convolvulaceae*	2	4
20	*Malvaceae*	3	4
21	*Plumbaginaceae*	2	4
22	*Polygonaceae*	2	4
23	*Linaceaea*	1	3
24	*Oleaceae*	3	3
25	*Asclepiadaceae*	2	2
26	*Crassulaceae*	1	2
27	*Cyperaceae*	2	2
28	*Hypericaceae*	1	2
29	*Orobanchceae*	1	3
30	*Plantaginaceae*	1	2
31	*Primulaceae*	2	2
32	*Rutaceae*	2	2
33	*Aspleniaceae*	1	2
34	*Salicaceae*	1	2
35	*Violaceae*	1	2
36	*Valerianaceae*	1	2
37	*Anacardiaceae*	1	1
38	*Apocinaceae*	1	1
39	*Araceae*	1	1
40	*Campanulaceae*	1	1
41	*Cannabaceae*	1	1
42	*Celastraceae*	1	1
43	*Cistaceae*	1	1
44	*Dioscoreaeceae*	1	1
45	*Eleagnaceae*	1	1
46	*Equisetaceae*	1	1
47	*Iridaceae*	1	1
48	*Lithraceae*	1	1

49	*Moraceae*	1	1
50	*Paeoniaceae*	1	1
51	*Resedaceae*	1	1
52	*Rhamnaceae*	1	1
53	*Saxifragaceae*	1	1
54	*Simaroubaceae*	1	1
55	*Solanaceae*	1	1
56	*Tamaricaceae*	1	1
57	*Thymelaeceae*	1	1
58	*Ulmaceae*	1	1
59	*Urticaceae*	1	1
60	*Verbenaceae*	1	1
61	*Vitaceae*	1	1
	Total	221	351

Figure 1 shows the ten largest families in the flora of Bulgaria (Angelova et al., 2006). The families in first three places on both figures are Asteraceae, Poaceae and Fabaceae. The biggest differences between two figures are the positions of families Lamiaceae and Rosaceae. The Lamiaceae, which is in the ninth position for the country moves up to the fourth place for the flora of Kaliakra. The presence of many species of family Lamiaceae is due to a specific geographical location of the research area, namely its proximity to the Eastern Mediterranean and Pontic phytogeographical centres (sources of species for this family). The fact that representatives of the Lamiaceae are mainly thermophytes and xerophytes and they are located in the appropriate environmental conditions in the research area is also important. The last fact is valid and for family Boraginaceae, which is in the seventh position in the flora of Kaliakra, but is not among the ten most numerous families of the Bulgarian flora.

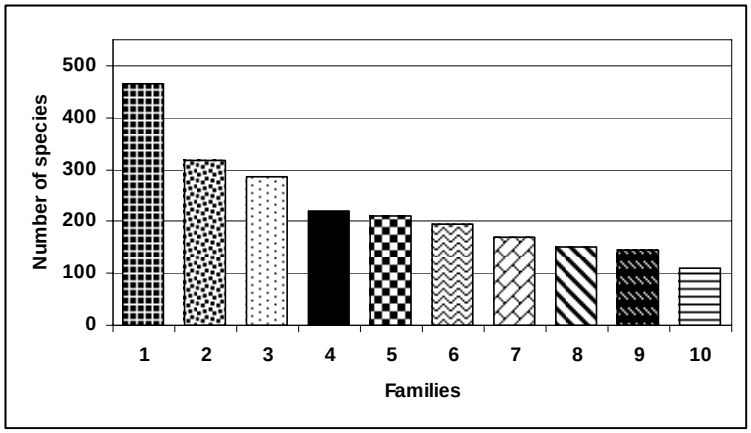

Fig. 1 - The ten richest families in species in the flora of Bulgaria: 1-*Asteraceae*, 2-*Poaceae*, 3-*Fabaceae*, 4-*Rosaceae*, 5-*Caryophyllaceae*, 6-*Brassicaceae*, 7-*Scrophulariaceae*, 8-*Apiaceae*, 9-*Lamiaceae*, 10-*Ranunculaceae*

The *Rosaceae*, which is in the fourth position for Bulgaria, shares a tenth place with *Liliaceae* in flora of Kaliakra. Low representation of the family Rosaceae can be explained by the fact that the family is rich in species of Alpine and Boreal origin for which the environmental conditions in the territory of Kaliakra reserve are not appropriate.

Family *Ranunculaceae*, which is ranks the tenth place for the country is not among the ten most numerous families in the flora of Kaliakra. This is due to the fact that much of the species of family Ranunculaceae are hygrophytes and mesophytes and the environmental conditions in the territory of the reserve do not advantage their development.

The first five families richest in genera are the same five families which are richest in species (Fig. 2): *Asteraceae* – 31, *Poaceae* – 24, Fabaceae – 14, *Brassicaceae* – 13, *Lamiaceae* – 12. From the established genera richest in species are: *Centaurea* – 7, *Astragalus* – 6, *Galium* – 6, *Veronica* – 6, *Bromus* – 5, *Euphorbia* – 5, *Geranium* – 5, *Allium* – 4, *Artemisia* – 4, *Vicia* - 4.

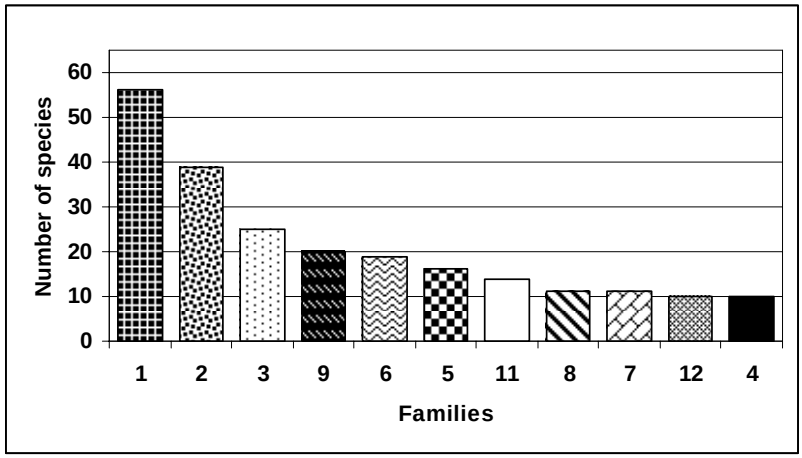

Fig. 2 - The ten richest families in species in the flora of Kaliakra reserve: 1-*Asteraceae,* 2-*Poaceae*, 3-*Fabaceae*, 9-*Lamiaceae*, 6-*Brassicaceae*, 5-*Caryophyllaceae*, 11-*Boraginaceae*, 8-*Apiaceae*, 7-*Scrophulariaceae*, 12-*Liliaceae*, 4-*Rosaceae*

According to their biological type the perennial herbaceous plants prevail in the flora of reserve - 168 species (47,86%); followed by annual herbaceous - 108 species (30,77%). The species in the next group are 28 (7,98%) and it includes: annual to biennial - 17, biennial to perennial – 4 and annual to perennial – 8. This group shares a third place with bushes and trees, also 28 species (7,98%) and the least of all are biennial - 15 species (4.27%).

The floristic genetic analysis shows the following distribution of species in geoelements:

1. Euro-Asian - 60 species (17,09%)
2. Sub-Mediterranean - 49 species (13,96%)
3. Euro-Mediterranean - 47 species (13, 39%)
4. Pontic-Mediterranean - 30 species (8,55%)
5. Cosmopolites – 23 species (6, 55%)
6. Mediterranean - 21 species (5,98%)
7. Euro-Siberian – 16 species (4,56%)
8. European - 15 species (4,27%)
9. Pontic - 13 species (3,70%)
10. Mediterranean-Asian – 13 species (3,70%)
11. Balkan - 12 species (3, 42%)

12. Sub–Boreal – 9 species (2, 56%)
13. Boreal – 8 species (2, 28%)
14. Pontic- Asian - 8 species (2,28%)
15. Adventive – 5 species(1,42%)

Generally, the species of different Mediterranean type of distribution (Sub-Mediterranean, Mediterranean, Euro-Mediterranean and Mediterranean- Asian) are 130, which constitute 37,04% of the total number of species on territory of reserve (Fig. 3).

The site is the richest in steppe-Pontic species in Bulgaria. Their scope is related mainly to the Euro-Asian, Euro-Siberian, Pontic-Mediterranean, Pontic, and Pontic-Asian geoelements. In the territory of the reserve, they are represented by a total of 127 species (36,18%) (Fig. 3).

The environmental conditions in the reserve are not appropriate for Boreal floristic elements (Boreal and Sub-Boreal–4,84%), so they a represented lessthoroughly.

On the territory of the reserve 45 plant species with conservation status are found (Tab. 2) - 15 species according to literary data (Delipavlov et al, 1979) and 30 according to our studies.

Kaliakra Reserve is classified as relatively poor in endemic taxa. Established eleven endemic plants (11 Balkan and 1 Bulgarian), which constitute 3,42% of the total number of species on studied territory. From the endemic species, the largest population has *Achillea clypeolata*. Other endemic species are presented with smaller populations.

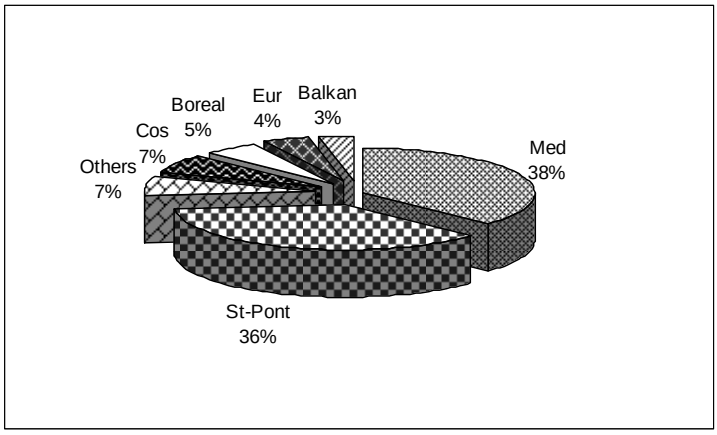

Fig. 3 - Distributions of species in geoelements: Med - species of different Mediterranean type of distribution, St-Pont - steppe-Pontic species, Cos – Cosmopolites, Eur- Europian , Boreal – Boreal and sub-Boreal, Balkan – different Balkan geoelements

Tab. 2 - Conservation status and endemism of plant species in Kaliakra reserve

Species	Endemism, categories	Red Book of Bulgaria, categories	Biodiversity Law Annex, №	Bern Convention
Achillea clypeolata Sibth. et Sm.	Balkan			
Alyssum borzeanum Nyár. *			3	+
Anemone sylvestris L. *		Endangered	3	
Artemisia lerchiana Weber. *		Rare	3	
Artemisia pedemontana Balb.		Endangered	3	
Artemisia pontica L.		Rare		
Astragalus cornutus Pall.		Endangered	3	

Astragalus spuneri Boiss.	Balkan			
Asyneuma anthericoides (Janka) Bornm. *	Balkan			
Aurinia uechtritziana (Bornm.) Cullen et T. R. Dudley *		Rare	2,3	+
Bellevalia sarmatica (Pall.ex Gweorgi) Woronow			3	
Buglossoides arvensis (L.) I.M.Johnst. subsp. *sibthorpiana* (Griseb.) R.Fern.		Rare		
Chamaecytisus jankae (Vel.) Rothm.	Balkan			
Centaurea arenaria M. Bieb. ex Willd. *		Rare	3	
Centaurea caliacrae Prod.	Balkan			
Centaurea napulifera Rochel subsp. *thirkei* (Sch.Bip.) Dostál	Balkan			
Centaurea varnensis Vel.	Balkan			
Cerastium gracile Dufour [syn. *Cerastium bulgaricum* R.Uechtr.] *		Rare		
Cladium mariscus (L.) Pohl.		Rare	3	
Convolvulus lineatus L.		Rare	3	
Crambe tataria Sebeok *		Rare	3	
Erysimum bulgaricum (Vel.)Anchev ex Polatschec	Balkan			
Ficus carica L.		Rare		
Geranium tuberosum L.		Rare		
Goniolimon besseranum (Schult. ex Rchb.) Kusn.		Endangered	3	
Gypsophila perfoliata L. [syn. *Gypsophyla trichotoma* Wender]		Rare	3	
Iris suaveolens Boiss. & Reut. *	Balkan			
Koeleria lobata (M.Bieb.) Roem. & Schult. [syn. *Koeleria brevis* Steven]		Rare		
Lactuca tatarica (L.) C.A.Mey		Rare		
Limonium latifolium (Sm.) O.Kuntze		Endangered	3	
Limonium meyeri (Boiss.) O.Kuntze		Endangered	3	
Matthiola odoratissima (Bieb.)R.Br.		Endangered	2, 3	
Nepeta ucrainica L. *		Rare	2,3	
Onosma heterophylla Griseb.		Rare		
Opopanax chironium (L.) W.D.J.Koch ssp. *bulgaricum* (Vel.) Andr.		Rare	3	
Orobanche essulae Panc. *	Balkan			
Paeonia tenuifolia L.		Endangered	2, 3	+
Potentilla emili-popii Nyár. *	Balkan	Rare	2, 3	+
Ruta graveolens L.		Endangered	3	
Scandix australis L.		Rare		
Sideritis syriaca L. *		Endangered		
Silene caliacrae Jord. et Pan. *	Bulgarian	Rare	3	
Stipa lessingiana Trin et Rupr.		Rare		
Typha shuttleworthii Koch et Sonder *		Rare	3	+

Vicia sativa L. subsp. *amphicarpa* (Dorthes) Asch. & Graebn.		Endangered	3	

*according to the literary data [6]

Erysimum bulgaricum is a newly distinguished species for the Balkan Peninsula from M. Ancev and A. Polatschek (Ancev et al., 2003). *Erysimum bulgaricum* is found in the south-eastern and eastern parts of the Balkan Peninsula. In Bulgaria it is wide-spread in the South-East and East of the country in localities in the Upper Thracia plain, the Tundzha hilly region, along the Black Sea coast (Balchik, Kavarna, Kaliakra cape), in the East Stara Planina and in North-Eastern Bulgaria. Erysimum bulgaricum occurs in dry grassy habitats.

Thirty-three plant species, from the flora of Kaliakra, are included in the "Red Book of Bulgaria" - 11 in the category "Endangered" and 22 in the category "Rare"; 24 species fall into annexes of Biodiversity Law. In the annex 1 of the Bern Convention five species are included. From these species with a few and small populations are: *Astragalus cornutus, Belevallia sarmatica, Limonium latifolium, Limonium meyeri, Matthiola odoratissima, Gypsophila trichotoma, Ruta graveolens*. Well shaped populations have *Artemisia pontica, Ficus carica, Opopanax chironium subsp. bulgaricum, Paeonia tenuifolia, Stipa lessingiana.*

Conclusions

In conclusion, the flora of Kaliakra, in the main part is made up of the species of two phytogeographic areas - Eastern Mediterranean and steppe-Pontic.

Forty five endemic, rare, endangered and protected plant species with high conservation value can be find on territory of Kaliakra reserve.

The primary steppe vegetation, which is distributed on such big area, cannot be found nowhere else in Bulgaria. It determines the territory's exceptional conservation value.

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Annex I - Checklist of the plant species recorded from us of the Kaliakra Reserve

Species	Familia	Floristic element	Biological type
Achillea clypeolata	Asteraceae	Bal	P
Achillea setacea	Asteraceae	subMed	P
Acinos rotundifolius	Lamiaceae	Med-CAs	1
Adonis flammea	Ranunculaceae	Eur-subMed	P
Adonis vernalis	Ranunculaceae	Eur-Sib	P
Aegilops cylindrica	Poaceae	Eur-As	1
Aegilops neglecta [syn. Aegilops ovata]	Poaceae	subMed	1
Agropyron cristatum ssp. pectinatum	Poaceae	Eur-Pont	P
Agropyron cristatum subsp. ponticum	Poaceae	Eur-Pont	P
Agrostis sp.	Poaceae		
Agrostis verticillatus	Poaceae	Eur-As	P
Ailanthus altissima	Simaroubaceae	Adv	T
Ajuga chamaepytis	Lamiaceae	Pont-Med	1,2
Ajuga laxmannii	Lamiaceae	SSib	P
Alcea rosea [syn. Althaea rosea]	Malvaceae	Med	2
Alliaria petiolata	Brassicaceae	Eur-as	1,2
Allium flavum subsp. tauricum	Liliaceae	Med	M
Allium flavum subsp. flavum	Liliaceae	Med	M
Allium moschatum	Liliaceae	Pont-Med	P
Allium rotundum	Liliaceae	Eur-OT	P
Allium saxatile	Liliaceae	Med-As	P
Althaea cannabina	Malvaceae	Med-As	P
Althaea hirsuta	Malvaceae	Pont-Med	P
Alyssum caliacrae	Brassicaceae	Pont	P
Alyssum desertorum	Brassicaceae		1
Alyssum hirsutum	Brassicaceae	subMed	1
Anagallis arvensis	Primulaceae	Cos	1,2
Anchusa arvensis [syn. Lycopsis arvensis]	Boraginaceae	Eur-Med	1
Anchusa stylosa	Boraginaceae	subMed	1

Androsace maxima	Primulaceae	Eur-As	1
Angelica sylvestris	Apiaceae	Eur-Sib	2
Anthemis austriaca	Asteraceae	Eur-Med	1,2
Anthemis tinctoria	Asteraceae	Eur-Sib	P
Arabis recta [syn. Arabis auriculata]	Brassicaceae	Eur-As	1
Arenaria serpyllifolia	Carryophyllaceae	Eur-As	1,2
Artemisia absinthium	Asteraceae	Pont-Med	P
Artemisia austriaca	Asteraceae	Eur-Sib	P
Artemisia pedemontana	Asteraceae	Pont-Med	P
Artemisia pontica	Asteraceae	Pont	P
Arum orientale	Araceae	Med	P
Asparagus verticillatus	Liliaceae	Pont-As	P
Asperula tenella	Rubiaceae	subMed	P
Asphodeline lutea	Liliaceae	Pont-Med	P
Asplenium adiantum-nigrum	Aspleniaceae		P
Asplenium trichomanes	Aspleniaceae	Cos	P
Aster oleifolius	Asteraceae	Pont-Sib	P
Astragalus cornutus	Fabaceae	Pont-As	P
Astragalus hamosus	Fabaceae	Eur-As	P
Astragalus monspessulanus	Fabaceae	Pont-Med	P
Astragalus onobrychis	Fabaceae	Eur-As	P
Astragalus spruneri	Fabaceae	Bal	P
Astragalus varius [syn. Astragalus virgatus]	Fabaceae	Pont-As	P
Atriplex hastata	Chenopodiaceae	Boreal	1
Atriplex nitens	Chenopodiaceae	Eur-As	1
Atriplex oblongifolia	Chenopodiaceae	Eur-As	1
Avena barbata	Poaceae	Med-CAs	1
Avena clauda	Poaceae	Med-CAs	1
Bassia prostrata [syn. Kochia prostrata]	Chenopodiaceae	Eur-as	B
Bellevalia sarmatica	Liliaceae	Pont	P
Beta trigyna	Chenopodiaceae	Med	P
Bombycilaena erecta	Asteraceae	Eur-Med	1
Brachypodium pinnatum	Poaceae	SSib	P
Brachypodium sylvaticum	Poaceae	Eur-As	P
Brassica elongata	Brassicaceae	Eur-as	2, P
Brassica juncea	Brassicaceae	As	1
Brassica nigra	Brassicaceae	Cos	1
Bromus hordeaceus	Poaceae	SMed	1-P
Bromus japonicus	Poaceae	Med-CAs	1
Bromus squarrosus	Poaceae	subMed	1
Bromus sterilis	Poaceae	Boreal	1
Bromus tectorum	Poaceae	Boreal	1

Buglossoides arvensis subsp. sibthorpiana	Boraginaceae	Euro-As	1
Buglossoides purpurocaerulea	Boraginaceae	Eur-As	P
Calystegia sepium	Convolvulaceae	Cos	P
Camelina microcarpa	Brassicaceae	Pont-CAs	1,2
Camelina rumelica	Brassicaceae	Pont-CAs	1,2
Campanula sibirica	Campanulaceae	subMed	2
Capsella bursa-pastoris	Brassicaceae	Cos	1,2
Cardaria draba subsp. draba	Brassicaceae	Eur-Med	P
Carduus pycnocephalus	Asteraceae	Med	1
Carduus thoermeri	Asteraceae	Pont-Pann-Bal	1
Carex michelii	Cyperaceae	Eur	P
Carthamus lanatus	Asteraceae	subMed	1
Celtis australis	Ulmaceae	Med	T
Centaurea caliacrae	Asteraceae	Bal	1
Centaurea diffusa	Asteraceae	Pont-Med	2
Centaurea napulifera subsp. thirkei	Asteraceae	Pann-Bal	1- P
Centaurea salonitana	Asteraceae	Pont-Med	P
Centaurea solstitialis	Asteraceae	Eur-Med	1
Centaurea varnensis	Asteraceae	Bal	2
Cephalaria transylvanica	Dipsacaceae	Pont-Med	1
Cephalaria uralensis	Dipsaceae	Pont-Med	P
Cerastium pumilum	Caryophyllaceae	Eur-Med	1,2
Cerastium glomeratum	Caryophyllaceae	Cos	1
Ceratocephalus testiculatus	Ranunculaceae	Eur-As	1
Cerinthe minor susbsp. auriculata	Boraginaceae	Pont-Med	1-P
Chamaecytissus jankae	Fabaceae	Bal	B
Chenopodium album	Chenopodiaceae	Cos	1
Cichorium intybus	Asteraceae	Eur-Sib	P
Cirsium vulgare	Asteraceae	Eur-Med	2
Cladium mariscus	Cyperaceae	Kos	P
Clematis vitalba	Ranunculaceae	Eur	B
Clypeola jonthlaspi	Brassicaceae	Med	1
Conium maculatum	Apiaceae	Eur-As	1
Consolida regalis	Ranunculaceae	Eur-Med	1
Convolvulus arvensis	Convolvulaceae	Cos	P
Convolvulus cantabrica	Convolvulaceae	Pont	P
Convolvulus lineatus	Convolvulaceae	Eur-As	P
Conyza canadensis	Asteraceae	NAm(Adv)	1
Coronilla scorpioides	Fabaceae	subMed	1
Coronilla varia	Fabaceae	Eur-Med	P
Crataegus monogyna	Rosaceae	subBoreal	B, T
Crepis foetida subsp. rhoeadifolia	Asteraceae	Eur-Med	1
Crepis sancta	Asteraceae	subMed	1

Cruciata pedemontana	Rubiaceae	Med-CAs	1
Crupina vulgaris	Asteraceae	subMed	2
Cynanchum acutum	Asclepiadaceae	Med-CAs	B
Cynodon dactylon	Poaceae	Cos	P
Cynoglossum creticum	Boraginaceae	Med-CAs	1,2
Dactylis glomerata	Poaceae	Eur-As	P
Daucus carota subsp. carota	Apiaceae	Eur-As	1
Dianthus leptopetalus	Caryophyllaceae		P
Dianthus pseudarmeria	Caryophyllaceae	Med	1
Digitalis lanata	Scrophulariaceae	subMed	1,2
Echinochloa crus-gallii	Poaceae	Cos	1
Echinops exaltatus	Asteraceae	Eur	P
Echinops ritro subsp. ruthenicus	Asteraceae	Eur-Sib	P
Echinops sphaerocephalus	Asteraceae	Eur-Med	P
Echium italicum	Boraginaceae	subMed	2
Echium vulgare	Boraginaceae	Eur-As	2
Elaeagnus angustifolius	Eleagnaceae	Adv	B
Elymus elongatus [syn. Agropyron]	Poaceae	Pont-SMed	P
Elymus repens	Poaceae	Boreal	P
Equisetum telmateia	Equisetaceae	Boreal	P
Erodium ciconium	Geraniaceae	subMed	1,2
Erodium cicutarium	Geraniaceae	subBoreal	1
Erophila verna	Brassicaceae	Eur-Med-Cas	1
Eryngium campestre	Apiaceae	Pont-Med	P
Erysimum bulgaricum	Brassicaceae	Bal	P
Erysimum diffusum	Brassicaceae	CSEur	2, P
Euonymus europaeus	Celastraceae	Eur-As	B, T
Eupatorium cannabinum	Asteraceae	Eur-As	P
Euphorbia agraria	Euphorbiaceae	subMed	P
Euphorbia helioscopia	Euphorbiaceae	Eur-As	1
Euphorbia myrsinites	Euphorbiaceae	subMed	P
Euphorbia nicaeensis s.l.	Euphorbiaceae	Eur-Med	P
Euphorbia nicaeensis subsp.dobrogensis	Euphorbiaceae	Eur-Med	P
Falcaria vulgaris	Apiaceae	Eur-As	1-P
Festuca valesiaca	Poaceae	Pont	P
Ficus carica	Moraceae	Med(Adv)	B, T
Filipendula vulgaris	Rosaceae	Euro-Med	P
Fragaria viridis	Rosaceae	Eur-Sib	P
Fraxinus ornus	Oleaceae	subMed	D
Fumaria rostellata	Papaveraceae	Eur-Med	1
Fumaria officinalis	Papaveraceae	Eur-Med	1
Fumaria schleicheri	Papaveraceae	Eur-As	1
Galega officinalis	Fabaceae	Pont-Med	P

Galium album subsp. pycnotrichum	Rubiaceae	Eur-As	P
Galium aparine	Rubiaceae	Eur-As	1
Galium flavescens	Rubiaceae	Bal-Dac	P
Galium glaucum	Rubiaceae	subMed	P
Galium humifusum	Rubiaceae	Eur-Med	P
Galium verum subsp. verum	Rubiaceae	Eur-As	P
Geranium columbinum	Geraniaceae	subMed	1
Geranium dissectum	Geraniaceae	Eur-As	1
Geranium molle	Geraniaceae	Eur-Med	1,2
Geranium rotundifolium	Geraniaceae	Eur-As	1
Geranium tuberosum	Geraniaceae	subMed	P
Glaucium corniculatum	Papaveraceae	Eur-As	1,2
Goniolimon besserianum	Plumbaginaceae	Pont	P
Gypsophila perfoliata (G. trichotoma)	Caryophyllaceae	Eur-As	P
Gypsophila palasii (G. glomerata)	Caryophyllaceae	subMed	P
Haplophyllum suaveolens	Rutaceae	Med	P
Helianthemum salicifolium	Cistaceae	subMed	1
Heliotropium europaeum	Boraginaceae	Eur-As	1
Herniaria incana	Caryophyllaceae	Eur-Med	1
Hordeum bulbosum	Poaceae	Eur-As	P
Hordeum murinum	Poaceae	Boeal	1
Humulus lupulus	Cannabaceae	Eur-Sib	P
Hypericum elegans	Hypericaceae	Eur-Sib	P
Hypericum perforatum	Hypericaceae	Cos	P
Inula oculus-christi	Asteraceae	Eur-Med	P
Iris pumila	Iridaceae	subMed	P
Jasminum fruticans	Oleaceae	Pont-CAs	B
Jurinea consanguinea subsp.arachnoidea	Asteraceae	subMed-Sib	P
Kickxia elatine	Scrophulariaceae	subMed	1
Koeleria lobata (K. brevis)	Poaceae	Pont-Med	P
Koeleria nitidula	Poaceae	Pont	P
Koeleria splendens	Poaceae	Pont-Med	P
Lactuca tatarica	Asteraceae	Pont-As	P
Lactuca viminea	Asteraceae	Eur-Med	1
Lamium amplexicaule	Lamiaceae	Eur-As	1
Lamium purpureum	Lamiaceae	Eur-Med	1
Lappula patula (syn.L.marginata)	Boraginaceae	Eur-As	1
Lathyrus cicera	Fabaceae	subMed	1
Lembotropis nigricans	Fabaceae	Eur-Med	B
Leontodon crispus	Asteraceae	Pont-Med	P
Leontodon hispidus	Asteraceae	Eur-Med	P
Ligustrum vulgare	Oleaceae	subMed	B
Limonium latifolium	Plumbaginaceae	Pont	P

Limonium meyeri	Plumbaginaceae	Pont-CAs	P
Linaria genistifolia	Scrophulariaceae	Pont-Sib	1
Linum austriacum	Linaceae	subMed	P
Linum tauricum	Linaceae	Pont-Med	P
Linum tenuifolium	Linaceae	Pont-Med	P
Lolium perenne	Poaceae	Eur-As	P
Lotus corniculatus	Fabaceae	Eur-Med	P
Lycopus europaeus	Lamiaceae	Eur-As	P
Lythrum salicaria	Lithraceae	subBoreal	P
Malva sylvestris	Malvaceae	Cos	P
Marrubium peregrinum	Lamiaceae	subMed	P
Marrubium vulgare	Lamiaceae	Eur-As	P
Matricaria perforata	Asteraceae	Eur-Med	1
Matthiola odoratissima	Brassicaceae	Pont-Med	P
Medicago minima	Fabaceae	Eur-As	1
Medicago sativa subsp. falcata	Fabaceae	Cas(Adv)	P
Melica ciliata	Poaceae	Eur-subMed	P
Melilotus alba	Fabaceae	subBoreal	1
Mentha longifolia	Lamiaceae	Eur-Sib	P
Mercurialis annua	Euphorbiaceae	subMed	1
Milium vernale	Poaceae	subMed	1
Minuartia sp.	Caryophyllaceae		
Minuartia glomerata	Caryophyllaceae	Eur-Med	1- P
Minuartia setacea	Caryophyllaceae	Pont	P
Muscari racemosum	Liliaceae	subMed	P
Myosotis arvensis subsp. arvensis	Boraginaceae	Eur-As	2
Myosotis stricta	Boraginaceae		1
Nigella arvensis	Ranunculaceae	subMed	1
Nonea pulla subsp. atra	Boraginaceae	subMed	1
Onobrychis gracilis	Fabaceae	Pont-Med	P
Ononis pusilla	Fabaceae	subMed	P
Onopordum acanthium	Asteraceae	Eur-Med	1
Onopordum tauricum	Asteraceae	Med	1
Onosma heterophylla	Boraginaceae	subMed	P
Onosma taurica	Boraginaceae	subMed	P
Opopanax chironium ssp.bulgaricum	Apiaceae	Med	P
Ornithogalum comosum	Liliaceae	Med	P
Ornithogalum refractum	Liliaceae	subMed	P
Orobanche caryophyllaceae on Galium aparine	Orobanchaceae	Eur	P
Orobanche sp. on Achillea	Orobanchaceae		P
Orobanche sp. on Thymus	Orobanchaceae		P
Paeonia tenuifolia	Paeoniaceae	subMed	P

Paliurus spina-christi	Rhamnaceae	Eur-As	B, T
Papaver hybridum	Papaveraceae	Med-CAs	1
Papaver rhoeas	Papaveraceae	Eur-Sib	1
Parietaria officinalis	Urticaceae	Eur	P
Periploca graeca	Asclepiadaceae	Pont-Med	B
Petrorhagia prolifera [Tunica prolifera]	Caryophyllaceae	Pont-Med	1
Phleum subulatum	Poaceae	Eur-As	1
Phragmites australis	Poaceae	Cos	P
Picris hieracioides	Asteraceae	Eur-As	1- P
Plantago lanceolata	Plantaginaceae	Cos	P
Plantago major	Plantaginaceae	Boreal	P
Plumbago europaea	Plumbaginaceae	subMed	P
Poa angustifolia	Poaceae	Cos	P
Poa bulbosa	Poaceae	Eur-As	P
Polygonum aviculare	Polygonaceae	Cos	1
Populus alba	Salicaceae	Eur-As	T
Populus canescens	Salicaceae	Eur-Med	T
Potentilla recta	Rosaceae	subBoreal	P
Potentilla pedata	Rosaceae	Med	P
Prunus mahaleb	Rosaceae	Eur-Med	B, T
Psilurus incurvus	Poaceae	subMed	2
Pulicaria dysenterica	Asteraceae	Eur-Med	2
Pyrus elaeagrifolia	Rosaceae	Med	T
Ranunculus oxyspermus	Ranunculaceae	Med-CAs	P
Reseda lutea	Resedaceae	subBoreal	1, P
Rhus coriaria	Anacardiaceae	Med-As	B
Rosa sp. -1	Rosaceae		B
Rosa sp.- 2	Rosaceae		B
Rumex obtusifolius	Polygonaceae	Eur-Med	P
Rumex patientia	Polygonaceae	Eur-As	P
Rumex tuberosus	Polygonaceae	Boreal	P
Ruta graveolens	Rutaceae	Pont-Med	P
Salsola kali subsp. ruthenica	Chenopodiaceae	Eur-As	1
Salvia aethiopis	Lamiaceae	Eur-As	2, P
Salvia austriaca	Lamiaceae	Eur	P
Salvia nemorosa	Lamiaceae	Eur-OT	P
Salvia nutans	Lamiaceae	Eur-Sib	P
Sanguisorba minor	Rosaceae	subBoreal	P
Satureja coerulea	Lamiaceae	subMed	B
Saxifraga tridactylites	Saxifragaceae	subBoreal	1
Scabiosa argentea	Dipsaceae	Bal-Anat	1- P
Scabiosa micrantha	Dipsaceae	Pont-Med	1
Scabiosa ochroleuca	Dipsaceae	Eur-Sib	2, P

Scandix australis	Apiaceae	Eur-Med	1
Scandix pecten-veneris	Apiaceae	Eur-As	1
Scorzonera hispanica	Asteraceae	Med	P
Scorzonera laciniata	Asteraceae	Med	P
Scorzonera mollis	Asteraceae	Med	P
Sedum sp.	Crassulaceae		P
Sedum urvillei subsp. hillebrandtii (syn.S.sartorianum)	Crassulaceae	Eur	P
Senecio vernalis	Asteraceae	Eur-Med	1
Seseli tortuosum	Apiaceae	subMed	1,2
Setaria verticillata	Poaceae	Cos	1
Sherardia arvensis	Rubiaceae	Med	1
Sideritis montana	Lamiaceae	subMed	1
Silene conica s.l.	Caryophyllaceae	subMed-as	1
Silene dichotoma	Caryophyllaceae	Eur-Med	1,2
Silene exaltata	Caryophyllaceae		P
Sisymbrium orientale	Brassicaceae	Eur-As	1,2
Solanum nigrum	Solanaceae	Cos	1
Sonchus arvensis	Asteraceae	Eur-As	P
Sonchus oleraceus	Asteraceae	Cos	1
Spartium junceum	Fabaceae	Med(Adv)	B
Spergularia media	Caryophyllaceae	Eur-As	P
Stachys recta	Lamiaceae	Eur-Med	P
Stachys atherocalyx	Lamiaceae	Pont-Med	P
Stipa capillata	Poaceae	Pont-Med	P
Stipa pennata	Poaceae	Eur	P
Stipa lessingiana	Poaceae	Eur-As	P
Tamarix ramosissima	Tamaricaceae	Eur-As	B
Tamus communis	Dioscoreaeceae	subMed	P
Tanacetum corymbosum	Asteraceae	Eur-Med	P
Tanacetum millefolium	Asteraceae	Pont	P
Taraxacum erythropsermum	Asteraceae	Eur	P
Taraxacum officinale	Asteraceae	Eur-Med	P
Taraxacum serotinum	Asteraceae	Pont	P
Teucrium chamaedrys	Lamiaceae	Eur-Med	P
Teucrium polium subsp. capitatum	Lamiaceae	Pont-Med	P
Thalictrum minus	Ranunculaceae	Eur-Sib	P
Taeniatherum caput-medusae	Poaceae	Eur-As	1
Thlaspi perfoliatum	Brassicaceae	Eur-Med	1
Thymelaea passerina	Thymelaeaceae	Pont	1
Thymus pannonicus	Lamiaceae	Eur	P
Thymus zygioides	Lamiaceae	subMed	P
Torilis nodosa	Apiaceae	Eur-As	1

Tragopogon dubius	Asteraceae	Eur-Med	2
Trigonella gladiata	Fabaceae	subMed	1
Trigonella monspeliaca	Fabaceae	subMed	1
Tussilago farfara	Asteraceae	Eur-As	P
Valerianella carinata	Valerianaceae	Eur-Med	1
Valerianella pumila	Valerianaceae	Pont-Med	1
Verbascum banaticum	Scrophulariaceae	Bal-Dac	2
Verbascum ovalifolium	Scrophulariaceae	Pont-Bal	2
Verbena officinalis	Verbenaceae	Cos	P
Veronica arvensis	Scrophulariaceae	Eur-Sib	1
Veronica austriaca subsp. austriaca	Scrophulariaceae	Eur-Med	P
Veronica hederifolia	Scrophulariaceae	Eur-Med	1
Veronica polita	Scrophulariaceae	Eur-As	P
Veronica prostrata	Scrophulariaceae	Eur	P
Veronica spicata subsp. prodanii	Scrophulariaceae	Pont	P
Vicia sativa subsp. amphicarpa	Fabaceae	Med	1
Vicia pannonica	Fabaceae	Eur-Med	1
Vicia peregrina	Fabaceae	Eur-As	1
Vicia sativa subsp. nigra	Fabaceae	Eur-Med	1
Vinca herbacea	Apocinaceae	Eur-Med	P
Viola arvensis	Violaceae	Eur	1
Viola kitaibeliana	Violaceae	Eur-Med	1
Vitis sylvestris	Vitaceae	subMed	B
Vulpia myuros	Poaceae	subBoreal	1
Xanthium spinosum	Asteraceae	Cos	1
Xeranthemum annuum	Asteraceae	subMed	1

1 - annual herbaceous plant
2 - biennial herbaceous plant
P - perennial herbaceous plant
B - bush
T - tree

ROMANIAN BOTANICAL CONTRIBUTIONS TO THE STUDIES OF FLORA IN BULGARIAN DOBROGEA

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Abstract: Since the Bulgarian botanists do not know the botanic research that Romanian botanists made in Bulgarian Dobrogea we consider that it is appropiate to make them known. A short history of botany in Dobrogea is given. Also the authors' contribution to the Flora and Mycobiota of Bulgaria. A list of taxa (Tracheophyta and Fungi) described by romanian botanists and over than 160 number of bibliography is added.
Keywords: Botanical history, Bulgarian Dobrogea, described taxa, bibliography;

Introduction

Since the Bulgarian botanists do not know the botanic research that Romanian botanists made in Bulgarian Dobrogea we consider that it is appropiate to make them known.

The oldest knowledge over plants in Dobrogea had the people that had lived on these places from ancient times. Plants have been used in economical purpose, for food, clothing, constructions, remedies for illnesses etc.

It is known that Dioskurides, one of the greatest doctors of antiquity, had left us as inheritance several hundreds of plants, described and even illustrated. A number of over 60 of them would be of Dacian origin. Over the dacian names of Dioskurides plants there been made botanic research but most with contradictory results. This is also due to the fact that lots copies after Dioskurides work had been done in the middle ages with lots of adding's during the years.

Recently, Constantin Drăgulescu from Sibiu University has issued a very interesting and bold hypothesis, that is: it is probably that Dioskurides himself, it some of its students, have flowed the roman armies trough Dobrogea, thus being possible that some names of plants to have been picked up by the students from the local peoples. Drăgulescu is identifyind even a number of approximately 20 plants that would exist also in Dobrogea, from Dioskurides' lists. It is a very interesting hypothesis that makes as meditates.

Another information regarding Dobrogea would be represented by the metopes from Adam-Klissi. This monument has been built by the Romans to celebrate the victory of the roman armies over the gethic people. On this metopes there are figured also several plants. Their analysis leads to the conclusion that eventual the architects that buolt this monuments were from southern origin and did not know well the areas around the monument. While the Trajan's Column (from Rom, with a very good copy at the archeology Museum in Bucharest) brought up surprisingly results, through the meaning that the architect that accompanied Traian had seen plants from Transilvania and had eternalized them of thew Column. This is the case of the fir tree, which seems that 2000 years ago had not been known by the Romans and they would have known it on these places. Another very interesting aspect on naturalistic point of view is the fact that the Column it is figured a scene in which a delegation sent by Dekebal to Trajan was carrying a message written on a huge mushrooms (a Polyporaceae, after the pores can by seen it).

On the mosaic discovered in Constanța there figured several plants, though they are very stylized and do not have much of a great for the histors of botanics from Dobrogea. Maybe only an aesthetic one.

Some hints to the vegetation in Dobrogea the great poet Ovidius is also making in its writings.

In the 17 century the great Turkish traveler Evvia Celebi is signaling in its travels through Dobrogea a plant, *Prunus spinosa* and says that he has been impressed by the fact that up north to Mangalia the „porumbes were as big as plums in Turkey" (Dobrogeanu, 1913).

The first Romanian botanic research have started after the year 1914 an have continued until today. The greatest explorer of entire Dobrogea has been Iuliu Prodan who even wrote a monograph very valuable over the province. Among other botanists that had researched Bulgarin Dobrogea we enumerate I. C. Constantineanu (the first in IX 1914), Zaharia Panțu, Alexandru Borza, Traian Săvulescu and collaborators, Iuliu Nyárády, Emil Pop and others. We mention that the International Phytogeographic trip orgnized in the year 1931 in Romania had as objective also a few areas from Bulgarian Dobrogea. Thus we have large lists of plants from Caliacra Cape and even from the Ceracman Collin (Borza, 1931).

Discussions

What is my connection to the flora from Balcanic Peninsula and from Bulgaria? Exactly 60 years ago, my natural sciences professor Paul Pteancu, has tought me botanics in high school. He had been the best student of Alexandru Borza, one of the gretest Romanian botanists. Paul Pteancu had been sent to the Romania high school in Sofija to teach there natural sciences an expecially to familiarize with the Balcanic Peninsula flora because proferssor Borza was the adept of the postglaciary migrations towards the Carpathians of the flora an wanted to prepare his student for continouing the grounding of this theory.

We ourselses have made botanic and mycologic researches through Bulgaria starting the year 1973 when had particpated to the first Flora anf Vegetation Congress of the Balcan Peninsula, held in Varna. Wee had then one of the greatest botanist of Europe: T. G. Tutin, J. Jalas, H. Meusel, A. L. Takhdadjean, G. Fekete, Sz. Priszter, J. Holub, S. M. Walters, C. Zahariadi, A. Strid, F. Ehrendorfer, W. Greuter and others. With that occasion I have visited also the Botanical Garden in Balcic, Caliacra Cape and have climbed on the „White hill" from Balcic, frecvent pinted from many romanian painters (Şirato, Tonitza, Petraşcu, Dărăscu, Iser etc.). With the occassion of Botanical Congress from Varna I have made botanical trips highly attractive, from Varna to Sofija (Mount Emine, Ajtos, Sliven, Stara-Zagora, Bacicovo, Plovdiv, Velingrad, Borovecz, Assenovgrad, Pirin and Rhodopi Mountains etc.).

Starting the year 1997 I have had even an official collaboration with several Bulgarian botanists and mycologists among which Cvetomir Denchev, Sharkova, Gussev etc. I have collaborated with them on mycologic researches on some groups of fungus on the Bulgarian and Romanian coasts of Dobrogea (Peronosporales, Erysiphaceae, Uredina-les, Ustilaginales) I have visited then many interes-ting areas from eastern Bulgaria, environs of Balcic, from Ecrene to Duranculac, then towards south: Emine Cape, Burgas, Strandja Mountains etc. Several notes have been publisched by us with highly interesting results.

Several plants and fungi have been distributed in the exsiccatae: Flora Romaniae Exsiccata and Herbarium Mycologicum Romanicum.

Outnumbered taxons have been described all this time from Bulgarian Dobrogea (species and varieties). Among the more special species we mention:
Agropyron bazargicensis Prodan,
Agropyron sablensis Prodan,
Alyssum caliacrae Nyár. (Bolata Dere),
Astragalus nyaradyanus Prodan (Cavarna),
Bromus dobrogensis Prodan (Cavarna),
Bromus scoparius L. subsp. *cavarnae* Prodan,
Centaurea caliacrae Prodan,
Crambe dionisopolysi Prodan (Balcic),
Crambe tataria Sebeok subsp. *cavarnae* Prodan,
Cyclamen durostoricum Panțu & Solacolu
Dianthus borzaeanus Prodan,
Dianthus campestris Bieb. subsp. *serbanii* Prodan
Dianthus dobrogensis Prodan,
Euphorbia bazargica Prodan,

Euphorbia cadrilateri Prodan,
Euphorbia dobrogensis Prodan,
Festuca media Prodan (Balcic),
Onosma ponticum Prodan (Balcic),
Poa romanica Prodan (Simionova),
Potentilla bazargica Prodan,
Potentilla cavarnana Prodan,
Potentilla emilii-popii Nyár.
Stachys leucoglossa Griseb. ssp. *caliacrae* Prodan,
Stachys patula Griseb. subsp. *ajugaefolia* Prodan.

And countless variety and forms. Also some fungus: *Calospora crataegi* Săvul. & Sandu, *Cercospora psoraleae-bituminosae* Săvul. & Sandu, *Cucurbitaria pontica* Săvul. & Sandu, *Puccinia dob-rogensis* Săvul., *Uromyces trifolii-purpurei* Const.

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MACROPHYTOBENTHOS EVOLUTION UNDER PRESENT ENVIRONMENTAL QUALITY OF ROMANIAN BLACK SEA COASTAL WATERS AS TO EARLIER DECADES

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Abstract: More than a century has passed since macroalgal flora was studied for the first time by Russian and Romanian scientists, and later on by Bulgarian, Turkish and Georgian ones. Several decades ago these studies showed a much higher number of taxa as presently found in the coastal waters.

This paper shows the latest data on macrophytic algae from the Romanian littoral, after a five years long survey along the coast, in seven sites situated between Constanţa and 2 Mai, in different periods of the year compared with previous data, in order to point out the gradual decline of this major component of the Black Sea ecosystem, with special emphasize on endangered taxa. The algae were collected from various types of hard substratum, and from each sample, algae were identified and representative individuals were kept and dried for the herbarium collection. For biomass estimation three samples were randomly taken from a surface of 100 cm^2 at each depth (between 0,5 - 7 m), and the algal material was dried 24 hours at 105^0C and weighed.

The present observations show that the Romanian Black Sea coastal zone has been subjected to severe ecological disturbance during the last five decades; and as a result of complex and multiple anthropogenic pressures and with unfavourable natural factors, a considerable reduction of macroalgal species is evident within the general decline of biodiversity.

Keywords: macrophytobenthos, Romanian Black Sea coast, Chlorophyta, Phaeophyta, Rhodophyta

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Introduction

More than a century has passed since macroalgal flora was studied for the first time by Russian and Romanian scientists, and later on by Bulgarian, Turkish and Georgian ones.

The beginning of marine benthal algology at the Romanian Black Sea coast is marked out by the first information about native algal flora found in A. Kanitz (1881), where J. Schaarschmidt listed 233 species of algae, out of which 50 marine, and only six macrophyta are mentioned. In 1907, E. Teodorescu published a monograph of the algological flora from Romania (both fresh and marine waters) were 32 species of macrophyta where mentioned in samples taken from rocky bottoms along the Romanian coast (Teodorescu, 1906). The most decisive step in the development of marine biology in general and algology in particular, is the foundation of the Marine Zoological Station at Agigea in 1926 by I. Borcea, and of the Bio-oceanographic Institute in Constanta in 1932 by G. Antipa. Starting her activity in 1930, the outstanding algologist Maria Celan contributed with taxonomical, cytological and ecological research upon macrophytic vegetation from the Black Sea coast. Celan' s contribution was represented by: first distinction made between the two species of *Cystoseira* (Celan, 1935), new macroalgal species described for the Black Sea or for the Romanian sector (Celan, 1936; Celan, 1938), cytological studies (Celan, 1940), taxonomical studies (Celan, 1948; Celan, 1958; Celan et Serbănescu, 1959Celan, 1960; Celan, 1977). Later, together with A. Bavaru, the studies were extended to algal communities (Celan et Bavaru, 1973; Celan et Bavaru, 1978).

Important contributions to the knowledge of algal flora belong to H. V. Skolka, who was the first to describe the repartition of red algae *Phyllophora* (Skolka, 1956), and continued the observations regarding macroalgae phytocoenoses and their repartition along the shore (Skolka et Bodeanu, 1971; Skolka et al., 1980). Mainly after 1970, A. Bavaru completed his research in algal systematics and phytocoenology, with contributions on the macrobenthic vegetation in general (Bavaru, 1970; Bavaru, 1977; Bavaru, 1981) and especially *Cystoseira* populations (Bavaru, 1971; Bavaru, 1972). Research on macroalgae extended also to their physiology and chemistry; e.g., A. S. Bologa studied the photosynthetic productivity of benthic algae (Bologa, 1979; Bologa, 1980), as well as their capacity to accumulate radioactive isotopes, representing useful bioindicators for this type of pollution (Bologa et al., 1983).

Several decades ago these studies showed a much higher number of species, subspecies and varieties as presently found in the coastal waters. The continuous quantitative and qualitative lowering of algal diversity and biomass becomes evident when analyzing the related literature.

According to A.D. Zinova, in 1967, the Black Sea macroalgoflora totalized a number of 277 species with 74 Chlorophyta, 3 Xanthophyta, 71 Phaeophyta and 129 Rhodophyta (Zinova, 1967). But research carried out after 1970 showed a gradual impoverishment, especially from the qualitative point of view, of the macroalgal flora. The observations on the both qualitatively and quantitatively decline of macroalgal flora, initiated by Celan, were confirmed. In 1969, only 77 species were identified (Skolka, 1969), later, in 1977, 86 species (Bavaru, 1977), and 69 and 55 respectively, after 1980 (Vasiliu, 1984; Vasiliu, 1996).

It is considered that these changes are due to a number of causes such as: massive frosts, silting of the rocky bottom with suspended matter, decrease of light penetration in the water column due to same suspensions, increase of eutrophication (Bologa, 1987-1988).

So, it is evident that increasing eutrophication and pollution have considerably changed the structure and functioning of the Black Sea ecosystem, mainly in its NW corner, where human activities, discharge of polluted fresh waters, inflow of sewage and industrial wastes, affected both the qualitative and quantitative state of benthic and planktonic communities; that is why macrophytobentos has shown a gradual and continuous decline. In the last 20 to 30 years, the phytal zone on the NW shelf has shrunk to a tiny fraction of its previous size: at present, the area where macrophytobenthos can develop is only a narrow inshore strip, between 2 to 7 m depth which is the only zone where there is enough light for photosynthesis. Knowing the importance of algae as food and shelter for animals as well as source of oxygen and external metabolites, such a decline is catastrophic for benthic life and for the entire ecosystem of in this part of the Black Sea.

Unfortunately very few research has been carried out today regarding the present state of the macroalgal flora (Bologa, 2001). Taking this in consideration, a new approach of such studies is absolutely necessary in order to establish the major modifications that occurred in the state of macrophytobenthos, under the influence of harmful factors that disturbed the quality of marine environment and biodiversity (Bologa et Sava, 2006; Sava, 2002).

The paper shows the latest data on macrophytic algae along the Romanian littoral, after a five years long survey along the coast, compared with previous data, in order to point out the gradual decline of this major component of the Black Sea ecosystem, with special emphasize on endangered taxa.

Material and Methods

Sampling stations

One of the most important conditions for the development of macrophytes is the presence of a hard substratum, of various types. Therefore, the selection of study sites considered as principal criteria the presence of a rocky, natural or artificial bottom, In some cases, the algae were collected from the shells of mussels that covered the whole surface of rocky bottoms. The location of the sampling station covered a length of over 60 km, between Constanta to 2 Mai, close to Bulgarian border.

The locations of the study sites as well as the sampling depths are illustrated in Table 1 and Figure 1.

Table 1 - Sampling stations of macrophytobenthos, with indication of transects and depths

No.	**Sampling station**	**Transect**	**Bottom type**	**Sampling depth**
1.	Constanta	Cazino	Rocky -natural	0.5 to 1 m
		Trei Papuci	Rocky- natural	0.5 to 1 m
		Pescarie	rocky / tetrapods natural and artificial	0.5 to 4 m
2.	Agigea		rocky -natural	0.5 to 1 m
3.	Eforie Nord		rocky / tetrapods – natural and artificial	0.5 to 1 m
4.	Eforie Sud		dam	0.5 to 3 m
5.	Costinesti		rocky- natural	0.5 to 3 m
6.	Mangalia		rocky / tetrapods –natural and artificial	0.5 to 6 m
7.	2 Mai		Rocky –natural	0.5 to 5 m

Fig.1 - The location of sample stations along the Romanian Black Sea coast

The research has been carried out between 2000 and 2005, in different periods of the year, both in warm and in cold season, in order to collect macroalgal species that develop all year round together with the species that could only be found in certain periods of the year.

Qualitative determinations

Samples for qualitative determinations have been collected from various depths between 0.5 and 6 m, in plastic bags, together with a label, mentioning place and time of collection. All samples were brought fresh in the laboratory, carefully washed for sediments and associated fauna, and sorted out in three main groups: Chlorophyta (green algae), Phaeophyta (brown algae), Rhodophyta (red algae). Species identification was made macroscopically where possible, but for difficult genera, microscopic examination was necessary. Representative individuals were kept for herbarium collection.

Quantitative measurements

For accurate results regarding the major modification of the macrophytobenthos, quantitative determinations are also necessary giving the possibility to appreciate biomass dynamics of these algae during the last years, comparative with previous decades.

The method used for quantitative measurements is a classical one, and in order to be adequate, certain requirements were respected, taking in consideration that sometimes sampling can be difficult, because of the irregular and diverse type of substratum, but, on the other hand, that algal samples must be representative for the studied algal population.

In present work, the method of squares was used, using a metallic frame that covered a surface of 100 cm^2. Three samples were collected from each station, transect and depth and each one was introduced in plastic bags and labeled. Samples were brought fresh into the laboratory, washed for the associated fauna and sediments, and dried in oven at 105^0 C. The estimation of biomass was calculated from the mean weight of the three samples and appreciated as dry weight.

Results and Discussions

Qualitative results

In the samples collected during six years of study, 16 Chlorophyta, 5 Phaeophyta and 10 Rhodophyta were found, as shown in the following list.

CHLOROPHYTA

Ord. ULVALES

Fam. Ulotrichaceae

1. *Ulothrix implexa* (Kutz.) Kutz.
2. *Ulothrix flacca* (syn. *U. pseudoflacca* Wille) Dillw.Thur.

Fam. Ulvaceae

1. *Ulva rigida* Ag. (Fig.2)
2. *Enteromorpha intestinalis* (L.) Link.
3. *Enteromorpha flexuosa* (Wulf. et Roth) J.Ag.
4. *Enteromorpha compressa* (L.) Grev. (Fig.3)
5. *Enteromorpha linza* (L.) J.Ag.
6. *Enteromorpha prolifera* (O.F.Mull) J.Ag.

Ord. CLADOPHORALES

Fam. Cladophoraceae

1. *Cladophora vagabunda* (L.) Hoeck
2. *Cladophora albida* (Huds.) Kutz.
3. *Cladophora sericea* (Huds.) Kutz.
4. *Cladophora laetevirens* (Dillw.) Kutz.
5. *Cladophora dalmatica* Kutz.
6. *Chaetomorpha aerea* (Dillw.) Kutz.

Fam. Acrosiphonaceae

1. *Urospora penicilliformis* (Roth.) Aresh.

Ord. BRYOPSIDALES

Fam. Bryopsidaceae

1. *Bryopsis plumosa* (Huds.) Ag.

PHAEOPHYTA

Ord. ECTOCARPALES

Fam. Ectocarpaceae

1. *Ectocarpus siliculosus* (Dillw) Lyngb.
2. *Ectocarpus confervoides* (Roth) Le Jolis.

Ord. SCYTOSIPHONALES

Fam. Scytosiphonaceae

1. *Scytosiphon lomentaria* (Lyngb) J.Ag.

Ord. PUNCTARIALES

Fam. Punctariaceae

1. *Punctaria latifolia* Grev.

Ord. FUCALES

Fam. Cystoseiraceae

1. *Cystoseira barbata* (Good. et Wood.) Ag.

RHODOPHYTA

Ord. BANGIALES

Fam. Bangiaceae

1. *Porphyra leucosticta* Thur.
2. *Bangia fuscopurpurea* (Dillw.) Lyngb.

Ord. CRYPTONEMIALES

Fam. Corallinaceae

1. *Corallina officinalis* L.

Ord. RHODIMENIALES

Fam. Champiaceae

1.*Lomentaria clavellosa* (Thurn.) Gail. (Fig.4)

Ord. CERAMIALES

Fam. Ceramiaceae

1. *Ceramium rubrum* (Huds.) C. Ag. (Fig.5)
2. *Ceramium elegans* (Roth.) Ducl.
3. *Ceramium diaphanum* (Lightf.) Roth.
4. *Callithamnion corymbosum* (Ducl.) Ag.

Fam. Rhodomelaceae

1. *Polysiphonia elongata* (Huds.) Harv.

Ord. GIGARTINALES

Fam. Phyllophoraceae

1. *Phyllophora pseudoceranoides* (Gmel.) Newr.et A.Tayl. (syn. *P. membranifolia* (Good. et Wood.) J.Ag

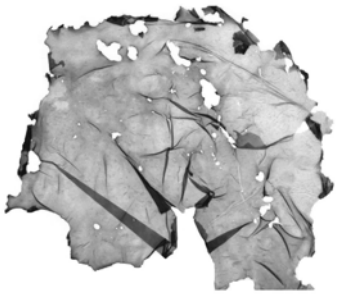

Fig. 2 - *Ulva rigida* Ag.

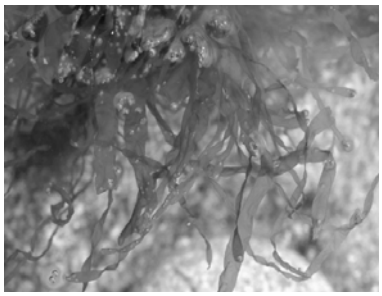

Fig. 3 - *Enteromorpha compressa* (L.) Grev.

Fig. 4 - *Lomentaria clavellosa* (Thurn.) Gail.

Fig. 5 - *Ceramium rubrum* (Huds.) C. Ag.

Compared with previously reported results, it is very evident that the number of species from each phylum decreased over the years (Table 2).

Analyzing both the present list and the table, several observations result:

-about the exact number of species of macrophytes, opinions differ from author to author, as a result of incertitudes created by some forms and varieties and by the consideration of microscopic forms;

-it is very obvious that, over the years, most species belonged to green algae. This can be explained by the fact that eutrophication, that generally has a negative influence on marine biota, favourized the development of green algae. Some genera like: *Ulva, Enteromorpha, Cladophora* persisted and proliferated under these environmental conditions;

-as to the brown algae, the number of species also decreased and nowadays, only four cold season species were found;

-red algae are also sensitive to pollution and their number has also decreased over the years, but some genera of red algae (*Ceramium*) can also develop in eutrophic waters, sometimes covering the hard substratum up to 90%;

-another obvious fact is the lack of perennial species: only one such species was found in the samples (red alga *Polysiphonia*); *Cystoseira barbata* (brown) and *Phyllophora* (red) have been found in various locations along the shore during field trips, on the beach, teared out from their rocky bottom probably during storms;

-the positive sign that can be pointed out is the reappearance of species that were considered lost for many years, such as *Lomentaria clavellosa*, but unfortunately, no exact data about its location and biomass could be achieved, as the thalli were collected from the beach, teared away from the rocky bottom.

Table 2 - Number of macroalgal species along the Romanian Black Sea coast identified between 1977 and 2002

Phyllum	Bavaru, 1977	Vasiliu, 1980-1995	Sava,1995-2002
Chlorophyta	**31**	**22**	**16**
Phaeophyta	**14**	**9**	**4**
Rhodophyta	**41**	**24**	**10**
Total	**86**	**55**	**30**

It is evident that the benthic algal flora has endured a gradual, but continuous decline and the accentuation of this decline is not only due to natural factors but mainly to anthropogenic ones. Also, another important feature is the uniform aspect of the present vegetation and the fact that the new algal communities consist of a very small number of species. Nevertheless some of them, evinced considerable biomass.

Quantitative results

The qualitative data are completed with quantitative ones, allowing a better understanding of the structure and functioning of the algal populations. As it became evident from analyzing the samples, green and red algae were dominant, brown algae being represented by a few number of species, as a consequence, the biomass estimates were made only for the two major groups: Chlorophyta and Rhodophyta.

The evolution of biomass since 200 evinced that green algae were dominant. Also for a complete image of the present state of macroalgal vegetation, the values of total biomass of both green and red algae, in all sampling sites are indicated (Table 3).

Table 3. Total biomass of Chlorophyta (green algae) and Rhodophyta (red algae) between 2000 and 2005 (g/m^3)

Year	**Green algae**	**Red algae**
2000	19,734	17,845
2001	18,828	17,910
2002	22,310	20,802
2003	25,000	18,010
2004	23,410	21,772
2005	15,581	7,830
TOTAL	124, 863	104,169

It is once more evident that the green algae prevailed and the quantities of red algae are lower.

The maximum development of green algae took place in 2003 (25,000 g/m^2), but close values were registered also in 2002 (22,310 g/m^2) and 2004 (23,410 g/m^2). In 2005, a significant decrease of Chlorophyta biomass is evident, the total value being almost half (15,581 g/m^2) of the one calculated for 2003.

As to the red algae, the maximum value of biomass (21,722 g/m^2) occurred in 2004, with slight differences compared with previous years, whereas in 2005 a reduced biomass was significant, with more than half values registered compared with the ones observed in 2000.

Even though the maximum values of green and red algae were not registered simultaneously, for 2005 it is evident that both decreased; this could be related to the amelioration of the state of the marine ecosystem along the Romanian shore in recent years, that could have beneficial consequences on the whole algal vegetation.

It has to be point out that the high biomass of green algae is due to species belonging to the genera *Ulva*, *Enteromorpha* and *Cladophora* that develop all year round, together with *Ulothrix* and *Urospora* that develop only during the cold season (spring and autumn). But high biomasses of red algae are almost entirely owed to species of *Ceramium*, found on rocky bottom the entire year. During spring *Porphyra*, and sometimes *Polysiphonia* and *Callithamnion* contributed quantitatively. Only in the warm season these last two mentioned species were found in appreciable quantities in samples. This can be explained because *Ceramium* species, have a high capacity of both asexuate and sexuate reproduction, so they can easily and quickly populate the rocky bottoms, sometimes even completely.

Conclusions

As to the severe environmental degradation of the Black Sea ecosystem in general and of its NW sector in special, macrophytobenthos deserve a notable attention, as a key component of coastal waters.

The impoverishment of the vegetation, starting in the '50's but very evident especially since 1970, is due to known natural and anthropic causes which deteriorated the quality of the marine environment (massive frosts registered in some years, progressive degradation of the marine coastal environment due to erosion, impurification of seawater quality due to increasing eutrophication, extension of hypoxia and even anoxia.

These changes affected not only the macrophytobenthos, but all biological components of the ecosystem, e.g. the structure and the functioning of benthic and pelagic communities, as well the qualitative and quantitative state of all phyto and zoocommunities.

Anthropogenic disturbances are still present, changing, directly and indirectly the ecosystem and community structure, by replacement of some phytocoenoses by others.

Recent observations confirmed: qualitative decline (few number of species), the almost disappearance of perennial species (brown and red algae) this fact having as consequence disappearance of associated or epiphytic species, the uniformity of algal belts, that consist mainly of opportunistic species with a short life cycle, much lower productions compared with those of *Cystoseira* in previous years; non-stable equilibrium of macrophytic communities.

The Romanian Black Sea coastal zone has been subjected to severe ecological disturbance during the last five decades; as a result of complex and multiple anthropogenic pressures together with unfavourable natural factors, a considerable reduction of macroalgal species within the general decline of biodiversity took place.

Future needs for improving the existing situation may consider:

- continuous biodiversity monitoring in order to enable observations of all changes that might occur;
- continuous observation of the evolution of physical-chemical parametres of shallow waters, with valuable informations upon the environment quality but also upon the expected amelioration of the state of the marine ecosystem;
- submission of projects that have to propose rapid but realistic rehabilitation programmes;
- the maintenance of the Marine Reserve 2 Mai –Vama Veche in the south part of the Romanian Black Sea coast, and its extension across the Bulgarian border, in order to extend the interest in conserving biodiversity in both countries, and increasing the possibility of more sound related projects and reconstruction plans.

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AMPHIBIANS AND REPTILES FROM THE BLACK SEA COAST AREA BETWEEN CAPE MIDIA AND CAPE KALIAKRA

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Abstract: We present a preliminary inventory of amphibian and reptile species along the coastline between Cape Midia (Romania) and Cape Kaliakra (Bulgaria). Eight amphibian species and nine reptile species were inventoried in the area. The inventory was not complete since the species accumulation curve did not reach the plateau, but the results can provide an useful baseline for a future monitoring program in the area. The two countries share many common environmental problems along the Black Sea coastline, but more efforts are required to integrate existing conservation and legislation measures into effective tools for biodiversity conservation.

Keywords: inventory, amphibians, reptiles, species richness, distribution, mapping, geodatabase

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Introduction

The coastal area between Cape Midia and Cape Kaliakra belongs to the Pontic (Black Sea) bioregion and presents unique characteristics. It stretches along approximately 120 km and has been impacted by humans for thousands of years. The Romanian coastline has been transformed by urban, tourism and industrial development, with few parts left in a semi-natural state. The Bulgarian coastline is less stressed by human development; here there are few localities and tourist facilities and no industrial areas. The area covered by the present study does not only follow a North-South latitudinal gradient, but also a mosaic of human-impacted areas.

Amphibians and reptiles are taxa that appeared and evolved during hundreds of millions of years, surviving several major extinction periods. Nevertheless, they are sensible to human impact and are good indicators of the state of the environment. Both amphibians (Stuart et al. 2004) and reptiles (Gibbons et al. 2000) are declining worldwide and are considered priority taxa for conservation (Gascon et al. 2007). Monitoring amphibian and reptile populations is recommended since they are sensible to even minor changes in the quality of their habitats (Dodd et al. *in press*). In the present paper we present a preliminary inventory of amphibian and reptile species along the coastline between Cape Midia (Romania) and Cape Kaliakra (Bulgaria), providing the baseline data for a future monitoring program in the area.

Materials and Methods

During April until August 2008 we conducted monthly field trips lasting four to five days each along the entire coastline. We used a combination of visual encounter, active search and dip-net sampling techniques to detect amphibians, as well as visual encounter and active search for reptiles. The geographical coordinates and altitude of each site were recorded with a handheld Garmin GPS device.

We also recorded the characteristics of aquatic and terrestrial habitat (type, area, maxim depth, pH, conductivity, vegetation, presence of predators) and the human impact. Existing distribution data was based on Szekely et al. (*in press*) for the Romanian part, and on several publications covering the area of interest in Bulgaria (Lepşi 1926; 1927; 1929; Beschkov 1984a; 1984b; 1985). We did not consider the updated taxonomic nomenclature, such as the one proposed by Frost et al. (2006) for amphibians; instead we used the taxonomy still valid in the national legislations. We built an amphibians and reptiles geodatabase in order to manage the geographic distribution of species records and perform spatial queries. The spatial data originated in two main sources: GPS data collection from the inventory in 2008 and locality data extracted from bibliographic sources.

Both types of data were spatially joined to the UTM 5x5 km grid system based on the corresponding cell code attributes, and then exported as polygon feature classes and related attribute tables into a personal geodatabase.

We performed the spatial analysis on species records and produced a series of maps with ArcGIS Desktop 9.3, using the ESRI Data and Maps 2008, and elevation Data from NASA, NGA, USGS as main basemap sources. The coordinate system used for each map was UTM Zone 35N, and datum: WGS 1984 (Figure 1).

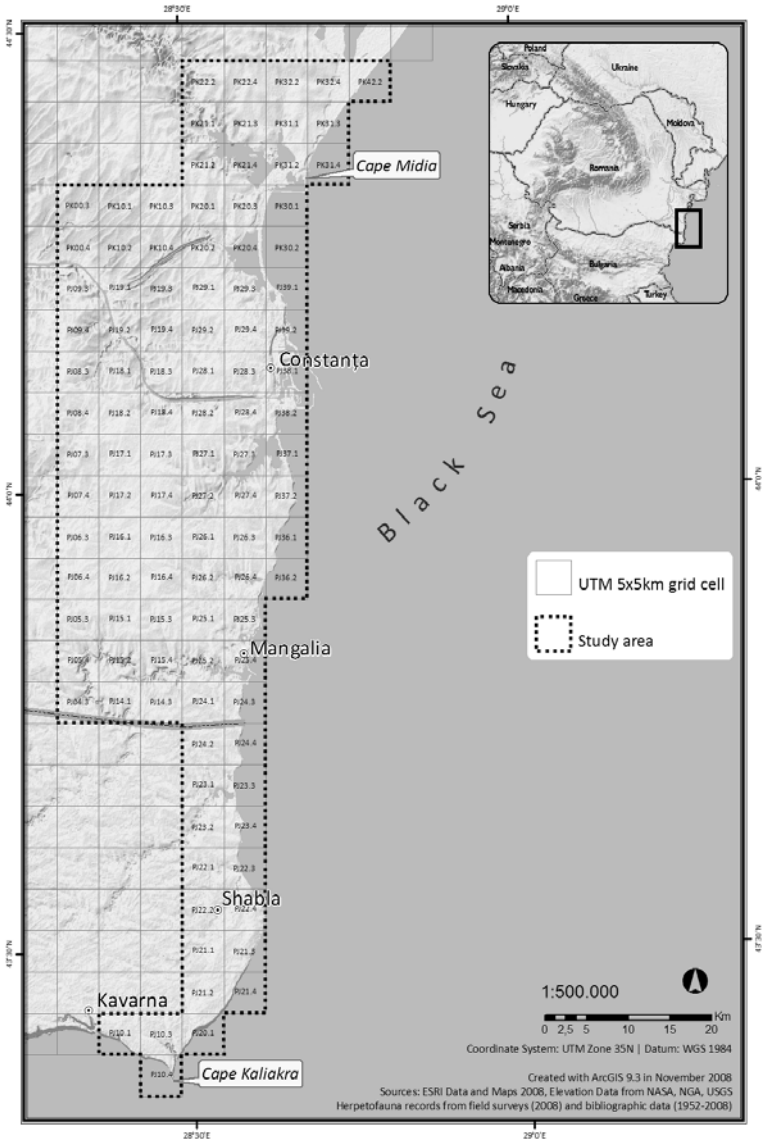


Figure 1 - The Black Sea coastal area between Cape Midia and Cape Kaliakra covered by the present study

A species accumulation curve was computed for amphibians and reptiles based on individual site data (*i.e.* sample based) using *EstimateS 7.5* (Colwell, 2005). Sample order was randomized 50 times and mean richness

estimates were computed for each sample accumulation level. This removes the effect of sample order and generates a smoother curve.

Results and Discussion

Amphibians and reptiles are widespread along the coastline, even in highly impacted areas. During our inventory we found individuals of eight amphibian species (*Bombina bombina, Pelobates fuscus, Pelobates syriacus, Bufo viridis, Hyla arborea, Rana kl. esculenta, R. lessonae, R. ridibunda*), and nine reptile species (*Testudo graeca, Emys orbicularis, Lacerta viridis, L. trilineata, Podarcis taurica, P. muralis, Pseudopus apodus, Coluber caspius, Natrix natrix, Vipera ammodytes*). Since the collecting effort differed between the two countries, we analyzed the data separately. The species accumulation curves based on the number of inventoried sites did not reach a plateau for both countries (Figures 2 and 3), indicating that the inventory was incomplete.

This is normal for the two taxa where species detectability varies within a wide range. Some species (*e.g. Pelobates* sp., *Eryx jaculus*) are active only during the night, or possess cryptic coloration (*e.g. Vipera ammodytes*) and thus have a lower detectability

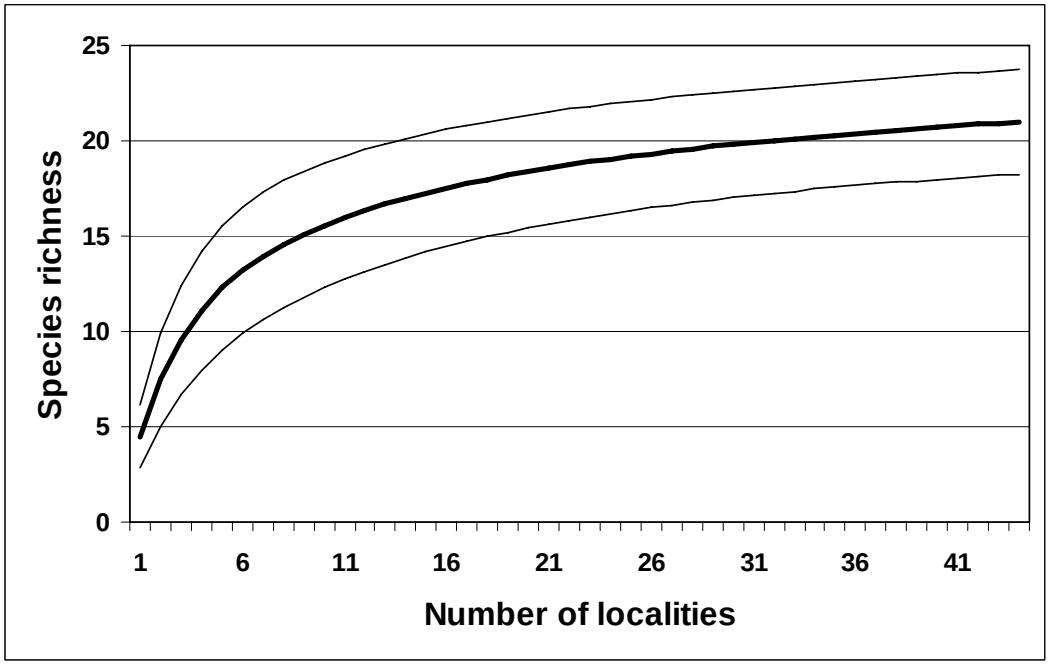
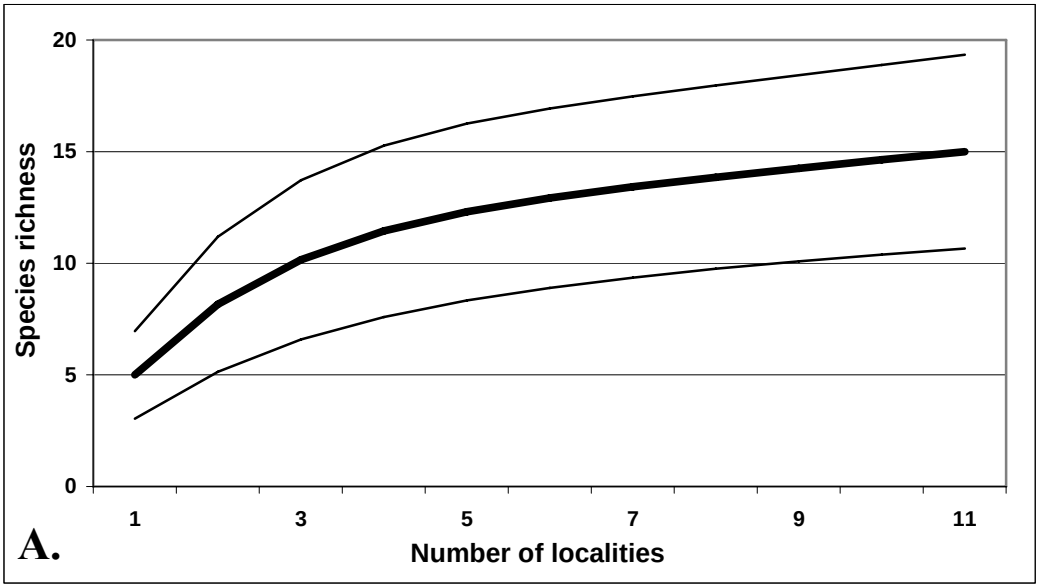


Figure 2 – Species accumulation curve for amphibians and reptiles inventoried along the coastline between Cape Midia and Vama Veche (Romania).



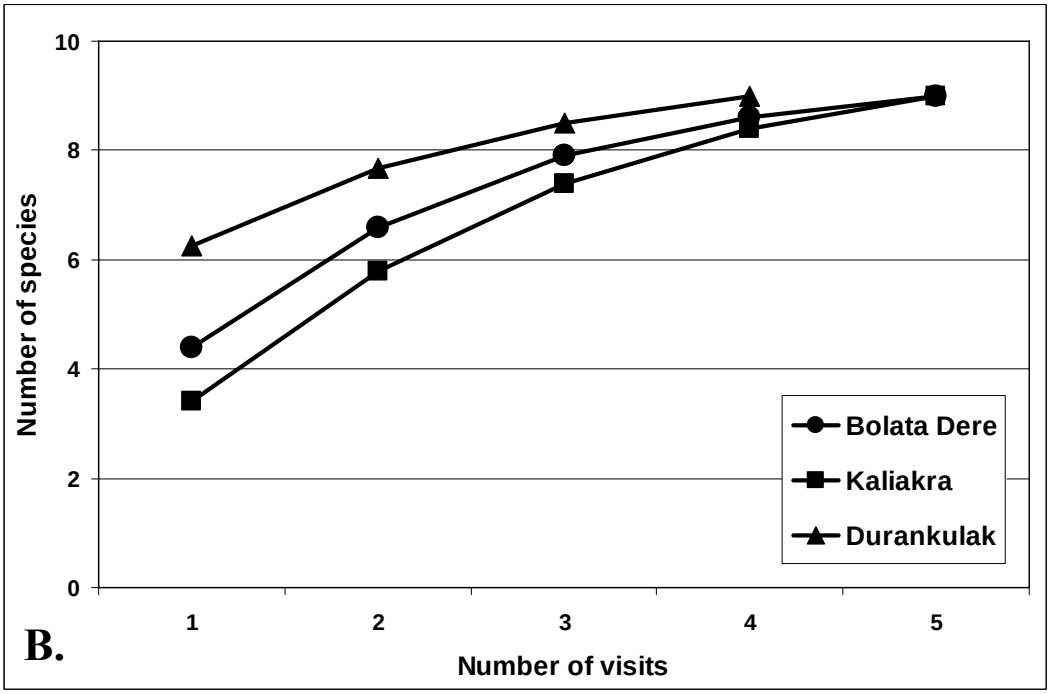


Figure 3 – A. Species accumulation curve for amphibians and reptiles inventoried along the coastline between Durankulak and Cape Kaliakra (Bulgaria). B. Species accumulation curve for three Bulgarian sites with high species richness according to the number of visits.

Some species were widespread and/or had a high detectability and were recorded from most sites and/or during each visit (Figure 4). This is the case for water frogs of the *Rana esculenta* complex and for the lizard *Podarcis taurica* and the tortoise *Testudo graeca*. Other species were rare, either limited to aquatic habitats (e.g. *Emys orbicularis, B. bombina*) or type of soil (e.g. *Pelobates* sp.).

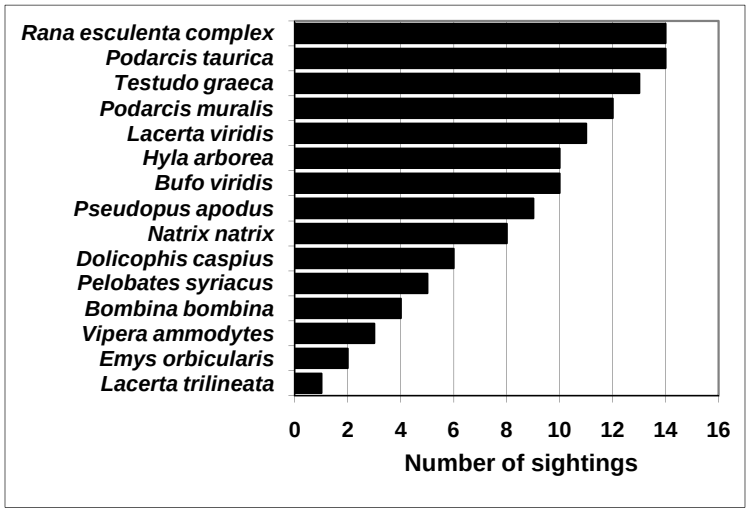


Figure 4 – Frequency of amphibians and reptiles based on the number of sightings along the Bulgarian coastline between Durankulak and Cape Kaliakra in 2008.

The highest species richness was recorded in Bulgaria in sites that contained both terrestrial and aquatic habitats (Durankulak, Bolata Dere, Rusalka) while the sites without freshwater aquatic habitats had a lower species richness due to the absence of most amphibian species (Figure 5).

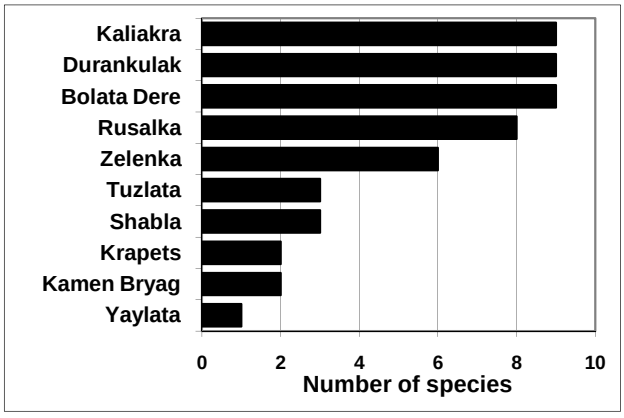


Figure 5 – Relative species richness of amphibians and reptiles in several sites inventoried in Bulgaria in 2008.

The species richness pattern can not be correlated with human density, a high number of species being recorded also from urban or industrial areas (Figure 6). Overall, coastal areas with wetlands hold the highest species diversity, while the lowest is recorded from inland arid plains used mainly in agriculture, with or without irrigation.

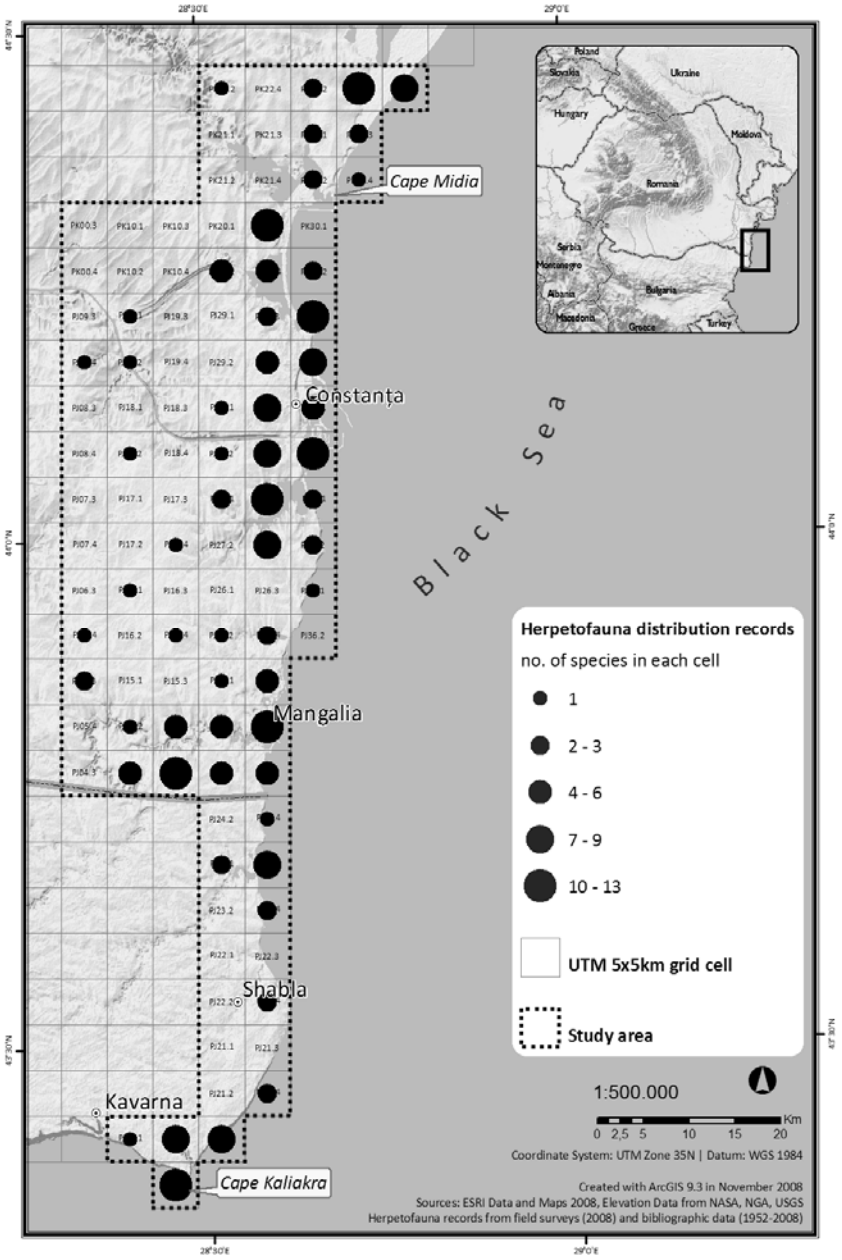


Figure 6 – Amphibian and reptile species richness along the coastline between Cape Midia and Cape Kaliakra.

The distribution of several amphibian and reptile species are presented below, including widespread species like *Bufo viridis* (Figure 7), *Podarcis taurica* (Figure 8), *Natrix natrix* (Figure 9), *Dolicophis caspius* (Figure 10), *Testudo graeca* (Figure 11), or species with specific habitat requirements and a more restricted distribution, like *Bombina bombina* (Figure 12), *Hyla arborea* (Figure 13) or *Podarcis muralis* (Figure 14).

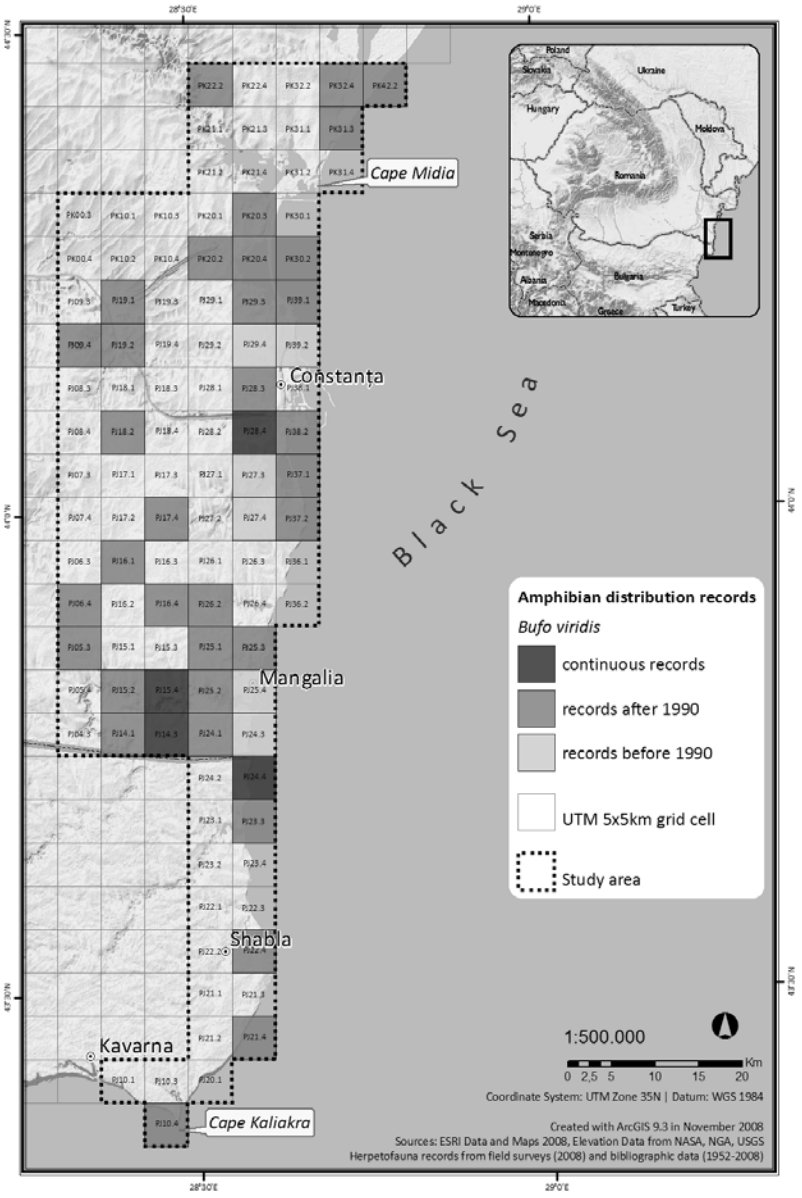


Figure 7 – Distribution of the Green Toad *Bufo viridis* along the coastline between Cape Midia and Cape Kaliakra.

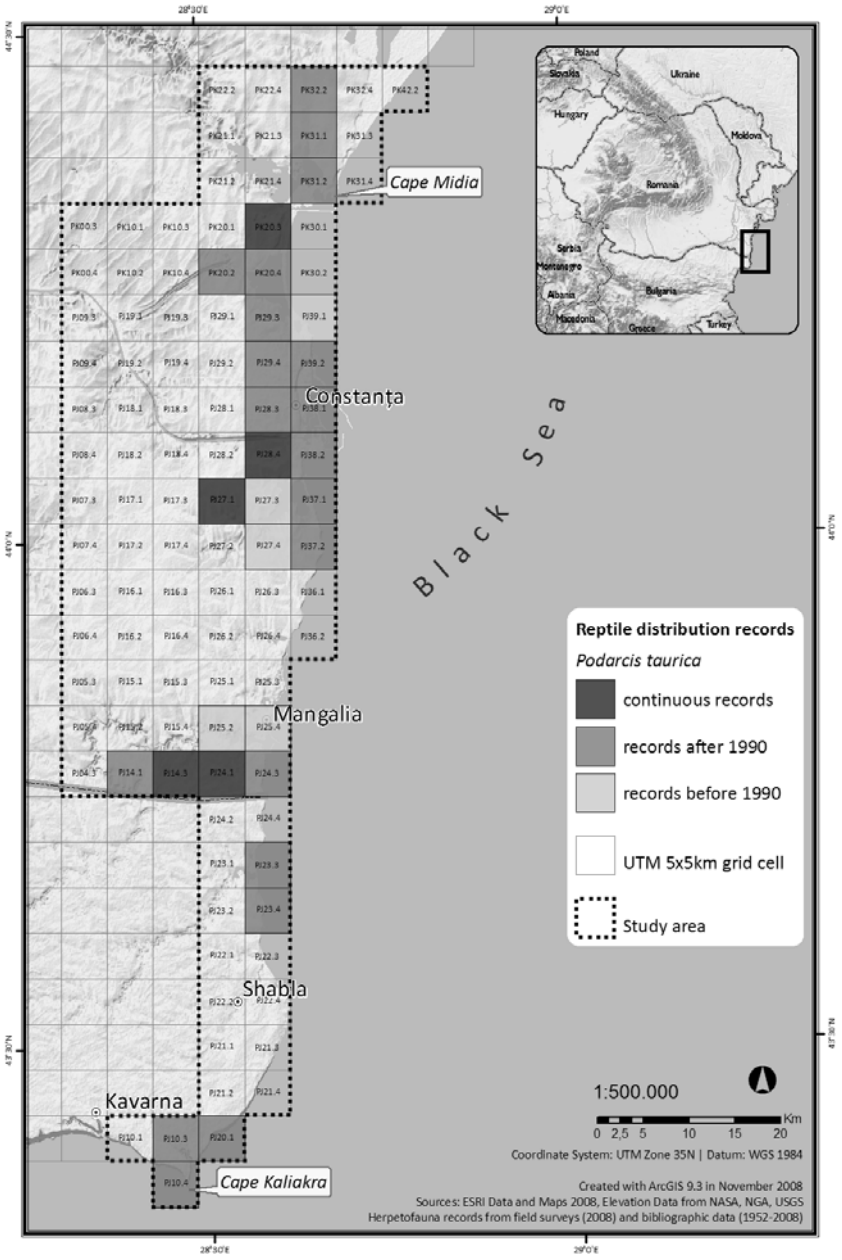


Figure 8 – Distribution of the Balkan Wall lizard *Podarcis taurica* along the coastline between Cape Midia and Cape Kaliakra.

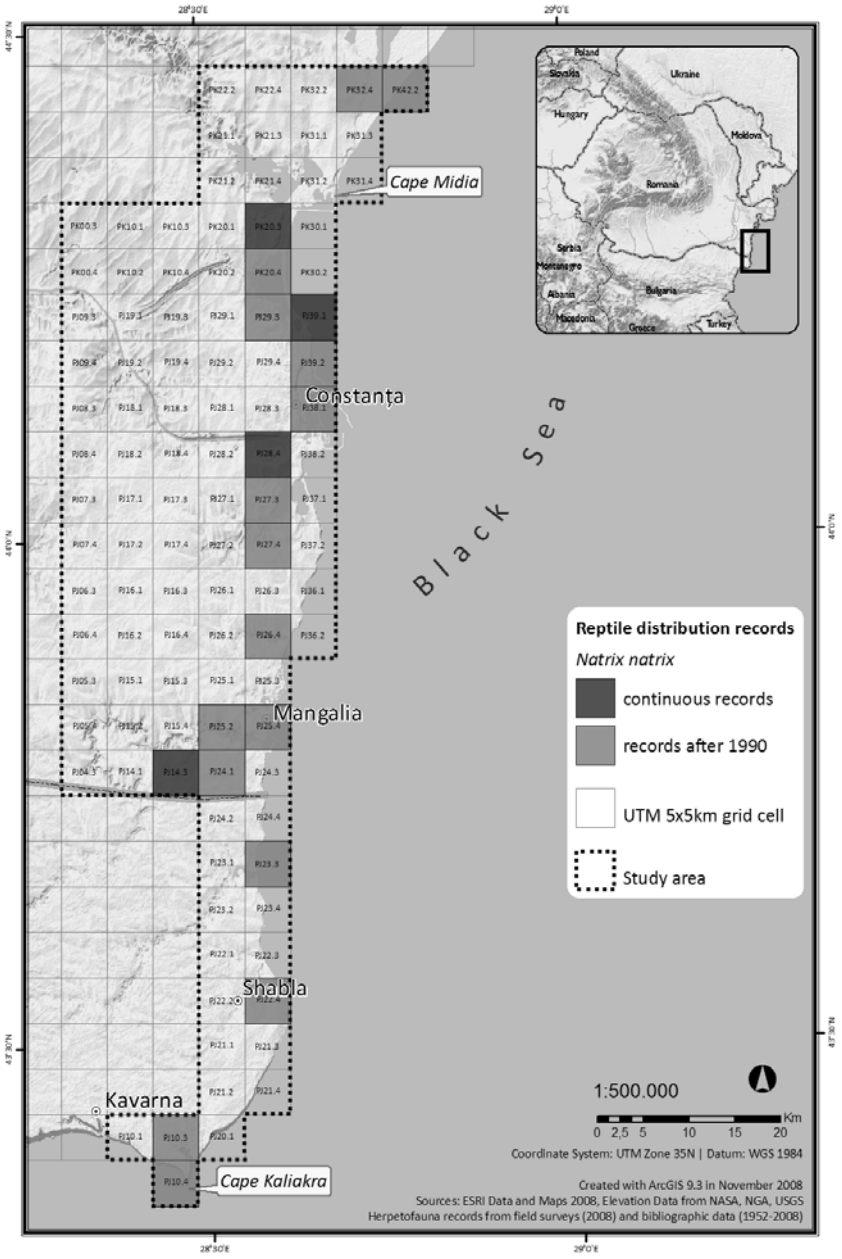


Figure 9 – Distribution of the Grass Snake *Natrix natrix* along the coastline between Cape Midia and Cape Kaliakra.

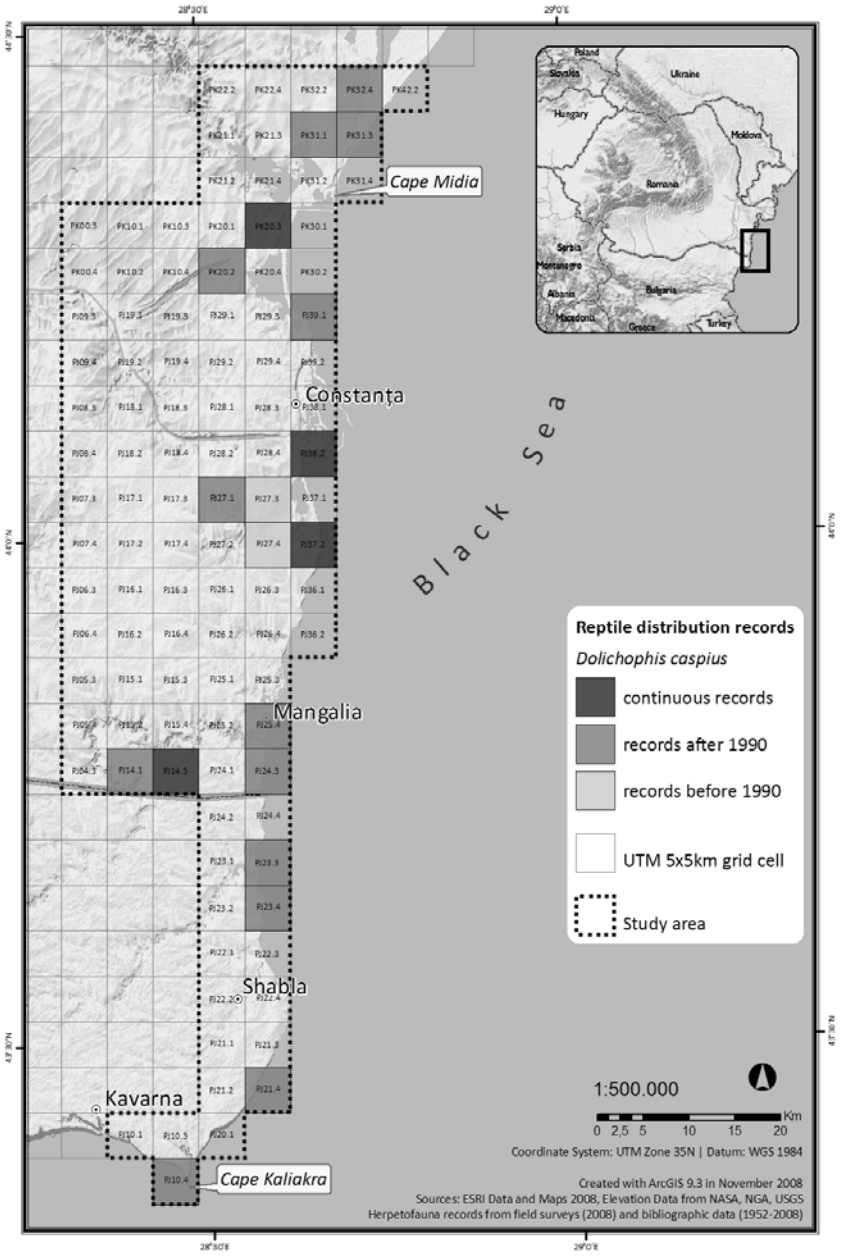


Figure 10 – Distribution of the Large Whip Snake *Coluber caspius* along the coastline between Cape Midia and Cape Kaliakra.

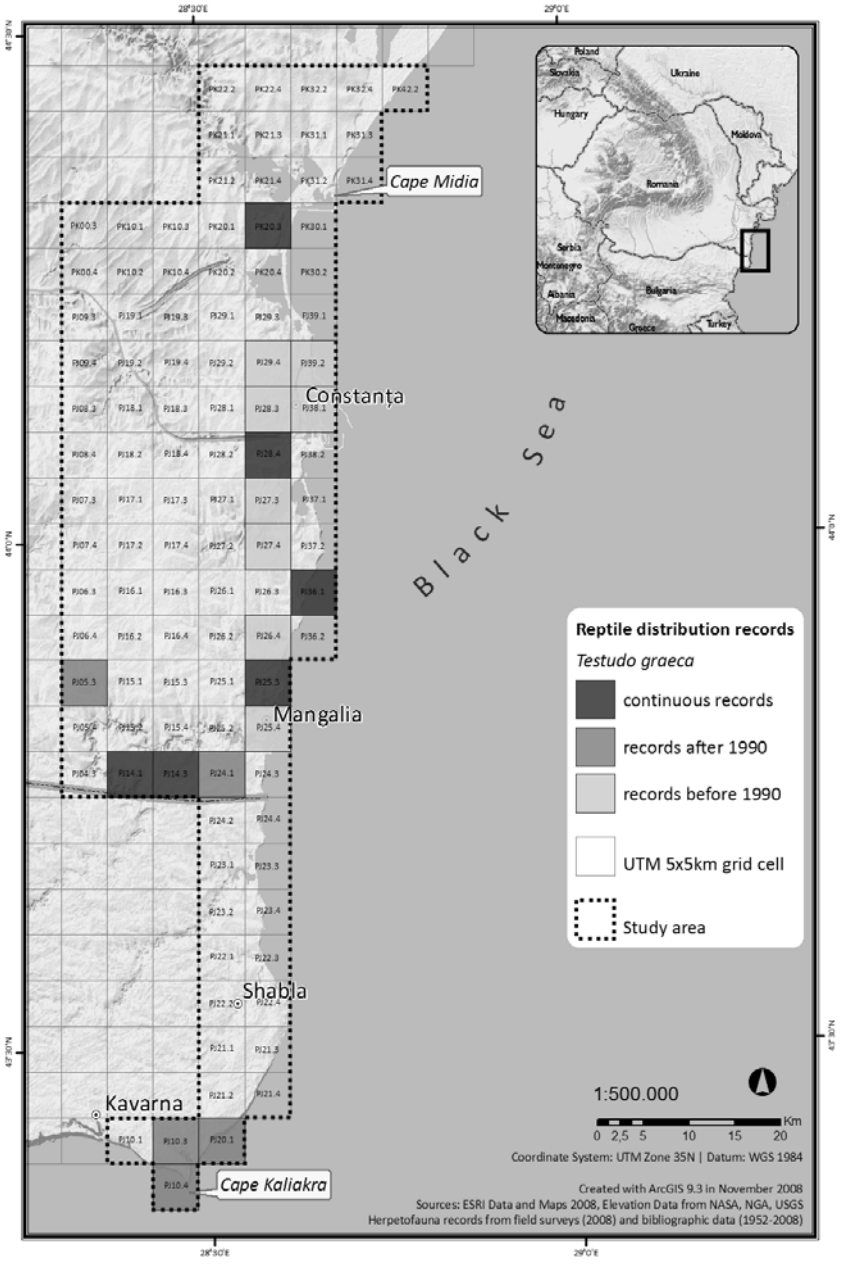


Figure 11 – Distribution of the Spur-thighed Tortoise *Testudo graeca* along the coastline between Cape Midia and Cape Kaliakra.

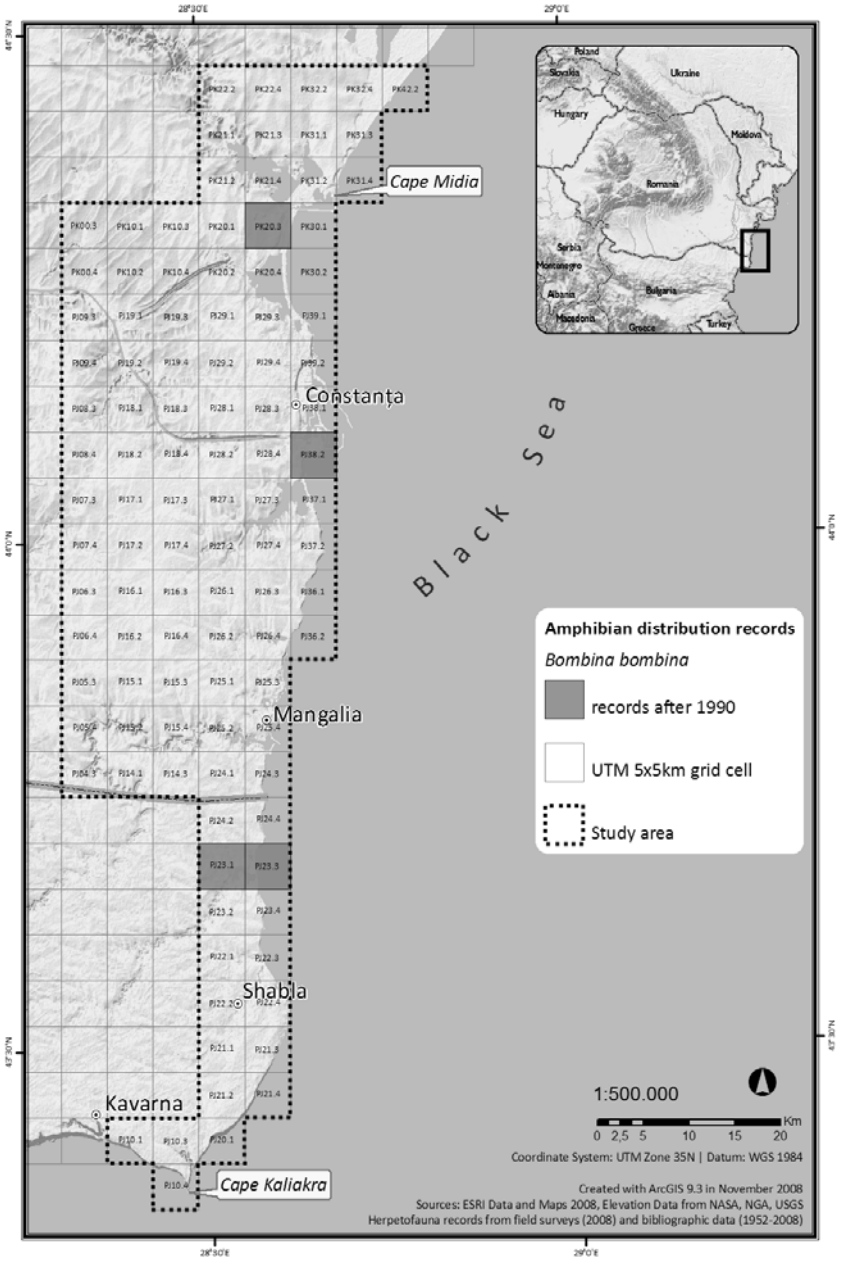


Figure 12 – Distribution of the Fire-bellied toad *Bombina bombina* along the coastline between Cape Midia and Cape Kaliakra.

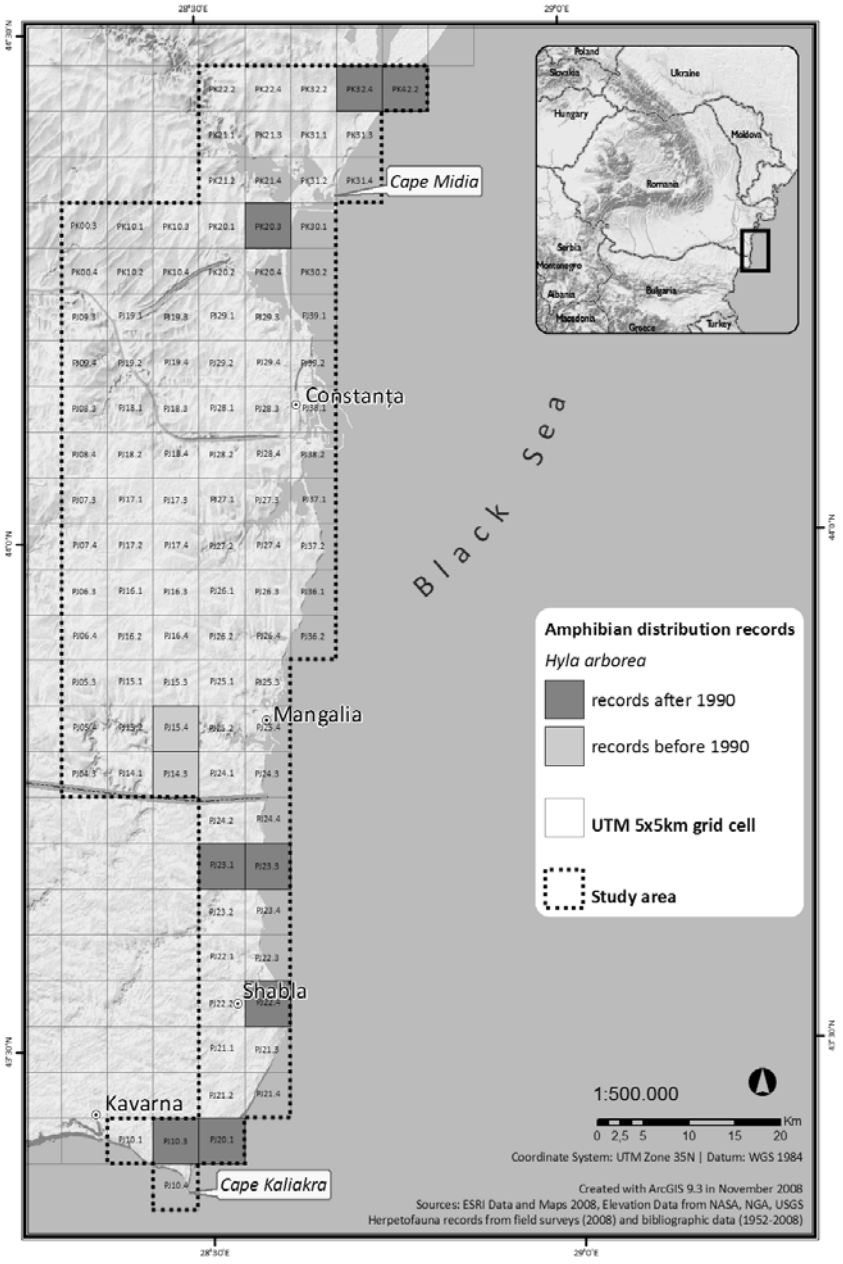


Figure 13 – Distribution of the Tree Frog *Hyla arborea* along the coastline between Cape Midia and Cape Kaliakra.

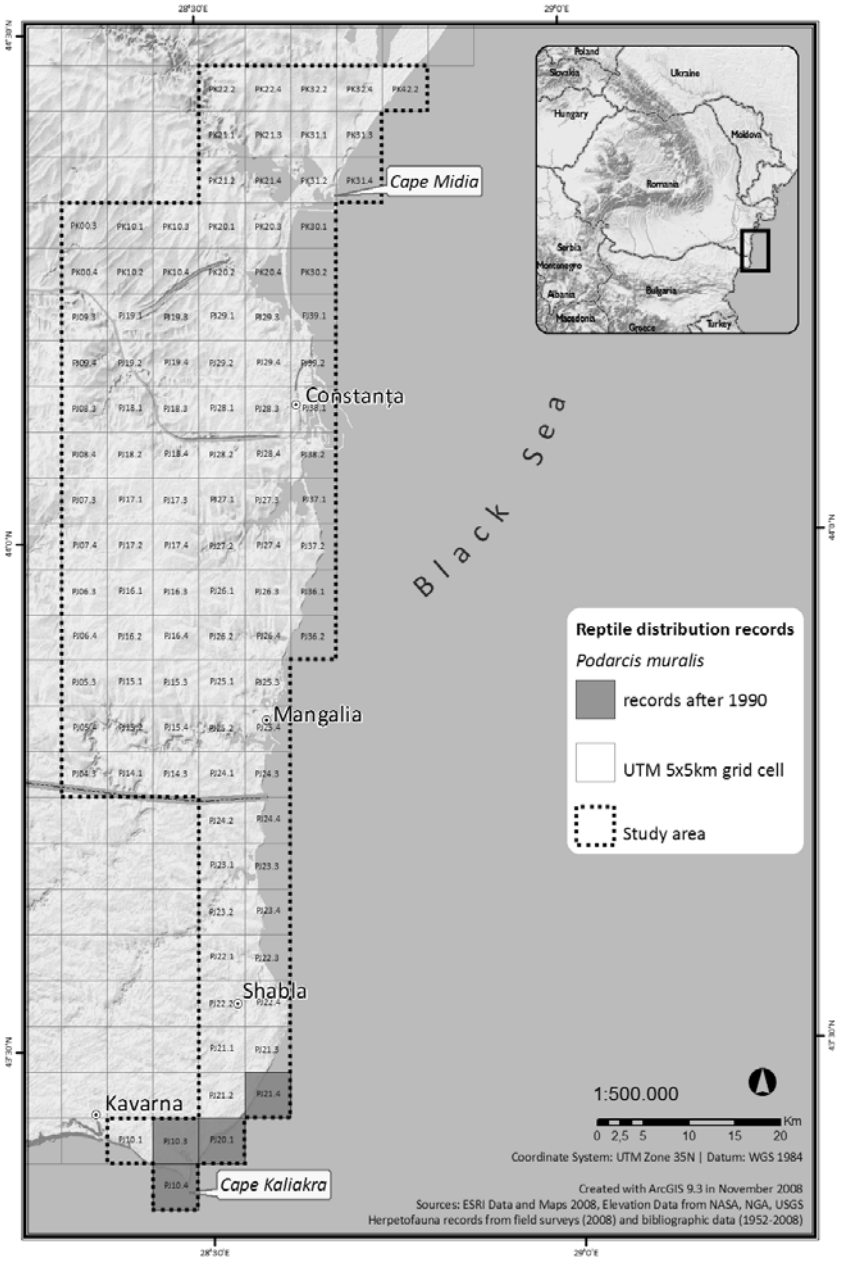


Figure 14 – Distribution of the Wall lizard *Podarcis muralis* along the coastline between Cape Midia and Cape Kaliakra.

Several species have an even more restricted distribution in the studied area, reaching either their northern distribution limit (e.g. *Ophisaurus apodus*) or their southern limit (e.g. *Eremias arguta*) (Figure 15).

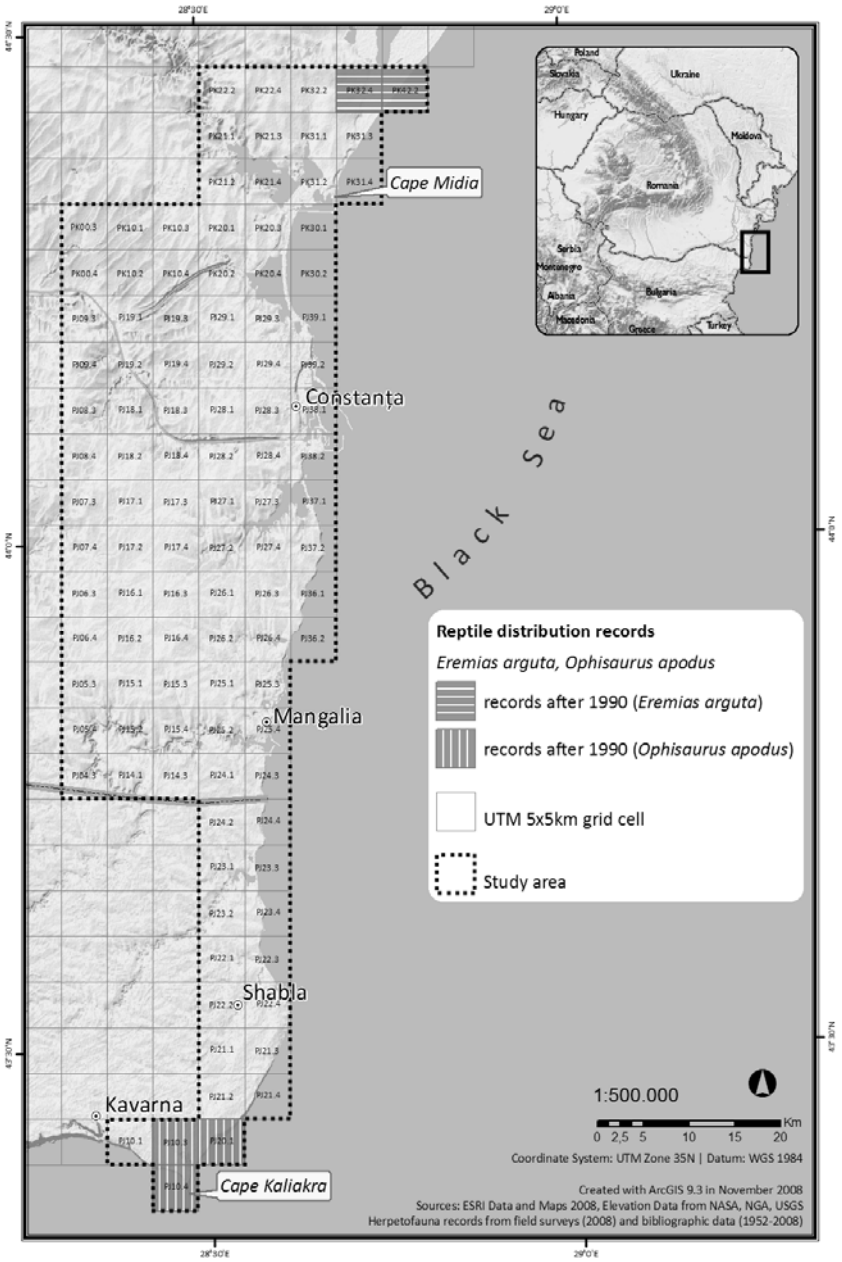


Figure 15 – Distribution of the Steppe Runner *Eremias arguta* and the European Glass Lizard *Ophisaurus apodus* along the coastline between Cape Midia and Cape Kaliakra.

The amphibian and reptile fauna is similar for the coastline stretches of the two countries, despite the rather large differences between Balkan countries (Atatür and Yilmaz 1986). Bulgaria has a higher amphibian and reptile species diversity as compared to Romania, despite its smaller area (Table 1). The area covered by our study is relatively uniform relatively to the number of species, only two reptile species being present only in one country each (*Eremias arguta* in Romania and *Pseudopus apodus* in Bulgaria).

Our inventory was not complete as indicated by the species accumulation curves. When comparing our results to the management plans for two protected areas in Bulgaria – Durankulak and Shabla the differences in species richness are significant. The species listed in the management plans are not based on inventories but on the coarse distribution of the amphibians and reptiles in Bulgaria. It is not backed by recent distribution maps (Gasc et al. 1997; Naumov and Stanchev 2008). For example, Trayanov (1996, unpublished report cited in the Draft Management Plan for Shabla Lake Complex in 1998) reports five amphibian and six reptile species in Shabla lake complex. For Kaliakra and Bolata Dere, the Draft Management Plan (1997) mentions 20 species, but the report is unreliable and does not refer to any bibliographic source. For example, it cites *Triturus cristatus*, which is not present in Bulgaria, clearly confusing it with *T. karelinii*, mentions *B. variegata*, confusing it with *B. bombina,* wrongly mentions *Lacerta taurica* and *L. muralis*, which belong to the genus *Podarcis*.

The herpetofauna of Romania and Bulgaria differs in both species richness and percentage of species protected. The conservation status of amphibians and reptiles varies between the two countries (Table 1). While in Romania all species, except for *Natrix natrix,* are included in OUG 57/2007, in Bulgaria only 2/3 are included in the annexes (Law 77/2002).

Table 1 – The number of species of amphibians and reptiles from Romania and Bulgaria and their conservation status. Romania also protects subspecies and they are represented in addition to the number of species preserved.

PARAMETERS	ROMANIA	BULGARIA
Surface (km^2)	237,500	110,910
Amphibians (number of species)	**19+1**	**18**
Protected by Habitats Directive (number)	20	17
Protected by Habitats Directive (%)	100%	94%
Number of amphibian species from the investigated coastline area	8	7
Reptiles (number of species)	**23+1**	**35**
Protected by Habitats Directive (number)	23	24
Protected by Habitats Directive (%)	96%	68%
Total number of species	42+2	53
Species density (number of species/10,000 km^2)	1.76/1.85	9.81
Number of reptile species from the investigated coastline area	8	9

A more detailed comparative analysis of the distribution and conservation status of amphibians and reptiles in the two countries is given in Tables 2 and 3.

Both countries share many environmental problems along the 170 km of terrestrial border in Dobrudja. Nevertheless there are many differences between the measures taken by the two governments in tackling environmental problems, starting from discrepancies in legislation and conservation status. Protecting the unique ecosystems and species diversity of the Black Sea Coast requires a higher degree of cooperation and joint measures, in a coherent approach.

Table 2 - A comparative analysis of the conservation status of amphibians in Romania, Bulgaria and according to international conventions or IUCN Red List. The EU Habitats Directive (92/43/EEC) was implemented in Romania by OUG 57/2007 and in Bulgaria by Law 77/2002. The Romanian Red List is according to Botnariuc and Tatole (2005) and the Bulgarian according to Beschkov (1985). The species inventoried during the present study are marked with ^{P}.

		ROMANIA		BULGARIA		INTERNATIONAL		
AMPHIBIAN SPECIES	Occurrence (present in only one country)	OUG 57/2007	Romanian Red List (2005)	Law 77/2002	National Red List (1985)	IUCN Red List (2008)	Bern Convention	Habitats Directive 92/43/EEC
Triturus dobrogicus		3	EN	III	-	NT	II	II
Triturus vulgaris		4B	NT	III	-	LC	III	-
Triturus vulgaris ampelensis	Romania	3, 4A	VU					
Triturus alpestris		4B	VU	II, III	rare	LC	III	-
Triturus cristatus		3, 4A	VU	II, III	-	LC	II	II, IV
Triturus karelinii	Bulgaria			-	-	LC	II	II, IV
Triturus montandoni	Romania	3, 4A	VU			LC		
Salamandra salamandra		4B	VU	III	-	LC	III	-
Bombina bombina^{P}		3, 4A	NT	II, III	-	LC	II	II, IV
Bombina variegata		3, 4A	NT	II, III	-	LC	II	II, IV
Pelobates fuscus^{P}		3, 4A	VU	II, III	-	LC	II	IV
Pelobates syriacus^{P}		4A	EN	II, III	threatened	LC	II	IV
Bufo bufo		4B	NT	III	-	LC	III	-
Bufo viridis^{P}		4A	NT	III	-	LC	II	IV
Hyla arborea^{P}		4A	NT	II, III	-	LC	II	IV
Rana dalmatina		4A	VU	II	-	LC	II	IV
Rana temporaria		4B, 5A	VU	II, IV	-	LC	III	V
Rana arvalis		4A	EN			LC		
Rana kl. esculenta^{P}		5A		IV	-	LC	III	V
Rana lessonae^{P}	Romania	4B				LC		
Rana ridibunda^{P}		5A		IV	-	LC	III	V
Rana graeca	Bulgaria			III	-	LC	III	IV

Table 3 - A comparative analysis of the conservation status of reptiles in Romania, Bulgaria and according to international conventions or IUCN Red List. The taxonomy is according to national legislation; in four species different names are used in the two countries. The EU Habitats Directive (92/43/EEC) was implemented in Romania by OUG 57/2007 and in Bulgaria by Law 77/2002. The Romanian Red List is according to Botnariuc and Tatole (2005) and the Bulgarian Red List according to Beschkov (1985).The species inventoried during the present study are marked with [P].

		ROMANIA		BULGARIA		INTERNATIONAL			
REPTILE SPECIES	Occurrence (present in only one country)	OUG 57/2007	Romanian Red List (2005)	Law 77/2002	National Red List (1985)	IUCN Red List (2008)	Bern Convention	Habitats Directive 92/43/EEC	CITES
Testudo graeca[P]		3, 4A	EN	II, III	-	VU	II	II, IV	II
Testudo hermanni		3, 4A	EN	II, III	-	LR/nt	II	II, IV	II
Emys orbicularis[P]		3, 4A	VU	II, III	-	LR/nt	II	II, IV	III
Mauremys rivulata	Bulgaria			II, III	threatened		II	II, IV	
Ablepharus kitaibelli		4A	EN	III	-	LC	II	IV	-
Mediodactylus kotschyi	Bulgaria			III	-	-	II	IV	-
Eremias arguta	Romania	4B	EN						
Lacerta agilis		4A	LC	-	-	-	II	IV	-
Lacerta praticola/Darevskia praticola		4B	VU	-	-	-	III	-	-
Lacerta viridis[P]		4A	LC	-	-	LC	II	IV	-
Lacerta trilineata[P]		4A	EN	-	-	LC	II	IV	-
Lacerta vivipara/Zootoca vivipara		4A		III	-	LC	III	-	-
Podarcis taurica[P]		4A	NT	-	-	LC	II	IV	-
Ophisops elegans	Bulgaria			III	rare	-	II	IV	-
Podarcis muralis[P]		4A	VU	-	-	LC	II	IV	-
Podarcis erhardii	Bulgaria			-	-	LC	II	IV	-
Anguis fragilis		4B	VU	III	-	-	III	-	-
Pseudopus apodus	Bulgaria			III	threatened	-	II	IV	-
Typhlops vermicularis	Bulgaria			III	rare	-	III	-	-
Eryx jaculus		4A	CR	III	threatened	-	III	IV	II, III
Coluber caspius/Dolicophis caspius[P]		4A, 4B	VU	III	-	-	II	IV	-
Coronella austriaca		4A	VU	III	-	-	II	IV	-
Elaphe longissima/Zamenis longissimus		4A	VU	III	threatened	-	II	IV	-
Zamenis situla	Bulgaria			II, III	threatened	LC	II	II, IV	-
Elaphe quatuorlineata		3, 4A	CR	II, III	threatened	-	II	II, IV	-
Elaphe sauromates	Bulgaria			II, III	-	-	III	-	-
Malpolon monspessulanus	Bulgaria			III	-	-	III	-	-
Telescopus fallax	Bulgaria			III	rare	-	II	IV	-
Natrix tessellate		4A	NT	-	-	-	II	IV	-
Natrix natrix[P]			LC	-	-	LC	III	-	-
Platyceps najadum	Bulgaria			III	-	-	II	IV	-
Platyceps collaris	Bulgaria			II, III	threatened	LC	II	-	-
Vipera aspis	Bulgaria			-	extinct	LC	III	-	-
Vipera ammodytes montandoni[P]		4A	CR	IV	-	-	II	IV	-
Vipera ammodytes ammodytes	Romania	4A	EN						
Vipera berus		4B	EN	-	-	-	III	-	-
Vipera ursinii		3, 4A	CR	II, III	extinct	EN	II	II, IV	I

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INVERTEBRATE DIVERSITY IN THE WESTERN PART OF BLACK SEA COAST: CAPE MIDIA - CAPE KALIAKRA ZONE

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Abstract: The western littoral part of the Black Sea is characterized by a series of specific habitats, from the rocky cliffs covered with tree clusters to the marine dunes. The invertebrate fauna of these habitats is very interesting, characterized by a number of endemic species, specific to the Pontic province. The present paper succinctly presents the data known to the present day for the area between Cape Midia and Cape Kaliakra. These data represent the result of the research activities accomplished within the Program PHARE CBC RO2005/017-535.01.02.02 which took place between April-August 2008.

Key words: invertebrate diversity, Black Sea littoral, Romania, Bulgaria

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Introduction

The Black Sea littoral represents a special area from many points of view. The special ecotone conditions are practically unique compared to other types of habitats, while the fauna, as well as the littoral flora, is strongly influenced by the marine climate. The species present here – psamophylous, hygrophile or thalassophylous – even though found in considerable numbers in the neighboring areas as well (steppe vegetation or wetlands), form a particular association.

Due to the narrow littoral area – a few hundred meters at most – the fauna associations – quite poor in species compared to those in the neighboring areas – are subject to much stronger anthropogenic pressure, any modification of the habitat leading to the disappearance of entire groups. Thus, the harbor developments on the one side, as well as the development of the specific touristic infrastructures on the other, have led to the disappearance of fauna encountered frequently on the beaches from large portions of the littoral (especially the area Mamaia-Eforie North).

From an ecological point of view, several types of fauna groups can be found in the littoral area. If we classify these groups according to the microhabitats, the following categories can be counted:

- The fauna of decomposing algae deposits and alluvial deposits;
- The fauna of the beach proper, with no vegetation;
- The fauna of psamophile vegetation with *Crambe maritima, Salsola* sp., *Cakile maritima*;
- The fauna of the herbaceous vegetation strip dominated by *Leymus sabulosus*;
- The fauna of the wetlands in the Vadu-Navodari area and the paramarine lake areas;
- The fauna of the high seawalls in the southern part of the littoral.

Among these particular types of fauna, those exclusive to the littoral area are the first four. Here, there is a number of typical species, while in the seawall fauna in the southern littoral and the wetland area north of Mamaia – more and more affected by the anthropogenic impact – the fauna is made up of species present in other types of habitats as well.

A specification must be made from the very beginning. The studies effected on the fauna in the littoral area in general and the entomofauna in particular have been sporadic and, with the exception of the valuable researches of Carol Nagy (Nagy, 1971, 1972), they usually approached aspects regarding one or another of the taxonomical groups. Comparative ecological studies on these interesting insect groups lack almost completely.

Material and Methods

The present paper is mostly based on specialized literature for the outlining of species into different taxonomic groups which occur in the littoral area. Also, the field observations within the Program PHARE CBC RO2005/017-535.01.02.02 between April-August 2008 completed the literature data for some of the insect groups.

Results and Discussions

The most interesting fauna group in the littoral area can be found in the vicinity of the wave breaking area, where algae debris or mollusk shells deposit all year round. All this decomposing debris represents a complex ensemble of habitat niches populated by an important number of living creatures. The trophic chains formed here are based on trophic resources of organic decomposing matter. Some of the species present in the detritus deposits can also be found in other areas, while other species are characteristic to a specific zone.

Particularly interesting is the presence of certain marine species that consume the same resources in this narrow portion. Thus, in the alluvial deposits of the littoral area and under the piles of algae, one can frequently encounter gammarid amphipods, while crabs like *Carcinus mediterraneus* (quite rare over the last decades at the Romanian littoral) or *Pachygrapsus marmoratus* usually feed during the warm season with mollusk cadavers thrown on the beach by the waves, and not only. The fauna encountered in the organic detritus deposits on the beach is made up especially of insects, which dominate in terms of number of species and individuals. A number of birds specialized in exploiting the same habitat niches complete the fauna here.

The insects encountered in this area are divided into several categories. A first category is represented by those species that consume decomposing organic matter. This category contains not only Dermaptera such as *Labidura riparia* (characteristic to the littoral area, where large populations can be found), springtails (Collembola) of the genera *Entomobrya* and *Tomocerus*, etc. but especially larvae and adults of brachycer Diptera and Coleoptera. Among these: *Euconnus waterhali* (Scydmenidae)*, Sapromyza bipunctata, Fucellia maritima* (in large numbers on the beaches, even in warm days during the cold season), *Choleva oblonga, Ptomaphagus varicornis, Sciodrepa watsoni, Catops tristis* (Catopidae), *Calobaea bifasciella, Ctenulus pectoralis, Salticella fasciata* (Sciomyzidae), *Pyrelia cadaverina, Piophila caripes* (Piophilidae), *Ephydra macellaria* (whose larvae feed on epibiont Diatomea on the rocks in the wave breaking area or on decomposing vegetal remains), *Lucilia sericata, Agyrtes castaneus, Necrodes littoralis, Ablataria laevigata* (Silphidae), *Lebia cyanocephala, Chlaenius festivus* (Coleoptera). The larvae of some of these species often practice cannibalism – phenomenon also observed in *Labidura*. Also on the sea shore, one can encounter certain species of Heteroptera such as *Prostemma gutula, Prostemma seneicole* – which take shelter in mollusk shells, *Prostemma sanguinea, Nysus senecionis* – found on rocky beaches in the southern littoral, *Tingis maculata*, *Aethus nigritus,* found on sandy beaches in the north, *Microvelia schneideri* – on the piles of decomposing algae.

Another category is represented by the carnivorous species that feed on larvae or adults of species in the first category or which they use as hosts. This group is made up especially of Coleoptera - *Cicindela trisignata, Clivina fosor, Clivina ypsilon, Paederus riparius* – or Hymenoptera genus – *Teleas, Brachymeria* (which are parasites for other species) and species *Bembix oculata*, *Bembix olivacea* (which feeds its larvae with different Diptera species captured on the detritus deposits on the beach), to which ants, Neuroptera or damselflies and dragonflies are added, but they are not as important. Certain birds that live on the beaches also feed on larvae of the different insect species that grow in the decomposing algae deposits.

The beaches proper, deprived of vegetation, have a poor fauna, represented especially by species from the neighboring areas – the vegetation zone or the sea shore with alga or mollusk deposits. On the beaches, one may encounter especially predatory species that are active in open field – such as the Cicindelida among Coleoptera, certain species of Hymenoptera such as *Pompilus plumbeus* or *Ammophila sabulosa*, Heteroptera such as *Aethus nigritus, Arma custos* (which hunts other insect species), *Saldula saltatoria,* certain predatory Diptera in the Asilida group, the spiders. More rarely, during the night, certain large Myriapoda can be found in the same area – *Scolopendra cingulata*, while during the day, sand lizards venture in the area – *Eremias arguta deserti*.

In the psamophile vegetation areas with *Crambe maritima* and *Cakile maritima,* as well as in the area with *Elymus sabulosus*, the fauna is richer. On the bushes of *Cakile maritima* or *Crambe maritima* one can often find individuals of Heteroptera, some common like *Eurydema ornata*, but this is also where *Eurydema spectabile* is encountered, a species strictly localized on the littoral strip and which does not exist in other habitats; important populations of this species also occur on bushes of *Crambe* in the northern littoral. Grasshopers (Orthoptera) are also represented by common species, often in large numbers – *Calliptamus italicus, Stenobothrus fischeri, Oedipoda germanica*, but also by species strictly localized on the littoral strip, like *Acrotylus longipes*, species existing only in this type of habitat. The populations of this species have disappeared in the Mamaia-Agigea area, while it is rare in the southern littoral. An isolated population remains only in the Agigea sand dunes reservation, in the area with *Convolvulus persicus*; vigorous populations can be found north of Mamaia. Other species found in these areas: Gasteropoda/Gastropoda – *Helicella obvia,* Odonata – species of *Agrion, Sympetrum, Ischnura pumilio*, Orthoptera – *Tetrix subulata,* etc., Mantodea – *Ameles decolor,* seldom *Mantis religiosa*, Neuroptera, Heteroptera – *Menccarus arenicola, Psacasta neglecta, Zicrona coerulea, Eysacoris punctatus,* etc., Coleoptera – *Lophyridia lunulata, Zbrus, Harpalus, Pogonidium laticolle*, a large number of adults of species of Diptera, Hymenoptera – *Ammophila sabulosa, Pompilus plumbeus, Bembix, Myrmecocystus*. Vertebrate species can also be encountered in the area – reptiles (*Eremias arguta deserti, Podarcis taurica*) or birds that sometimes nestle in these habitats.

The swampy areas are the richest in regards to the fauna, the following being dominant: Orthoptera – *Tettigonia viridissima, Calliptamus italicus, Oedipoda coerulescens, Acrida hungarica – in areas where* herbaceous vegetation dominates and the soil is not swampy, Nematocera Diptera the group of Chironomidae – *Chironomus plumosus, C. salinarius, Glyptotendipes* sp. and Culicidae – *Culex* sp., *Aedes* sp., Heteroptera (both the hydrocorisae *Nepa, Ranatra, Notonecta, Plea,* etc. - and geocorisae) and Lepidoptera – *Lycaena phlaeas, Lycaena dispar*. Well represented are also all types of insects with aquatic larvae or adults – Odonata of all genera (*Callopteryx, Agrion, Lestes, Sympecma, Sympetrum, Ischnura, Aeschna,* s.a.), Ephemeroptera – *Caenis, Baetis, Ephemera*), Coleoptera, etc. Still, the fauna of these habitats is not exclusive to the littoral area, as they are usually found around ponds and in Danube Delta and Danube Valley.

The largest areas of this kind can be found north of Vadu-Mamaia, as in the southern littoral they are restricted to the seashore between Eforie South and Costinesti, where fresh water infiltrations occur at the basis of the seawalls and this permits the development of compact bushes. They are also restricted to the Hergheliei Swamp near Mangalia.

The southern littoral with high seawalls partially covered by sparse vegetation represents another interesting habitat. The seawalls position makes them directly influenced by the salty marine moisture and by the strong sunlight. The vegetation living here is mostly of steppe origin. The particular importance of these habitats comes from the fact that the littoral steppe is almost entirely gone, being limited to a very narrow strip on the superior part of the seawalls, the rest being occupied by agricultural crops. The seawall entomofauna is also mostly represented by steppe species that take shelter in the vegetation from the edge of the seawalls or on that of the steep slopes, or it is made up of species that visit flowing plants in these narrow strips of wild vegetation. This justifies the exhaustive citation of all the taxa encountered in this area. There are frequent Odonata – *Sympecma fusca, Sympetrum vulgatum, Aeschna affinis*, Mantidae – *Mantis religiosa*, Orthoptera – *Gryllus desertus, Poecillimon brunneri, Isophya speciosa, Saga pedo* (very rare), *Tetrix subulata, Calliptamus barbarus, Calliptamus italicus, Oedipoda* sp., *Acrida hungarica, Tettigonia viridissima, Phaneroptera falcata,* Heteroptera – *Metopoplax origani, Reduvius personatus, Anthocoris nemorum, Liocoris tripustulatus*, etc, Homoptera – *Centrotus cornutus, Cercopsis sanguinolenta,* Neuroptera Chrysopidae and Myrmeleontidae, Coleoptera – *Calosoma inquisitor, Notiophilus palustris, Bledius furcatus,* a large number of species of Lepidoptera that visit flowering plants – *Pontia daplidice, Colias croceus, Colias erate, Polyommatus icarus, Vanessa cardui, Vanessa atalanta, Argynnis lathonia, Coenonympha pamphilus* etc, adults of Diptera that fly on the beach too, Hymenoptera.

Among the Gasteropoda/Gastropoda?, quite frequent are *Zebrina varnensis, Helicella obvia dobrudschae*, *Cernuella virgata variabilis, Helicopsis striata, Monacha carthusiana*, among the Myriapoda *Lithobius*

forficatus, Scolopendra cingulata, Scutigera cleoptrata, order Araneae with families Lycosidae and/or Salticidae.

The list of taxa in the Romanian littoral area

Gasteropoda - Pulmonata

Snails are poorly represented in the littoral areas (Grosuu, 1983, 1987, 1993; Negrea, 1994a, 1994b). The absence of vegetation on the beaches, as well as the influence of salt in the soil have caused the lack of Gasteropoda in the littoral strip. Numerous populations of *Helicella* or *Zebrina varnensis* can be encountered in the psamophile vegetation or the herbaceous areas on seawalls. In areas with swamp vegetation situated north of Mamaia, a number of aquatic or water loving species can occur. Similarly, in areas with trees or shrubs nearby the seashore, characteristic Gasteropoda occur.

Zebrina varnensis Pfeiff.
Ovatella (Myosotella) myosotis (Drap.)
Lymnaea stagnalis (L.)
Galba truncatula (O.F.Muller)
Ancylus fluviatilis (O.F.Muller)
Planorbis carinatus (Muller)
Planorbis planorbis (L.)
Zebrina varnensis (Pfeiff.)
Chondrula tridens (O.F.Muller)
Cecilioides acicula (O.F.Muller)
Oxychilus glaber (West)
Oxychilus dilus rumelicus (Hesse)
Multidentula ovularis (Olivier)
Milax kusceri H.Wagner
Milax dobrogicus Grossu
Cernuella virgata variabilis (Drap.)
Cernuella dobrogica Grossu
Helicella obvia dobrudsche Clessin
Helicella spiruloides Wagner
Helicopsis striata O.F.Muller
Helicopsis dejecta Cristofori et Jan
Helicopsis krynickii (Andr.)
Helicopsis derbentina (Krynicki)
Cochlicella acuta (O.F.Muller)
Monacha cartusiana (O.F.Muller)
Helix pomatia L.
Helix lucorum O.F.Muller

Myriapoda – Chilopoda

Millipedes and centipedes are poorly represented in the coastal habitats(Matic, 1966, 1992; Negru, 1994). Their ecological characteristic are often improper for most Myriapoda species. Still, some species can be present nearby beaches and mostly in the vegetation of high seawalls, the most frequent being *Scolopendra cingulata* and *Scutigera cleoptrata*.

Lithobius forficatus (L.)
Lithobius muticus Koch
Lithobius (Monotarsobius) crassipes Koch
Lithobius (Monotarsobius) burzenlandicus euxinicus Prunescu
Scutigeromorpha
Scutigera cleoptrata (L.)
Scolopendra cingulata L

Araneae

The spiders are a little studied group in the Romanian littoral area and not only (Fuhn, Gherasim, 1995; Fuhn, Niculescu-Burlacu, 1971; Oltean, 1968). Due to the complexities of the trophic relationships in which they are involved as a group of predators, a systematic inventory of this group is absolutely necessary in the future.

Lycosidae
Pardosa italica Tong.
Pardosa luctinosa Simon
Alopecosa cursor Hahn
Alopecosa sulzeri Pv.
Arctosa cinerea Fabr.
Lycosa vultuosa Koch
Lycosa radiata Latr.
Salticidae
Yllenus horvathi Chyz.

Euophrys erratica Walck.
Heliophanus flavipes Hahn.
Heliophanus kochi Simon
Marpissa muscosa Clerck
Sitticus dzieduszyckii Koch
Myrmarachne formicaria de Geer

Insecta

Ord. Collembola

Springtails are a group that has few demands regarding the environment conditions, they often occur in large agglomerations in the littoral area, sometimes in particular microhabitats, such as the ponds remaining on rocks after storms, where hundreds of individuals can be found. The springtail fauna in the littoral area has not yet been studied systematically.

Anurida maritima Guerin
Entomobrya marginata Tulb.
Heteromorus major Mon.
Tomocerus vulgaris (Tullb.)
Sminthurus sp.
Archisotoma besselsi (Pacard)
Friesea acuminata Denis
Onychiurus fimata Gisin
Seira ferrari Parona

Ephemeroptera

The larvae of Ephemeroptera are part of the pond fauna in the littoral area, while the adults occur in the entomofauna of herbaceous vegetation (Bogoescu, 1958). They are not present on the high seawalls in the southern littoral or on beaches. In the littoral area, only a few species can be found that also occur nearby fresh water habitats.

Palingenia longicauda (Olivier)
Ephemera vulgata L.
Caenis horraria (L.)
Baetis bioculatus (L.)
Cloeon dipterum (L.)

Odonata

Damselflies and dragonflies are predatory species and good fliers and they can be found frequently on beaches or in habitats in their vicinity, especially where there are ponds or swamps nearby(Bulimar, 1992, 1993; Cârdei, Bulimar, 1963; Griebler, 1994)

Zygoptera
Callopteryx splendens L.
Agrion pulchellum (van der Linden)
Lestes barbarus (van der Linden)
Lestes viridis (van der Linden)
Lestes dryas (Kirby)
Sympecma fusca Lind.
Agrion puella L.
Ischnura pumilio Charp.
Ischnura elegans Lind.

Anisoptera
Libellula quadrimaculata L.
Orthetrum cancellatum (L.)
Sympetrum pedemontanum Allioni
Sympetrum depressiusculum (Selys)
Sympetrum sanguineum L.
Aeschna grandis (L.)
Aeschna affinis Steph.
Anax imperator (Leach)

Orthoptera

Grasshoppers are one the groups represented especially in areas with herbaceous vegetation nearby beaches or on seawalls (Knechtel, Popovici-Baznosanu, 1950). Few species are adapted exclusively to the habitats with sparse psamophile vegetation like *Acrotylus longipes* with vigorous populations in the areas of Vadu-Mamaia and Eforie; the Agigea population, restricted to the sandy perimeter with *Convolvulus persicus* is currently endangered.

Tettigonioidea
Tettigonia viridissima (L)
Poecillimon brunneri Friv.
Isophia speciosa Friv.
Phaneroptera falcata Scop.
Saga pedo Pall.
Grylloidea
Gryllus desertus (Pallas)
Oecanthus pellucens Scop.
Gryllotalpa gryllotalpa (L)
Acridoidea
Tetrix subulata L.
Calliptamus italicus (L)
Acrida hungarica (Herbst)
Stenobothrus fischeri Ev.
Oedipoda germanica Latr.
Oedipoda coerulescens (L)
Acrotylus longipes Charp.

Blattodea

Roaches occur accidentally in the littoral area. One of the species – *Ectobius laponicus* – is characteristic to forests and can be found only in areas with trees (Comorova Forest), while the other species prefer human presence and can be found in areas with buildings. An interesting situation is given by *Periplaneta americana* – a species that has immigrated recently and that has been appearing frequently since 1990 around Constanta, all year round.

Ectobius laponicus L.
Phyllodromia germanica L.
Blatta orientalis L.
Periplaneta americana L.

Mantodea

Praying mantids are poorly represented in the European entomofauna. Only two of the four species of Mantida (characteristic to Dobrogea) occur in the littoral areas with high seawalls (Knechtel, Popovici-Baznosanu, 1950).

Mantis religiosa (L)
Ameles decolor (Charp.)

Dermaptera

Polyphage species by excellence, Dermaptera (earwings) are one of the groups characteristic to beaches. The piles of decomposing algae or bivalves and crustaceans represent a trophic niche where *Labidura riparia* in particular, develop extremely numerous populations along the entire littoral.

Forficula auricularia (L.)
Anechura bipunctata F.
Labidura riparia Pall.
Chelidurella acanthopygia Gen.

Thysanoptera

The trips are distributed in areas with herbaceous vegetation and they are rare or absent on the beaches with sparse vegetation. The adults and the larvae occur in plant inflorescences. As with other groups, a systematic inventory of Thysanopterae in the littoral areas does not exist yet (Knechtel, 1951; Vasiliu-Oromulu, 1992, 1998).

Terebrantia
Aelothrips intermedius Bag.
Aelothrips astutus (Priesner)
Limothrips angulicornis Jab.
Haplothrips angusticornis Priesner
Haplothrips reuteri Karny
Kakothrips robustus (Uzel)
Taeniothrips discolor (Karny)
Taeniothrips frici Uzel
Thrips tabaci (Lindeman)
Stenothrips graminum (Uzel)
Tubulifera
Pseudocryptothrips meridionalis (Priesner)
Haplothrips tritici Kurd.
Bolothrips icarus Uzel.
Bolothrips bicolor (Heeger)

Heteroptera

Heteroptera (bugs) – particularly their representatives of the order Gymnocerata, are one of the numerous groups in the terrestrial littoral biotopes. Unlike coleoptera or Diptera, Heteroptera populate the beach strips with herbaceous vegetation and especially the seawalls or the steppes nearby beaches. The special particularities of their eating habits do not permit them to occupy the trophic niches offered by the decomposing organic material on the beaches. Criptocerata can be found only in the ponds nearby the littoral or in the paramarine lakes (Kis, 1985, 1993 ; Schneider, Plattner, 1968).

Cryptocerata
Corixa punctata Illiger.
Hesperocorixa linnaei Fieb.
Peracorixa coccinea Fieb.
Sigara stagnalis pontica Jacz.
Sigara assimilis Fieb.
Sigara striata L.
Sigara iactans Jann.
Sigara lateralis Leach
Plea lechi McGreg. et Kirk.
Notonecta glauca L.
Ilyocoris cimicoides L.
Nepa rubra L.
Ranatra linearis L.
Gerris lacustris L.
Gerris odontogaster Zett.
Gerris argentatus Schum.
Hydrometra stagnorum L.
Gymnocerata
Stibaropus henkei Jak.
Byrsinus fossor Mulss. et Rey
Aethus nigritus F.
Aethus flavicornis (Fabricius)
Geotomus punctulatus (Costa)
Geotomus caucasius (Kolenati)
Cydnus atterimus Frst.
Legnotus limbosus (Geoffroi)
Legnotus picipes Fall.
Canthophorus melanopterus H.- S.
Schirus morio L.
Odontoscelis lineola (Rambur)
Odontoscelis dorsalis (Fabricius)
Odontoscelis fuliginosa L.
Irochrotus lanatus (Pallas)
Phimodera humeralis (Dalman)
Psacasta neglecta H.-S.
Psacasta exanthematica (Scopoli)
Eurygaster austriaca (Schrank)
Eurygaster itegriceps (Puton)
Eurygaster maura (L)
Ancyrosoma leucogrammes Gmel.
Graphosoma lineatum L.
Derula flavoguttata M.R.
Carpocoris mediterraneus (Tamanini)
Carpocoris pudicus Poda
Carpocoris fuscipinus Boh.
Antheminia lunulata Goeze
Palomena prasina L.
Eurydema ornata L.
Eurydema spectabile (L)
Eurydema ventrale (Kolenati)
Menaccarus arenicola Schltz.
Sciocoris sulcatus Fieber
Sciocoris helferi Fieber.
Sciocoris deltocephalus (Fieber)
Sciocoris macrocephalus Fieb.
Dryoderes umbraculatus Fabr.
Aelia acuminata L.
Neotiglossa pusilla Gmel.
Holcostethus sphacelatus Fabr.
Zicrona coerulea L.
Arma custos F.
Jalla domosa L.
Troilus luridus F.
Eysacoris punctatus L.
Henestaris halophilus Bur.
Lygaeosoma reticulatum H.-S.
Nysus punctipennis H.-S.
Nysus thymi Wlff.
Nysus senecionis Schill.
Metopoplax origani Kolenanti
Derephysia foliacea Fall.
Stephanitis piri Geoff.
Tingis maculata H.-S.
Reduvius personatus L.
Prostemma guttula F.
Prostemma seneicolle Stein
Prostemma sanguinea Rossi
Hebrus pusillus Fall.
Nabis apterus F.
Nabis ferus L.
Nabis brevis Schltz.
Microvelia schneideri Schltz.
Velia currens F.

Saldula saltatoria L.
Anthocoris nemorum L.
Orius nigra Wlff.
Orius minuta L.
Capsodes gothicus L.
Liocoris tripustulatus F.
Camptobrochis punctulatus Fall.
Codophila varia (Fabricius)

Homoptera

Homoptera represent another order that lacks data regarding the littoral areas. Entire taxonomic groups such as the suborder Auchenorhyncha are practically not studied. The aphids, for example, a very important group in the habitats with herbaceous vegetation can offer many interesting surprises.

Centrotus cornutus F.
Caliscelis bonellii Latr.
Cercopsis sanguinolenta L.

Neuroptera

Both the adults and the larvae are predatory species. Coniopterigida and Chrysopida occur especially in areas with thick or bushy herbaceous vegetation, or in the biotopes where there are trees as well. Ant lions (Myrmeleonidae), on the other side, are by excellence inhabitants of the open biotopes, with soil that is relatively poorly covered by vegetation; their larvae prefer sandy soils on the beaches or in their close vicinity, where they build characteristic traps. The adults can be encountered in the herbaceous vegetation nearby the beaches (Kis et al, 1970).

Coniopterygidea
Coniopteryx borealis (Tjeder)
Coniopteryx loispetsederi (Aspock)
Coniopteryx esbenpeterseni Tj.
Coniopteryx tjederi Kimm.
Hemerobiidea
Hemerobius humulinus L.
Hemerobius stigma Steph.
Hemerobius micans Oliv.
Aleuropteryx ornata (Kis)
Chrysopydea
Chrysopa carnea Steph.
Chrysopa hungarica (Klapalek)
Chrysopa abbreviata (Curtis)
Chrysopa commata (Kis-Ujhelyi)
Chrysopa phyllochroma (Wesmael)

Myrmeleonoidea
Dendroleon pantherinus (Fabr.)
Megistopus flavicornis (Rossi)
Creoleon lugdunense Villers
Myrmeleon formicarius (L)
Myrmeleon inconspicuus (Rambur)
Euroleon nostras (Fourcroy)
Acanthaclisis occitanica (Villers)
Acanthaclisis baetica (Ramb.)
Myrmecaelurus trigrammus (Pallas)
Neuroleon nemausiensis (Borkhausen)
Formicaleon tetragrammicus F.

Coleoptera

Coleoptera represent one of the best represented groups on the beaches and in the littoral areas, alongside diptera (Crisan, 1993 ; Ienistea, 1968; Nitu, 1992; Ostafciuc, 1994; Panin, 1955; Panin, Savulescu, 1961; Popovici, 1992; Ruicănescu, 1995; Serafim, 1993°, 1993b; Serafim, Ruicănescu, 1995; Teodor, 1993; Teodor, Traian, 1996). Among Coleoptera, a large number of species literally consume – as adults or as larvae – the remains of decomposing algae on the beach; other species are saprobic, coprophage or necrophage, while others are carnivorous, attacking mostly Diptera larvae. Considering that the group befitted from detailed studies at national level, the species in the littoral area are relatively well known, too.

Cicindella trisignata Dej.
Cicindella campestris pontica Motsch.
Cicindella lunulata nemoralis O.
Carabus violaceus L.
Calosoma inquisitor L.
Calosoma maderae auropunctatum Hbst.

Omophron limbatum F.
Clivina fossor L.
Clivina ypsilon Dej.
Dyschirus numidicus ponticus Lutshn.
Brachinus explodens Duft.
Brachinus crepitans L.
Brachinus angustatus Dej.
Polystichus conexus Fourc.
Notiophilus palustris Duft.
Ditomus capito Serv.
Lebia cyanocephala L.
Chlenius festivus F.
Amara similata Gil.
Amara familiaris Duft.
Amara aenea De Geer
Amara equestris Duft.
Trechus quadristriatus Schrk.
Microlestes minutullus Goeze
Microlestes plagiatus Duft.
Calatus cisteloides Panz.
Calatus fuscus F.
Zabrus blaptoides Creutz.
Zabrus curtus Dej.
Harpalus aeneus F.
Harpalus azureus F.
Harpalus serripes Luc.
Harpalus distinguendus Luc.
Bembidium varium Oliv.
Pogonidium laticolle Duft.
Pardileus calceatus Duft.
Lyperosomus aterrimus Hbst.
Staphylinus cesareus L.
Staphylinus murinus L.
Paederus riparius L.
Carpelinus memnonius Kiesw.
Philonthus fulvipes F.
Philonthus punctatus Grav.
Philonthus longicornis Steph.
Philonthus xantholoma Grav.
Tachyporus nitidulus F.
Tachyporus obtusus L.
Tachyporus chrysomelinus L.
Conosoma pubescens Grav.
Oxyporus rufus L.
Troglophloeus riparius Boisd.
Bledius tricornis Hbst.
Bledius furcatus Oliv.
Bledius unicornis Germ.
Haploderus caelatus Grav.
Oxytelus complanatus F.
Stenus ater Mannh.
Euplectes bicolor Denny
Hister sinuatus Illig.
Hister quadrimaculatus L.
Hister fimetarius Hbst.
Hister stercorarius Hoffm.
Hister quadrinotatus Scriba
Thanatophilus sinuatus F.
Agyrtes castaneus Payk.
Necrodes littoralis L.
Silpha orientalis Brull.
Silpha carinata Illig.
Drilus concolor Ahr.
Choleva oblonga Mull.
Ptomaphagus varicornis Rosh.
Scioderpa watsoni Spin.
Catops tristis Panz.
Dermestes lardarius L.
Dermestes mustelinus Er.
Attagenus piceus Oliv.
Anthrenus pimpinellae F.
Anthrenus scrophulariae L.
Anthrenus fuscus Oliv.
Atomaria ruficornis Marsh.
Heterocerus flexuosus Steph.
Scymnus apetzi Muls.
Phyllotreta poeciloceras Cond.
Cryptocephalis globicollis Sufr.
Cryptocephalus flavipes F.
Cryprocephalus bipunctatus L.
Crepidodera helxines L.
Apthona cyparissiae Koch.
Epicauta verticalis Illig.
Zonitis caucasica Pall.
Lydus balcanicus Steutz.
Lydus chalybaeus Tautsch.
Trichodes quadriguttatus Adams
Notoxus trifasciatus Rossi
Anthicus hispidus Rossi
Anthicus antherinus L.
Anthicus fenestratus Schm.
Anthicus humilis Germ.
Onthophagus lucidus Sturm.
Potosia fieberi Kr.
Epicometis hirta Poda
Scarabaeus affinis (Brulle)
Aphodius lugens (Creutzer)
Aphodius punctipenis (Erichson)

Aphodius immunus (Creutzer)
Trox hispidus (Pontoppidan)
Pentodon bidens (Pallas)
Pentodon idiota Herbst.
Polyphylla fullo (L.)
Anoxia orientalis (Kryn)
Anomala errans (Fabr.)
Maladera holoserica Scop.
Homaloplia alternata Kust.
Homaloplia ruricola F..
Homaloplia erythroptera Friv.
Coccinela septempunctata L.
Thea 22-punctata L.
Calamobius filum L.

Mecoptera

This order – that includes scorpionflies - It is represented by a single species – *Panorpa communis* L. – rarely on the beach, sometimes close to wetlands (Nagler, 1968).

Trichoptera

The members of this group are relatively rare on the beaches. However, the adults can sometimes be found in large numbers in the herbaceous vegetation of the high seawalls in the south or close to the moors in the area of Vadu-Navodari. Also, they can be present in the anthropic areas along the littoral, if there are permanent ponds nearby (Ciubuc, 1993).

Argypnia varia (Fabricius)
Limnephilus affinis Curtis
Limnephilus bipunctatus Curtis
Limnephilus decipiens (Kolenati)
Limnephilus flavospinosus (Stein)
Limnephilus sparsus Curtis
Colpotaulius incistus (Curtis)
Oecetis ochreacea (Curtis)

Lepidoptera

Moths and butterflies are less connected to the beach biotope, where the larvae do not find a variety of trophic resources. However, the adults can be encountered both on the beaches, where they visit the flowers of rare psamophile plants, but especially in the areas with herbaceous vegetation or bushes close to the beaches. Also, the presence of forested areas close to the seashore, such as Comorova or Neptun, facilitate the presence of forest species in the littoral area (Kovacs et Kovacs, 1998, 1999; Rakosy, 1997; Rakosy, Szekely, 1996; Rusti, 1992, 1994; Skolka, 1994; Vicol, 1997).

Tineidae
Euplocamus ophisus Cram.
Anemopogon quercicolellus H.-S.
Neurothaumasia ankerella Mn.
Tinea pellionella L.
Tinea flavescentella Haw.
Fermocelina inquinatella Zell.
Trichophaga tapetzella L.
Trichophaga abruptella Wall.
Monopis imella Hb.
Monopis nominella Zag.
Ethmiidae
Ethmia bipunctella F.
Aegeriidae
Chamaesphecia anellata (Zeller)
Chamaesphecia astatiformis (Herrich - Schaffer)
Chamaesphecia empiformis (Esper)
Paranthrene tabaniformis (Rottenburg)
Hepialidae
Triodia amasinus dobrogensis Car.
Cossidae
Phragmataecia castanea Hb.
Parahypopta caestrum Hb.
Zygaenidae
Zygaena contaminei Bsdv.
Adscita subsolana Stgr.
Adscita globulariae Hb.
Adscita mannii Led.
Geometridae
Cyclophora porata L.
Scopula tesselaria Bsdv.
Scopula turbidaria Hb.
Scopula marginepunctata Goeze
Scopula beckeraria Led.
Scopula incanata L.
Scopula laevigata Scop.
Scopula flaccidaria Zel.
Idaea vulpinaria H.-S.
Idaea filicata Hb.

Idaea levigata Scop.
Idaea camparia H.-S.
Idaea elongaria Ramb.
Idaea biselata Hfn.
Idaea politata Hb.
Idaea seriata Schr.
Idaea degeneraria Hb.
Rhodostrophia vibicaria Clerck.
Caclysme riguata Hb.
Lythria purpuraria L.
Lythria purpurata L.
Orthonoma obstipata F.
Catarhoe rubidata D. et S.
Epirrhoe galiata D. et S.
Epirrhoe rivata Hb.
Pelurga comitata L.
Euphitecia insigniata Hb.
Euphitecia variostrigata Alph.
Eupithecia centaureata D. et S.
Euphitecia breviculata Donz.
Euphitecia denticulata Treitsche
Euphitecia extensaria Fr.
Euphitecia simpliciata Haw.
Gymnoscellis rufifasciata Haw.
Anaitis plagiata L.
Lithostege duplicata Hb.
Lomaspilis marginata L.
Ligdia adustata D. et S.
Semiothisa glarearia Brahm.
Semiothisa aestimaria sareptanaria Stgr.
Narraga tessularia kasyi Mouch. et Pov.
Tephrina murinaria F.
Tephrina arenacearia D. et S.
Gnopharmia stevenaria Bsdv.
Eilicrinia trinotata Metz.
Apocheima pilosarium D. et S.
Biston stratarius Hfn.
Agriopis bajaria D. et S.
Dasycorsa modesta Stgr.
Peribatodes rhomboidaria D. et S.
Peribatodes secundaria D. et S.
Synopsis sociaria Hb.
Boarmia roboraria D. et S.
Serraca punctinalis Scop.
Ascotis selenaria D. et S.
Campaea margaritata L.
Aspitates ochrearius Rossi
Boarmia selenaria (Schiffer)
Calothysanis amata (L.)
Cidaria bilineata (L.)

Lasiocampidae

Gastroparca quercifolia L.
Odonestis pruni L.

Notodontidae

Phalera bucephala L.
Cerura vinula L.
Dicranura ulmi D. et S.
Paradrymonia vittata bulgarica de Freina
Pterostoma palpinum Cl.

Arctiidae

Pelosia obtusa H.-S.
Lithosia pallifrons Z.
Lithosia quadra L.
Eilema sororculum Hfn.
Eilema caniola Hbn.
Eilema pygmaeola Dbld.
Coscinia striata L.
Chelis maculosa mannerheimii Dup.
Phragmatobia fuliginosa L.
Spiris striata L.
Spilosoma lubricipedum L.
Spilosoma urticae Esp.
Arctia caja L.
Arctia villica L.
Ammobiota festiva Hfn.
Dysauxes famula pontica Frise

Noctuidae

Xestia c - nigum (L.)
Dysgonia algira (L.)
Agrostis ipsilon (Hufnagel)
Trachea atriplicis (L.)
Prodotis stolida (Fabr.)
Emmelia trabealis (Scopoli)
Autographa gamma (L.)
Autographa confusa (Stephens)
Mythimna albipuncta (Denis - Schiffermuler)
Heliothis maritima (Graslin)
Lacanobia oleracea (L.)
Catocala elocata (Esper)
Catocala puerpra (Giorna)

Sphingidae

Acherontia atropos (L.)
Herse convolvuli (L.)
Smerinthus ocellata L.
Laothoe populi L.
Celerio lineata livornica Esp.
Celerio euphorbiae L.

Pergesa elpenor L
Pergesa porcelus (L.)
Macroglosum stellatarum (L.)
Hesperiidae
Ochlodes venatus (Brem - Grey)
Charcharodus flocciferus (Zell)
Pyrgus serratulae. (L)

Papilionidae

Iphiclides podalirius (L.)
Papilio machaon (L.)
Pieridae
Leptidea sinapis (L.)
Anthocaris cardamines (L.)
Pontia daplidice (L.)
Pieris brassicae (L.)
Pieris napi (L.)
Pieris rapae (L.)
Colias croceus (Fourcr.)
Colias erate Esp.
Gonepteryx rhamni (L.)

Satyridae

Pararge megaera (L.)
Pararge maera (L.)
Maniola jurtina (L.)
Melanargia galathea (L.)
Coenonympha pamphilus (L.)
Lycaenidae
Lycaena phlaeas (L.)
Lycaena dispar L.
Plebejus idas (L.)
Plebejus argus (L.)
Plebejus argyrognomon (Bgstr)
Celastrina argiolus L.
Polyommatus icarus (Rott)
Aricia agestis (Schiff)
Nymphalidae
Nymphalis polychloros (L.)
Aglais urticae (L.)
Polygonia c - album (L.)
Vanessa atalanta (L.)
Vanessa cardui (L.)
Inachis io (L.)
Melitaea varia (Mey - Dun)
Melitaea trivia (Den et Schifer)
Melitaea phoebe (Schiff)
Argynnis lathonia (L.)
Argynnis pandora (Den et Schiff)

Diptera

Flies and mosquitos are relatively well represented in all the littoral areas (Albu, 1980; Ceianu 1999; Dinulescu, 1958; Ionescu, Weinberg, 1960, 1963, 1971; Neacsu, 1965; Pârvu, 1993a, 1993b, 1993c; Weinberg, 1994). The most frequent are brachycer Diptera, whose larvae feed on the piles of decomposing algae or on the cadavers of mollusks, crustaceans, fish and sometimes mammals and birds thrown on the beach by waves. A considerable number of this kind of species are characteristic to the beaches, and they can be found in numerous populations over the entire length of the littoral. Nematocera Diptera reach the beach accidentally; numerous populations of Chironomida and Culicida can be found in the north – Vadu-Navodari – or the Herghelie Swamp area in Mangalia, where there are swampy biotopes (where the larvae of these species develop) in the immediate vicinity of the beaches.

Nematocera

Tipulidae

Tipula oleracea.L.
Chironomidae.
Chironomus gr. *plumosus*
Chironomus halophilus Kieff.
Chironomus salinarius Kieff.
Einfeldia disidens Walk.
Haliella noctivaga Kieff.
Cryptocladopelma virescens Meig.
Parachironomus arcuatus Goet.
Leptochironomus tener
Dicrotendipes fusconotarsus Kieff.
Glyptotendipes barbipes St.
Glyptotendipes severinei Goet.
Endochironomus tendens Fabr.
Polypedilum nubeculossum Meig.
Polypedilum scalaenum Schr.
Tanytarsus excavatus Edw.
Paratanytarsus inoperatus Walk.
Culicidae
Aedes caspius Pall.
Aedes dorsalis Meig.
Aedes cantans Meig.

Aedes salinus Edw.
Aedes quartus Mart.
Aedes geniculata Edw.
Culex pipiens pipiens L.
Culex pipiens molestus Forsk.
Culex modestus Fic.
Culex tipuliformis Theobald
Urotaenia unguiculata Edw.
Taniorhynchus richardii Fic.
Anopheles maculipennis Meig.
Anopheles pseudopictus Grasse
Anopheles bifurcatus L.
Anopheles messeae Fall.
Anopheles labranchiae Fall.
Anopheles hyrcanus Pall.
Brachycera
Laphria fulva Mg.
Compsilura concinnata Mg.
Siphona geniculata De Geer
Monoleta cincta Nees
Limnobia nubeculosa Mg.
Erioptera trivialis Mg.
Limnophila oleracea Mg.
Bibio marci L.
Sciara thomae L.
Scatopse fuscipes Mg.
Hermione trilineata F.
Haplodonta viridula F.
Rhagio lieneola F.
Chrysops flavipes Meig.
Chrysops italicus (Meigen)
Chrysops pictus Meig.
Tabanus solstitialis Mg.
Tabanus lunatus F.
Tabanus bifarius Loew.
Chrysozona crassicornis Wahl.
Chrysozona pluvialis (L.)
Ochrops rusticus L.
Lapharia fulva Mg.
Philonicus albiceps Mg.
Exoprosopa jacchus F.
Exoprosopa germari Wied.
Villa hotentota L.
Anthrax fenestratus Fall.
Bombylius major L.
Tachista sabulosa Mg.
Syrphus tricinctus Fall.
Syrphus torvus O.-S.
Syrphus balteatus De Geer.
Erystalomyia tenax L.
Xylota femorata L.
Sapromyza bipunctata Kieff.
Cnemodon vitripenis (Meigen)
Lonchaea chorea F.
Chilosia melanura Beck.
Piophila caripes Mg.
Calobaea bifasciella Mg.
Ctenulus pectoralis Z.
Salticella fasciata Mg.
Bischoffia simplex Fall.
Tetanocera arrogans Mg.
Oxytaenia mikiana Hend.
Meroplius stercorrarius Rob.
Nemopoda nitidula Fall.
Themira putris L.
Themira anulipes Mg.
Limosina limosa Fall.
Rhamphomyia marginata L.
Melieria omissa Loew.
Euconnus watterhali Gyll.
Choleva oblonga Mull.
Ptomaphagus varicornis Rosh.
Scioderpa watsoni Spin.
Ephydra macellaria Egger
Fucellia maritima Hall.
Sepsis thoracica Rob.-Desv.
Coremacera catenata Scop.
Trypetoptera punctulata Scop.
Hemipenthes morio Loew.
Catops tristis Panz.
Fannia scalaris F.
Muscina stabulans Fall.
Musca tempestiva Fall.
Pyrella cadaverina L.
Heteronychia rohdendorfi P.-S.
Oxytaenia mikiana Hend.
Meroplius stercorarius R.-D.
Nemopoda nitidula Fall.
Sarcophaga carnaria L.
Bercaea hamorrhoidalis Fall.
Platystoma seminationis L.
Cylindomyia brassicaria F.
Tephromyia grisea Mg.
Metopia leucocephala Rossi
Histochaeta marmorata F.
Gymnosoma rotundatum L.
Echinomyia prompta Mg.
Lucilia ruficeps Mg.

Lucilia sericata Mg.
Limnophora notata Fall.
Dexia rustica F.
Spilogona dispar Fall.
Lispa hydromysina Fall.

Hymenoptera

The wasps and bees encountered in the littoral area are fewer compared to the Diptera or Coleoptera (Andriescu, 1993; Constantineanu et Constantineanu, 1993, 1997, 1998; Constantineanu, 1965; Ionescu, 1957, 1973 ; Iuga, 1958 ; Konnerth-Ionescu, 1963; Lacatusu, 1968; Nagy, 1968; Negru, 1965; Pascu, 1996, 1997; Scobiola, 1960, 1963; Scobiola-Palade, 1965, 1968, 1978, 1981). Among these species there are those that hunt on the beach and those that are parasites for larvae or adults of Diptera or Coleoptera. Anthophylous species are rare and only occur accidentally on the inflorescence of plants in the herbaceous vegetation area.

Teleas rugosus Kieff.
Teleas lamellatus Kieff.
Brachymeria minuta L.
Brachymeria intermedia Nees
Haltichella rufipes Oliv.
Pompilius plumbeus F.
Ammophila sabulosa L.
Ammophila heydeni Dhlb
Ammophila hirsuta Scop.
Ammophila affinis Kirby
Ammophila morawitzi Andr.
Bembix oculata Latr.
Bembix olivacea Cyr.
Cerceris rybyensis L.
Liris nigra Lind.
Stizus distinguendus Hand.
Philanthus triangulum F.
Philanthus coronatus F.
Philanthus venustus Rossi
Tetramorium caespitum L.
Formicoidea
Myrmecocystus cursor Fonsc.
Myrmecocystus viaticus F.
Myrmecocystis varialei Em.
Messor structor Latr.
Scelionidae
Sparasion frontalis Latr.
Megachilidae
Eriades maxillosus L.
Anthidium variegatum F.
Lithurgus chrysurus F.
Apoidea
Dasypoda plumipes Drury
Amegilla quadrifasciata quadrifasciata (Villers)
Tetralonia ruficornis (Mocsary)
Amobates (amobates) punctatus (Fabr.)
Xylocopa violacea L.
Bombus agrorum L.
Bombus terrestris L.
Bombus lapidarius L.
Vespa germanica L.

The entomofauna in the Bulgarian littoral

The area included in the project, located as far as Cape Kaliakra, is characterized by a much richer habitat diversity, compared to the Romanian littoral area. Thus, if the northern part of the Bulgarian littoral, between Krapets and Durankulak, is characterized by sandy beaches stretched in the vicinity of paramarine lakes or high loess seawalls, south of cape Shabla the seawall becomes rocky and its height rises to over 50 meters. In this case, a new type of habitat occurs – rather a complex of habitats – characterized by a different entomofauna that can be seen north of Vama Veche. Thus, the seawall plateau is often terraced and covered by shrubs and tree clusters in which certain species of southern origin occur. A particular complexity in terms of habitat structure can be encountered in Kamen Bryag, Yailata, Rusalka, Bolata Dere and the south-oriented seawall from cape Kaliakra, where a particular vegetation develops and shelters a largely unstudied entomofauna.

Considering these reasons, we appreciate that the entomofauna of the Bulgarian littoral is much richer compared to the one at the Romanian littoral. The dune vegetation areas, exceptionally well preserved both in Durankulak and Shabla, permit the existence of important invertebrate populations that occur only isolate in the Romanian littoral area (the Agigea and Eforie South zones have been strongly affected by the anthropogenic impact and only preserve partially the characteristic species).

However, the richest, most interesting and complex entomofauna can be encountered in the portions where the limestone seawall, furrowed by a system of fissures and caves (which permit the development of a characteristic fauna), is terraced and covered by forest, as well as the seawall in cape Kaliakra, where the underground water drains permit the development on the almost vertical wall of a vegetation that is mostly hygrophile, looking like a jungle. Sadly, these areas have not been studied by specialists interested in more detailed entomofauna studies and unfortunately, in some cases (Rusalka), the anthropogenic impact can already be seen. These areas are protected at national level, which means, at least theoretically, that their very important entomofauna biodiversity and flora are preserved.

The Durankulak Area. It is characterized by the presence of a littoral strip that separates the lake from the sea, a strip on which vegetal associations characteristic to the marine dunes occur. They are very well preserved due to the inexistence of an access route and to the fact that the anthropogenic impact in the area is minimal compared to the Romanian littoral. In the north and south, the high loess seawalls are covered with herbaceous vegetation, while the ridge of the seawalls display plants of different wood types, from *Fraxinus ornus* and *Carpinus orientalis* to *Pinus nigra* and *Amorpha fruticosa*. At the basis of the seawall that edges the littoral strip in the north, there are very well preserved associations dominated by *Crambe maritima.*

All these habitats are completed by the presence in the immediate vicinity of Lake Durankulak with wetland vegetal associations. In this area, the invertebrate fauna is much richer compared to the area north of cape Midia, where there are no wetlands even though there are high seawalls.

Important populations of Orthoptera have been identified as they are characteristic to the associations dominated by sand plants such as *Acrotylus longipes* present in extremely large numbers starting with June. A considerable number of *Cicindela hybrida* also occurs in May. In the area with *Crambe maritime*, the population of the Mediterranean Heteroptera *Eurydema spectabile* reaches a very high density, the number of individuals per one plant exceeding 200. Among Lepidoptera – which are quite numerous in the area due to the habitat diversity – are worth mentioning especially *Lycaena dispar* – characteristic to wet habitats – and *Zerynthia hypsipyle*, both being on the lists of the Habitat Directive. The forest skirts south and north of the littoral strip shelter a considerable number of species of lepidopters such as *Euchloe ausonia, Brenthis daphne, Argynnis pandora, Melitatea phoebe*, *Melanargia galathea, Zygaena filipendulae* while the flowers in the littoral strip *Astragallus* attract a large number of *Colias croceus, Vanessa cardiu, Aricia agestis, Polyommatus icarus, Polyommatus bellargus*. A number of rare species are cited in the area such as *Scopula corrivalaria* and *Diachrysia chryson deltaica* signaled in Bulgaria only in this area, as well as *Triodia amasinus dobrogensis, Macrochilo cribrumalis, Schrankia costaestrigalis, Eupithecia variostrigata, Eupithecia inturbata, Diachrysia*

nadeja, Athetis furvula, Proxenus lepigone, Apamea sicula, Agrotis obesa scitha, Agrotis vestigialis, Pelosia obtusa, Hyles hippophaes, *Colias erate, Pseudophilotes vicrama, Melitaea trivia* (Abadjiev, Beshkov, 2007).

The Shabla Area. The marine dunes in this area are larger compared to those in Durankulak, but they shelter a smaller entomofauna due to th fact that the vegetation is also poorer in species. Common species have been identified in this area: *Pieris rapae, Colias croceus, Lycaena phlaeas, Polyommatus icarus, Coenonympha pamphilus* alongside the noctuid *Drasteria caucasica*, species characterisitc to the sandy habitats. Other species are cited in the specialized literature in the area of sand dunes and neighboring wetlands, such as *Triodia amasinus dobrogensis, Eupithecia variostrigata, Eupithecia biornata, Eupithecia ochridata, Oxicesta geographica, Simyra albovenosa, Schrankia costaestrigalis, Cucullia asteris, Proxenus lepigone, Archanara dissoluta, Agrotis vestigialis, Pelosia obtusa, Rhyparioides metelkana,* many of them present in Durankulak, an area similar in many aspects regarding the habitat conditions (Abadjiev et al, 1999; Abadjiev, Beshkov, 2007; Beshkov, Abadjiev, 2000)

Cape Kaliakra – Bolata Dere

Located at the southern extremity of the littoral area north of cape Kaliakra, Bolata Dere valley represents an extremely interesting mixture of habitats. Thus, the narrow valley oriented east-west is sheltered by strong winds, except those that blow from the sea. The valley is swampy, populated by associations of hygrophile plants and associations of xerophile bushes on the slopes dominated by species such as *Paliurus spina-christi*. The valley and sea plateau are dominated by *Iris* and *Asphodeline lutea*. In this sheltered valley, the diurnal Lepidoptera are represented by common species *Papilio machaon, Iphiclides podalirius, Anthocaris cardamines, Gonepteryx rhamni, Lycaena phlaeas* – as well as by rarer species such as *Pyrgus sidae* sau *Melitaea trivia*.

The cape Kaliakra area is very interesting in what regards the invertebrate fauna. The high seawall (over 50 m), south oriented, offers shelter from the dominant winds and permits the development of an extremely interesting vegetation with numerous species characteristic to wetlands (due to the numerous water infiltrations) and thermophile species that form associations with jungle aspect. On the limestone plateau, there is a xeric habitat characterized by species adapted to a very dry climate. Among them, the enormous agglomerations of xerophile Gasteropoda, as well as large populations of Orthoptera that populate the plateaus with natural vegetation above the seawall. A number of interesting Lepidoptera have been indentified during the field trips, such as *Strymon ilicis, Zygaena ephialtes*, alongside common species such as *Argynnis pandora, Pararge megera* or *Synaphe moldavica*. The Lepidoptera fauna in cape Kaliakra also includes rare species, such as *Lycaena dispar, Maculinea arion, Catopta thrips* – present on the lists of the Bern Convention, a number of subspecies characterized by the light colors of their wings (feature directly connected to the limestone soil) – *Autophola asiatica argentea, Autophila dilucida argentea, Auchmis detersa argentea, Caradrina pertinax argentea, Dichagyris melanura albida, Dichagyris renigera argentina, Dichagyris flavina pretiosa, Agrotis obesa nivea, Meganola albula nivalis*. These are completed by rare and localized species such as *Triodia amasinus dobrogensis, Oncocnemis michaelorum, Lemonia balcanica, Lasiocampa quercus, Nychiodes waltheri, Eupithecia variostrigata, Pandesma robusta, Clytie syriaca, Panchrysia aurea, Oxicesta geographica, Cryphia ochsi, Cryphia amasina, Acontia titania, Pyrrhia purpurina, Pyrrhia victorina, Eutelia adoratrix, Mycteroplus puniceago, Proxenus lepigone, Chortodes morrisii, Oxytripia orbiculosa noctivolans,Lacanobia praedita, Hadula odontites, Hadena persimilis, Euxoa cos crimaea, Euxoa conspicua, Nola cristatula, Nycteola siculana, Sphingonaepiopsis gorgoniades, Hyles gallii, Hyles hippophaes, Thymelicus acteon, Pyrgus cinarae, Pseudophilotes vicrama, Glaucopsyche alexis, Plebejus sephirus, Melitaea trivia, Melitaea aurelia,* (Abadjiev, Beshkov, 2007).

Apart from the Lepidoptera, it is worth mentioning the presence in the area of an Orthoptera – *Asiotmethis limbatus* – species characteristic to the limestone habitats, rare and localized in eastern Europe, present also in the Romanian Dobrogea and once signaled in the Romanian littoral area, but currently extinct.

Rusalka. The Rusalka area is quite similar as habitat structure with cape Kaliakra. The difference lies in the fact that the limestone plateau is crashed forming a series of 4-5 successive terraces, covered by a complex of trees and shrubs that alternate with clearings dominated by herbaceous plants. The limestone plateau is dominated by herbaceous plants, but the habitats are less dry compared to the high seawall in Kaliakra. In this area, the entomofauna is extremely interesting, comprising on a reduced territory, species characteristic to the marine beaches, to the limestone seawalls, to the east-Balkan thermophile forests or to the steppe habitats. Among Lepidoptera, we remark the presence of interesting species that have not been observed in the other areas investigated during the Program PHARE CBC RO2005/017-535.01.02.02. Thus, among the rhopalocera, the following species were observed in July *Strymon accaciae, Scolitantides orion* and *Pseudophilotes vicrama*, *Philotes baton* (present also in Bolata Dere and cape Kaliakra), *Pyrgus cirsii, Pyrgus armoricanus*.

Conclusions

Analyzing comparatively the two areas studied from a biodiversity point of view within the Project PHARE CBC RO2005/017-535.01.02.02 the conclusion is that there are a number of similarities and differences between the Romanian littoral area and the Bulgarian one. Thus, the Romanian littoral displays (from a biodiversity point of view as well) a continuation north of the limestone shore in the Cape Kaliakra area. The diversity of the entomofauna decreases from south to north with the disappearance of certain habitats – limestone seawalls covered with tree clusters – north of cape Shabla. From the point of view of the entomofauna, three types of associations can be distinguished in this area of the western littoral of the Black Sea: a dominant association of forest and steppe species south of cape Shabla, an association with steppe and maritime dunes species between cape Shabla and cape Midia and a dominant association with species characteristic strictly to the littoral strips – north of cape Midia. From far, the richest in number of species is the area between Yailata and cape Kaliakra.

From the point of view of the originality of fauna associations in the Romanian littoral area, the wild beaches area can be distinguished on the one hand, where human influence is minimal and where numerous populations of insects still remain alongside other invertebrates that feed either on vegetal or animal remains thrown by waves onto the beach, or on the vegetation characteristic to the sandy beaches. These areas suffered the most in the past because of the anthropogenic impact and we appreciate that they should be protected everywhere where it is necessary.

Unfortunately, the entomofauna of these areas is mostly not studied, either at the level of taxonomy or ecology. Studies to outline the complex relationships among different species of insects in the vegetal associations in the littoral area should be a priority in order to understand the structurs of these habitats characteristic to the Pontic region.

Due to the fact that a large part of the wild littoral is included in the Danube Delta Biosphere Reservation, the unaltered preservation of these habitats can be considered certain today.

The Agigea Maritime Dunes Reservation and the seawalls in the southern littoral do not share a similar situation.

Firstly, the reduction of reservation surface and the severance of any direct connection to the seashore (the harbor installations Constanta South-Agigea are currently located in front of the reservation) have led to the turning of the reservation into steppe which made the once sands lie almost entirely fallow, except a very small surface in the north. This way, the initial flora and fauna have changed profoundly. Still, that surface is protected by law, which means its protection is certain.

The seawalls in the southern littoral are an interesting area where the flora and fauna characteristic to the original steppe interpenetrates the beach flora and fauna. If in the close past this area was extremely little affected by human activities, the accelerated rhythm of construction in some parts of the southern littoral in the superior part of the seawall raises a number of problems now. Due to the sewage system which is located in the close vicinity of the seawalls, the soil quality will inevitably change as certain opportunistic plant species will enter and thus deeply alter the original flora. This kind of situations occurred over the entire length of the seawall

in the vicinity of the cities and towns of Constanta, Eforie North or Eforie South, where the flora is currently dominated by weeds. This is why we consider imperative the decision to declare protected areas these seawall zones currently unaffected by the anthropogenic impact.

In the Bulgarian littoral, the degree of preservation is much higher. The lack of access routes, of large urban agglomerations in the littoral area and the lack of harbors and resorts make the area between Durankulak and cape Kaliakra much better preserved, compared to the Romanian littoral. A large part of the coastline is included in different protected areas, which is a guarantee for its protection in the future. However, a widening of these areas is desired in order to create a green corridor. This would also prevent the development of any considerable projects that would alter the habitats radically.

A general conclusion regarding the fauna of invertebrates in the analyzed area is that the correct way is to treat this area as a continuum from this point of view as well, the gradual modification of the fauna being in fact a reflection of the habitat structure in the coastal area.

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STUDY ON THE AVIFAUNISTICAL DIVERSITY IN THE COASTAL AREA BETWEEN CAPE MIDIA (ROMANIA) AND CAPE KALIAKRA (BULGARIA)

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Abstract: The paper presents the result of the ornithological observations made in the summer of the 2008 on the wetlands from the Romanian and Bulgarian Black Sea coast. We observed 172 species of birds: in Romania 153 species and in Bulgaria 121 species. Some of this species we have seen only on the Romanian sea coast, some of them only on the Bulgarian sea coast. There are significant differences between the habitats from the two countries and the anthropic impact. They are still important bird populations in this area, but the human impact has a very big influence on these populations. We need solutions for the protections of this beautiful area.

Keywords: Birds, Black Sea Coast, Wetlands, Bulgaria, Romania.

Introduction

Habitats. Birds are dependent on the habitats they are living in, just as any other living creature. Naturaly, this means that habitat variety will lead to an even larger bird species diversity. The coastal habitats between Cape Midia and Cape Kaliakra are varied and alternate some with others. This favors bird populations, offering them great living conditions.

Unfortunately, the coastal area is more and more under anthropic influence. People have a great tendency towards the coastline, proven by the large number of settlements (cities and holiday resorts) present everywhere on the globe. There is an important traffic, both terrestrial and aquatic. The warm season is reserved to aestival tourism, a factor extremely disturbing for the birds which may nest here.

We believe that habitat variety, alongside the anthropic impact are the leading factors in determining the area's bird diversity.

In the studied area, we can distinguish the following types of the habitat:

- The Black Sea. This is about the sea's water surface situated close to the shore. Here, species of waterfowl and good flying birds can find shelter, birds belonging to *Gaviiformes, Podicipediformes, Anseriformes, Charadriiformes* orders and *Fulica atra.* Of course, this is not only a nesting place, it is just an area destined to resting and feeding.

- Marine Beach. There exists an entire series of beaches in the studied area, fine feeding and resting place for *Charadriiformes* species (limicoles, gulls and terns). These should've also been fine nesting places of this species, but because of the tourists and other anthropic activities, practically, these beaches cannot be used this way.

- Claysh cliffs. These cliffs are found especially in the Romanian area, as the cliff between Tuzla and Costinesti or the cliff between 2 Mai and Vama Veche. A similar cliff is found at Durankulak, in the north (Bulgaria). These are less affected areas by the human influence, and can still provide fine nesting places for species which build their nests here, as the *Falco tinnunculus, Coracias garrulus, Merops apiaster, Sturnus vulgaris, Passer montanus*.

- Stony cliffs. This sort of cliff does not exist in Romania, only in Bulgaria, at Kamen Bryag, Yaylata, Rusalka and Kalyakra Cape. These are tall cliffs, which are of little use to men. For this reason, they are favourable for the nesting places of some birds as the *Oenanthe pleshanka*, largely spread in the area.

- Coastal steppes. If in Romania this habitat almost does not exist anymore (in the coastal area), because of the antropic aggression, in Bulgaria, steppes still can be found above cliffs, at Kamen Bryag, Yaylata, Rusalka and Kaliakra Cape. Here nest birds characteristical of open areas, as the *Burhinus oedicnemus, Melanocorypha calandra, Alauda arvensis, Lanius collurio, Lanius minor, Anthus campestris, Motacilla alba, Passer montanus,* etc.

- Litoral lakes. More or less influenced by human activity, the lakes are excellent habitats, for a large number of bird species. Practically, several ecosystems can be found here, from the beaches, reed beds, open water surfaces or bushes of the shore, good places for birds, good for nesting and also for resting or feeding. There are many lakes situated in the near vicinity of the sea-side, both in Romania (especially) and Bulgaria. A large number of aquatic species may be found here.

- Forested areas. Forests do not exists in the word's true meaning in the studied area, but there are some areas with trees and bushes, there are parks, which are good habitats for a large number of birds (*Passeriformes*). Usually, these are not good nesting places, but during migration and in the cold season, they are great refugees for many species of birds.

- Anthropic habitat. Here species of birds are found characteristical to settlements and harbours. The birds here have an importance which is not to be neglected, especially now that some species have started conquering this new territory, as the *Larus cachinnans*, bird nesting in the cities on the Romanian sea-coast.

Here, is an extremely brief, a presentation of the principal habitats in Dobruja's coastal area. Of course, wet areas are prioritary and have the utmost importance for local birds.

Migration. The coastal area in the west of the Black Sea is one of the most important way of migration in Europe. Here, the Pontic and Sarmatic ways are found, followed by a large variety of species. This means that during spring and fall, both the Bulgarian and the Romanian coasts are passed by a large number of birds, especially aquatic birds, but also small passerines (*Passeriformes*) and birds of prey (*Falconiformes*). Most species of migrating birds in the Danube Delta follow this route. Birds that nest in northern Europe and even in northern Asia fly, in the majority of cases, along the west coast of the Black Sea.

This fact makes bird fauna in the coastal area of Bulgaria and Romania become distinctly rich (leading to a large avifaunistical diversity). For this reason, the existence of resting and feeding places for birds is extremely important for their survival. We mention only the wetlands of Techirghiol Lake and Hergheliei Swamp, from Romania (Banica, G. 1996, Banica, G. 2000) and Durankulak Lake and Sabla Lake (Bulgaria).

Wintering. There exist many aquatic species that winter in the wetlands on the shores of Dobruja (both Romanian and Bularian). This fact increases the specific diversity of birds from the area. For the the red breasted goose (*Branta ruficollis*), Dobruja it's the main wintering area. To illustrate the distinct importance of this area for aquatic birds wintering here, we need to mention that the numbers of the species from the Orders *Gaviiformes, Podicipediformes, Pelecaniformes, Ciconiiformes, Anseriformes, Gruiformes* si *Charadriiformes* of this period of the year can go beyond one million individuals (Munteanu, D. et al. 1989).

Antropic impact. Since the dawn of time, people have preferred the closeness of water. This is why the sea side has always been a favourite place for settling. Unfortunately, the large urban crowding on the sea shores contributed decisively to chasing birds away from these areas. Some birds from the sea coast have witnessed their habitat become more and more restrained. Here are some differences between the Bulgarian and the Romanian coast. While the Romanian shore is invaded and even suffocated with construction (between Cape

Midia and Vama Veche), between Durankulak and Cape Kaliakra, the sea shore is far less affected by anthropic activities. This fact makes us hope that at least this area will be protected in the future for the benefit of bird populations transiting the area year after year. The anthropic impact on the Romanian sea side will lead to less bird species nesting here, because during the warm season come the most important waves of tourists, which greatly inconvenience the area. On the other hand, during winter and spring, most touristical locations remain unhabited, and birds, especially the aquatic species, can find great resting and feeding places. In wetlands from Bulgarian coastal areas, some birds can still nest under fine conditions, an example being the nesting colony of cormorants (*Phalacrocorax carbo sinensis*) from Durankulak. In Romania, litoral lakes are used as fish farms (with one exception, Hergheliei Swamp). The exploitation of fish resources leads to a conflict between fishermen and fisheating birds. The disturbance provoked by the farm staff can influence other species of birds. During summertime, lakes are also used by tourists, fact contributes to the disturbance of birds.

Material and Methods

We used binoculars (usually Olympus 10x50) and telescopes (usually Optolyth 30x75) for our observations. We made transects along the sea coast and along the lakes side, in order to identify the species of birds and their numbers (effectivs). The book-guides used are Bruun, B. et all. 1999, Peterson, R. et all. 1989 and Svensson, L. et all. 2000.

Our observations from Bulgaria were made in: 09.05.2008–11.05.2008, 06.06.2008–08.06.2008, 18.07.2008-20.07.2008 and 08.08.2008-10.08.2008. The points of observations in Bulgaria were Durankulak (the sea and the lake), Krapets (on the sea), Shablenska Tuzla (the lake and the sea), Kamen Bryag (the steppe and the sea), Yaylata (the cliff and the sea), Rusalka (the steppe, the cliff, the sea), Bolata Dere (the gorges and the sea), Kaliakra Cape (the steppe, the cliff and the sea) and Kavarna (the sea). The observations from Romania was made in the following Points: Grind Chituc, Vadu, Corbu, Navodari, Mamaia, Constanta, Eforie Nord, Eforie Sud, Costinesti , Mangalia and Vama Veche. Here, the observations were made from April till September.

Results and Discussion

During our research on the sea side of both countries, the following species of birds have been seen (Table 1 and Table 2 – the names of the birds are according with Munteanu, D. 1998):

Table 1 - Bird Species from the North Eastern Bulgarian Black Sea Coast (2008)

No.	Scientific Name	English Name	Romanian Name
1	*Gavia arctica* (Linnaeus)	Black-throated Diver	Cufundar polar
2	*Podiceps cristatus* (Linnaeus)	Great Crested Grebe	Corcodel mare
3	*Phalacrocorax carbo sinensis* (Linnaeus)	Cormorant	Cormoran mare
4	*Phalacrocorax aristotelis* (Linnaeus)	Shag	Cormoran motat
5	*Phalacrocorax pygmaeus* (Pallas)	Pygmy Cormorant	Cormortan mic
6	*Botaurus stellaris* (Linnaeus)	Bittern	Buhai de balta
7	*Ixobrychus minutus* (Linnaeus)	Little Bittern	Starc pitic
8	*Nycticorax nycticorax* (Linnaeus)	Night-Heron	Starc de noapte
9	*Ardeola ralloides* (Scopoli)	Squacco Heron	Starc galben
10	*Egretta garzetta* (Linnaeus)	Little Egret	Egreta mica
11	*Casmerodius albus* (Linnaeus)	Great White Egret	Egreta mare
12	*Ardea cinerea* Linnaeus	Grey Heron	Starc cenusiu
13	*Ardea purpurea* Linnaeus	Purple Heron	Starc rosu
14	*Ciconia nigra* (Linnaeus)	Black Stork	Barza neagra
15	*Ciconia ciconia* (Linnaeus)	White Stork	Barza alba

16	*Platalea leucorodia* Linnaeus	Spoonbill	Lopatar
17	*Cygnus olor* (Gmelin)	Mute Swan	Lebada de vara
18	*Tadorna tadorna* (Linnaeus)	Shelduck	Califar alb
19	*Anas strepera* Linnaeus	Gadwall	Rata pestrita
20	*Anas platyrhynchos* Linnaeus	Mallard	Rata mare
21	*Anas querquedula* Linnaeus	Garganey	Rata caraitoare
22	*Anas clypeata* Linnaeus	Shoveler	Rata lingurar
23	*Aythya nyroca* (Guldenstadt)	Ferruginous Duck	Rata rosie
24	*Circus aeruginosus* (Linnaeus)	Marsh Harrier	Herete de stuf
25	*Accipiter nisus* (Linnaeus)	Sparrowhawk	Uliu pasarar
26	*Buteo buteo* (Linnaeus)	Common Buzzard	Sorecar comun
27	*Buteo rufinus* (Cretzschmar)	Long-legged Buzzard	Sorecar mare
28	*Falco tinnunculus* Linnaeus	Kestrel	Vanturel rosu
29	*Falco vespertinus* Linnaeus	Red-footed Falcon	Vanturel de seara
30	*Falco subbuteo* Linnaeus	Hobby	Soimul randunelelor
31	*Coturnix coturnix* (Linnaeus)	Quail	Prepelita
32	*Phasianus colchicus* Linnaeus	Pheasant	Fazan
33	*Gallinula chloropus* (Linnaeus)	Moorhen	Gainusa de balta
34	*Fulica atra* Linnaeus	Coot	Lisita
35	*Haematopus ostralegus* Linnaeus	Oystercatcher	Scoicar
36	*Himantopus himantopus* (Linnaeus)	Black-winged Stilt	Cataliga
37	*Recurvirostra avosetta* Linnaeus	Avocet	Ciocintors
38	*Burhinus oedicnemus* (Linnaeus)	Stone Curlew	Pasarea ogorului
39	*Glareola pratincola* (Linnaeus)	Collared Pratincole	Ciovlica ruginie
40	*Charadrius dubius* Scopoli	Little Ringed Plover	Prundaras gulerat mic
41	*Pluvialis squatarola* (Linnaeus)	Grey Plover	Ploier argintiu
42	*Vanellus vanellus* (Linnaeus)	Lapwing	Nagat
43	*Calidris ferruginea* (Pontoppidan)	Curlew Sandpiper	Fugaci roscat
44	*Calidris alpina* (Linnaeus)	Dunlin	Fugaci de tarm
45	*Tringa erythropus* (Pallas)	Spotted Redshank	Fluierar negru
46	*Tringa totanus* (Linnaeus)	Redshank	Fluierar cu picioare rosii
47	*Tringa ochropus* Linnaeus	Green Sandpiper	Fluierar de zavoi
48	*Tringa glareola* Linnaeus	Wood Sandpiper	Fluierar de mlastina
49	*Larus melanocephalus* Temminck	Mediterranean Gull	Pescarus cu cap negru
50	*Larus minutus* Pallas	Little Gull	Pescarus mic
51	*Larus ridibundus* Linnaeus	Black-headed Gull	Pescarus razator
52	*Larus genei* Breme	Slender-billed Gull	Pescarus rozalb
53	*Larus cachinnans* Pallas	Yellow-legged Gull	Pescarus argintiu
54	*Gelochelidon nilotica* (Gmelin)	Gull-billed Tern	Pescarita razatoare
55	*Sterna sandvicensis* Latham	Sandwich Tern	Chira de mare
56	*Sterna hirundo* Linnaeus	Common Tern	Chira de balta
57	*Chlidonias hybridus* (Palllas)	Whiskered Tern	Chirighita cu obraji albi
58	*Chlidonias niger* (Linnaeus)	Black Tern	Chirighita neagra
59	*Chlidonias leucopterus* (Temminck)	White-winged Black Tern	Chirighita cu aripi albe
60	*Bubo bubo* (Linnaeus)	Eagle Owl	Bufnita
61	*Streptopelia decaocto* (Frivaldszky)	Collared Dove	Gugustiuc

62	*Streptopelia turtur* (Linnaeus)	Turtle Dove	Turturica
63	*Cuculus canorus* Linnaeus	Cuckoo	Cuc
64	*Caprimulgus europaeus* Linnaeus	Nightjar	Caprimulg
65	*Apus apus* (Linnaeus)	Swift	Drepnea neagra
66	*Apus melba* (Linnaeus)	Alpine Swift	Drepnea mare
67	*Merops apiaster* Linnaeus	Bee-eater	Prigorie
68	*Coracias garrulus* Linnaeus	Roller	Dumbraveanca
69	*Upupa epops* Linnaeus	Hoopoe	Pupaza
70	*Dendrocopos syriacus* (Hemprich et Ehrenberg)	Syrian Woodpecker	Cocanitoare de gradini
71	*Melanocorypha calandra* (Linnaeus)	Calandra Lark	Ciocarlie de baragan
72	*Galerida cristata* (Linnaeus)	Crested Lark	Ciocarlan
73	*Alauda arvensis* Linnaeus	Skylark	Ciocarlie de camp
74	*Riparia riparia* (Linnaeus)	Sand Martin	Lastun de mal
75	*Hirundo rustica* Linnaeus	Swallow	Randunica
76	*Hirundo daurica* Linnaeus	Red-rumped Swalow	Randunica roscata
77	*Delichon urbica* (Linnaeus)	House Martin	Lastun de casa
78	*Anthus campestris* (Linnaeus)	Tawny Pipit	Fasa de camp
79	*Anthus spinoletta* (Linnaeus)	Water Pipit	Fasa de munte
80	*Motacilla flava flava* Linnaeus	Blue-headed Wagtail	Codobatura galbena
81	*Motacilla flava feldegg* Michahellis	Black-headed Wagtail	Codobatura cu cap galben
82	*Motacilla alba* Linnaeus	White Wagtail	Codobatura alba
83	*Luscinia luscinia* (Linnaeus)	Thrush Nightingale	Privighetoare de zavoi
84	*Phoenicurus phoenicurus* (Linnaeus)	Redstart	Codros de padure
85	*Saxicola rubetra* (Linnaeus)	Whinchat	Maracinar negru
86	*Oenanthe oenanthe* (Linnaeus)	Wheatear	Pietrar sur
87	*Oenanthe pleschanka* (Lepechin)	Pied Wheatear	Pietrar negru
88	*Turdus merula* Linnaeus	Blackbird	Mierla
89	*Acrocephalus shoenobaenus* (Linnaeus)	Sedge Warbler	Lacar mic
90	*Acrocephalus scirpaceus* (Hermann)	Reed Warbler	Lacar de stuf
91	*Acrocephalus arundinaceus* (Linnaeus)	Great Reed Warbler	Lacar mare
92	*Hippolais pallida* (Hemprich et Ehrenberg)	Olivaceous Warbler	Frunzarita cenusie
93	*Sylvya communis* Latham	Whitethroat	Silvie de campie
94	*Sylvya atricapilla* (Linnaeus)	Blackcap	Silvie cu cap negru
95	*Phylloscopus sibilatrix* (Bechstein)	Wood Warbler	Pitulice sfaraitoare
96	*Phylloscopus collybita* (Vieillot)	Chiffchaff	Pitulice mica
97	*Phylloscopus trochilus* (Linnaeus)	Willow Warbler	Pitulice fluieratoare
98	*Muscicapa striata* (Pallas)	Spotted Flycatcher	Muscar sur
99	*Parus palustris* Linnaeus	Marsh Tit	Pitigoi sur
100	*Parus major* Linnaeus	Great Tit	Pitigoi mare
101	*Sitta europaea* Linnaeus	Nuthach	Ticlean
102	*Oriolus oriolus* (Linnaeus)	Golden Oriole	Grangur
103	*Lanius collurio* Linnaeus	Red-bached Shrike	Sfrancioc rosiatic
104	*Lanius minor* Gmelin	Lesser Grey Shrike	Sfrancioc cu frunte neagra
105	*Garrulus glandarius* (Linnaeus)	Jay	Gaita
106	*Pica pica* (Linnaeus)	Magpie	Cotofana

107	*Corvus monedula* Linnaeus	Jackdaw	Stancuta
108	*Corvus frugilegus* Linnaeus	Rook	Cioara de semanatura
109	*Corvus corone cornix* Linnaeus	Hooded Crow	Cioara griva
110	*Sturnus vulgaris* Linnaeus	Starling	Graur
111	*Sturnus roseus* (Linnaeus)	Rose-coloured Starling	Lacustar
112	*Passer domesticus* (Linnaeus)	House Sparrow	Vrabie de casa
113	*Passer hispaniolensis* (Temminck)	Spanish Sparrow	Vrabie negricioasa
114	*Passer montanus* (Linnaeus)	Tree Sparrow	Vrabie de camp
115	*Carduelis chloris* (Linnaeus)	Greenfinch	Florinte
116	*Carduelis carduelis* (Linnaeus)	Goldfinch	Sticlete
117	*Carduelis cannabina* (Linnaeus)	Linnet	Canepar
118	*Emberiza citrinella* Linnaeus	Yellowhammer	Presura galbena
119	*Emberiza schoeniclus* (Linnaeus)	Reed Bunting	Presura de stuff
120	*Emberiza melanocephala* Scopoli	Black-headed Bunting	Presura cu cap negru
121	*Miliaria calandra* (Linnaeus)	Corn Bunting	Presura sura

Table 2 - Bird species from Romanian Black Sea Coast (2008)

No.	**Scientific Name**	**English Name**	**Romanian Name**
1	*Tachybaptus ruficollis* (Pallas)	Little Grebe	Corcodel mic
2	*Podiceps cristatus* (Linnaeus)	Great Crested Grebe	Corcodel mare
3	*Podiceps grisegena* (Boddaert)	Red-necked Grebe	Corcodel cu gat rosu
4	*Podiceps nigricollis* C.L.Brehm	Black-necked Grebe	Corcodel cu gat negru
5	*Phalacrocorax carbo sinensis* (Linnaeus)	Cormorant	Cormoran mare
6	*Phalacrocorax pygmaeus* (Pallas)	Pygmy Cormorant	Cormoran mic
7	*Pelecanus onocrotalus* Linnaeus	White Pelican	Pelican comun
8	*Pelecanus crispus* Bruch	Dalmatian Pelican	Pelican cret
9	*Botaurus stellaris* (Linnaeus)	Bittern	Buhai de balta
10	*Ixobrychus minutus* (Linnaeus)	Little Bittern	Starc pitic
11	*Nycticorax nycticorax* (Linnaeus)	Night-Heron	Starc de noapte
12	*Ardeola ralloides* (Scopoli)	Squacco Heron	Starc Galben
13	*Egretta garzetta* (Linnaeus)	Little Egret	Egreta mic
14	*Casmerodius albus* (Linnaeus)	Great White Egret	Egreta mare
15	*Ardea cinerea* Linnaeus	Grey Heron	Starc cenusiu
16	*Ardea purpurea* Linnaeus	Purple Heron	Starc rosu
17	*Ciconia ciconia* (Linnaeus)	White Stork	Barza
18	*Plegadis falcinellus* (Linnaeus)	Glossy Ibis	Tiganus
19	*Platalea leucorodia* Linnaeus	Spoonbill	Lopatar
20	*Cygnus olor* (Gmelin)	Mute Swan	Lebada de vara
21	*Anser anser* (Linnaeus)	Greylag Goose	Gasca de vara
22	*Tadorna tadorna* (Linnaeus)	Shelduck	Califar alb
23	*Anas strepera* Linnaeus	Gadwall	Rata pestrita
24	*Anas crecca* Linnaeus	Teal	Rata mica
25	*Anas platyrhynchos*	Mallard	Rata mare
26	*Anas querquedula*	Garganey	Rata caraitoare

27	*Anas clypeata*	Shoveler	Rata lingurar
28	*Netta rufina*	Red-crested Pochard	Rata cu ciuf
29	*Aythya ferina*	Pochard	Rata cu cap castaniu
30	*Aythya nyroca*	Ferruginous Duck	Rata rosie
31	*Haliaeetus albicilla*	White-tailed Eagle	Codalb
32	*Circus aeruginosus*	Marsh Harrier	Herete de stuf
33	*Circus macrourus*	Pallid Harrier	Herete alb
34	*Circus pygargus*	Montagu's Harrier	Herete sur
35	*Accipiter nisus*	Sparrowhawk	Uliu pasarar
36	*Buteo rufinus*	Long-legged Buzzard	Sorecar mare
37	*Aquila pomarina*	Lesser Spotted Eagle	Acvila tipatoare mica
38	*Aquila clanga*	Spotted Eagle	Acvila tipatoare mare
39	*Hieraaetus pennatus*	Booted Eagle	Acvila mica
40	*Falco tinnunculus*	Kestrel	Vantirel rosu
41	*Falco vespertinus*	Red-footed Falcon	Vanturel de seara
42	*Falco subbuteo*	Hobby	Soimul randunelelor
43	*Perdix perdix*	Grey Partridge	Potarniche
44	*Coturnix coturnix*	Quail	Prepelita
45	*Phasianus colchicus*	Pheasant	Fazan
46	*Rallus aquaticus*	Water Rail	Carstel de balta
47	*Porzana porzana*	Spotted Crake	Crestet pestrit
48	*Porzana parva*	Little crake	Crestet cenusiu
49	*Gallinula chloropus*	Moorhen	Gainusa de balta
50	*Fulica atra*	Coot	Lisita
51	*Haematopus ostralegus*	Oystercatcher	Scoicar
52	*Himantopus himantopus*	Black-winged Stilt	Cataliga
53	*Recurvirostra avosetta*	Avocet	Ciocintors
54	*Burhinus oedicnemus*	Stone Curlew	Pasarea ogorului
55	*Glareola pratincola*	Collared Pratincole	Ciovlica ruginie
56	*Charadrius dubius*	Little Ringed Plover	Prundaras gulerat mic
57	*Charadrius alexandrinus*	Kentish Plover	Prundaras de saratura
58	*Vanellus vanellus*	Lapwing	Nagat
59	*Gallinago gallinago*	Snipe	Becatina comuna
60	*Limosa limosa*	Black-tailed Godwit	Sitar de mal
61	*Numenius arquata*	Curlew	Culic mare
62	*Tringa erythropus*	Spotted Redshank	Fluierar negru
63	*Tringa totanus*	Redshank	Fluierar cu picioare rosii
64	*Tringa stagnatilis*	Marsh Sandpiper	Fluierar de lac
65	*Tringa ochropus*	Green Sandpiper	Fluierar de zavoi
66	*Actitis hypoleucos*	Common Sandpiper	Fluierar de munte
67	*Larus melanocephalus*	Mediterranean Gull	Pescarus cu cap negru
68	*Larus minutus*	Little Gull	Pescarus mic
69	*Larus ridibundus*	Black-headed Gull	Pescarus razator
70	*Larus genei*	Slender-billed Gull	Pescarus rozalb
71	*Larus cachinnans*	Yellow-legged Gull	Pescarus argintiu
72	*Gelochelidon nilotica*	Gull-billed Tern	Pescarita razatoare
73	*Sterna caspia*	Caspian Tern	Pescarita mare

74	*Sterna sandvicensis*	Sandwich Tern	Chira de mare
75	*Sterna hirundo*	Common Tern	Chira de balta
76	*Sterna albifrons*	Little Tern	Chira mica
77	*Chlidonias hybridus*	Whiskered Tern	Chirighita cu obraji albi
78	*Chlidonias niger*	Black Tern	Chirighita neagra
79	*Chlidonias leucopterus*	White-winged Black Tern	Chirighita cu aripi albe
80	*Streptopelia decaocto*	Collared Dove	Gugustiuc
81	*Streptopelia turtur*	Turtle Dove	Turturica
82	*Cuculus canorus*	Cuckoo	Cuc
83	*Athene noctua*	Little Owl	Cucuvea
84	*Asio otus*	Long-eared Owl	Ciuf de padure
85	*Caprimulgus europaeus*	Nightjar	Caprimulg
86	*Apus apus*	Swift	Drepnea neagra
87	*Alcedo atthis*	Kingfisher	Pescaras albastru
88	*Merops apiaster*	Bee-eater	Prigorie
89	*Coracias garrulus*	Roller	Dumbraveanca
90	*Upupa epops*	Hoopoe	Pupaza
91	*Dendrocopos major*	Great Spotted Woodpecker	Ciocanitoare pestrita mare
92	*Dendrocopos syriacus*	Syrian Woodpecker	Ciocanitoare de gradini
93	*Melanocorypha calandra*	Calandra Lark	Ciocarlie de baragan
94	*Galerida cristata*	Crested Lark	Ciocarlan
95	*Lullula arborea*	Woodlark	Ciocarlie de padure
96	*Alauda arvensis*	Skylark	Ciocarlie de camp
97	*Riparia riparia*	Sand Martin	Lastun de mal
98	*Hirundo rustica*	Swalow	Randunica
99	*Delichon urbica*	House Martin	Lastun de casa
100	*Anthus campestris*	Tawny Pipit	Fasa de camp
101	*Motacilla flava*	Blue-headed Wagtail	Codobatura galbena
102	*Motacilla alba*	White Wagtail	Codobatura galbena
103	*Troglodytes troglodytes*	Wren	Ochiuboului
104	*Erithacus rubecula*	Robin	Macaleandru
105	*Luscinia luscinia*	Thrush Nightingale	Privihetoare de zavoi
106	*Luscinia megarhynchos*	Nightingale	Privighetoare roscata
107	*Phoenicurus ochruros*	Black Redstart	Codros de munte
108	*Phoenicurus phoenicurus*	Redstart	Codros de padure
109	*Saxicola rubetra*	Whinchat	Maracinar mare
110	*Saxicola torquata*	Stonechat	Maracinar negru
111	*Oenanthe isabellina*	Isabelline Wheatear	Pietrar rasaritean
112	*Oenanthe oenanthe*	Wheatear	Pietrar sur
113	*Turdus merula*	Blackbird	Mierla
114	*Acrocephalus agricola*	Paddyfield Warbler	Lacar rasaritean
115	*Acrocephalus palustris*	Marsh Warbler	Lacar de mlastina
116	*Acrocephalus scirpaceus*	Reed Warbler	Lacar de stuf
117	*Acrocephalus arundinaceus*	Great Reed Warbler	Lacar mare
118	*Hippolais pallida*	Olivaceous Warbler	Frunzarita cenusie

119	*Sylvia nisoria*	Barred Warbler	Silvie porumbaca
120	*Sylvia curruca*	Lesser Whitethroat	Silvie mica
121	*Sylvia communis*	Whitethroat	Silvie de campie
122	*Sylvia borin*	Garden Warbler	Silvie de zavoi
123	*Sylvia atricapilla*	Blackcap	Silvie cu cap negru
124	*Phylloscopus collybita*	Chiffchaff	Pitulice mica
125	*Phylloscopus trochilus*	Willow Warbler	Pitulice fluieratoare
126	*Muscicapa striata*	Spotted Flycatcher	Muscar sur
127	*Ficedula albicollis*	Collared Flycatcher	Muscar gulerat
128	*Panurus biarmicus*	Bearded Tit	Pitigoi de stuf
129	*Parus palustris*	Marsh Tit	Pitigoi sur
130	*Parus caeruleus*	Blue Tit	Pitigoi albastru
131	*Parus major*	Great Tit	Pitigoi mare
132	*Certhia brachydactyila*	Short-toed Treecreeper	Cojoaica cu degete scurte
133	*Oriolus oriolus*	Golden Oriole	Grangur
134	*Lanius collurio*	Red-backed Shrike	Sfrancioc rosiatic
135	*Lanius minor*	Lesser Grey Shrike	Sfrancioc cu frunte neagra
136	*Garrulus glandarius*	Jay	Gaita
137	*Pica pica*	Magpie	Cotofana
138	*Corvus monedula*	Jackdaw	Stancuta
139	*Corvus frugilegus*	Rook	Cioara de semanatura
140	*Corvus corone cornix*	Hooded Crow	Cioara griva
141	*Sturnus vulgaris*	Starling	Graur
142	*Sturnus roseus*	Rose-coloured Starling	Lacustar
143	*Passer domesticus*	House Sparrow	Vrabie de casa
144	*Passer hispaniolensis*	Spanish Sparrow	Vrabie negricioasa
145	*Passer montanus*	Tree Sparrow	Vrabie de camp
146	*Fringilla coelebs*	Chaffinch	Cinteza
147	*Carduelis chloris*	Greenfinch	Florinte
148	*Carduelis carduelis*	Goldfinch	Sticlete
149	*Carduelis cannabina*	Linnet	Canepar
150	*Emberiza citrinella*	Yellowhammer	Presura galbena
151	*Emberiza hortulana*	Ortolan	Presura de gradina
152	*Emberiza schoeniclus*	Reed Bunting	Presura de stuf
153	*Miliaria calandra*	Corn Buntng	Presura sura

This show that in the period of study (april-august 2008), a number of 172 species of birds have been observed on the sea coast between Cape Midia and Cape Kaliakra (Romania-Bulgaria). In Romania (the sea coast between Cape Midia and Vama Veche), 153 species of birds have been seen. In Bulgaria (the sea coast between Durankulak and Cape Kaliakra), 121 speces of birds have been observed. A number of 42 species of birds have been seen only on the Romanian litoral, while 19 bird species have only been witnessed on the Bulgarian litoral.

Because most of my time has been spent on the Romanian sea side, it is only natural that the number of species identified here will be larger that the one from Bulgaria, because there exist common birds, which is impossible not to appear on the Bulgarian sea coast, because the migration follows both the Romanian and the Bulgarian coast-line. Species as *Tachybaptus ruficollis, Podiceps griseigena, Podiceps nigricollis* or *Gallinago*

gallinago, Limosa limosa, Numenius arquata, Charadrius alexandrinus, identified on the Romanian coast, will surely pass during migration on the Bulgarian litoral.

This is also available for a number of species from Bulgaria, as the *Gavia arctica,, Buteo buteo, Burhinus oedicnemus, Pluvialis squatarola, Tringa glareola, Caprimulgus europaeus, Acrocephalus schoenobaenus*, which were identified on the sea coast in past years but have not been observed in the study period.

In the north of the study area (Romania) some aquatic bird species also appear during summer-time, arriving from the nesting places in the Danube Delta and from Razelm-Sinoe lagunas, which we have not been able to identify on the Bulgarian litoral: *Pelecanus onocrotalus, Pelecanus crispus, Plegadis falcinellus* si *Anser anser*. Moreover, the number of birds of prey species (*Falconiformes*) is considerable larger in Romania than in Bulgaria (12, respectively 7).

Rocky cliff ecosistems from Bulgaria and the lack of antropic impact lead to species living here not able to be seen on the Romanian litoral.

One of this species is *Phalacrocorax aristotelis* (Shag). We have only witnessed this bird on the sea and on the marine cliffs from Cape Kaliakra, Bolata Dere and Rusalka. The species prefers the sea and rocky cliffs and only occasionally appears on the Romanian sea side. The motif is the lack of rocky cliffs (non-existent on the Romanian littoral) and the extremely powerful anthropic impact on the Romanian coast. The birds are still nesting in the area of Bulgaria rocky cliffs in tens of mates.

Another species which is not found on the Romanian littoral is *Apus melba* (Alpine swift). During the study period, we have only met this birds at Kavarna, Cape Kaliakra and Bolata Dere. A nesting colony exists in Kavarna on the sea-oriented wall of the spectaculous Cerahman Hill (10-12 mates).

A swallow rare in Romania is the *Hirundo daurica* (Red-rumped Swallow) seen in the study area at Yaylata (Kamen Briag), Rusalka, but especially in the Bolata Dere canyon (probably it's nesting place). The lack of rocky walls for the birds to nest in leads to the disappearance of it's area before the Romanian-Bulgarian border.

Oenanthe pleshanka (Pied Wheatear) is frequently met on the on the marine rocky cliffs of Bulgaria: Yaylata, Rusalka, Bolata Dere and Cape Kaliakra, where it also nests. It is entirely missing from the romanian littoral.

Another species that can commonly be found in the area of lake Durankulak and lake Sabla is *Passer hispaniolensis* (Spanish Sparrow). If it is more frequent here (it nests in the lake surroundings) and is more numerous then *Passer montanus* (Tree Sparrow) and *Passer domesticus* (House Sparrow), past the Romanian-Bulgarian frontier, the situation is opposite, the most numerous being *Passer domesticus* followed by *Passer montanus*, and *Passer hispaniolensis* is entirely missing from the Romanian littoral.

Emberiza melanocephala (Black-headed Bunting) is another bird frequently found between Durankulak and Yaylata (Kamen Briag) where it also nests. On the Romanian littoral, the species is rarely found, probably because the human impact causing an accentuated degradation of the habitat.

We must state that some species, as the *Hirundo daurica, Oenanthe pleshanka* and *Passer hispaniolensis*, even if they don't appear on the Romanian sea-coast, penetrated Dobrogea through the south-west, in the Canaralelor area from Baneasa, where these birds have found favorable habitats, coming up from the north towards and reaching Cheile Dobrogei and even Macin Mountaines.

In July 2008 we had the chance to see the migration of the *Riparia riparia* (Sand Martin) on the Bulgarian sea coast. We estimated about 14 000 birds passing from north to south on 18-20.07.2008. On the Sabla lake, on 20.07.2008, was 10 000 sand martins.

Most of this birds are protected by the international laws, like the Birds Directive – European Council Directive 79/409 EEC – Annex I (Table 3):

Table 3 - Bird Species from Eastern Bulgarian Black Sea Coast (2008)
Birds Directive (European Council Directive 79/409 EEC) Annex I

No.	Scientific Name	English Name	Romanian Name
1	*Gavia arctica* (Linnaeus)	Black-throated Diver	Cufundar polar
2	*Phalacrocorax carbo sinensis* (Linnaeus)	Cormorant	Cormoran mare
3	*Phalacrocorax aristotelis* (Linnaeus)	Shag	Cormoran motat
4	*Phalacrocorax pygmaeus* (Pallas)	Pygmy Cormorant	Cormortan mic
5	*Botaurus stellaris* (Linnaeus)	Bittern	Buhai de balta
6	*Ixobrychus minutus* (Linnaeus)	Little Bittern	Starc pitic
7	*Nycticorax nycticorax* (Linnaeus)	Night-Heron	Starc de noapte
8	*Ardeola ralloides* (Scopoli)	Squacco Heron	Starc galben
9	*Egretta garzetta* (Linnaeus)	Little Egret	Egreta mica
10	*Casmerodius albus* (Linnaeus)	Great White Egret	Egreta mare
11	*Ardea purpurea* Linnaeus	Purple Heron	Starc rosu
12	*Ciconia nigra* (Linnaeus)	Black Stork	Barza neagra
13	*Ciconia ciconia* (Linnaeus)	White Stork	Barza alba
14	*Platalea leucorodia* Linnaeus	Spoonbill	Lopatar
15	*Aythya nyroca* (Guldenstadt)	Ferruginous Duck	Rata rosie
16	*Circus aeruginosus* (Linnaeus)	Marsh Harrier	Herete de stuf
17	*Accipiter nisus* (Linnaeus)	Sparrowhawk	Uliu pasarar
18	*Buteo rufinus* (Cretzschmar)	Long-legged Buzzard	Sorecar mare
19	*Haematopus ostralegus* Linnaeus	Oystercatcher	Scoicar
20	*Himantopus himantopus* (Linnaeus)	Black-winged Stilt	Cataliga
21	*Recurvirostra avosetta* Linnaeus	Avocet	Ciocintors
22	*Burhinus oedicnemus* (Linnaeus)	Stone Curlew	Pasarea ogorului
23	*Glareola pratincola* (Linnaeus)	Collared Pratincole	Ciovlica ruginie
24	*Tringa glareola* Linnaeus	Wood Sandpiper	Fluierar de mlastina
25	*Larus melanocephalus* Temminck	Mediterranean Gull	Pescarus cu cap negru
26	*Larus genei* Breme	Slender-billed Gull	Pescarus rozalb
27	*Gelochelidon nilotica* (Gmelin)	Gull-billed Tern	Pescarita razatoare
28	*Sterna sandvicensis* Latham	Sandwich Tern	Chira de mare
29	*Sterna hirundo* Linnaeus	Common Tern	Chira de balta
30	*Chlidonias hybridus* (Palllas)	Whiskered Tern	Chirighita cu obraji albi
31	*Chlidonias niger* (Linnaeus)	Black Tern	Chirighita neagra
32	*Bubo bubo* (Linnaeus)	Eagle Owl	Bufnita
33	*Caprimulgus europaeus* Linnaeus	Nightjar	Caprimulg
34	*Coracias garrulus* Linnaeus	Roller	Dumbraveanca
35	*Dendrocopos syriacus* (Hemprich et Ehrenberg)	Syrian Woodpecker	Cocanitoare de gradini
36	*Melanocorypha calandra* (Linnaeus)	Calandra Lark	Ciocarlie de baragan
37	*Anthus campestris* (Linnaeus)	Tawny Pipit	Fasa de camp
38	*Lanius collurio* Linnaeus	Red-bached Shrike	Sfrancioc rosiatic
39	*Lanius minor* Gmelin	Lesser Grey Shrike	Sfrancioc cu frunte neagra

We can sea easily that a large number of species of birds are protected by this important European law. That means the study area is very important for this protected birds. All this species are present also on the Romanian litoral.

Conclusions

In Romania the anthropical impact is very heavy for the populations of birds (especially in the summer). For this reason, here, the number of nesting birds is very poor.

In Bulgaria, it is a less anthropical impact, the area is not affected by the people. In Bulgaria still exist an important number of nesting birds.

The habitats are different in the two countries: in Romania are especially sand beaches and in Bulgaria are especially rocky cliffs. That means some species are seen only on the Bulgarian sea coast.

The whole area is very important for the migratory birds. Here it is a major way for them.

In winter, the human impact is not so important, that means the area is also an importat wintering area.

The preservation of the Bulgarian sea coast is very important, because in Romania the littoral is already affected by the tourism.

In Romania, the most important wetlands from the sea-coast are Techirghiol Lake and Hergheliei (Mangalia) Swamp. Here we can find the bigger number of species of birds (and the large number of birds, too).

We have seen 172 species of birds in the study area – a large avifaunistical diversity.

For the future, it is very important to study the relations between the people and birds, in order to make possible the survival of the men and birds.

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THE ORNITHOFAUNA OF SEASIDE BULGARIAN DOBROUDJA

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Abstract: The aim of the paper is the ornithological evaluation of the territory of the coastal Bulgarian Dobroudja, the presentation of typical species of nesting birds from the coastal steppe areas and the water birds in the humid zones of the Lakes Shabla and Durankulak, Another aim is the presentation of some bird species not typical for this territory that hibernate in south, passing trough this part of the Dobrudja.

Keywords: ornithofauna, Bulgarian Dobroudja, seaside, nesting birds, steppe areas, humid zones.

Introduction

Dobroudja, named in the antiquity Scythia Minor is historical-geographic region, situated in the North-East part of the Balkan Peninsula. On the north and north-west bordered by the river Danube, on the east by Black Sea, and on the south by Batovska river. Bulgarian Dobroudja now is divided in two parts North and South Dobroudja. Seaside Dobroudja has not so good expressed borders. She started with the territories of the municipalities Balchik, passing over the municipality Kavarna, Shabla and ended by the state border with Romania. The terrain is almost flat, come on with the elevation "0". On some places is cutting by little gullies, part of the coast is rocky, with caves, which disrupt the flat character of the land. There are two big firth lakes, Shabla and Durankulak, as well as three hyperhalline reservoirs /tuzlas/, which are very important for the concentration of the ornithofauna of the region.

The climate of Bulgarian Dobroudja is temperate to transitional continental. The coastal area belongs to the continental- Mediterranean climatic region and characterized as a proximately mild winter and hot, dry summer. The coastal area belongs to the continental- Mediterranean climatic region; during the summer the maximum air temperatures are lower, and during the winter they are above 0, the snow cover is unstable. Strong north and north-east winds prevail. They are often accompanied by abundant snow falls and icing.

Natural vegetation has been significantly altered due to the long-term anthropogenic effect. Natural environment is preserved only in single small locations not included in agricultural activities. The region is characterized with xerothermic oak forests (with admixes of elm, hornbeam, etc.), lime-tree forests, and various species of xerothermic grass communities. The northernmost flooded forest, Baltata, is also located in this region. Secondary growth of Oriental hornbeam and (Jerusalem) Christ thorn can be observed, as well. On the whole, the Dobroudja region is a typical agrarian area. Under the influence of the people the firmer forests are vanished and transformed their landscape, looking like steppe. In 50-th years of the future century, the steppes are ploughed up and reduce into agriculture areas. In the same time was formed the forest shelter belts to protect the fields from the hard north winds as well during the winter as during the summer (dry winds). All these works are to restrict the erosion of the fruitful level of the soil and to keep the snow-cover during the winter. The forest shelter belts are very important for the forming of the nest ornithofauna of the region, and also for the bird migration. The fauna is represented by Euro-Siberian and European species. The region is rich in steppe species, both animals and plants. They are widespread mostly in the eastern part of the territory.

On the lands of Kavarna municipality two nature-archaeological reserves Kaliakra and Jailata are situated, and in Shabla municipality - protected natural areas Shabla lake, Shablenska tuzla and Durankulak lake. Between the village of Balgarevo, cape Kaliakra and Eni Kulak area are the best preserved typical steppe communities in Dobroudja. The steppes here are the largest and in best conditions. Typical for these biotopes are species, like

short-toed lark (*Calandrella brachydactyla*), calandra lark (*Melanocorypha calandra*), black-headed bunting (*Emberiza melanocephala*), different species of wheatear (*Oenanthe*) and isabellina-weatear (*Oenanthe isabellina*) and Stone-Curlew (*Burhinus oedicnemus*) among them. Here some rare species - Eagle-owl *(Bubo bubo*) and Long-legged Buzzard (*Buteo rufinus*) also nidificate.

Nesting populations of these typical for the steppe species are best presented on this confined space. The area between Tyulenovo and Kaliakra is well known from the specialists and fans like a place, where a most beautiful and uncommon pink starlings (*Stumus roseus*) can be seen. These "wanderers" of the steppes are staying and nesting here only if they have enough nutritive value. Otherwise the flocks migrate to the south toward Turkey, or move to the north toward Rumania and Ukraine.

The cape Kaliakra is the most eastern point of this seacoast. He is extremely important for the migratory birds. The region is famous as a medial station for a great amount of migratory birds along the Black Sea coast. It is known long ago, that here alight coveys of white storks and, quails and many little songbirds for a rest. During this period here feed migratory small birds of prey: harrier, falcons, hawks. When bad climatic conditions appears, the aquatoria around the bay, give shelter to the migrating, hibernating and aquatic birds. Sometimes here can be observed hundreds of loons, wild ducks, mallards etc. heaping. On the rock cornice from Kaliakra to Tyulenovo nested also the aristotelis cormorant (*Phalacrocorax aristotelis*). In spite of this, it is considered as vulnerable and is included to the new Red list of the species in this category.

Therefore, this strategic for the birds region and especially the Kaliakra cape uses to be quite like a magnet for the ornithologists. No matter of the already existing large information over the bird species, found in this aria during different seasons, the parameters of the nest communities in this biotope is not well known. In spite of the permanent narrowing of this typical for Dobroudja landscape, it is necessary to make description of the here nesting birds' populations, starting from an investigation of the possibilities for enlargement of the already existing reserve Kaliakra. With the help of the Bulgrian - Switzerland Programme, during the year 1996 a lot of similar surveys have been done by Bozhidar Enchev and Stoyan Nonev.

Material and Methods

During the nesting season in 1996 three reports concerning the nesting birds in the region have been made. For that purpose, five different in their vegetation substance and ground structure, sectors has been determined.

- Typical for the Kaliakra steppe. With grass coverage to height of 10-12 centimeters. Average count of vegetation stalks above the medium height – 66,24m2. Stone coverage – approx.10-20%. Single bushes - here and there within the sector. Separate groups of trees (pine, oleaster and others) along the road Bulgarevo village – Cape Kaliakra. On this platform a stone-pit near Cape Zelenka is also situated. Through it passes a power transmission line constructed from cement and metal columns. Here also 40 goats and 240 sheep graze. Area – 73 hectare.
- Area with cadastre number № 128 to the south of the Eni kulak countryside. Here the grass is with different height and it forms mosaic spots from 10 to 50 centimeters. The average height is from 18 to 20 centimeters. Average count of vegetation stalks above the medium height – 457,28m2. However the grass seems to be loose, because of the fact that the high grasses are the stalks of the wheat plants indeed. Stones – 10%. Area – 26,2hectare. Extremely well preserved steppe. No trace of a human influence.
- Steppe bushy area, overgrown with hornbeam, oak, sumac, wild briar, hawthorn and ashl trees. The height of the bushes riches 3m. Coverage about 40%. Between the bushes there is typical steppe vegetation, the same as in sector №1. Area - 30 hectare.
- Cape Kaliakra: from the first fortress wall to the cape (cadastre numbers 293, 296, 298,299). This sector is full of variety. The biggest part of the area is occupied with archaeological excavations. Among them there is exuberant, thick grass vegetation, and single low bushes. In the front part of the of the cape there are several buildings for living and around them and along the edge of the rock there are some

group of trees and some single ones, thick bushes and several cypresses. A small number of open rock caves are also situated in this sector. Area – 26,5 hectare.

- A sector, located to the south of the Eni kulak countryside; between the Eni kulak, the strip of a land over the sea and the Bolata gulch. The average height is from 20 to 30 centimeters. Average count of vegetation stalks above the medium height – 100,8m2. Groups of thorn bushes, oak, ashl tree, wild briar and hornbeam and others. Coverage about 20%. There are areas without stones at all, total coverage – about 10%. Area – 16 hectare.

For the determination of the number of the nidificating couples the map-making method was used. It gives the best possible results in such territories.

Results and Discussions

During the nesting season in 1996 in the steppes of the plateau of cape Kaliakra 32 species of nidificating birds were found. In this number we don't include those that inhabit rock perches (12 species), 6 more additional species connected with some specific bio-zones in Bolata, as well as those, feeding in the steppe. We will discuss them separately. The location of the species in different sectors and the density of their populations are put in tables 1-5.

On the fist sector the greatest number of nidificating birds was found (Table 1). The bigger part of those species nests on the ground (7 species) or in halls in the ground (6 species). Prevailing species here are the larks (*Melanocorypha calandra, Calandrella brachydactyla* and the *Wood-lark*). The availability of some hollow cement columns makes possible the nesting of the starling, the sparrow and the blue crow too.

Table 1 - Number and density of the nesting birds in the sector №1 /Steppe on the East of Bulgarevo village, 73 hectares

№	Species	Number of nesting birds	Density of couples/10ha
1	*Melanocorypha calandra*	33	4,52
2	*Calandrella brachydactyla*	27	3,7
3	*Alauda arvensis*	23	3,15
4	*Oenanthe oenanthe*	14	1,92
5	*Anthus campestris*	8	1,1
6	*Galerida cristata*	8	1,1
7	*Sturnus vulgaris*	8	1,1
8	*Oenanthe pleschanka*	7	0,96
9	*Oenanthe isabellina*	6	0,82
10	*Lanius minor*	5	0,68
11	*Upupa epops*	5	0,68
12	*Miliaria calandra*	4	0,55
13	*Burhinus oedicnemus*	3	0,41
14	*Emberiza melanocephala*	3	0,41
15	*Lanius collurio*	3	0,41
16	*Merops apiaster*	3	0,41
17	*Falco tinnunculus*	2	0,27
18	*Carduelis cannabina*	1	0,14
19	*Coracias garrulus*	1	0,14

20	*Passer domesticus*	1	0,14
21	*Pica pica*	1	0,14
22	*Strptopelia decaocto*	1	0,14
	Total	167	22,88

The magpie makes its nests not only on the trees but in bushes near the road and on the metal parts of the electrical columns as well. After that the kite uses those same nests. The presence of the turtle-dove is not typical, having in mind the fact that its nest is situated on the black pine tree near the road.

The sector № 2 is nothing but one typical for the steppes grass community where there aren't almost any bushes and no pasture at all. Almost identical conditions in the entire area allows here to nidificate only limited number of birds. They are adapted to the open air-spaces and they nest on the ground. Their thickness here is vastly higher in comparison with the other sectors (table 2).

Table 2 - Number and density of the nesting birds in the sector №2/cad. №128; 26,2 ha

№	Species	Number of nesting birds	Density of couples/10ha
1	*Melanocorypha calandra*	33	12,60
2	*Alauda arvensis*	11	4,20
3	*Calandrella brachydactyla*	6	2,29
4	*Miliari calandra*	2	0,76
5	*Emberiza melanocephala*	2	0,76
6	*Anthus campestris*	1	0,40
7	*Burhinus oedicnemus*	1	0,40
8	*Lanius collurio*	1	0,40
	Total	57	21,76

The small number of single bushes limits the presence of the inhabiting species to two – *Emberiza melanocephala* and *Lanius collurio.*

Along the Bolata gulch a bio-zone is differentiating. It differs from those we have determined as typical steppe. (sector №1) Here increases the number of the bushes, they are much higher and they make groups with vastly coverage. In this way, some conditions for nesting of additional number of species not typical for steppe region origin. (table3)

Table 3 - Number and density of the nesting birds in the sector №3/ thin bushes entering the "Bolata" object; 30 ha/

№	Species	Number of nesting birds	Density of couples/10ha
1	*Miliaria calandra*	6	2,0
2	*Emberiza melanocephala*	3	1,0
3	*Alauda arvensis*	2	0,7
4	*Carduelis cannabina*	2	0,7
5	*Lanius minor*	2	0,7
6	*Melanocorypha calandra*	2	0,7

7	*Sylvia nisoria*	2	0,7
8	*Galerida cristata*	1	0,3
9	*Hippolais pallida*	1	0,3
10	*Pica pica*	1	0,3
11	*Sylvia communis*	1	0,3
12	*Upupa epops*	1	0,3
	Total	24	8,0

That's why we divide the sector in this bio-zone, nevertheless that it is inseparable part of the landscape as a whole.

Although the larks inhabit this sector too, their number here is vastly smaller. Here we can find the great number of Emberiza calandra. It prefers this bio-zone because it uses the top of the bushes from where it marks its territory. Typical for this area is also the *Emberiza melanocephala*. Some two other species of garden warbler appears and they also prefer thin bushes. Because of the lack of high trees here the magpie also nests.

The sector №4 has its specific characteristics and it differs thoroughly from the main part of the region. That's why here is settled a community including a great variety of species and part of them are sparrows and swallows (table 4).

Table 4 - Number and density of the nesting birds in the sector №4/ from the firs fortress wall to the cape Kaliakra, cad. №293, 296, 298 and 299, 26,5 ha

№	Species	Number of nesting birds	Density of couples/10ha
1	*Oenanthe pleschanka*	15	5,66
2	*Passer domesticus*	11	4,25
3	*Emberiza melanocephala*	7	2,64
4	*Miliaria calandra*	5	1,89
5	*Oenanthe oenanthe*	5	1,89
6	*Carduelis cannabina*	3	1,13
7	*Passer montanus*	3	1,13
8	*Galerida cristata*	2	0,75
9	*Lanius collurio*	2	0,75
10	*Parus major*	2	0,75
11	*Passer hispaniolensis*	2	0,75
12	*Upupa epops*	2	0,75
13	*Anthus campestris*	1	0,38
14	*Athene noctua*	1	0,38
15	*Carduelis carduelis*	1	0,38
16	*C. chloris*	1	0,38
17	*Hippolais pallida*	1	0,38
18	*Sylvia communis*	1	0,38
	Total	65	24,53

On this sector, in the existing caves also 8 more couples of swallows are nesting.

The most numerous species here is the black-backed wheatear and this is predetermined from the fact that there are a lot of stone walls and holes in the rocks. The next one is the sparrow. It also finds here the optimum conditions for nesting in the already existing buildings and for feeding – in the surrounding grass areas. The greater part of the species is presented here with the small number of couples.

Natural platform №5 is situated along the coast. The grass here is high and the bushes are gathered in small groups.

Table №5. Number and density of the nesting birds in the sector №5/ between the Eni kulak and the Bolata gulch, 16 ha

№	Species	Number of nesting birds	Density of couples/10ha
1	*Melanocorypha calandra*	17	10,6
2	*Miliaria calandra*	4	2,5
3	*E. melanocephala*	3	1,9
4	*Oenanthe pleschanka*	3	1,9
5	*Alauda arvensis*	2	1,2
6	*Carduelis cannabina*	2	1,2
7	*Lanius collurio*	1	0,6
	Total	32	20,0

The great number of *Melanocorypha calandra* (Table 5) and the absence of the *Calandrella brachydactyl*a is determined from the high grass here. In the west the grass became lower and the steppe starts to carry the characteristics of the sector №1. Here the count of the *Calandrella brachydactyla* is much higher (50 couples) than the number of the *Melanocorypha calandra* (10 couples).

In the researched territory 3 couples of nesting partridge were found. The density of this species have been calculated, having in mind the whole territory of the area and it is 0, 04 couples per 10 hectares.

Conclusions

During the period 1978-79 a survey concerning the territory and the number of the *Phalacrocorax aristotelis* have been made by expert-curators from the Regional Museum of History – Dobrich. On the vertical rock formations near Tulenovo village and Kaliakra cape about 40 couples of these birds have been found with an annual population increase of 7 to 10 nests (baby birds). Today (2007) we can find here about 180-250 couples of the *Phalacrocorax aristotelis*, or we may say that the number of the birds increases and the species is stable.

But we couldn't say such kind of words for the *Burhinus oedicnemus*. The pasture here is not enough and the height of the grass is three or four times bigger than the height of the *Burhinus oedicnemus*. This fact breaks the conditions which assure the existing of the species. And if we put in addition the facts that the density of the *Canis aureus* and *Elarus agentatus* on this territory increases as well the presence of the rambling dogs, the great number of buildings that appears and the wind generators in the area, we may certainly say that the population of this species is threatened with extinction.

Now the information needs to be refreshed, especially because of the coming changes in steppe communities – result of the wind generators constructing.

The steppes of the seaside Dobroudja are turning into wet zones on the territory of Shabla and Durankulak. The Shabla Lake is declared as protected zone from the year of 1979. Inseparably part of the Shabla Lake complex is the Shablenska tuzla. This complex is one of the most well kept from anthropogenic influence wetland on the Black Sea coast. The Shabla and Durankulak lakes are included in the European Program Burd Life International - ornithological important places. The Durankulak Lake is declared as natural landmark during

the year 1980. Because of the fact, that they are keeping definite quantities of the aquatic birds, they are reported for Ramsar places under Ramsar convention, with Bulgaria as a side in it. The lakes play a certain part during the migration of the birds and especially in winter time. Practically the whole population, about 56 000 representatives, of the world threatened with extinction red gizzard goose (*Branta ruficollis*) hibernates here. Big quantities from the white frontlet goose (*Anser albifrons*), different types of mallards, swans and others also find a shelter here, during the winter. The role of the lakes and the shores increases vastly, when the weather in the Danube Delta is getting worse and the swamps are frozen. By such meteorology conditions our lakes are full of birds.

The nesting ornithofauna is represented with 57 species, 10 from them are rare. Here can be found the border west area of the territories occupied with India warbler (*Acrocephalus agricola*). Because of these, there are tourists, very found of birds, coming from whole Europe. In the Durankulak Lake, during the migration, periodically one rare species, also can be found. This is the Stiff-tailed duck (*Oxyura leucocephala*) - an object of international project which is after its protection. Durankulak is the next station on its migration way to Greece after the Rumanian lakes in Dobroudja.

During the last years, the natural communities in Dobroudja are subjects of powerful anthrop-genetic pressure. There are almost no remains from the steppe biotopes in the region. In them a number of characteristic species are found, which because of the coming changes, quick and precipitously reduce their quantity. The steppes are from a great significance for the migration for some distinct species. Here they rest and feed. That's why their protection is very urgent. The question for the possible reintroduction of some species also needs detailed investigation. It is necessary to examine suitable terrains and to work out a similar program, in which specialists at large, representatives of state and NGOs to be able to take part.

The Seaside Dobroudja, possesses varied and interesting ornithofauna. The natural diversity of Dobroudja in every season and the fact that this region is on the Black Sea migration way of the birds, are giving extremely good possibilities for development of ecology and alternative tourism in any time of the year. Utilization of this opportunity and the protection of the wild nature must be the utmost task for the municipalities and the local public.

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STUDY OF THE POLYCHAETA FAUNA (ANNELIDA) FROM THE MEDIOLITTORAL AND INFRALITTORAL OF THE BLACK SEA: LITTORAL SEGMENT CAPE MIDIA – CAPE KALIAKRA

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Abstract: Polychaeta represent an important component of the marine benthos by the number of species, the density of the abundance and biomass recorded in various benthic biocenosys of the Pontic basin. Our research subject area is characterized by the existence of a mosaic of habitats, from the sedimentary ones, from the sheltered areas of the beach protection breakwaters or port premises (reported on the Romanian seaside length), to the ones made up from platform exposed to the direct wave action from Vama Veche; from those encountered in the low depth (mediollittoral and infralittoral) to the sedimentary and shell-type substrate from 15 or 25 meters deep (Constanta and Cap Kaliakra). Community best represented by Polychaeta is the one from the hard substrate habitats of all the horizons of depth, where there are encountered vagile forms of the **Palpata**, as well as tubicolous forms of Scolecida group, with sedentary lifestyle and detritivorous-filtrates or sediment-feeding style.

Keywords: polychaeta community, benthic fauna, sedimentary, hard and phytal substratum

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Introduction

Fauna of polychaeta group from the Mediterranean-Pontic basin includes approximately 400 species, ie 5% of the total number of polychaeta species known until today; for the Black Sea are quoted from this group 199 species, which is 49.5% of Mediterranean polychaeta fauna and 2.5% of the species cited in Planetary Ocean.

Structural changes reported in recent years at Planetary Ocean communities level led experts to conduct studies on benthic wildlife in general and thus of the polychaeta; these studies followed a reassessment of the taxonomic lists from various geographical regions, and especially particularly studies focusing on specific bio-geography of specific and supra-specific taxons and on their distribution at regional level, depending on the main category of substrate.

Concerning for polychaeta bio-geography knowledge has become a concern because it has identified some species or habitats in regions that previously had not been reported or others report the disappearance of habitats in which another time it was considered characteristic (Bartolomaeus, 2005; Bellot, 2004; Musco, 2005; Glasby, 1999, 2005). In this context, we mention the research conducted by (Sergheva, 1998; Kisseleva, 1968, 1985) on the fauna of anoxic biotopes of the Black Sea which quotes a new species for science – *Vigtoriella zaikai* KISSELEVA (Sergheva, 1998) and a new species for the Black Sea of the genus *Protodrilus* HATSCH; representatives of this genus, *Protodrilus* (other species than *P. flavocapitatus* ULIJ) have been identified by us too in different habitats of the north-western of the Pontic basin from 50-60 m depth. In the category of species which lately have not been reported in mediollittoral habitats, with gross sediments from the south of Constanta, are *Ophaelia bicornis* SAVIG and *Praegeria remota* SOUTH. (Băcescu, 1972; Paraschiv and Gomoiu, 2002; Paraschiv, 2006) or in the infralittoral sedimentary habitats: *Arenicola marina* L. (Gomoiu, 1981)

Material and Methods

Our study is based on several categories of data obtained by us during 2002-2006 periods (Fig. 1): - 57 samples from small depth community (mediollittoral and infralittoral), and - 20 samples obtained through

research carried out in the research programs: GEF/Akademik Cruise-2003 and GEF/Parshin Cruise CERES-2005 and CERES 2006.

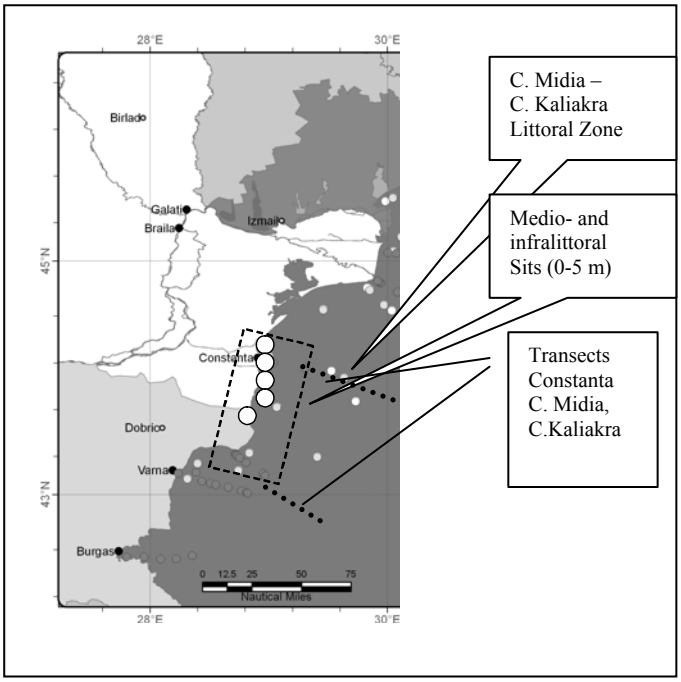

Fig. 1 – Researched area: Cape Midia – Cape Kaliakra and the localization of the sampling points

Samples were collected from locations arranged perpendicular to the shore line, using a device type corer, (being withheld evidence in its entirety - sediment and biological material caught), from different horizons of depth (Table 1), after which fixing and conservation were conducted in order to be processed in the laboratory.

Table 1: The number of samples which were included in this study and the localization of collecting point

Localization of samples collecting point	**Depth (m)**	**No. samples**	**Substratum**
Mediollittoral C. Midia, Constanta, Eforie Sud, Mangalia, Vama Veche	0	12	Hard and sedimentary phytal
Infralittoral: C. Midia, Constanta, Eforie Sud, Mangalia, Vama Veche	1,3 and 5	45	Hard and sedimentary Exclusive rocky
Transects: Cape Midia – Constanta and Cape Kaliakra	8, 15 and 25	20	Sediments: Sandy silt and muddy
Total samples		**77**	

Results and Discussions

In this study have been identified 54 species for the main types of habitat considered: sedimentary, hard (especially associated to the phytal and zoo-bioderm) and stone; out of this species, Nereidae JOHN. are 17%, Phyllodocelidae LEVIN are19%, 9% Syllidae SAVIG. (45% of which is **Aciculata-Palpata** group) and 50% of

Scolecidae BLAIN (sedentary, with external tubs of sediment, out of which 37% represents Spionidae GRUBE) 7% from other groups; juvenile and larval forms are dominated by spionidae, followed by nereidae.

Although the number of samples collected in the Kaliakra area is much lower compared to the rest, polychaets recorded a bigger increase in this sector than in the rest of the coast area (58%, Fig. 2); in addition, species cited only in habitats of these areas represent 62% of the species cited only with a single presence (Fig. 3).

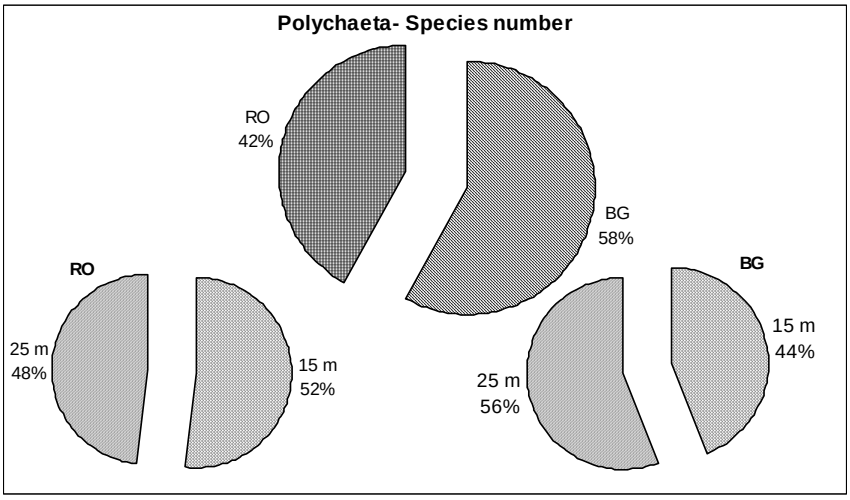

Fig. 2 – Distribution of the number of species identified in the researched area: C. Kaliakra-Bulgarian littoral and the rest of the researched area-Romanian littoral

Also in the area C. Kaliakra, in the biotopes from 25 m depth, polychaets recorded the highest number of species identified, relative to the total number cited for the entire area; in the habitats located between C. Midia and Vama Veche were recorded values approximately equal for the number of species recorded on various depth horizons (Fig.2).

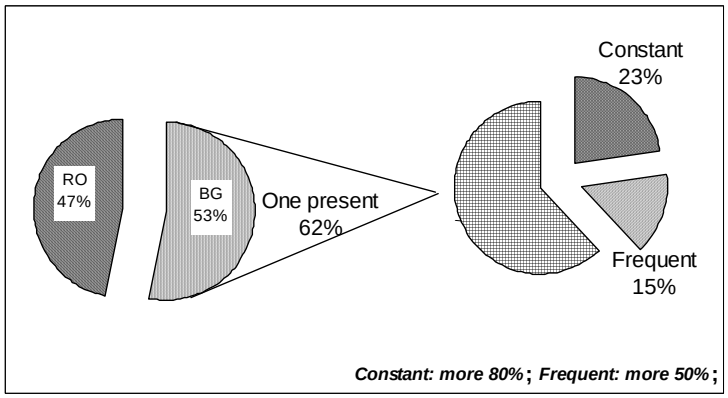

Fig. 3. – The analysis of the polychaeta species frequency in the two sectors of the studied area

Staying in the same context, data analysis performed for the fauna of benthal metazoars (79 species), presents the northern extremity of the analyzed area (Cape Midia - Constanta) as the area with the greatest number of species and the highest values of density on abundance particularly in the horizon of depth to 15 m

(especially by representatives of groups **Polychaeta** - 27 species and **Mollusca** - 23 species, Fig. 4).

In specific literature it is considered that approximately 75% of the benthic fauna of the Planetary Ocean is encountered in combination with hard substrate (rock, coral reefs, artificial reefs, hydro-technical constructions, or shell-type), 20% is populating sedimentary biotopes and only 5% of the benthic fauna is associated to the phytal substrate (Parsons, 1977).

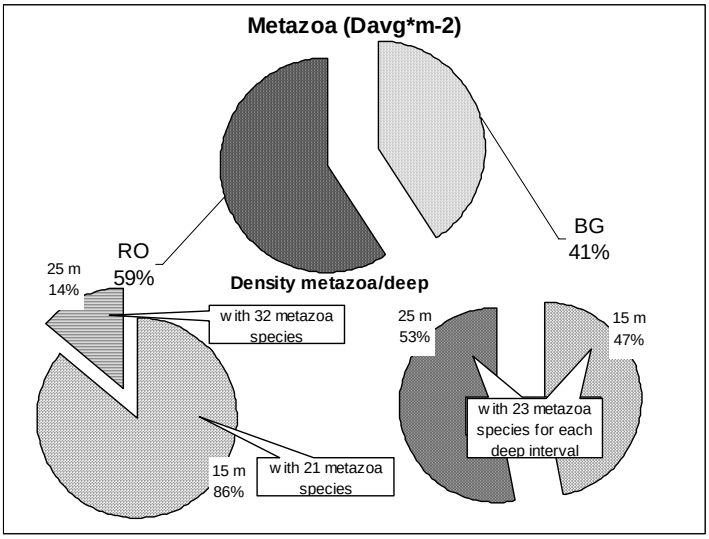

Fig. 4. - Analysis of the number of species and of the density after the benthic fauna abundance from the two sectors of the studied area

For the study area presented shows is highlighted an almost constant presence of nereidae species, with high waist: *Neanthes succinate* LEUCK., *Nereis rava* EHLERS., with affinity for hard substrate, frequent in association with epibenthic fauna of this substrate; they are present also in association with various sedimentary deposits and this is correlated with the presence of rocks and stones large enough, at whose shelter can form such accumulation of sediments (Fig. 5); the last species quoted by us as a novelty for the Romanian coast (Paraschiv *et.al*., 2001); as well as a novelty in the `90 was reported for the first time at the Romanian seacoast a species of nereid, *Namanereis litoralis* MAR., in the mediollittoral sediments, at shelter from waves and with high concentration in particulate organic matter in interstitial water (Surugiu and Manoleli, 1998; Paraschiv and Gomoiu, 2002); populations of this polychaeta are described in the literature as typical for the mediollittoral with sediments dominated by fine fractions and with increased organic load (Vinogradov, 1968); in the study conducted by us, we found it in high enough number in the fauna associated to the protection breakwaters of the port of Cape Midia.

Among the species characteristic to the rocky substrate, with epibenthic consisting in mussels and macro-algae associations, and frequently encountered by us, we quote: *Platynereis dumerilii* AUDOU.&EDW. and *Perinereis cultrifera* GRUBE.

Among the forms of vagile polychaeta, a fairly large percent of species, especially among syllidae and phyllodocelidae, presents an accentuated affinity to the hard substrate particularities (38%, Fig. 5).

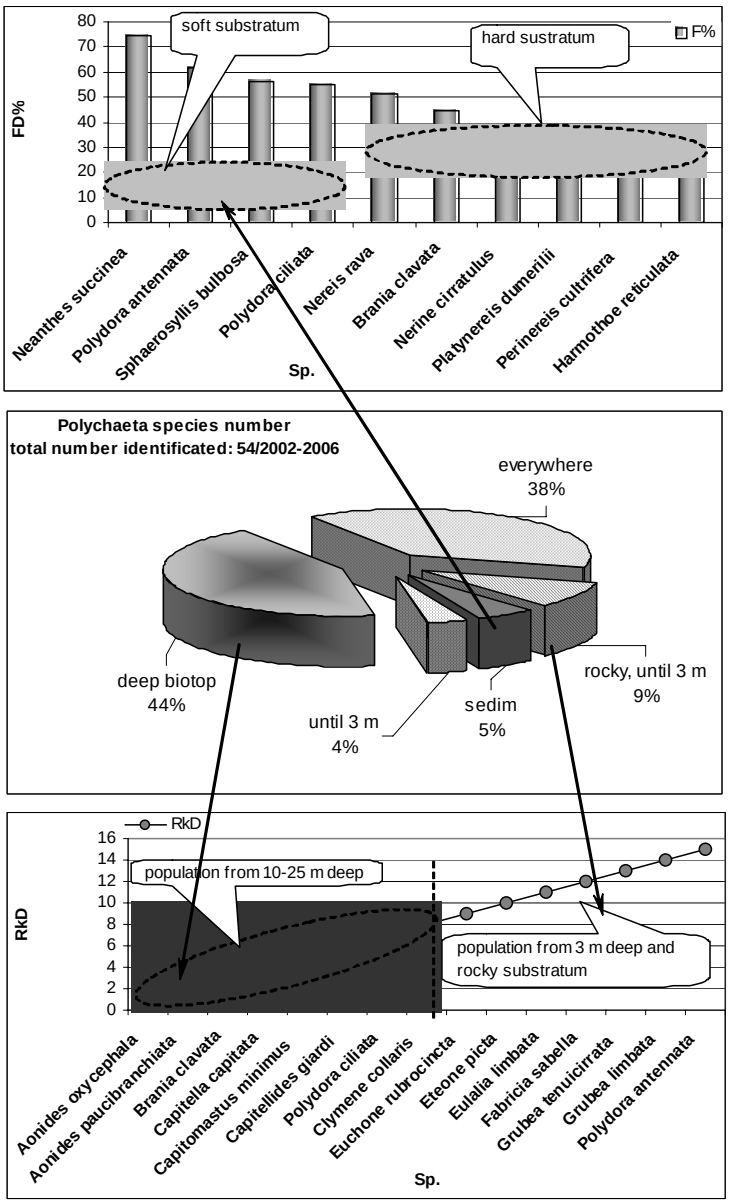

Fig. 5 – The structure of the Polychaeta communities from the different types of occupied habitats

A relatively large number of species (44%), are identified only in biotopes at depths exceeding 10 m; this is explained mainly by the presence at these depths of a particular type of sediments that form the matrix substrate (silt with slimy matrix) and the preference is given rather by the need to "build" the tube to carry out life-cycle and to a lesser extent by bathymetric factors; among these species we quote: the species of *Capitella* BLAINV., *Capitomastus* LANGERH, *Polydora* BOSK and *Aonides* CLAP., species *Eucymene* CLAP. and

Heteromastus CLAP. whose population occupies the first positions (after the rank given by the frequency – F% and dominance – D_D % values) in the polychaeta fauna communities of the investigated sector (Fig. 5).

Mediollittoral floor is characterized on the entire length of the analyzed coastline segment by sedimentary habitat with fine grading (C. Midia, Constanta), average and rough (Eforie Sud) and rough mixed with fragments of shell more or less run (Vama Veche); habitats of the far south, are populated by rare species strictly affinity of sediment habitats: *Saccocirrus papillocercus* BOBR. (216 indv.m^{-2}) and *Nerilla antennata* SCHM. (1068 indv.m^{-2}) (Surugiu, Manoleli, 1998-1999); the most part of the species that have been identified in the biotopes of this floor and that dominate through values of the average density of the populations are the ones associated to the hard substrate epibenthic organisms (Fig. 6): *Neanthes succinea* (12 378 indv.m^{-2}), *Perinereis cultrifera* (936 indv.m^{-2}), *Platynereis cultrifera* (1 097 indv.m^{-2}) and *Nereis rava* (Nereidae), *Brania clavata* CLAP.(1 174 indv.m^{-2}) and *Sphaerosyllis bulbosa* SOUTH. (Syllidae), species of the *Polydora* genus (3 114 indv.m^{-2}Populations of these species record the first five values of density rank (Rk_D) because of the frequency and/or increased densities. In the mediollittoral sediments from Eforie South is highlighted increased average density values (438 indv.m^{-2}) recorded by the population of *Namanereis litoralis*.

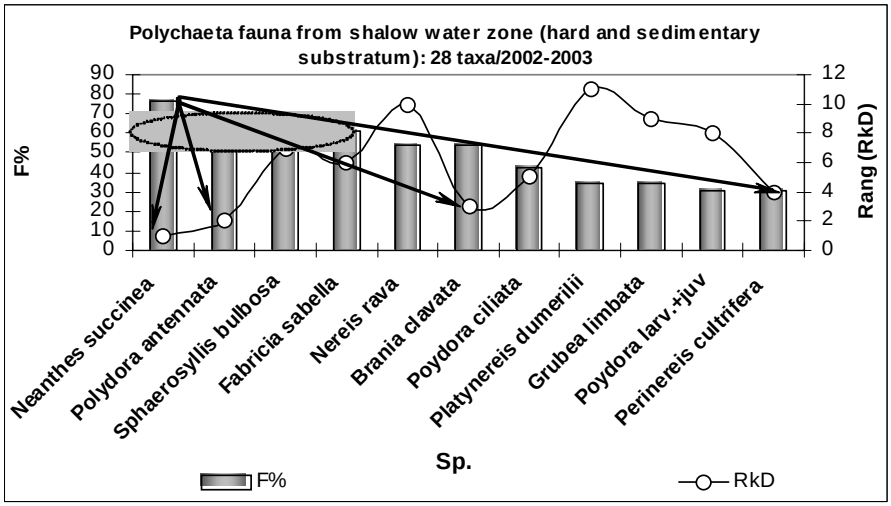

Fig. 6 – The structure of polychaeta associations from the sediments and rocky substrate of the mediollittoral area, Cape Midia - Vama Veche

The sedimentary habitats of the infralittoral are dominated throughout the entire length of the analyzed coastline segment by a lower number of species, but which develops increased effectives, even if they are not recorded consistently; at this level the species of Scolecidae group are dominant (Fig. 7): *Nerine cirratulus* DELLE-CHIAJE (3 758 indv.m^{-2}), *Spio filicornis* O.F.M. (1 418 indv.m^{-2}), *Polydora ciliata* JOHN. (1 087 indv.m^{-2}); the *Neanthes* nereid population is reported especially in areas with development mussels effectives, but with much lower values (650 indv.m^{-2}).

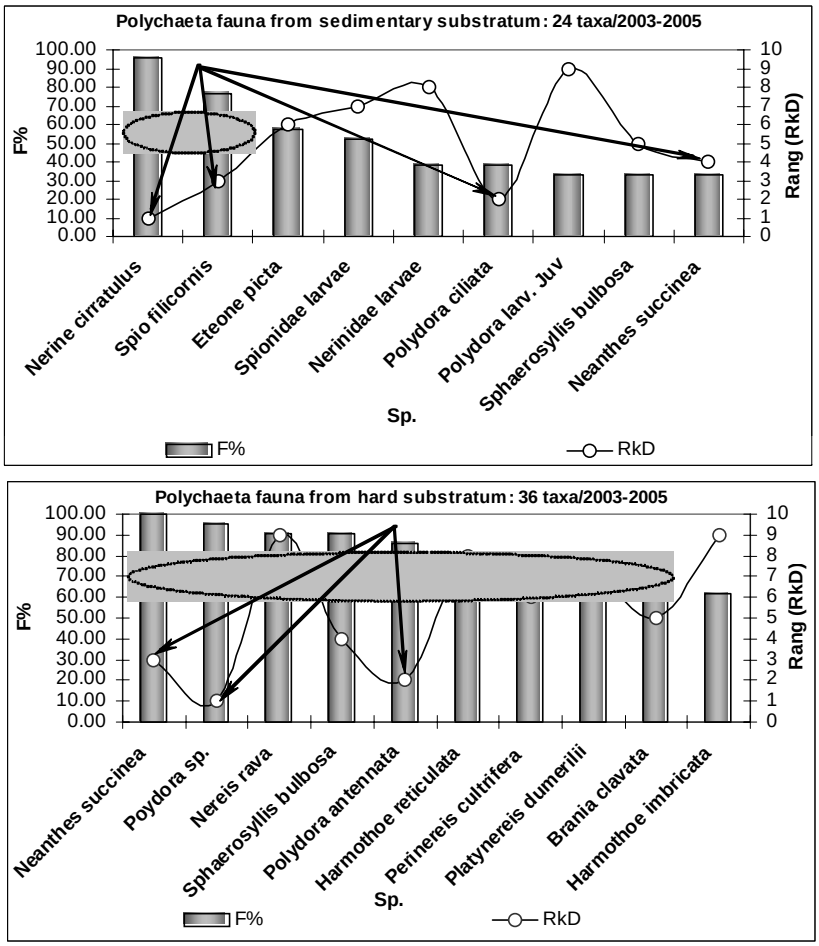

Fig. 7 – The structure of the polychaeta associations from the sediments and rocky substrate of the infralittoral (until 25 m), Cape Midia – Cape Kaliakra

The hard substrate infralittoral is characterized by the fact that the frequency index values are very close to a relatively large number of species (Fig. 7), though dominant through effectives are only two populations of the *Polydora* (*Polydora* sp. 32 017 indv.m^{-2} and *P. antennata* 15 034 indv.m^{-2}); at a significant difference (6511 indv.m^{-2}) is encountered the population of the *Neanthes* (Rk_D 3) and species *Sphaerosyllis* (Rk_D 4; 4029 indv.m^{-2}). While with lower effectives, we report the presence of populations of certain genus from Phyllodocelidae group: genus *Harmothoe* KINBERG. (*H. reticulata* CLAP. and *H. imbricata* L., on average 1400 indv.m^{-2}), *Polynoe scolopendrina* SAVIG. (1250 indv.m^{-2}), *Eteone picta* QUATR., *Eulalia limbata* CLAP. and *E. viridis* MULLER (on average 740 indv.m^{-2}), *Euchone rubrocincta* SARS (65 indv.m^{-2}).

Analyzing from the feeding stand point the associations formed by polychaeta-fauna, two main groups are highlighted: the predators - 33% (in this group being included non-selective carnivores) and the detritivore species - 29% (consuming particulate organic substance, indifferent of the mechanisms used, Fig. 8).

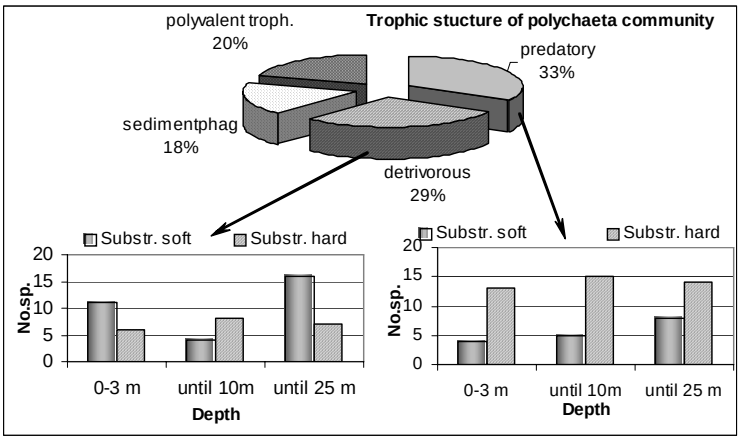

Fig. 8 – Trophic structure of polychaeta communities from different habitats types

The group of predator species includes the syllidae (*Sphaerosyllis bulbosa*, *Syllis gracilis* GRUBE, *Brania clavata*, *Grubea limbata* CLAP.and *G. tenuicirrata* MAR.), *Harmothoe* şi *Phyllodoce* SAVIG. species from genus. Some nereidae species are included in the non-selective carnivores group because they present a multiple trophic valence recognized in the literature (eg *Hediste diversicolor* O.F.M.). The largest number of species in this group was identified in the hard substrate habitats associated to the infralittoral floor (Fig. 8).

The second group which includes a relatively large number of species is the on of detritivorous species; in this largest group are included the species of spionidae, scolecidae and terebelidae (**Canalipalpata**): the species of genus *Aonides* CLAP, *Polydora*, *Spio* FABR., *Nerine*, *Euclymene* CLAP., *Heteromastus* CLAP, Capitelida, and some nereidae – *Namanereis litoralis*. Out of these species are highlighed selective micro- or macro-detritivorous, as well as non-selective species.

Conclusions

The variety of the biotopes encountered in the littoral sector Cape Midia - Cape Kaliakra (between 0 and 25 m deep) is the premise of their employment by a diverse fauna; there are are encountered sedimentary habitats with mixture variants of the clay, silt and sandy fractions (the last category with grading subdivisions of fine, medium and rough sand, mineral or biogenic – shells material, rough, strongly run), as well as habitats characterized by a hard substrate (limestone platforms more or less extensive in the southern extremity of the area investigated, the protection breakwaters for the beaches and of the harbor from C. Midia to Mangalia, or substrate composed of strongly compacted shell material).

On the basis of the 77 benthos samples collected from the C. Midia - C. Kaliakra sector, there were identified a total of 199 specific and supraspecific taxa: 117 taxa of 14 major groups of metazoars identified in the small depth benthal domain, to the north of Mangalia (with more sedimentary habitats) and 82 taxa of 18 major groups, for the Vama Veche - Cap Kaliakra sector; this situation is due to rather low number of samples collected from this sector than to the lower diversity (this not allowing the identification of a greater segment benthos fauna typical to the hard substrate).

However we mention the presence of a greater number of species in the group **Polychaeta** (**Annelida**) in the southern extremity of the investigated littoral sector (58% of the total number of polychaeta species - 54) compared with 42% recorded in the benthos domain of north of Mangalia; this is explained by the greater variety of categories of sedimentary habitats or with hard substrate in the area. A constant presence (presence in percents of more than 90%) in almost all types of habitat is registered nearly 23% of Polychaeta species (*Nerine cirratulus*, *Polydora* species complex, *Capitella capitata* FABR., *Sphaerosyllis bulbosa*, etc); a high enough percentage (62%) is represented by the category of species cited as unique presence in one habitat or another, in a

coastal area or another; from this fauna segment, 18 fauna species are cited as unique presence for the habitats from the south of Vama Veche (hard substrate: *Microspio mecznikowianus* CLAP., *Janua pagenstecheri* QUATRE, or at more than 15 m depth).

We signalize the presence of the populations of some polychaeta species cited by us in previous works as new presence for areas situated to the south of Odessa Bay: *Nereis rava* and *Namanereis litoralis*; if approximately 10 years ago we were reporting in the mediollittoral from Eforie South the presence of *Namanereis* species population, at present we can say that it is present as well in the sedimentary deposits sheltered at the base of the brakewaters from Cape Midia (even if not in increased effectives, 487 indv.m^{-2}).

Mediollittoral sedimentary habitats from Cape Midia to Constanta, are characterized by an extremely poor polychaeta fauna, consisting of more juvenile and larval stages of spionidae; as one goes further to the south, the sediments granulometry of this is changing, the rough fractions becoming dominant (Eforie Sud, Mangalia); in these habitats, considered in the `70 as being populated by the association of *Ophelia bicornis* polychaeta species (now disappeared from these habitats) we believe that restructuring of the invertebrate communities take place; deposits of small fragments, of bivalves shells (especially mussels) from the mediollittoral from Vama Veche, exposed to wave action, are populated mainly by two typical interstitial species: *Saccocirrus papillocercus* and *Nerilla antenna*; since in the literature *Nerilla antenna* is described as a typical small depth and psammophyl species and we have identified the representatives of this species and in association with phytofil fauna, as well as in habitats from sandy depths greater than 30m, we believe that it could be in this case a species complex, too.

The mediollittoral with rocky substrate and epibenthos is dominated by nereidae species: *Neanthes succinea*, *Perinereis cultrifera*, *Platynereis dumerilii*, *Nereis rava*.

The infralittoral with sediments is populated mostly by species of *Polydora* complex, by *Nerine cirratulus*, *Spio filicornis*, *Pygospio elegans* CLAP., *Prionospio cirrifera* WIREN; to a high enough extent, to the northern area investigated, capitelidae species develop populations with relative great effectives: *Capitella capitata*, *Capitella minima* LANGER., *Capitelides giardi* MESNIL, and the species *Euclymene collaris*, *Heteromastus filiformis*.

In the infralittoral areas with hard substrate (particularly to the south of the area investigated), where are commonly encountered mussels colonies, associated to this particular type of habitat are encountered to a higher extent species of syllidae, phyllodocelidae, vagile forms, and mostly predators.

Under feeding aspect, the polychaeta communities in the area studied are grouped into four major groups: predators (ravening and non-selective, *Syllidae, Harmothoe, Polynoe* SAVIG.), detritivorous (macrophagous and micophagous), the majority of scolecidae group), sedimentophagous (most of capelidae species) and the group of the species with a polyvalent trophic regime (the majority of nereidae species).

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NATURA 2000 EUROPEAN ECOLOGICAL NETWORK IN ROMANIA

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Abstract: Natura 2000 is a Community-wide network of nature protection areas established under the 1992 Habitats Directive. It also includes areas designated under the 1979 Birds Directive. Aim of the network is long-term survival of Europe's most valuable and threatened species and habitats. Natura 2000 is not a system of strict nature reserves where all human activities are excluded.

Keywords: Natura 2000, Habitats Directive, Birds Directive, environmental assesment, Constanta County's sites

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Introduction

European ecological network Natura 2000 is a network of protected natural areas, through implementation of European Directives 92/43/EEC - Directive on the conservation of natural habitats and species of plants and wild animals (Habitats Directive) and 79/409/EEC - Directive on the conservation of wild birds (Birds Directive). The term Natura 2000 comes from the Habitats Directive and symbolizes efforts to conserve biodiversity for the year 2000 and in the future.

Discussions

Protected areas Natura 2000 are of two types: Special Areas of Conservation - SAC-s, designated under the Habitats Directive and Special Protected Areas for Birds - SPA-s established under the Birds Directive. The establishment of this network of protected areas where special measures are taken to conserve biological diversity also fulfils a clear Community obligation under the UN Convention on Biological Diversity.

Nature 2000 sites selection in Romania follows two different selection processes. First, the identification and delimitation of SPA-s is entirely based on scientific criteria, and than declared as Natura 2000 sites.

Second process concerns SAC-s selection, and follows few steps. Once the national list of Sites of Community Importance (SCI-s) have been adopted it is then for the Romanian State to designate these sites as SAC-s as soon as possible and within six years at most (complying by Habitats Directive criteria in the Biogeographyc Seminars debates). During this period the state should establish the necessary management or restoration measures for the sites to ensure their favourable conservation status (FCS). The first FCS monitoring report will be in 2013 for the SCI-s declared in Romania.

The purpose of Natura 2000 network is to stem the decline of biological diversity by maintaining or restoring favorable conservation status of species with different degrees of endangerment (rare, vulnerable or endangered) and natural habitats of European interest. The conservation status are favorable when the species is maintained in the long term, not the natural habitats aren't reduced are also are sufficiently broad to maintain populations in the long term. In the same time, Natura 2000 network is the main instrument of the European Union for the Conservation of biodiversity and nature, it's irreversible loss means to affect the production of goods and services and semi-natural ecosystems, and economic well-being and health of human populations.

European ecological network objectives are identifying, maintaining and restoring key areas to protect species of wild fauna and flora, and corridors linking of these, which make it possible migration and exchange between the peoples populating the same species as habitats of different areas.

Romania is characterized by: the presence of five biogeographical regions (Pannonian, Steppic, Alpine, Continental and Pontic or the Black Sea region) due to geographical position - being the only country in Europe

with five biogeographical regions, the diversity of hydro-geomorphological units, maintaining a share of approximately 45% of natural ecological systems or partly natural from total area of the country and maintaining most types of systems and complex natural ecological systems.

Both European Directives 92/43/EEC and 79/409/EEC have been translated into Romanian legislation by several legislative acts, namely: Emergency Ordinance no. 57/2007, with subsequent amendments on the regime of protected natural areas, conservation of natural habitats, wild flora and fauna, Order of the Ministry of Environment and Sustainable Development no. 1964/2007 declaring sites of community importance as part of European ecological network Natura 2000 in Romania and the Government Decision no. 1284/2007 declaring special protected areas for birds as part of European ecological network Natura 2000 in Romania.

Specific lows in Romania (Emergency Ordinance no. 57/2007; Order of the Ministry of Environment and Sustainable Development no. 1964/2007, Government Decision no. 1284/2007) provides for all the plans, programmes and projects to be carried out in the Natura 2000 sites and close to them the obligation of applying the procedure of making environmental assessment for plans and programs and procedure framework for environmental impact assessment for projects.

Thus, not any type of human activity is *a priori* prohibited in Natura 2000 sites or in the vecinity, the situations are distinct from case to case and evaluate differentiated. Projects and plans to be achieved, however, are of major public concern, including the sake of social or economic order. For this development proposals competent authority for environmental protection will determine and establish the compensatory measurements necessary to protect the coherence of the Natura 2000 network.

In our country are designated 108 areas of special protection for birds (SPA-s), meaning approximately 12% of the area of national territory and 273 sites of Community importance (SCI-s), which means approximately 13% of the area of the country.

In the county of Constanta are 20 SCI-s (Fig. 1) and 22 SPA-s (Fig. 2) declared to protect a significant number of very diverse habitats (forest, meadow, coastal, swamp, rocks, sand) and a number of important species of flora and fauna of Community interest.

Fig. 1 Limits of sites of Community importance (SCI-s) within the county of Constanta

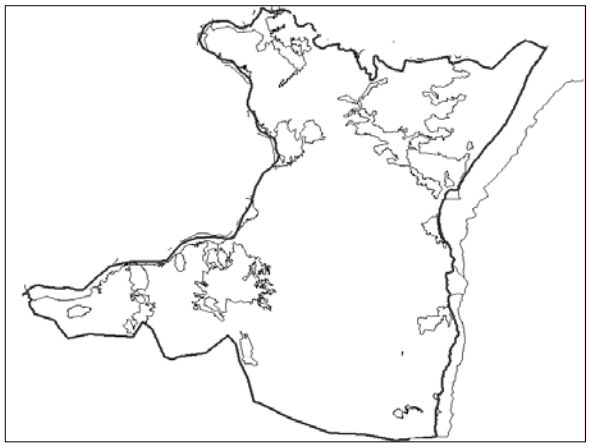

Fig. 2 Limits of areas of special protection for birds (SPA-s) on the county of Constanta

The 20 sites of Community Importance present wholly or partly within the county of Constanta are the following:

1. ROSCI0006 Balta Mică a Brăilei
2. ROSCI0012 Braţul Măcin
3. ROSCI0022 Canaralele Dunării
4. ROSCI0053 Dealul Alah Bair
5. ROSCI0065 Delta Dunării
6. ROSCI0066 Delta Dunării - zona marină
7. ROSCI0071 Dumbrăveni - Valea Urluia - Lacul Vederoasa
8. ROSCI0073 Dunele marine de la Agigea
9. ROSCI0083 Fântâniţa Murfatlar
10. ROSCI0094 Izvoarele sulfuroase submarine de la Mangalia
11. ROSCI0114 Mlaştina Hergheliei - Obanul Mare şi Peştera Movilei
12. ROSCI0149 Pădurea Esechioi - Lacul Bugeac
13. ROSCI0157 Pădurea Hagieni - Cotul Văii
14. ROSCI0172 Pădurea şi Valea Canaraua Fetii - Iortmac
15. ROSCI0191 Peştera Limanu
16. ROSCI0197 Plaja submersă Eforie Nord - Eforie Sud
17. ROSCI0201 Podişul Nord Dobrogean
18. ROSCI0215 Recifii Jurasici Cheia
19. ROSCI0269 Vama Veche - 2 Mai
20.ROSCI0273 Zona marină de la Capul Tuzla.

The list of specially protected areas for birds on the county of Constanta includes the following sites:

1. ROSPA0001 Aliman – Adamclisi
2. ROSPA0002 Allah Bair – Capidava
3. ROSPA0005 Balta Mică a Brăilei
4. ROSPA0007 Balta Vederoasa
5. ROSPA0008 Băneasa - Canaraua Fetei
6. ROSPA0017 Canaralele de la Hârşova
7. ROSPA0019 Cheile Dobrogei
8. ROSPA0031 Delta Dunării şi Complexul Razim – Sinoie
9. ROSPA0036 Dumbrăveni

10. ROSPA0039 Dunăre – Ostroave
11. ROSPA0040 Dunărea Veche - Brațul Măcin
12. ROSPA0053 Lacul Bugeac
13. ROSPA0054 Lacul Dunăreni
14. ROSPA0056 Lacul Oltina
15. ROSPA0057 Lacul Siutghiol
16. ROSPA0060 Lacurile Taşaul – Corbu
17. ROSPA0061 Lacul Techirghiol
18. ROSPA0066 Limanu – Herghelia
19. ROSPA0076 Marea Neagră
20. ROSPA0094 Pădurea Hagieni
21. ROSPA0100 Stepa Casimcea
22. ROSPA0101 Stepa Saraiu – Horea.

Whereas the Natura 2000 network certainly includes nature reserves most of the land is likely to continue to be privately owned and the emphasis will be on ensuring that future management is sustainable, ecologically, economically and socially. We make the mention that in Constanta County all the natural reserves are included in Natura 2000 sites, thus their protection status is consolidated.

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FORMULATION OF A SHORELINE DEVELOPMENT INDEX TO EXAMINE THE RELATIONSHIP BETWEEN DEVELOPMENT AND ECOLOGICAL INTEGRITY

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Abstract: This paper presents a rapid methodology that was created for the assessment of shoreline development around an urban lake. Human activity on the land affects the functionality of different areas of the lakeshore. This multi-metric index attempts to collect information to examine the interconnectivity of aquatic, shoreline, riparian, biotic, and viewscape variables at sites along Lake Tabacarie, Constanta Romania. The aquatic, shoreline, and riparian variables were observed by using a modified point-transect methodology following the lake shoreline. Vegetation, organic debris, garbage, ground cover, and land usage were assessed at each sample point around the lake perimeter. The biotic variables were assessed by observation of presence of birds, amphibians, and other fauna at each site. Viewscape was evaluated using a qualitative assessment of natural landscape and culturally important or aesthetically pleasing built environs as compared to impervious surface areas (e.g. parking lots), degraded building, or commercial areas directly on the shore. Data collected were processed into a point scale and scores were given to 98 locations around Lake Tabacarie. The scores created by the application of this methodology can be utilized as indicators of the integrated environmental health and human activity. Furthermore, it can help inform and monitor sustainable development around Lake Tabacarie.

Keywords: sustainable development, Tabacarie lake, functional zones, shoreline development index;

Introduction

An interdisciplinary study was undertaken to develop a framework for integrated sustainable development for the Lake Tabacarie area, Constatana Romania. The first step of this study was to define the spatial characteristics of the built and natural environmental features, in an attempt to define "functional zones" that could serve as a basis for creating a systems-based model for studies of social, environmental, and economic factors.

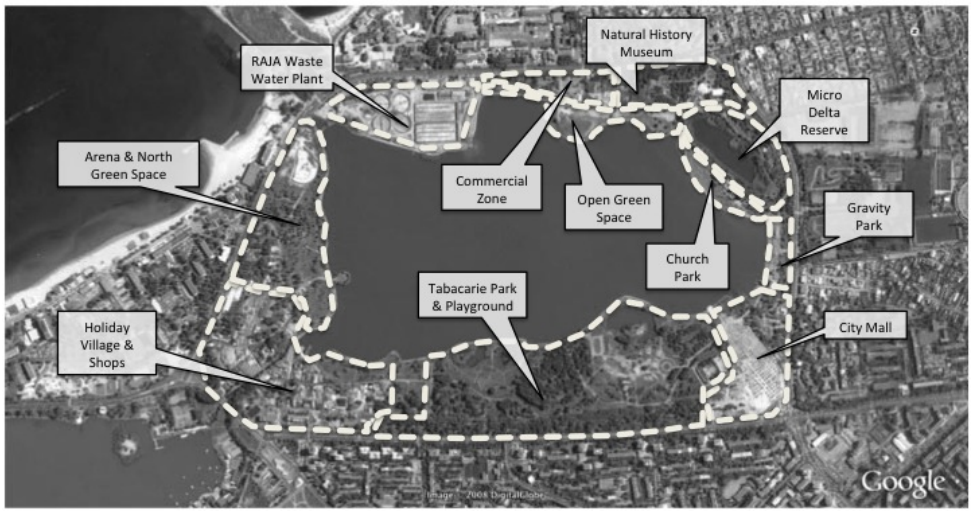
Based upon examination of satellite orthophotos, the area around the lake was divided into different land cover zones and the human activities within these zones were described (Figure 1). This formed the basis for eleven "functional zones", including the (1) Holiday Village, Luna Park, and Shops, (2) Tabacarie Park and Playground, (3) City Park Mall, (4) Activity Park, (5) St. Mina Church Area, (6) Micro Delta Reserve, (7) The Natural Science Park, (8) Open Green Space, (9) Commercial Area, (10) North Water Treatment Plant, and (11) Arena and North Green Space.

Human actions on land affect the shoreline, which in turn affects the aquatic zone. This is an issue of connectivity. Connectivity assumes the union of smaller parts. The functional zones are connected by the Lake Tăbăcărie shoreline.

The purpose of the study described in this paper is to develop a multi-metric index to gather the data needed to quantify and understand the relationships between human activities on the shoreline and the ecological integrity of the lake. This shoreline index provides a methodology to rapidly assess components of the

ecological integrity along the shoreline and visualize the spatial relationships as part of indentifying and monitoring sustainable development opportunities.

Figure 1: Functional Zones for Tabacarie Lake



Material and Methods

A visual survey was conducted to gather information for 98 locations around Tabacarie Lake. At each location, data were evaluated for an area 10m by 10m square at each survey point.

Five components of the Shoreline Development Index were considered: the *Aquatic Zone*, the *Shoreline Zone*, the *Riparian Zone*, a *Biotic Component*, and an *Aesthetic Component*. For each sampling point, a transect depth of 5m into the aquatic zone and 10 m into the riparian zone, with a 1m depth from the water edge for shoreline was used at each location. For the aquatic zone, shoreline, and riparian zone, the percent coverage of different vegetation, ground cover and land uses were estimated visually (see example data sheet in Figure 2).

Figure 2: Shoreline Development Index

Lake Name: Micro Delta | Site Number: P31 1 | Latitude: N 44.20567 | Photo Number: 100 0649
Date: 7-5-08 | Site Description: Mouth 1 | Longitude: E 29.64187 | Name: Megan 0648

Aquatic Zone (10m)

Transect Width (m): 10 m
Transect Depth (m): 5 m

Vegetation (%)	% Surface (to equal 100)
Sedges	5
Reeds	0
Floating Vegetation	0
Submergent Vegetation	0
Floating Debris	5
Submerged Debris	0
Litter (Non-organic)	0
Other	90% open water

Shoreline Zone (1 meter from water)

Slope: 50° — Gentle (<10) / Moderate (< 25) / Steep (> 26) / Wall

Ground Cover (%)	% Surface (to equal 100)
Bare Soil	0
Grass	95% L.F. non-woody
Sedge	5%
Reed	0
Shrub	0
Tree	0
Rock	0
Concrete / Wall	0
Other	0

Riparian Zone (10 m)

Ground Cover (%)	% Surface (to equal 100)
Bare Soil	0
Grass	90%
Sedge	0
Reed	0
Shrub	0
Tree	5%
Rock	5%
Concrete / Wall	0
Other	

Land Use (%)	% Surface (to equal 100)
Park / Natural	60%
Cropland	0
Pasture	0
Animal Yard	30%
Parking	0
Road / Trail	0
Trail	10%
Commercial	0
Residential	0
Other	0

NOTES
Buffer width (m): 60 m
Pollution Sources (pipes etc): none; 1 to the South, 1 to the North
Ownership: (Public) / Private / Unknown
1 tree
Willow
canopy 30% cover

The presence of birds, amphibians, and other fauna at each site were noted as either absent, present or many. Aesthetic value was determined by a qualitative assessment of natural landscape and culturally important or aesthetically pleasing built environs visible from the site. The surveys also took note of pollution sources, canopy cover, public vs. private ownership, and the "buffer zone" between lake and manmade surface.

It should be noted that surveys were meant to be a rapid assessment of the locations. One person took consistent notes and filled out the surveys. Pictures of each location were taken from the shore facing land and from the land facing water. GPS was used to accurately identify locations.

Aquatic Component

Data were entered into Microsoft Excel ™, and the statistical distributions of the different variables were examined.

Variables that were considered to contribute positively to ecological integrity were assigned positive scores and summed to generatate a "good" score. Variables those that were considered to subtract from ecological integrity were given negative scores and summed to create a "bad" score.

The presence of vegetation was considered as something that added value to the aquatic zone. The types of vegetation that were present included, reeds, sedges, submerged and floating vegetation. The aquatic good score was determined by adding percent of reeds, sedges, submerged vegetation and floating vegetation, and was given the variable name "AqGoodScr". Equation 1 shows how the variables where added:

Equation 1: AqGoodScr = PercReed + PercSedge + PercSubVeg + PercFloatVeg, where

AqGoodScr = good score for the aquatic component,
PercReed = percent of reed,
PercSedge = percent of sedge,
PercSubVeg = percent of submerged vegetation,
PercFloatVeg = percent of floating vegetation.

Based upon the total AqGoodScr, a point value between 0 and 15 was assigned. Table 1 shows the scores once all the good variables were added and the point values that were given to each range of scores. The variables that were considered good received the highest scores.

Table 1: Aquatic Good Scores

AqGoodScr (Total)	Points Given
0-5	0
5-20	3
20-40	6
40-60	9
60-80	12
80-100	15

Negative variables were determined to be the categories of percent litter and percent other. The percent other category usually consisted of algae and brown foam and thus was determined to be a negative variable. The equation given to the bad score of the aquatic zone was named "AqBadScore." Equation 2 shows how the variables were added.

Equation 2: AqBadScr = PercLitter + PercOther, where

AqBadScr = aquatic bad score,
PercLitter = percent of litter,
PercOther = percent of other.

Table 2 shows the scores once all the bad variables were added and the point values that were given for each range of scores. Low scores were given the most points as they signified the absence of bad variables.

Table 2: Aquatic Bad Scores

AqBadScr (total)	Points Given
0-5	5
5-20	3
20-40	2
40-100	0

Once the points were given for each site, the total aquatic score was found at each site. Equation 3 represents the total equation score. The most points a site could have were 20 points.

Equation 3: AqTOTscr = AqGoodScr + AqBadScr, where

AqTOTscr = aquatic total score,
AqGoodScr = aquatic good score,
AgBadScr = aquatic bad score.

Shoreline Component

After all of the data was inputted into excel, each of the different variables was assessed as a positive or negative aspect of the shoreline. The percentage of reeds, sedges, grass, and trees were determined to be positive, or "good" variables, and were added up as the "SLGoodScr":

Equation 4: SLGoodScore = %reed + %sedge + %grass + %tree, where

SLGoodScore – good score for shoreline component.

Table 3 shows the scores once all the good variables were added and the point values that were given to each range of scores. The variables that were considered good received the highest scores, and those who did not scored good, were given the lower scores.

Table 3: Shoreline Good Scores

Added Good Scores	Points Given
0-10	0
10-20	2
20-40	4
40-60	6
60-80	8
80-100	10

The percentage of litter, wall and rock on the shoreline was determined to be negative or "bad" variables and were added up as the "SLBadScr":

Equation 5: SLBadScore = %Litter + %Wall + %Rock, where

SLBadScore = bad score for shoreline component.

Table 4 shows the scores once all the bad variables were added and the point values that were given to each range of scores. Absence of bad variables was given the highest scores.

Table 4: Shoreline Bad Scores

SLBadScore	Points Given
0-10	10
10-20	5
20-40	3
40-100	0

The total shoreline score was then decided by adding the points given for the good score and the points given for the bad score. The highest points given could add up to 20. Equation 6 shows the total shoreline score:

Equation 6: SLTOTScr = SLGoodScr + SLBadScr, where

SLTOTScr – total score for shoreline component,
SLGoodScr – good score for shoreline component,
SLBadScr – bad score for shoreline component.

Riparian component

Within the riparian zone, positive variables included percent grass, reed, sedge and shrubs or trees. Equation 7 shows the equation that was used to determine the "RipGoodScr"

Equation 7: RipGoodScr = PercReed + PercSedge + PercShrbTree + PercGrass, where

RipGoodScr = good score for riparian,
PercReed = percent of reed,
PercSedge = percent of sedge,
PercShrbTree = percent of shrubs and trees,
PercGrass = percent of grass.

Table 5 shows the scores once all the good variables were added and the point values that were given to each range of scores. The variables that scored good received the highest scores.

Table 5: Riparian Good Scores

RipGoodScr (total)	Points Given
0-10	0
10-20	2
20-40	4
40-60	6
60-80	8
80-100	10

Negative variables were determined as percent concrete, bare soil, and other. The other variable was usually found to be litter. Equation 8 shows the equation that was used to find the "RipBadScr."

Equation 8: RipBadScr = PercConcrete + PercBareSoil + PercOther, where

RipBadScr = bad sore for riparian component,
PercConcrete = percent of concrete,
PercBareSoil = percent of bare soil,
PercOthere = percent of others.

Table 6 shows the scores once all the bad variables were added and the point values that were given for each range of scores. Low scores were given the most points as they signified the absence of bad variables.

Table 6: Riparian bad scores

RipBadScr (total)	Points Given
0-10	10
10-20	5
20-40	3
40-100	0

The final score for each site was decided by adding the RipGoodScr and RipBadScr variables. The highest score for each site was 20.

Equation 8: RipTOTScr = RipGoodScr + RipBadScr, where

RipTOTScr = total score for riparian,
RipGoodScr = good score for riparian,
RipBadScr = bad score for riparian.

Biotic Component

The biotic aspect was broken down into two parts. One variable was created for the presence of frogs and another was created for the presence of birds. Both scores had a total of ten points and then could be added to equal 20 total points. Frogs were divided into difference categories. They were either "none", "present" or "many" at a site. Table 7 shows how the points were determined for the presence of frogs.

Table 7: Presence of frogs

Presence of Frogs	Points Given
None	0
Present	5
Many	10

Presence of birds was done in the same way. Birds were either determined to be "none", "present" or "many" at a site. Table 8 shows how the points were determined for the presence of birds.

Table 8: Presence of birds

Presence of Birds	Points Given
None	0
Present	5
Many	10

At each site then the presence of frogs was added with the presence of birds. For each site the highest score could be 20 points. Equation 9 shows how this was done.

Equation 9: BioScr = Frogs + Birds, where

BioScr = score for the biotic component,
Frogs = presence of frogs,
Birds = presence of birds.

Aesthetic Quality Component

The aesthetic quality section was broken down into three sections of what could be seen in the viewscape. These sections included natural beauty, aesthetically pleasing built areas, and aesthetically unpleasing built areas. The natural viewscape was given a total of ten points. Likewise, the aesthetically pleasing built areas were also given a total of ten points. The unpleasing built areas had a total of five points that could be taken away from the total score. Once each of these scores was determined in each function zone the scores were added or subtracted. Equation 10 was used to determine the final aesthetic score.

Equation 10: AestScr = Natural + PleasingBuilt – UnpleasingBuilt, where

AestScr = score for the aesthetic component,
Natural = presence of natural features,
PleasingBuilt = pleasing built environment,
UnpleasingBuilt = unpleasing built environment.

This equation was then used to give each functional zone a score based on the view that could be seen within that zone.

Total Score At Each Site

After all five of the components were assessed and given points, they were then added together to make an overall score at each site. Equation 11 shows everything that was added to make the final overall score.

Equation 11: TotalSDIScr = AqTOTScr + SLTOTScr + RipTotScr + BioScr + AestScr, where

TotalSDIScr = total Shoreline Development Index score,
AqTOTScr = total score for the aquatic component,
SLTOTScr = total score for the shoreline component,
RipTotScr = total score for the riparian component,
BioScr = total score for the biotic component,
AestScr = total score for the aesthetic component.

Table 9: Total SDI Score

Total SDI Score	Value
0-20	Poor
20-40	Average
40-60	Good
60-80	Very Good
80-100	Excellent

Each of the five components was added to make up the total score at each site. Table 9 shows how the scores were then interpreted.

Results and Discussions

The index results show the connectivity of the riparian zone to the shoreline zone, to the actual aquatic zone. Human activity and its effect on the lake can be quantified, and relations can be understood. Connectivity assumes the union of smaller parts. The smaller parts in this case are the functional use zones around the lake. The functional zones with all of their different uses have the lake as their common connection.

When the scores were given to 98 locations around Lake Tabacarie and the Microdelta at the Dolphinarium the results showed most sites to be average, followed by a high amount of poor scoring sites (Fig 3 and 4). Excellent and very good sites were found at the Microdelta and the bay in Tabacarie Park. The high occurrence of reeds along the shoreline and in the aquatic zones in these areas correlated with higher amounts of fauna. Shoreline comprised of concrete wall was an occurrence at a great number of sites and affected the scores negatively.

The Bay and the Microdelta from the Dolphinarium scored excellent, while most of the sites varied between poor and average.

The Microdelta at the Delphinarium scored “very good” and has the potential to be a model for the revitalization of aquatic, shoreline, and riparian zones on Lake Tabacarie.

Fig. 3 Total Shoreline Development Index Scores

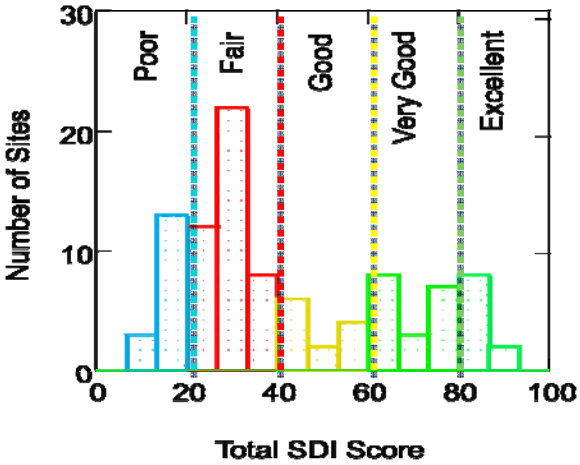
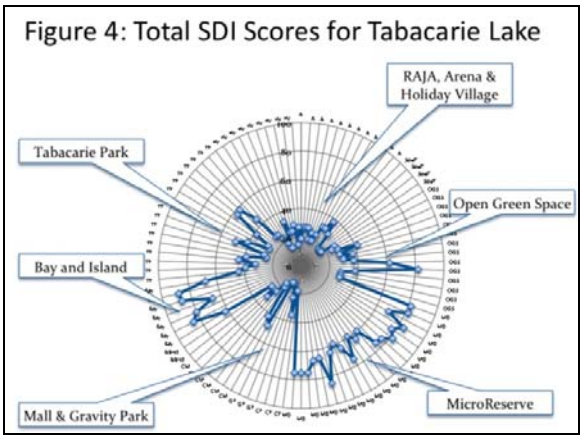


Fig. 4: Distribution of Shoreline Scores around Tabacarie Lake



Amphibian and avian numbers were highest in the Microdelta and a correlation was found between their numbers and a heavily vegetated shoreline.

The zone that scored "excellent" the most was the Bay in Tabacarie Park. Generally high percentages of reed and vegetation with low levels of built environment generated an example of a potentially healthy area of the lake system.

Conclusions

There is a growing need to monitor and evaluate the impacts of development on lake ecosystems (Roan et al 2006, Jennings et al 2003) and to develop indicators that include biotic and abiotic aspects related to sustainable development in and around coastal zones (Butler and deMaynadier 2008, Jackson 2002). It is the interaction among the physical and biological components that contributes to the healthy functioning of ecosystems impacted by human activity.

The index presented in this paper provides a rapid method for characterizing the physical and biological features of the shorelines of urban lakes that are related to sustainable development. The impacts of development in the Tabacarie Lake system are growing rapidly. As such, the need to identify areas for preservation and restoration is great. The index presented here can serve as a method for both monitoring impacts and for planning future developments to improve the functioning of the lake system.

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FIVE YEARS OF ACTIVITY CONCERNING THE EDUCATION OF THE COASTAL LANDS PROTECTION

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Abstract: The coastal lands constitute an ecological balance of the actions and retroactions from flora, fauna and climate. For this reason, it is imperative their sensible conservation and capitalisation. Its constitute the living environment for numerous animals and plants species. But, always, the man has intervened in their balance with the negativest results. In conservation preoccupation of coastal ecosystems, its frames the theoretical and practical activities carried on in the line of pupils by *G.C.E.E.M*. during 2003 – 2008, two. The major purpose was the development of conscience of young generation concerning the importants of the coastal lands in sustenable maintenance. The present paper point events went by the time of the Wetlands World Day, of the Water World Day, of the Earth Day, of the Black Sea International Day and of during the springs and the summers.

Keywords*:* pupils, ecological education, coastal lands

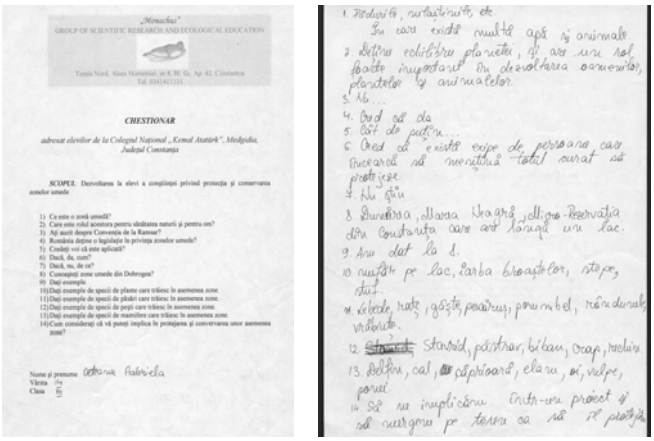
Introduction

The projects adressed to pre – school children, middle school pupils (with age between 11 – 14 years) and high school pupils (with age between 15 – 18 years) and students, too.

The purposes of projects was the development of concience of childrens concerning the protection and conservation of coastal lands through: a) the pupils verification concerning their knowledges about coastal lands; b) the delivering of conferences; c) the lectured on coastal lands; d) the maked of trips in various coastal lands from Constantza County; d) the carrying on by pictures, drawings and grapfic arts competitions; e) the drawing up, the printing and the distribution of instructive teaching aids; f) the seeing of documentary films; h) the acting of sketchs (Corneanu et al. 2005).

Results and Discussions

The pupils verification. The pupils answers showed that they owned some knowledge about nature. But, they wish to know more about that and they will mixed up in projects concerning the knowledge, the protection and the rehabilitating of it (figure 1).



CHESTIONAR

adresat elevilor de la Colegiul Național „Kemal Atatürk", Medgidia, Județul Constanța

SCOPUL. Derularea la elevi a conștiinței privind protecția și conservarea zonelor umede

1) Ce este o zonă umedă?
2) Care este rolul acestora pentru sănătatea naturii și pentru om?
3) Ați auzit despre Convenția de la Ramsar?
4) România deține o legislație în privința zonelor umede?
5) Credeți voi că este aplicată?
6) Dacă, da, cum?
7) Dacă, nu, de ce?
8) Concepeți zone umede din Dobrogea?
9) Dați exemple
10)Dați exemple de specii de plante care trăiesc în asemenea zone
11)Dați exemple de specii de păsări care trăiesc în asemenea zone.
12)Dați exemple de specii de pești care trăiesc în asemenea zone.
13)Dați exemple de specii de mamifere care trăiesc în asemenea zone
14)Cum considerați că vă puteți implica în protejarea și conservarea unor asemenea zone?

Nume și prenume Octavian Gabriela
Vârsta 14
Clasa 8

Fig. 1 - The pupils verification

The delivering of conferences. The participation in great number of pupils at conferences organized for they it showed their interest in theoretical and practical problems of nature in general and specially of coastal zone. The lectures were maked by specialists and pupils. The pupils papers showed that they major preoccupations are: the dolphins of Black Sea, the effects os pollution and the erosion of coastal zones, the algae from romanian littoral of Black Sea and their importance in human food, legislation, the history of scientific researchs concerning coastal lands, etc. The pupils met mans of science, they knowed their preoccupations and science problems from nowadays (figure 2).

Fig. 2 - The delivering of conferences

The lectured on coastal lands. In other stage, the pupils participated to lectures on coastal lands. They learned: what is a coastal land and how its take form; the species which habits in such places, their adaptations at environment as well these threats and the protection measures that its will taked; the international and national legislation with reference from these and their application; theit statute. The lectures ended with pupils questions showing their interes about nature (figure 3).

The maked of trips. With such stock of knowledge concerning coastal lands, the childrens participated to study trips in various protected and other coastal lands from Constantza County (figure 3). The pupils received binoculars, cameras, cases for the measurement of physical and chemical parameters, botanical cases, etc. They achieved observations concerning the phenomenons which happened in these zones. They learned to collect and to determine plants and animals species from respective zones. They learned to make herbariums, insect collections and the others, too. Finally, they understood the species adaptations at such environments (Axini, Bercu, 2006).

Fig. 3 – The maked lessons and trips

The carrying on by pictures competitions. Its carryed on competitions of pictures, drawings and grapfic arts. The participations were many middle school pupils from Constantza County schools and pre – school childrens from two nursery schools in Constantza Town.

The drawing up of instructive teaching aids. In same projects, the pupils received teaching aids concerning the coastal lands: posters, leaflets, booklets, etc. In others projects, the pupils distributed the leaflets with coastal lands informations (figure 4).

Fig. 4 - The drawing up of instructive teaching aids

The seeing of documentary films. The pupils saw documentary films concerning wild life from coastal places, the dolphins and 2 Mai – Vama Veche Submarine Reservation.

The acting of sketchs. The last years, it was written and it staged a little play. The sketch was acted by middle school pupils from „Kemal Atatürk" National High School.

The granting of diplomae and prizes of participant pupils in projests. For the implication in conferences, we granted an number of: 5 excellent prizes, 7 prizes I, 6 prizes II, 6 „The Seal of Black Sea" Prizes, 7 „The Dolphin of Sea" Prizes (see table 1). For participation to the competitions of pictures, drawings and grapfic arts, we granted an number of: 4 excellent prizes, 3 prizes I, 5 prizes II, 4 prizes III, 2 mentions and 5 „Lirica Mării" Prizes (see table 2). The great number of diplomae and prizes shows the passion of the pupils and their wish for the knowledge and the protection od nature, of coastal lands in particular. In general, the diplomae maked and financed by G.C.E.E.M. We gives prizes than: popularity science books, atlases, posters, leaflets, instructive teaching aids concerning biology and ecology of coastal lands.

Table 1. Diplomae gave the pupils for the active participation to conferences

THE PRIZE	NUMBER OF PRIZES		NUMBER OF PUPILS		NUMBER OF PAPERS	
	Middle School	High School	Middle School	High School	Middle School	High School
The Excellent Prize	2	4	2	13	2	3

The Prize I	5	2	5	2	5	4
The Prize II	5	1	5	1	5	1
„The Seal of Black Sea ” Prize	-	6	-	15	-	6
„The Dolphin of Sea " Prize	4	7	4	10	5	2
TOTAL	**16**	**20**	**16**	**41**	**17**	**16**

Table 2. Diplomae gave the pupils for the active participation to pictures, drawings and grapfic arts competitions

THE PRIZE	NUMBER OF PRIZES		NUMBER OF PUPILS		NUMBER OF PAPERS	
	Middle School	Middle School	Middle School	High School	Middle School	High School
The Excellent Prize	4	-	4	-	4	-
The Prize I	3	-	3	-	3	-
The Prize II	5	-	5	-	5	-
The Prize III	4	-	4	-	4	-
The „Lirica Marii” Prize	5	-	9	-	5	-
Mention	2	-	2	-	2	-
TOTAL	**23**	**-**	**27**	-	23	-

The Foundation of J.T.R. Group

In 2007, was born the group of Junior Terrestrial Rangers (J.T.R.), formed by middle school pupils with age between 11 – 15 years. This group is composed by one leader, one spokesman, one environmental reporter and group members. Their mission is the study and the protection of reserves, in general, of nature from Dobrudja by lands studies, conversations with public and the distribution of teaching aids concerning nature informations, etc.

Future views

Such projects, in special those with practic parts, were a success. All this, its advises us to change them into programs which we are going to develop years by years. The direct beneficiaries will be pupils from others school institutes from Constantza County.

In future, we are going to be more pupils in J.T.R. group, to expand their action area and to achieve by experience changes with similar groups both in our country and others.

Some of high school pupils will be include in research projects and they even will be to a scientific profession.

Collaborations

In all this projects, we colaborated with:

1) Faculty of Natural Sciences and Agricultural Sciences – Ph. D., Associate Professor Marius Skolka;

2) Agency of Environment Protection, Constanta – advisers Zoica Călătoiu, Mihaela Condur, Marcela Popovici;

3) National Institut For Marine Research And Development „Grigore Antipa”, Constantza, Romania – strategy – cooperation manager, Ph. D. Nicolae Papadopol, biologist Maria Moldoveanu, engineer Ph. D. Laura Alexandrov, engineer Ph. D. Tania Zaharia and others;

4) Museal Complex of Natural Sciences – general manager Decebal Făgădău, biologist Ph. D. Elena Şerbănescu, biologist Adela Bologa;

5) The national Administration „Romanian Waters" „Dobrogea – Litoral" „Waters Directorate – office leader Josefina Lipan;

6) The Romanian Naval League, Constantza Subsidiary – biologists Ph. D. Ioan and Florica Porumb, contra-admiral George Petre;

7) Consulate General of the Republic of Turkey, Constantza – general consul Haluk Ağca

as well with school institutes from Constatza County:

1) „Dimitrie Cantemir" Middle School, Constantza – headmaster, teacher of history Teodora Maria Muşat, teacher of chemistry Marina Marinescu, teacher of geography Neriman Asan, teacher of drawing Bogdan Ionuț Ene, teacher of technological education Violeta Cojocaru;

2) „Decebal" Theoretic High School, Constantza – teacher of biology Romica Milea,

3) „George Călinescu" Theoretic High School, Constatza – teacher of drawing Bogdan Ionuț Ene;

4) „Omnia" High School, Constantza – teacher Ph. D. Carmen Atanasiu;

5) „George Emil Palade" School Group, Constantza;

6) O.N. Nursery School no. 51, Constantza – headmaster Doina Albu;

7) Middle School, Crucea – teacher of Romanian language and literature Carmen Maria Dumitrescu;

8) „Nicolae Bălcescu" Theoretic High School, Medgidia – teachers of geography Anca Elena Bălaşa and Şeila Selim;

9) „Kemal Atatürk" National College, Medgidia - teacher of geography Şeila Selim, teacher of drawing Iuliana Neacşu, schoolmaster Eugenia Ungureanu and

10) „Spiru Haret" Middle School, Medgidia – teacher of biology Felicia Simion, teacher of drawing plastică Iuliana Neacșu;

11) „Lazăr Edeleanu" School Group, Năvodari – teacher of biology Corina Tudoraş and Middle School no. 3, Năvodari.

Conclusions

The participation of pupils at theoretical and practical activities of these projects show their interest in nature and costal lands, too. They wish to participate at various projects and programes concerning the study, the research and the reconstruction of such zones.

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FORMS AND METHODS OF ECOLOGICAL EDUCATION AND UPBRINGING

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Abstract: The paper deals with aspects of ecological education accomplished through a collaboration among schools and some NGOs from the Dobrich district. This collaboration is materialized through different activities with the pupils: excursions to get acquainted to the biodiversity, participation to cleaning and reforestation campaigns, information campaigns and activities for the dissemination of the information regarding the protection of the environment, biodiversity monitoring activities (especially birds), exhibitions with topics related to biodiversity, etc.

Keywords: ecological education, environment, information campaigns, Dobrich district.

Introduction

Due to the over-loaded curriculum, the responsibilities of Ecological education and sustainable development are put on the extracurricular activities. They enable reassertion of already acquired knowledge in the field of Ecological studies and create possibilities for the students to participate, in practice, in preservation and restoration of the Environment.

Young people should be actively engaged in social activities and should be a part of what is happening in their Municipality and the whole region. This expresses their willingness to live together in clean streets, clean neighborhoods and to have a word on the social changes. Social integration of the young will help them cope with the negative trends of our time, such as self-isolation, anonymity, lack of motivation.

Materials and Methods

The system of extracurricular work includes components which are divided into two groups:

Group 1. Principles, methods, means, stimulus, material, technological and financial provision of the activities within the system. The first three of the stated components are known from Pedagogy but are adapted to the goals of Ecological education and sustainable development. The rest of the components are developed in our school according to the given conditions.

Group 2. Forms of work for educating in Ecological and sustainable development concern. The optional course called Ecology and Health works twice a week on an approved curriculum including theoretical and practical activities.

The curriculum dwells on the following modules:

1. Black Sea- charm and magic
2. Humid Areas- a laboratory under the open sky
3. Water- the spring of life
4. Love and concern for the Environment
5. Planet Earth- our home

The goal of the program is not merely acquiring certain knowledge but also:

- to prompt students to value more the Environment in which they live and study;
- to understand the importance of every person in finding solutions for ecological problems;
- to present positive and healthy ways of living;
- to develop a sense of personal responsibility;
- to demonstrate the idea of public engagement;
- to set up an adequate behavior and interest in research and exploratory activities.

The activities planned for the realization of the themes include excursions; meetings with representatives of Biodiversity Foundation , Bulgarian Association for Birds Preservation, lectors from the University of Shumen, Association for Ecology and Sustainable Development-Getia Pontika; forestation and cleaning campaigns; informational, propaganda and preservative work.

With this eco district been created, the ideas of the optional course become popular, papers and research themes are written. The young environmentalists take part in eco competitions, quizzes, contests on ecological themes, etc.

Ecopulse Club is a constant extracurricular form which tackles environmental issues and sustainable development. It was founded on 4 October 2000. Its members vary from 5^{th} till 8^{th} grade students with special interest in Natural sciences, all enthusiastic environmentalists.

By using different methods and forms of education, students have the opportunity to be active in studying the ecological peculiarities, cultural and historic heritage of Black Sea Dobrudja as well as other regions of our country. Symbols of the club are *Branta ruficollis* and cape Chirakman. The activities of Ecopulse are of both permanent and temporary character but always related to significant dates like:

29 December- International Day of Preserving the Ecological Diversity

22 March- International Day of the Water

22 April- International Day of the Earth

5 June- International Day of Preserving the Environment

The club is open for new members and every student who is concerned about the future of our planet is welcomed. The group of members is flexible and its members may depend on the discussed issues, the interests and abilities.

The program of the club is realized through interactive education and modern forms and methods of work with a practical orientation- "brain attack", debate, discussion. The curriculum is based on the knowledge, the skills and the attitude of the students in the different cultural-educational areas. The Environment is considered in its unity and wholeness with emphasis on the three spheres of interaction- natural, social and technological, and on the global challenges of our time. This type of education directs students towards the answers of the questions: "What needs to be done?", "How does it need to be done?", "Why does it need to be done?", "What is my personal role and responsibility?". The curriculum provide conditions for maximum number of students to be active participants in practical activities concerning preservation and restoration of the Environment In this way, they build up motivation and responsible attitude towards current and possible problems on a regional and national scale.

The activities of a temporary character might be eco lecture, excursion, expedition, eco camp, informational and propaganda campaign, preservation activity, working on projects, presentations and conferences.

Eco lecture - the themes are logically connected with important dates for the green-minded activists (i.e. 16 September- International Day of Ozone Layer Preservation; 3 October- International Day of Birds; First week of April- The Week of Forests; 15 May- International Day of the Climate; 29 August- the European Night of the Bat, etc.) These dates are good occasion for meetings with specialists and scientists in various fields of knowledge. Guests of Ecopulse Club have been representatives of Bulgarian Association for Birds Preservation, of Group for Studies and Preservation of Bats, ornithologists from Association for Preservation of Humid Areas- Claverock, Scotland. Our students were given the chance to see latest presentations on Birds diversity, on Bulgarian *ichthyofauna*, on the biological specifics of *Branta Leucopsis*.

Informational and propaganda campaign - it aims raising the ecological consciousness of students, parents, society. With the help of the Board of Trustees of our school, we published flyers of the Youngsters section of Bulgarian Association for Birds Preservation in school, calendars, posters, etc. For the purposes of the Informational and propaganda campaign, we set up a special "eco nook" in the school.

Preservation activity - it is oriented towards conservation and reproduction of the Environment Serving these goals, many organized campaigns take place: cleaning the seaside area, around the Turkish bath in Kavarna, which is presently a museum, the pedestrian lane to the seaside; forestation; making and placing rags

and bird feed-boxes, etc. Our students take part in such activities with consciously and with a great sense of responsibility. This fact proves that, as a result of the Ecological education, the long way of transition Knowledge of the Environment- Attitude towards the Environment- Behavior is accomplished.

Technological and financial provision is a crucial factor for the efficiency of the Ecological education and sustainable development. With this regard, we carry out projects that are often sponsored by the Board of Trustees, the Regional Inspection of Preservation and Control of Public Health- Dobrich, the Association of Ecology and Sustainable Development- Detia Pontika, parents.

Eco excursions - they contribute to the connection between the theoretical knowledge acquired from the optional Ecology course and the real natural conditions. Student may have first-hand experience with preserved species when visiting: the lakes in Shabla and Durankulak, cape Kaliakra, the Preserved area of Bolata, Yailata National Archaeological Reserve, Reserve Srebarna, Poda Preserved Natural Center, Atanasovsko Lake close to Burgas, etc.

Eco camps - they give students the chance of long-term direct communication with Nature which helps perceiving it fully will all senses. Eco camps are organized after the end of the school year in different bases. The schedule of an Eco camp consists of theoretical studies (lectures, discourses), practical activities with ecological character and time for brakes. Eco camps could be combined with visits to museums, historic monuments, exhibitions, caves and other places of interest in the certain area.

Project work - it teaches students to work in a team, to form complex knowledge based on various informational resources, to gather rich practical experience. Students' active presence in the Monitoring of the regular bird species was materialized in the project International Ecology Forum Srebarna 2006. Their efforts were rewarded with First price for young participants.

The last challenge before the students from 4th grade of Yordan Yovkov Primary School is the National students competition named The Project of Our Class for a Life without Cigarette Smoke. We take part in the Smoking Prevention section with the project I Do Not Smoke and I am Independent. On 4 November 2008 we founded a Club of the non-smoker called I Do Not Smoke and I Want the Others to Know It! The activities in the club will be competitions, lectures, presentations, speaking on radio shows, conferences, etc.

Our students could compare their progress and awareness of environmental issues with their peers on the following forums: Fifth National Competition in Natural Sciences and Ecology- Dobrich; National Contest "Water- the spring of life"- Burgas: final stage of the National Olympiad of ornithology. Our students were deeply touched and inspired by the example of the Peace Corps volunteers from USA and France whom they met.

They also talked to scouts from Varna and Sofia who taught them how to train their endurance, how to put a tent together, how to set fire and to orientate in the wild nature.

Results and Discussions

It has become a tradition in our school to celebrate 22 April- International Day of the Earth with an exhibition of the biological diversity of Bulgaria. Thus the intertextual connection between Biology, Geography, History, Literature and Art is justified. The purpose of the exhibition is to form a modern notion of the world and to imply the necessity of preserving the ecological balance and the rational use of Nature's wealth. Its educational idea is to make students aware of at least a part of the valuable resources of Planet Earth, of the diversity of species and, as a result, to recruit new members.

On the exhibition in question, abundance of items was presented: 20 paintings; photos; collections of *Mollusca*; research papers on *Galanthus nivalis* and *Centaurium erythraea* as well as on the theme Peoples Actions in Preserving the Endangered Plants; descriptions of favorite sea and river creatures; of favorite flower; essays on the themes Problems In the Environment I Live In, Is Life Possible on Earth without Photosynthesis?

After studying about Magnoliopsida and Liliopsida in the regular Biology classes for 7th grade, the optional course continues the theme by gathering and organizing herbarium. Now our collection consists of: *Rosaceae- Rubus idaeus, Rosa canina, Agrimonia eupatoria, Cydonia oblonga; Asteraceae- Bellis perennis, Achillea millefolium, Matricaria chamomilla, Cirsium arvense, Ranunculaceae- Consolida regalis, Clematis*

vitalba; Ranunculus repens, Ficaria verna, Aquilegia vulgaris; Liliaceae- Convallaria majalis, Asparagus officinalis; Poaceae- Poa pratensis, Cynodon dactylon, Setaria glauca.

Consistent observations lead to the students' ability of unmistakably identifying the following bird species: *Phalacrocoeax carbo, Fulica atra, Larus cachinnans, Motacilla cinerea, Alcedo atthis, Corvus monedula, Dendrocopos syriacus, Oriolus orilus, Carduelis chloris, Merops apiaster, Melanocorypha calandra, Carduelis carduelis, Hirundo rustica*.

Conclusions

Working with children is a responsibility as well as a motivation. Not once have they provoked me with their own ideas resulting from their touch with books, with popular science films, with Internet. It is of great importance to have these ideas in mind and to impress on young people that the future of our planet depends on our current behavior.

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