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Faculty of Natural Sciences and Health Care

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„Vegetation of Central and South Kolkheti lowland coast dunes and freshwater ponds, conservation and wise use"

(presented for gaining academic degree of PhD of Biology)

Specialty: **Bio diversity**

Annotation

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Batumi-2017

PhD thesis was done at the Batumi Shota Rustaveli State University Department of Biology

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Introduction

Actuality of the issue: Research of Kolkheti province's biodiversity in separate districts has long history of study, but there is still unequally studied its separate biomes and habitats, flora and plants. In this context, till latest period it was almost unstudied and there was not exact database of Kolkheti coast dunes and freshwater puddle's flora cover which is distinguished with high sensitivity among habitats of Georgia. These both habitats represent emerald network and habitats to be protected by the European Union Information System.

According to the EUNIS classification, there is first attempt to reveal habitats of Georgia and freshwater puddles and sandy dunes which are protected by directive. From this point of view, results of dissertation have significant value.

In the frames of dissertation work, for the first time there was made database of emerald network habitats-about cover of freshwater puddle and sandy dune. There was established area of these habitats. Also there was revealed species of Kolkheti lowland and freshwater ponds that are in danger, there were established communities and species that were given corresponding IUCN categories and criteria.

Aim and tasks of the research: Basic aim of the dissertation theme's research is study of habitat's sandy dunes and freshwater puddles flora, conservation and rational usage which are spread in the Central and South Kolkheti Black Sea coastline.

Following tasks should be done for the fulfillment of the given aim:

- collection of the literature about dissertation work;

- definition of exact spreading location of endemic and relict, species of emerald network and composition of maps with Arc-view 10 program;

- study of anthropogenic impact (cutting of forest, grazing of cattle, fire);

- reveal of invasive species;

- establishment of floral grouping according to the PC ord program, reveal of the species that are in danger and establishment of conservative status according to the IUCN criteria and categories;

- recommendations for awarding conservative status to the habitats with special biodiversity existing outside the protected area.

Scientific novelty of the work: For the first time in Georgia was created database about habitats of emerald network-freshwater puddles and sandy dune's floral cover. Area of these habitats was established.

-There were revealed species of Kolkheti lowland dune's and freshwater puddle that are in danger, there were established communities and species to which were given IUCN categories and criteria.

There were prepared recommendations for freshwater puddle and dune's habitats and species *ex-situ & in-situ* for conservation and rational usage, which was sent to the corresponding organs.

Theoretical and practical value of the work: Theoretical value of the work is expressed in the following:

- from 2015 year Meditterenian seacoast freshwater puddles-emerald network, Natura 2000 and species are protected by Bern Convention, they are: *Ceratophyllum demersum, Potamogeton natans,Marsilea quadrifolia, Salvinia natans, Utricularia minor* – IUCN Red List awarded global status, as habitat being under vulnerable;

- results of the work were included in the document "Emerald network's habitats in Georgia".

- results of the work were reflected in the European Union EUNIS habitat's list.

Results of the work research has special meaning in the direction of Natural Sciences and in the educational process of students.

Work has also practical value as: conservation of biodiversity (habitats and species), wise use, development of conscious about environment protection and development of eco tourism.

Object of the research: Object for research is Natura 2000, species and habitats of emerald network and protected under Bern Convention- sandy dunes of Kolkheti lowland coastline and freshwater puddle from Sarphi to Anaklia.

Method of research: Basic research means:

- description and reveal of the species on the object for research;
- study of habitats and floral cover density according to the DAFOR - method; where: D dominant kind, A-dense, F-massive, O-several and R-rare. Name of the given habitat comes from the dominant species.

- (relevee) method of the description of the plants, which includes relief, squares (Domin –Krajina method). During the research special attention is paid to the type of location, its ecological state, floral cover (in %), composition of species and their multitude, ability of living of separate species.

Material of research of the floral species is volumes of Georgia's flora: I-XVII. a. Dmitrieva's "Key of flora of Ajara"-volumes 1&2. According to the modern classification of the kinds of plants, for specifying is used: Flora of Helvetiki, over-saturated ferns of Europe, web-sites: www.plant.list and www.ipni.org.

For the description of the species on the field, there was worked out special field form. In this form is noted: cover (%) of the separate species and surface of the soil, evaluation according to the Domini's scale, height, number of tiers, phases of layers, anthropogenic influence, time, weather. Each data was included in the file of excel, which is then necessary for PC ord program, that establishes floral sub-societies and frequency of meeting of these species. After this it is possible to detect rare species and definition of conservative status. Totally is made: 447 square meter in natural freshwater puddles and on the coast dunes 776 square meter. 400 pieces of herbarium is taken. Stationary processing of the taken material was done in Batumi Shota Rustaveli State University's, in Phytopathology and Biodiversity Institute's Kolkheti peat and water eco system's conservation department's "Ecological and Scientific center of Kolkheti over-saturated landscape" and in the administration of Kolkheti National Park.

Approbation of the work: Pre-discussion of the thesis was held on 12th of July, 2017 year, in the Faculty of Natural Sciences and Health Care, department of Biology of BSU.

Results of the research, on which was based work, in different time was mentioned during international meetings and scientific conferences:

- In the administration of Kolkheti National Park-discussion of the plan of Kolkheti National park's managment-2017 year;
- In the administration of Kobuleti protected territories-discussion of the plan of Kobuleti preserve and Kobuleti management-2017 year ;
- International student's conference of Batumi Shota Rustaveli State University, ecology of Black Sea pool-with the presentation "habitats and species of Kolkheti lowland's emerald network". 2015 year, 31 October;

- Ministry of Environment and Natural Resources Protection of Tbilisi, Strasburg Euro Commission Meeting of Emerald Network, 17 November, 2014 year;
- International Scientific Practical Conference dedicated to the 100 anniversary of the foundation of Batumi Botanical Garden, Batumi, 2013 year.

Publications: Around the theme of dissertation is published 11 scientific works.

Volume and structure of the dissertation work: Dissertation includes 164 pages, is composed from 6 chapters, there are included 28 tables, 7 diagrams, 71 pictures, 10 map in the text. Basic text includes 126 pages, conclusions and recommendation, list of bibliography, which is composed from 81 Georgian and foreign sources, enclosure is presented by 41 colored photos.

Material-technical base: Material-technical base of the dissertation work was:

- Kolkheti mire and water eco system conservation department of Batumi Shota Rustaveli State University, Institute of phytopathology and biodiversity;
- Society of protection of wild nature "Tchaobi";
- Ministry of environment and natural resources protection of Georgia, administrations of protected territories agency of Kolkheti National Park and Kobuleti State preserve;
- Warsaw University of Poland-insurance with PC ord program

I. Literature survey

General description of Kolkheti lowland: Caucasus and accordingly Kolkheti is among 36 hotspot of the world that are distinguished with biodiversity and being under danger. Kolkheti is phyto- geographical region: Universe – Ancient Mediterranean coastline;District – Sub Mediterranean Sea; Province - Kolkheti or East Euxinae, Area – Kolkheti lowland and foot-hill (Gagnidze 1996).

Geographical location. Kolkheti lowland (in natural borders) is plan and it is located between Black Sea and branching of great and small Caucasus ridge. In the formation of unique biodiversity of Kolkheti lowland important role played Geological past of Black Seaand special creation-new Black Sea terrace or dune. In the epoch of quaternary ice age Kolkheti presented refugium of species.

Climate: Annual middle temperature of Kolkheti lowland is $14,1^0$; sediments are typical here, its middle indication wavers: in South Kolkheti (Kobuleti) from 2531 mm and in Central Kolkheti (Poti)-to 1457 mm. There is high relative dampness, which annually wavers

from 70% to 83%. Frosts are very rare. All above listed environmental conditions creates unique biodiversity for existence of special habitats and species in Kolkheti.

Emerald Network. Agreement about conservation of emerald network's habitats and species was signed by the Ministry of Environment protection of Georgia in 2007 year. Therefore, country took obligation to protect habitats and species that are listed in this document and exist in wild form, also they should restore them. Object for research of dissertation work-coast dunes and freshwater habitats represent habitats of emerald network of Georgia.

Bern's convention "Protection of the wild nature of Europe and natural habitats" (www. Bern convention). Species discussed in the dissertation work: *Marsilea quadrifolia, Salvinia natans, Typha minima* is protected by the convention of Bern.

Experimental part

2. Natural freshwater ponds

2.1 Global status of natural freshwater ponds

Due to anthropogenic factor degradation of freshwater puddle as well as degradation of important habitats for biodiversity, made scientists of Mediterranean coastline countries, to evaluate natural freshwater puddles by global IUCN Red List, as eco systems being under vulnerable (www.iucnredlist.org). In 2015 year, IUCN Red List officially awarded global status to Mediterranean coastline freshwater puddles.

In the documents of emerald network (Inter Emeraldman_dm) is given definition of natural freshwater puddles, according to which freshwater puddles are deepening of land with greenish and brownish clean water, where pH is 5-6, indicator species of Kolkheti natural freshwater puddles flora are: *Trapa colchica, Salvinia natans, Marsilea quadrifolia, Ceratophyllum demersum,Ceratophyllum submersum, Potamogeton natans.*

2.2. Main criteria of natural freshwater ponds definition:

Criteria 1. Site necessary should present primary habitat of species being under danger or having other conservative status (endemic, relict of Cenozoic epoch) this kind of species of Kolkheti lowland freshwater puddle is *Salvinia natans.*

Criteria 2. Site is known as habitat with unimportant quantity one or more (or infra-specific taxon, as typical) limited quantity of species, as for example-*Marsilea quaadrifolia.*

Criteria 3. Site is important and valuable for the grouping of the species of habitats, which is framed by corresponding bio-geographical, unites as Trapa *colchica.*

2.3. Freshwater ponds with domination of *Marsilea quadrifolia*

The only place of spreading of *Marsilea quadrifolia* is near Tskaltsminda, village Kvavilnari, freshwater ponds near coast dunes.

2.4. Freshwater ponds with domination of *Salvinia natans*. Due to the construction of infrastructural projects of Black Sea of Georgia, area of freshwater ponds with domination of *Salvinia* is reducing little by little. For today on the lowland of Kolkheti puddles with domination of *Salvinia* remained only: on the coastline of Anaklia with little population and with two small ponds, numerous populations are in the river Tsiva. Also in Tchuriani, in the puddles being near road of South side of Khulevi terminal, also few numbers of this population is in freshwaters and canals of Imnati mires.

2.5. Freshwater ponds with domination of *Trapa colchica*. *Trapa colchica* is ancient representative of flora. While studying stratigraphy of peat in fossil layers on the depth of **8**-9 m, was found its fruit that indicated its spread in ancient geological epochs. *Trapa colchica* is indicator of freshwater. Its community is always accompanied by (*Phragmites australis)* and (*Typha angustifolia)*

Natural freshwater ponds with the domination of *Trapa colchica* remain in wild form on the coastline of Kolkheti lowland, on the left side of river Tchorokhi outfall.

Special attention should be paid to *Rhamphicarpa medwedewii,* which is constant, accompanied by Trapa *colchica* and *Marsilea quadrifolia* in natural freshwater puddles of over-saturated habitats. We can meet only 6 kinds of it in the world and all of them are spread in tropical countries (India, South Africa, and Tropical Australia) and only 7th kind is met in Kolkheti.

Flora of Kolkheti freshwater ponds is represented in the following forms (tab.1): with 2 families, 2 genus and 2 species; angiospermae: dicotyledonea- with 6 families, 8 genus and 11 species. Monocotyledonea are presented with 10 families, 21 genus and 33 species. Totally in the freshwater pondss are registered 46 species with 19 families and 28 genus, (Tab. 1).

Tab. 1

Flora of freshwater ponds

	Ferns
	Marsileaceae
1	*Marsilea quadrifolia* L.
	Salviniaceae
2	*Salvinia natans* (L.) All.
	ANGIOSPERMAEDICOTYLEDONEA
	Haloragaceae
3	*Myriophyllum spicatum* L.
4	*M. verticillatum* L.
	Lentibulariaceae
5	*Utricularia vulgaris* L.
	Orobonchaceae
6	*Ramphicarpa medwedewii* Albov.
	Plantaginaceae **Juss.**
7	***Callitriche*** *polustris* L.
8	*C. stagnalis* Scop.
	Ranunculaceae **Juss.**
9	*Ranunculus muricatus* L.
10	*R. sceleratus* L.
	Trapaceae
11	*Trapa colchica* Albov
12	*Trapa maleevii* V.N.Vassil.
	MONOCOTILEDONEAE
	Alismataceae **L.**
13	*Alisma plantago- aquatica* L.
14	*Sagittaria sagittifolia* L.
	Araceae **Juss.**
15	***Acorus*** *calamus* L.
16	***Spirodela*** *polyrrhiza* (L.) Schleid.
	Butomaceae **Mirb.**
17	***Butomus*** *umbellatus* L.
	Ceratophyllaceae
18	***Ceratophyllum*** *demersum* L.

19	***C.*** *submersum* L.
	Cyperaceae **Juss..**
20	***Bulbostylis*** *tenerrima* (Fisch.& C.A.Mey. ex Ledeb.)Palla
21	***Eleocharis*** *palustris* (L.) Roem.&Schult..
22	***Pycreus*** *korshinskyi* (Meinsh.) V.I.Krecz.
23	***Scirpus*** *triqueter* Godr. (*Schoenoplectus litoralis* (Schrad.) Palla)
24	***Schoenoplectus*** *juncoides* (Roxb.) Palla
25	***S.*** *lacustris* (L.) Palla
26	***S.*** *mucronatus* (L.) Palla
27	*S. triqueter* (L.) Palla
28	*S. sylvaticus* L.
	Hydrocharitaceae **Juss.**
29	***Egeria*** *densa* Planch.
30	*Hydrocharis morsus- ranae* L.
	Juncaceae **Juss.**
31	***Juncus*** *lampocarpus* Ehrh. Ex Hoffm. (*Juncus articulatus* L.)
32	***Luzura*** *forsteri* (Smith)DC. *(Juncus forsteri* Smith)
	Poaceae
33	***Calamagrostis*** *arundinacea* (L.) Roth.
34	*C. epigeios* (L.) Roth.
35	***Paspallum*** *paspaloides* (Michx.) Scribn. (*Paspalum distichum* L.)
36	*P. thunbergii* Knth ex Steud.
37	***Phragmites*** *australis* (Cav.) Trin. Ex Steud.
38	***Arundo*** *donax* L.
	PotamogetonaceaeDumort.
39	***Potamogeton*** *filiformis* Pers. (*Stuckenia filiformis* (Pers.) Borner)
40	***P.*** *crispus* L
41	*P.natans* L.
42	*P. pectinatus* (L.) (*Stuckenia pectinata* (L.) Borner
	Thyphaceae
43	***Sparganium*** *neglectum* Beeby *(Sparganium erectum subsp.* neglectum (Beeby) K.Richt)
44	***Typha*** *angustifolia* L.
45	*T. latifolia* L.
46	*T . minima Hoffm. (Typha laxmannii* Lepech.)

3. coast dunes

3.1. Flora and vegetation: coast sandy dunes are met on the coastline of Kolkheti: in Maltakva, (map 1), on the coast of Anaklia few, on the coast of Tchuria, Grigoleti, Ureki, near Tskaltsminda, Ureki, Shekvetili, in Kobuleti, near river Choloki.

Kolkheti Black Sea coast is presented with dune plants floral complex of typical inhabitants of sand, as *Eryngium maritimum*, *Euphorbia peplis, Leymus racemosus* subsp. *sabulosus*, *Ammophila arenaria*, *Crambe maritima.* They create whole dune floral cover of coast, these are: phsamophytes, mesophytes, xerophytes. Primary growth of dunes starts from small-grained non-fixed, moving sandy dune, where dominated crawler and deep-rooted species that are tolerant towards salt, there are - *Convolvulus persicus, Calystegia soldanela, Plantago lanceolata* and so on. Also here you can find perennial herbaceous kinds, as: *Eryngium maritimum, Euphorbia paralias* and coniferous. - *Vitex rotundifolia.* The latest can be met on the border of moving and fixed dunes.

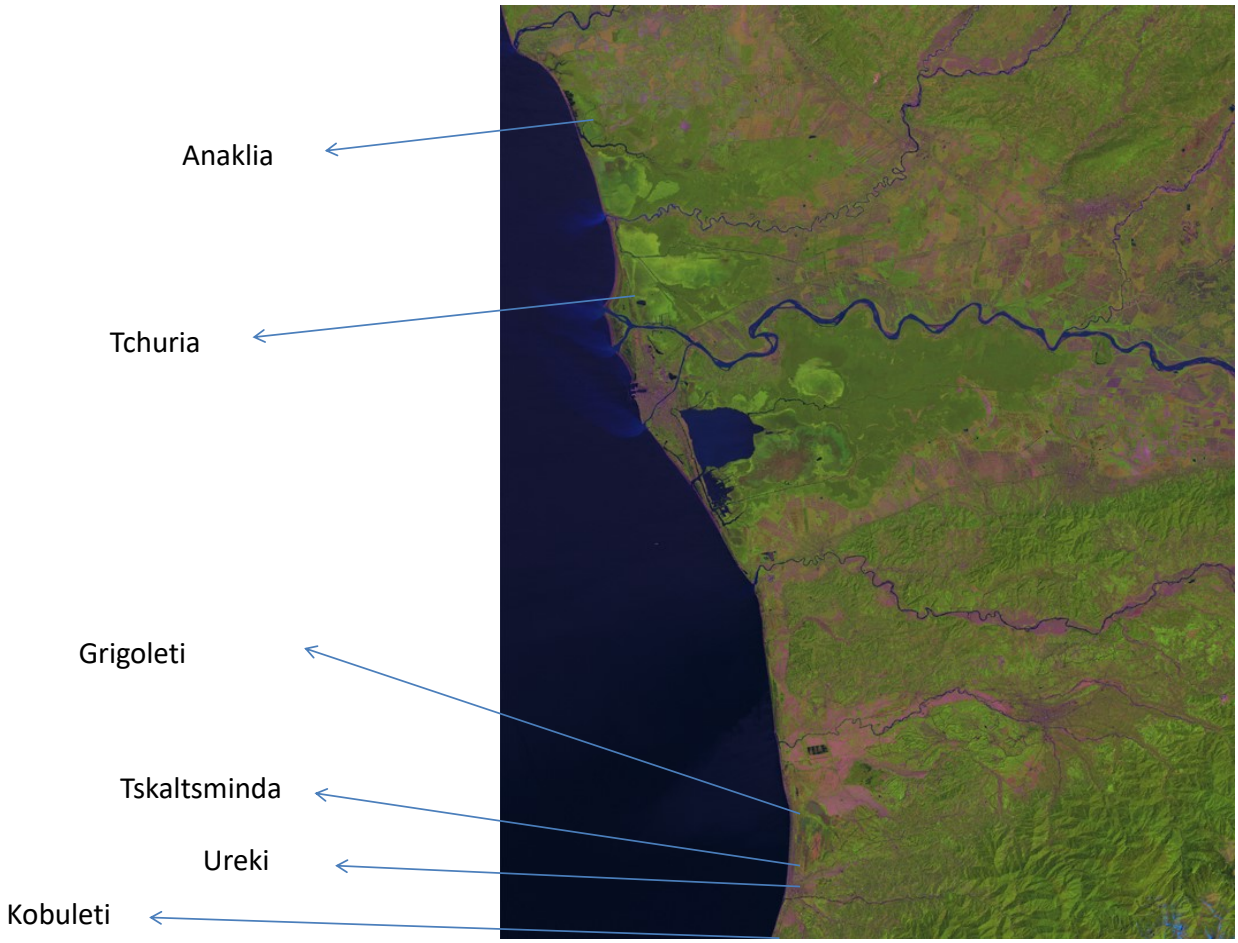
On the Kolkheti coast dune are grown different geographical elements:

- Eurasian as: *Poa bulbosa, Secale sylvestris;*
- Cosmopolitans, as: *Calystegia soldanela;*
- Species of central and South Mediterranean coastline: *Crambe maritima, Elymus farctus, Eryngium maritimum, Carex colchica:*
- Species of Mediterranean Sea: *Stachys maritima, Pancratium maritimum;*
- Elements of Ponto: *Medicago falcata, Silene euxina, Jurinea albicaulis, Festuca arenicola.*

Special kind of Kolkheti coast dune is -*Leymus racemosus* subsp. *sabulosus.* This is transition indicator of phsamophytes between Black Sea South-West, South-East and East coast.

Coast sandy dunes are divided into not-fixed (small-grained), semi fixed and fixed dunes.

I. Not-fixed dunes are well spread in Maltakva. It differs from dune of Romania, where pioneer species is *Cakile maritima,* pioneer species of Kolkheti is *Tournefortia (Argusia) sibirica. From Argusia sibirica*-starts Kolkheti coast psamofits.



Map 1. Locations of coastline dunes on Kolkheti lowland

Embryonic non fixed dunes- These are associations created in autumn: *Embry Xanthio italisi-Leymetum sabulosi.* These dunes are bit above from places where *Argusia sibirica* is grown. *Xanthium strumanium subsp. italicum and Eringium maritimum* is seen almost everywhere. We can see a lot of *Lactuca tatarica* and *Salsola ruthenica,* but there is little number of *Ammophylla arenaria, Elymus farctus, and Crambe maritima.* On the dune of Anaklia is grown separate kinds of *Lupinus polyphyllus*. Here or there you can find - *Euphorbia maritima.* The most fixed and spread plant sub-society is *Eringium maritimum* & *Pancratium maritimum.*

II. semi fixed dunes

Half fixed dunes are behind not fixed dunes. Floral cover is basically presented by graining.

III. Fixed dunes-On the fixed dunes here or there cattle grazes well, especially horse, here are grown: *Carlina acaulis, Cirsium acaule, Silybum marianum, Raphanus maritimus. Anthemis euxina*, *Stachys maritima*.

In autumn you can see graining on the dunes. It can be well seen on the dune of Tchuria coast.

I. line –not fixed dune:

First line is created by grouping near sea coast-*Pancratium maritimum* and *Xanthium strumanium* subsp. *Italicum.*

Second line is typical grouping of sandy xerophytes, where dominates: *Euphorbia paralias, Eryngium maritimum, and Verbascums gnaphalodes.*

Third line is grouping of bulbous plants-where is grown -*Eryngium maritimum,* where is also above mentioned grouping: *Euphorbia paralias, Eryngium maritimum, and Verbascums gnaphalodes.*

Then is grouping of sending out root runners as: *Carex colchica, Imperata cylindrica, Cynodon dactylon.*

II. semi fixed dune. Here dominates *Petrorhagia saxifraga,Cota tinctoria,Paliurus spina Christi*, *Convolovulus persicus,and Otanthus maritimus grouping.* In this habitat only in one place is remained fig - *Ficus carica. Here is grown - Carex colchica*.

III. Fixed dune, here dominated invasive species: *Sporobolus fertilis.Solidago canadensis, Polygonum perfoliatum.*

Hyppophaeta- Emerald network, European Union EUNIS's directives, Natura 2000 issues thorny communities in order to conservate them, on the fixed dunes you can find places covered with wood, where dominates: *Hyppophae rhamnoides, Berberis vulgaris, Malus orientalis, Pyracantha coccinea, Mespilus germanica, Ruscus colchicus, Paliurus spina- christi.* Thorny plants community we can find on the Black Sea coast in Kolkheti, outfall of river Tchorokhi in over-saturated habitats and on the fixed dunes of Anaklia.

Hyppophae rhamnoides **in Anaklia:** Thorny is spread in Anaklia and its plant community can be seen in the participation of Ponto and Kolkheti floral elements: *Hyppophae rhamnoides, Asparagus littoralis, Ficus carica, Rubus anatolicus, Ruscus ponticus, and Verbascum gnaphalodes.*

Hyppophaeta - Hyppophae rhamnoides with domination near outfall of river Tchorokhi. Here cover of plant is presented as layers. On the first layer is grown: *Hyppophae rhamnoides, Alnus barbata, Salix caprea*. II layer is presented with - *Rubus hirtus, Sambucus ebulus, Rubus anatolicus, Humulus lupulus* III layer is grassy: *Carex sylvatica,*

Rumux acetosella, Potentila reptans, Duchesnea indica, Prunela vulgaris, Polygonum hydropiper, Mentha aquatica,Leontodon taraxacoides, Sysirinchium angustifolium, Cynodon dactylon. IV layer is presented with moss - *Aulocomnium palustre. The following ones are grown as liana: Lonicera caprifolia, Smilax excelsa.*

Difference is composition (near outfall of Tchorokhi 19 species and on the dunes of Anaklia 7) is caused with the fact that dune in Anaklia needs special adaptation for plants and accordingly it excludes diversity of floral species.

3.2. Invasive species: Invasive species are less spread on the coast of dune, it comes from the peculiarity of bio-types. In spite of the fact that they can't adapt well with sea waves and sandy soil, some invasive species are still becoming wild, which changes look of sandy dunes. On the non-fixed, moving dunes, on the border of fixed and non-fixed dune is grown*Xanthium strumarium* subsp. *Italicum.* Number of these species population is associated with the factor of human. It was introduced from America, well adapted to environment and became wild, there were created firm communities with *Cenchrus longispinus* and it participates in all non-fixed dune's plant community. In the floral cover of non-fixed dunes can be seen adventive *Ambrosia artemissifolia.*It is spread on the whole coastline and is from Kobuleti to Anaklia. The following species made monopoly: *Gomphocarpus fruticosus* and *Vitex rotundifolia. The* latest participates in the whole coastline dune's floral community. Special attentionshould be paid to *Amorpha fruticosa.* It dominates in almost all over-saturated habitats of Kolkheti lowland and participates in almost all communities of the coastal dune.

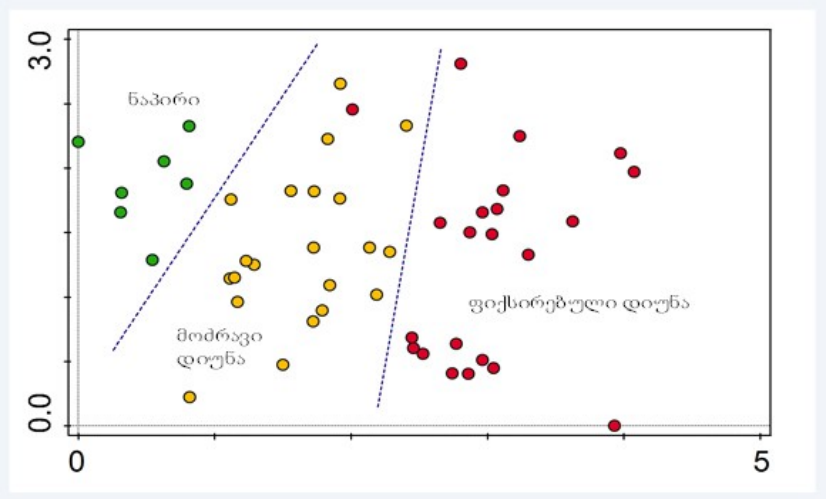
3.3. Spring ephemerons and ephemerids: It is very interesting group of plants and is met in the Kolkheti Black Sea coast's littoral zone rich with ephemerons. Groups of sandy dune's ephemerons species:

a. Xerophytes with the participation of ephemerons and ephemerids: *Anthemis euxina, Silene euxina, Stachys maritima, Verbascum gnaphalodes, Medicago maritima, Vulpia myuros, Cyperus capitatus, Koeleria foetida.* Near summer they are changed with: *Equisetum ramosissimum, Plantago lanceolata, and Scabiosa litoralis.*

b. Grouping, where ephemerons species participate with graining and legume, as: *Madicago marina & Vulpia myuros.*

3.4. Community of plants on dunes of Anaklia coast with PC ord program:

Statistical proceedings of data was done in the university of Warsaw in Poland according to the PC ord program, There is shown all floral- 49 Relevee (pic,1, pic. 2,) which was done from Grigoleti to Anaklia from sea coast (green circles), moving non-fixed (yellow circles) on the fixed dunes (red circles).

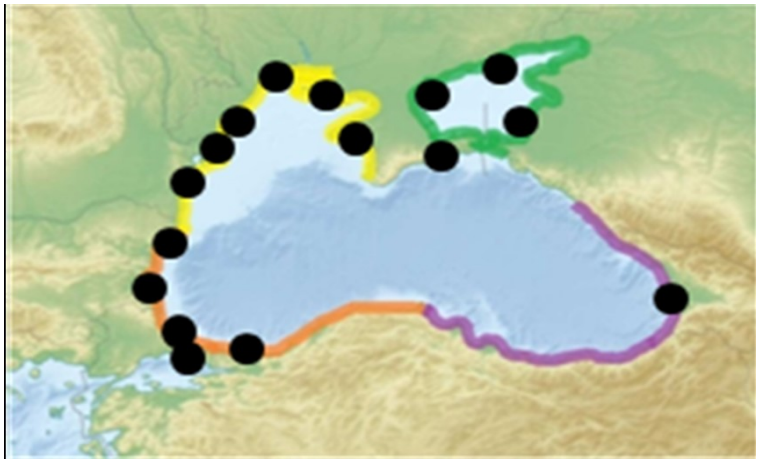


Pic. 1. Floral grouping in Anaklia Sea coast, where:
o - fine-grained non-fixed dune; o - moving and thicken dune; o - fixed dunes

On the below given picture is shown all grouping according to the dominant species Floral communities from sea coast to land are changed in this way: moving non-fixed dunes near sea coast is presented with ten groupings, where dominant species are: 1. *Argusia sibirica,* 2. *Euphorbia hirsuta, 3. Juncus maritimus,* 4. *Cakile maritima* subsp. *Euxina 5. Trifolium arvence,* 6. *Carex colchica,* 7.*Xanthium strumanium* subsp. *Italicum,* 8. *Salsola tragus,* 9. *Euphorbia maritima*, 10. *Euphorbia peplis,* non-fixed dunes are presented by 14 floral communities, where following species dominates according to the grouping: 11. *Imperata cylindica,* 12.*Cyperus capitata,* 13. *Medicago faasciculata,* 14.*Otanthus maritimus,* 15. *Petrorhagia saxifrage, 16. Crepis foetida, 17. Plantago lanceolata,* 18. *Digitaria ciliaris,* 19. *Elymus racemosus*, 20. *Stachys 60maritima*, 21.*Carex colchica*, 22.*Cyperus capitatus, 23.Trifolium arvense, 24. Xanthium strumanium s*ubsp *Italicum,* On the half fixed dunes there are 24 groupings with domination of following species: 25. *Cynodon dactylon,* 26. *Plantago lanceolata,* 27. *Anisantha tectoria,* 28. *Pancratium maritimum,* 29.*Equisteum ramosissimum,* 30. *Polygonum convolvulus,* 31.*Calystegia soldanela,* 32.*Glycirhyza grabra,* 33. *Juncus maritimus,* 34. *Erigeron 60 canadensis*, 35. *Ambrosia artemisiifolia,* 36. *Asparagus*

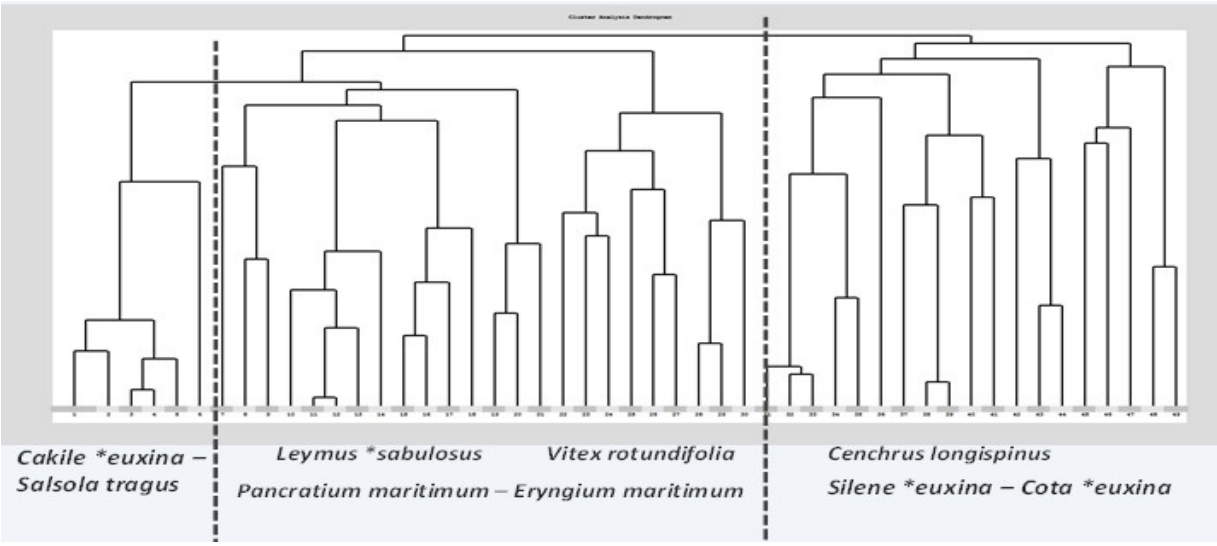
littoralis, 37. *Vitex rotundifolia,* 38. *Silene euxina,* 39. *Paliuris spina-christi,* 40.*Convolvulus persicus,* 41. *Imperata cylindica,* 42. *Euphorbioa paralias,* 43. *Leymus racemosus* subsp. *Sabulosus,* 44. *Verbascum gnaphalodes*, 45.*Raphanus maritimus,* 46. *Cenchrus longispinus,* 47.*Plantago indica,* 48. *Convolvulus persicus,* on the fixed dunes there is floral grouping: 49. *Rubus anatolicus,* on the half fixed and fixed dunes are grown: *Cladonia sp., Oulocomnium palustre.*

From the relevee analysis was revealed *Cakilete maritima* subsp. *euxina* is poor floral community. To this grouping on the areas of well-known Black Sea was added also Kolkheti dune.



Map. 2. *Cakileta maritimaareas on the Black Sea coast*

Diagnostic species of *Cakileta maritima* are: *Euphorbia maritima* subsp. *Euxina, Salsola tragus,* and constant accompanied species are: *Xanthium strumanium* subsp. *italicum, Eryngium maritimum, Cynodon dactylon* (map.2).



Pic.2 Relevee floral communities (totally 49 relevee) from Grigoleti to Anaklia

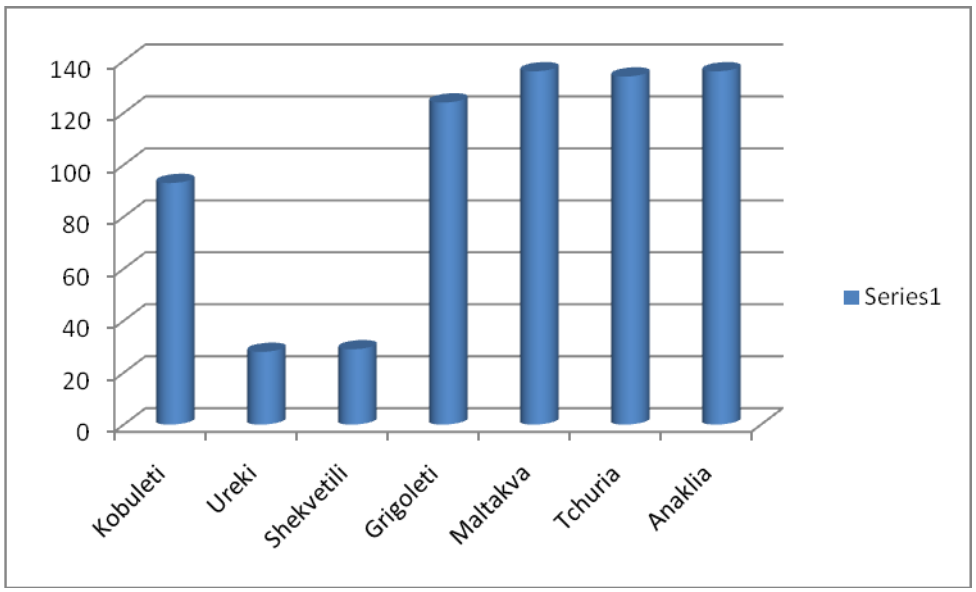
According to the PC ord program, from Grigoleti to Anaklia was expressed Mediterranean Sea plant communities- *Cakile euxina –Salsola tragus.* Diagnostic species are: *Euphorbia paralias, Pancratium maritimum, Eryngium maritimum, Cynodon dactylon, Xanthium strumanium subsp. Italicum*, *and Leymus racemosus subsp. sabulosus.*

PC ord program also showed South-East floral communities rich with - *Sileno euxinae-Anthemetum euxinae* on the stable non-fixed dunes. From which diagnostic species are: *Silene euxina, Cota tinctoria* subsp. *Euxina, Anisantha tectorium, Petrorhagia saxifraga, Plantago lanceolata, Plantago indica, Verbascum gnaphalodes, Equisetum ramosissimum, Rumex acetosella, Stachys maritima, Medicago minima, Trifolium arvense, and Crepis phoetida* (map.3).

On the well-known Black Sea area grouping *Silene euxinae-Anthemetum euxinae* was added to Kolkheti Black Sea coast dune.

Map. 3. Spread of *community-Sileno euxinae-Anthemetum euxinae*

3.5. Flora of sandy dunes: Diag.1 shows distribution and number of species of flora of Kolkheti coastline sandy dunes Kobuleti - 93 species, Shekvetili -29, Ureki - 28, Grigoleti-124, Maltakva -136, Tchuria -134, Anaklia-136 species.



Diagr. 1. Number of Species

While making field researches was revealed four new species for the flora of Georgia: *Eryngium bourgatii* (Grigoleti), *Sisyrinchium californicum* (Anaklia), *Cleome gynanda* (Choloqi), *Blackstonia parviflora* (Maltakva).

4 Species of freshwater ponds and coastline of sandy dunes being in danger

Based on the 5 years - 2012-2017 research of dissertation work was revealed following species that are in danger in Kolkheti coast dunes and freshwater puddles.

4.1. Species of freshwater ponds being in threat:

1. *Marsilea quadrifolia L.*

   Category: endangered (CR), Criteria: C1a (i)

   Reason of reducing: fragmentation of habitat, degradation and complete disappearing.

   Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

   Species is protected by Global Red List IUCN category: LC

2. *Trapa colchica L.*

   Category: Endangered (CR), Criteria: C1a (i)

   Reason of reducing: assimilation with coast, fragmentation of habitat, degradation and complete disappearing.

   Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

Species is protected by Global Red List IUCN category: CR

Quotation: Batsatsashvili, K. & Machutadze, I. 2014. *Trapa colchica*. The IUCN Red List of Threatened Species 2014: e.T200581A2670883. http://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T200581A2670883.en

3. *Salvinia natans* (L.) All

Category: endangered (EN) ,Criteria: C1a (i)

Reason of reducing: assimilation with coast, fragmentation of habitat, modification and degradation.

Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

Species is protected by Global Red List IUCN category: LC

Quotation: Allen, D.J. 2011. *Salvinia natans*. The IUCN Red List of Threatened Species 2011:e.T163996A5688211. *http://dx.doi.org/10.2305/IUCN.UK.20112.RLTS.T163996A5688211.en*. (Allen 2011:34).

4. *Ceratophyllum demersum* –turnip-root chervil

Category: Endangered (EN), Criteria: C1a (i)

Reason of reducing: assimilation with coast, degradation of habitat.

Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

Species is protected by Global Red List IUCN category: LC

Quotation: Zhuang, X. 2013. *Ceratophyllum demersum*. The IUCN Red List of Threatened Species2013:e.T164459A17618637. http://dx.doi.org/10.2305/IUCN.UK.20131.RLTS.T164459A17618637.en.

5. *Ceratophyllum submersum* L.

Category: Endangered (EN), Criteria: C1a (i)

Reason of reducing: assimilation with coast, degradation of habitat.

Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

Species is protected by Global Red List IUCN category: LC

6. *Typha minima* Funck

   Category: Endangered (EN), Criteria: C1a(i)

   Reason of reducing: assimilation with coast, degradation of habitat.

   Conservative measures: It is necessary to make *in-situ* conservation in natural spreading area and *ex-situ* conservation in Botanical Gardens.

   Species is protected by Global Red List IUCN category: LC

7. Callitriche stagnalis L.

   Category: Endangered (EN),Criteria: C1a(i)

   Reason of reducing: assimilation with coast, modification and degradation of habitat.

   Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

   Species is protected by Global Red List IUCN category: LC

8. Sagittaria sagitiifolia L.

   Category: Endangered (EN), Criteria: C1a (i)

   Reason of reducing: assimilation with coast, modification of habitat, fragmentation and degradation.

   Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

9. Utricularia minor L.

   Category: Critically Endangered (EN), Criteria: D

   Reason of reducing: assimilation with coast, modification of habitat, fragmentation and degradation.

   Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

   Species is protected by Global Red List IUCN category: LC

10. *Potamogeton natans L.*

   IUCN category: LC, Critertia C1a(i)

   Reason of reducing: assimilation with coast, modification of habitat, fragmentation and degradation.

   Conservative measures: It is necessary to make *ex-situ* conservation in Botanical Gardens, to make decorate artificial pools.

Threatened plant Species of sandy coast dunes:

Species of flora of non-fixed dunes being in danger:

1. *Otanthus maritimus* (L.) Hoffingg & Link

   Category; Critically Endangered (CR),Criteria: D

   Reason of reducing: species separately can be seen on the coast of Tchuria, but it was destroyed due to assimilation of dune, while construction of port.

   There are only two places of spread in Kobuleti and Tchuria dune's floral cover. Also they can be grown in Anaklia.

   Conservative measures: It is necessary to make bank of seeds

2. *Cakile miritima* subsp. *euxina* Pobed.

   Category: Critically Endangered (CR), Criteria: C1a (i)

   Reason of reducing: erosive processes of coast, grazing of cattle, massive tourism; it can be well seen on the dunes of Maltakva coast, where they are trampling down by the cars of tourists.

   Conservative measures: it is necessary to protect in the primary places of spreading, making of the bank of seeds.

3. *Convolvulus persicus L.*

   Category: Critically Endangered (CR) , Criteria: C1a (i)

   Reason of reducing: species can be seen on the coast of Tchuria, but it was destroyed due to construction of port. Only several of them are remained.

   Conservative measures: It is necessary to protect in the primary places of spreading, to make bank of seeds.

4. *Tournefortia (Argusia) sibirica* (L.) Dandy

   Category: Critically Endangered (CR), Criteria: C1a (i)

   Argusia sibirica there were two individual on the coast dune of Tchuria. They were damaged during the port construction, erosion of coast dune.

   You can find a lot of populations on the coast dune of Maltakva. There can be found dozens of these species.

   Reason of reducing: anthropogenic factor, infrastructural projects.

   Conservative measures: it is necessary to protect primary areas of spreading, creation of banks of seeds.

Species being in danger in half fixed dunes

5. *Imperata cylindica* (L.)

   Category: Critically Endangered (CR), Criteria: C1a (i)

   Reason of reducing: Scouring away of Tchuria sandy dunes due to the construction of Khulevi Port Terminal.

   Conservative measures: it is necessary to protect primary areas of spreading, creation of the bank of seeds.

6. *Asparagus maritimus* L *(A.litoralis)*

   Category: (CR), Criteria: C1a (i)

   We can find separate copies in: Anaklia, coast of Tchuria, Ureki.

   Reason of reducing: species as separate copy can be found on the coast of Tchuria, but it was destroyed due to construction of port and erosive procedures. It is only remained in Anaklia and several of them in Grigoleti.

   Conservative measures: Due to the fact that species can be found on half fixed and fixed dunes, it can be multiplied in Botanical gardens; protected areas. There can be created decorative fields.

7. *Scabiosa litoralis* L.

   Category: VU, Criteria: EN A1

   Reason of reducing: grazing of cattle

   Conservative measures: *in-situ* conservation.

8. *Medicago maritima* L.

   Category: (CR), Criteria: C1a (i)

   Reason of endangering: separate species can be found in Anaklia and Kobuleti coast dune, in small ecological parts.

   Conservative measures: it is necessary to protect primary areas of spreading, creation of banks of seeds.

9. *Crambe maritima* L.

   Category: (CR) , Criteria: D.

   Spreading: only three copies of this species can be found on the coast of Gonio, also some of them can be found in Anaklia and Tchuria coast dune.

   Threats: assimilation of coast, infrastructural projects.

Necessity of conservative measures: *ex-situ conservative measures in Batumi Botanical Garden.*

10. *Glaucium flaum* L.

Category: (CR) .Criteria: C1a (i)

Spreading: They can be found in Gonio and on the coast of Batumi Botanical Garden.

Threats: assimilation of coast, infrastructural projects.

Conservative measures: it necessary to protect primary areas of spreading, creation of the seeds of bank.

11. *Leymus racemosus* subs.*subulosus*

Category: (CR), Criteria: C1a (i)

Spreading: Species can be found in Cholokhi, Grigoleti, on Tchuria coast dune we can find in small grouping.

Threats: assimilation with coast, infrastructural projects.

Conservative measures: it is necessary to protect primary area of spreading, creation bank of seeds.

Flora of Kolkheti sand dune vegetation is consists: 191 species and subspecies (36 species of monocotyledoneae, 151 species of dicotyledoneae, one species of gymnocarpae and three species of fern) 49 family (Monocotyledoneae 5 family, dicotyledoneae 42 family) and 135 genera of Monocotyledoneae 28 Genera, dicotyledoneae 105 Genera, one gymnocarpae and one Ferns (tab.2).

Flora of Kolkheti sand dune

Tab. 2

Flora of coastal dune vegetation

	Equisetaceae
1	***Equisetum*** *fluviatile*L.
2	*E.arvense*L.
3	*E. ramosisimum*Desf.
	Pinaceae
4	***Pinus****pinaster* Aiton
	Boraginaceae
5	***Tournefortia sibirica***L. (*Argusia sibirica* (L.) Dandy)

6	***Heliotropium*** *ellipticum* Ledeb.
	Convolvulaceae
7	***Calystegia*** *soldanella* (L.) R.BR
	C. sepium **(L.) Br.**
8	***Convolvulus*** *persicus* L.
	Fabaceae Leguminosae
9	***Amorpha fruticosa*** **L.**
10	***Ornithopus*** *compressus* L.
11	***Astragalus*** *onobrychis* L.
12	*A. melilotoides* Pall.
13	*A. galegiformis* L.
14	***Sophora*** *alopecuroides* L
15	***Ononis*** *arvensis* I.
16	***Medicago*** *falcata.* Subsp. *tenderiensis (*Klokov)Vassilcz.
17	*M. minima* (L.)
18	*M. rigidula* (L.) All.
19	*M. lupulina* L.
20	*M. falcata*L.
21	*M. maritima* L.
22	*M. sativa* subsp. *Varia(Martyn)Arcang(M.sylvestris* L.)
23	***Trifolium*** *subterraneum* L.
24	*T. fragiferum* L.
25	*T. resupinatum* L.
26	*T.tumens* M. Bieb.
27	*T.repens* L.
28	*T. hybridum* L.
29	*T. micranthum* Viv.
30	*T. campestre* Schreb.
31	*T. striatum* L.
32	*T.scabrum* L.
33	*T. arvense* L.
34	***Dorycnium*** *pentaphyllum* subsp. *herbaceum (*Vill.)Rouy
35	***Lotus*** *tenius* Waldst. & Kit.
36	*L. angustissimus* L.
37	*L. corniculatus* L.

38	***Galega*** *oficinalis* L.
39	***Glycyrrhiza*** *glabra*L.
40	***Ornithopus*** *compressus* L.
41	***Coronilla*** *varia* L.
42	***Lathyrus*** *tuberosus* L.
43	***Lupinus****polyphyllus*Lindl
44	*L. pratensis* A. Heller
45	*L. hirsutus*L.
	Malvaceae
46	***Malva*** *ambiqua* Guss,. M. *sylvestris var ambiqua* baker.
	Rosaceae
47	***Potentilla*** *reptans* L.
48	***Geum*** *urbanum* L.
49	***Crataegus*** *macrophylla* Sarg.
50	***Rubus*** *anatolicus* Focke
	Linaceae
51	***Linum*** *bienne* Miller.
	Oxalidaceae
52	***Oxalis*** *corniculata* L.
	Zygophyllaceae
53	***Tribulus*** *terrestris* L.
	Euphorbiaceae
54	***Euphorbia*** *nutans* Lag.
55	*E. stricta* L.
56	*E. palustris*L.
57	*E.chamaesyce*L.
58	*E. peplis* L.
59	*E. paralias* L. Fourr
60	*E. pubescens* Vahl.
61	*E. maritima* L.
62	*E. hirsuta* L.
	Eleagnaceae
63	***Hyppophae*** *rhamnoides* L.
	Caprifoliaceae
64	***Valernanella*** *locusta* L.

	Punicaceae
65	***Punica*** *granatum* L.
	Geranoaceae
65	***Geranium*** *molle* L.
67	***Erodium*** *cicutariumn* L. Lher
	Asparagaceae
68	***Asparagus*** *officinalis* L. (*Asparagus litoralis* Steven.)
	Rhamnaceae
69	***Paliurus*** *spina- christi* Mill.
	Cistaceae
70	***Cistus*** *tausricis* C.Presl
	Umbeliferae Apiaceae
71	***Eryngium*** *maritimum* L.
72	*E. biehersteinianum* (M. Bieb.) Nevski
73	*E. bourgatii Couen.*
74	***Peucedanum*** *arenarium* hort ex. Sreng
	Rubiaceae
75	***Asperula*** *humifusa* (Bieb.) Bess.
76	***Galium*** *tricornotum* Dandy
	Asclepiadaceae Apocinaceae
77	***Gomphocarpus*** *fruticosus* L.
78	***Cynanchum*** *acutum* L.
	Solanaceae
79	***Physalis*** *alkegengi* L.
80	*Ph. ixocarpa*Brot. ex. Hornem
81	***Solanum*** *woronovii* Pojark.
	Scrophulariaceae
82	***Verbascum*** *piramidalis* Bieb.
83	*V. sessiliflorumMurb.*
84	*V. oreophillum* C. Koch.
85	*V. gnaphalodes* M. Bieb.
86	***Celsia*** *heterophylla* Desf.
87	***Linaria*** *vulgaris* Mill.
88	***Veronica*** *didima* Ten
	Linderniaceae

89	***Lindernia*** *procumbens* (Krocker) barb
	Orobanchaceae
90	***Parentucellia*** *latifolia* (L.) Careul.
	Lamiaceae
91	***Vitex*** *rotundifolia* L.
92	***Satureja*** *laxiflora* (C. Koch) Boiss
93	***Stachys*** *maritimus* L.
	Papaveraceae
94	***Claucium*** *flavum* Granz.
95	***Fumaria*** *capreolata* L.
	Cruciferae Brassicaceca
96	***Lepidium*** *texanum* Buckley.
97	***Coronopus****procumbens* Gilib.
98	*C. didymus* (L.) *Smith.*
99	***Cakile*** *maritime* subsp.*euxina* Pobed.
100	***Crambe*** *maritima* L.
101	*Raphanus maritimus* Smith.
102	*R. raphanastrum* L.
	Cleomaceae
103	*Cleome gynandra* L.
	Compositae (Asteraceae)
104	***Filago*** *eriocephala* Guss.
105	***Tagetes*** *minuta* L.
106	***Achilea*** *biebersteinii* G. Tag.
107	***Otanthus*** *maritimus* L.
108	***Matricaria*** *chamonilla* var. *recutita* L.
109	***Echinops*** *colchicus* D. Sosn.
110	***Silybum****marianum* (L.)Gaertn.
111	***Scolymus*** *hispanicum* L.
112	***Cynaria*** *scolymus* L.
113	***Cota****tinctoria* subsp. *euxina* (Boiss.)Oberpr.&Greuter *(Artemis euxina* Boiss)
114	***Leontodon*** *saxatilis* Lam.
115	*L. autumnalis* L.
116	***Carlina*** *acaulis* L.
117	***Cirsium*** *acaule* L. All

118	***Jurinea*** *albicaulis subsp.* Kilaee (Azn.) Kozuharov
119	***Xanthium*** *strumanium subsp. italicum* (Moretti) Greuter
120	***Artemisia*** *vulgaris* L.
121	***Ambrosia*** *artemissifolia* L.
122	***Erigeron*** *canadensis* L.
123	***Solidago*** *canadensis* L.
124	***Senecio*** *incanus* L.
125	***Crepis*** *foetida* L.
126	***Lactuca*** *tatarica* L.
127	***Onopordum*** *acanthium* L.
	Chenopodiaceae
128	***Tanacetum*** *corymbosum* Simonk.
129	***Dysphania*** *botrys* (L.) Mosyakin &Clemants (*Chenopodium botrys* L.*)*
	Cuscutaceae
130	***Cuscuta****cesartiana*Bertol.
131	***C.*** *chinensis*L.
	Primulaceae
132	***Anagalis*** *arvensis* L.
	Tamaricaceae
133	***Tamarix*** *tetrandra*Pall. Ex M.Bieb.
	Moraceae
134	***Ficus*** *carica* L.
	Caryophyllaceae
135	***Spergula*** *arvensis* L**.**
136	***Spergularia*** *marginata* DC
137	***Scabiosa*** *maritima* L.*Scabiosa atropurpurea* L.
138	***Polycarpon*** *tetraphillum* L.
139	***Silene*** *gallica* L. *S.anglica* L.
140	*S. thymifolia* Sm.
141	*S. dichotoma* subsp. *euxina* (Rupr.) Coode *&*Cullan (*S. euxina* Rupr)
142	*S. iberica* Bieb *S. racemosa Otth..*var. *iberica (*Bieb.) Boiss.
143	***Petrorhagia****saxifraga* (L.) Link
144	***Tunica*** *ascicula*(L.) Scop
145	***Arenaria*** *serpiliifolia* L.
146	***Cerastium*** *glomeratum*Thuill.

	Gentianaceae
147	***Blackstonia****perfoliata* L. Huds
	Amaranthaceae
148	***Atriplex*** *patula* L.
149	***Salsola*** *tragus* L
150	***Amaranthus*** *deflexus* L.
	Moraceae
151	***Ficus*** *carica* L.
	Polygonaceae
152	***Polygonum*** *litoralis* Meissn.
153	*P. convolvulus* L.
154	*P. perfoliatum* L.
	Liliaceca
155	***Asparagus*** *officinalis* L. *(A. litoralis* Stev.)
	Amarylidaceca
156	***Pancratium*** *maritimum* **L.**
	Phytolacaceae
157	***Tanacetum*** *corymbosum* (L.) Sh.Bip.
	Plantaginaceae
158	***Plantago*** *lanceolata* L.
159	*P. indica* L.
	Ruscaceae
160	***Ruscus*** *ponticus* L.
	Iridaceae
161	***Sysirinchium*** *californicum* L.
162	***Ruscus*** *ponticus* L.
	Cyperaceae
163	***Cyperus*** *longus* L.
164	*C. capitatus* Vand.
165	***Holoschoenus*** *romanus* L.
166	***Carex*** *colchica* J.Gray(*C. ligarica)* L.
	Juncaceae
167	***Juncus*** *maritima* L.

	Poaceae
168	***Poa*** *bulbosa* L.
169	***Digitaria*** *violascens* Link.
170	*D. ciliaris* (Retz.) Koeler
171	*D. pectiniformis* (Henrard) Tzelev
172	***Eleusine*** *tristachya* Lam.Lam.
173	*E. indica* (L.) Gaertn.
174	***Festuca****arenicola* (Prod.) Soo
175	***Cenchrus*** *longispinus* L.
176	***Ammophylla*** *arenaria* (L.)Link
177	***Leymus*** *racemosus* subsp. *Sabulosus* (M.Bieb.) Tzvelev
178	***Elymus*** *farctus* (Viv.) Runemark ex. Melderis
179	*E. racemosus* Lam.
180	***Elytrigia*** *jurinea* L.
181	***Vulpia****fasciculata* (Lebed.) Schult.
182	*V. myuros*L.C.C.Gmel.
183	***Rostraria*** *cristata* (L.) Tzvelev *(Koeleria macrantha* (Lebed.) Schult.)
184	***Lolium*** *rigidum var. lepturoides* (Boiss.) Fiori & Paoli
185	*L. loliaceum* (Bory & Chaub.) Hand.-Mazz
186	***Sporoborus*** *fertilis* (Steud.) Clayton
187	***Secale*** *sylvestre* L.
188	***Imparata*** *cylindica* L.
189	***Cynodon*** *dactylon* L.
190	***Aira*** *elegans* Savi
191	***A.*** *capillaris* Host.

5. EUNIS habitats to be protected by European Union

Dissertation work includes following EUNIS habitats and species as:

1.water surface floating *Utricularia minor* colony.

Spreading:

a) Kobuleti protected territories: near Ispani Bog, where is pH 4-6. In the herbal community participated: *Sphagnum cuspidatum, Utricularia* minor*, Egeria denca and Potomogeton natans.*

Threats: pond is without conservative status, it needs protection and union with Kobuleti protected territory.

b) Tchuria mire outer, right side of river Khobistskali.

Plant community: *Utricularia minor*, *Sphagnum palustre, Hydrocharis morsus-ranae, Typha angustifolia, Cladium mariscus*.

Threats: construction of planned sea port and modification of habitats.

c) There are four small sized freshwater ponds in Anaklia.

Plant community: *Utricularia minor, Trapa colchica, Potamogeton natans, Egeria denca, Ceratophyllum demersum*.

Threats: infrastructural projects, disappearing of habitats, existing of conservative status.

2. Coastal lagoons:

Plant community: *Trapa colchica, Trapa natans, Potamogeton pectinatus, Potamogeton natans, Ceratophyllum demersum.*

Threats: hunting, fishing, over-grazing, law environmental protection awareness.

3. coastal dune

3.1. dunes with domination of thorns.

Area:

a) Outfall of river Tchorokhi:

Plant community: *Hyppophae rhamnoides, Rubus anatolicus, Lonicera caprifolia, Periploca graeca, Salix caprea, Equisetum ramosissimum, Polygonum hydropiper, Hydrocotyle vulgaris*.

Threats: cutting wood and over grazing.

b) Anaklia coast

Plant community: *Hyppophae rhamnoides, Asparagus littoralis, Paliurus spina – christi.*

Threats: infrastructural projects, over grazing, degradation and modification of habitats, not having conservative status.

c) Coastline in Grigoleti and Maltakva.

Plant community: *Hyppophae rhamnoides, Rubus anatolicus, Juncus maritimus, Senecio erraticus, Pancratium maritimum, Eryngium maritimum.*

Threats: infrastructural projects, over grazing, degradation and modification of habitats, not having conservative status.

3.2. coastal dunes with domination of pine-tree

Spreading: Choloki, Tskaltsminda, Grigoleti, Maltakva

4. *Salvinia natans* freshwater ponds on the surface of water with domination of floating water fern

Location:

a) Freshwater puddles in Anaklia.

Plant communities: *Salvinia natans, Trapa colchica, Typha angustifolia, Potamogeton natans.*

Threats: infrastructural projects, law awareness, modification of habitats, degradation and disappearing.

b) Freshwater ponds situated in the South of Kulevi terminal

Plant community: *Salvinia natans, Hydrocharis morsus-ranae, Egeria denca.*

c) Ponds and canals near Imnati mire.

Plant community: *Salvinia natans, Potomogeton natans, Hydrocharis morsus-ranae, Sagittaria sagitiifolia, Nymphaea colchica, Spirodela polyrhiza.*

d) Canals near river Tsiva

e) The biggest population in Maltakva.

Threats: infrastructural projects, over grazing, law awareness, degradation and modification and disappearing of habitats.

5. Mediterranean herbal community

Area: coast of Tskaltsminda

Plant community: *Marsilea quadrifolia, Cyperus badius, Typha angustifolia, Mentha pulegium, Ceratophyllum demersum.*

Threats: over-grazing, territory is without status of conservation, law awareness, not having law about habitats.

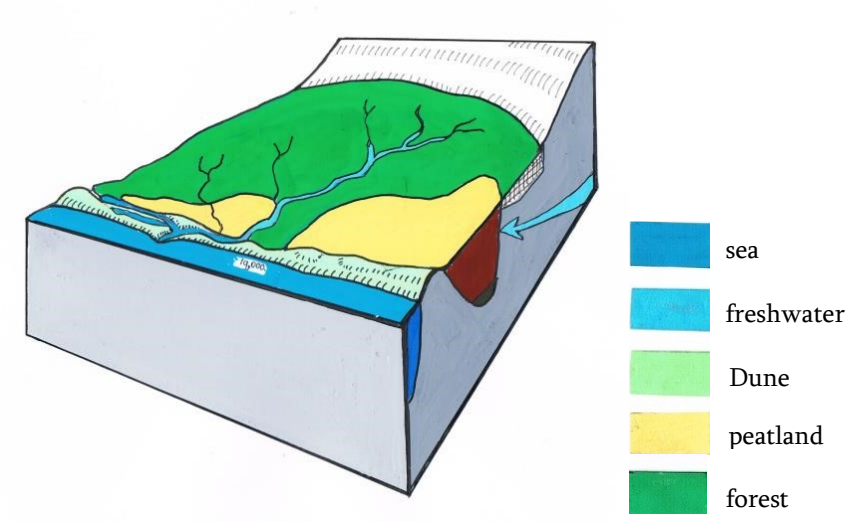
6. threats of biodiversity conservation

While making dissertation work was revealed 13 basic anthropogenic factors, which influences and makes danger to freshwater puddles of Kolkheti coast and bio-diversity of coast dunes.

As it is seen from the diagram the strongest anthropogenic influence is: urban development, infrastructural projects, law environmental protection awareness, not having law about habitats.

Special danger for Kolkheti coast dune and freshwater puddles is in Anaklia planned port, after which sandy dunes will be taken out from Kolkheti National Park's borders.

On the below given photo is seen conceptual model of Anaklia landscape ecology.



Pic: 3. Model of Anaklia landscape ecology

On the conceptual model (pic.3) is seen all that habitats, that are on coastal dune of Anaklia territory. If there is constructed highway on Anaklia-Tchuria coast dune, it will cause not only disappear of typical flora on dunes, also it will abolish immigration way of migrated birds (these territories are very important as it is immigration way for flying along birds). Ecological environment of river Tchuria and nearby territories will be abolished. Special danger for dunes and freshwater puddles is erosive process. Dune from Khobistskali protects freshwater puddles and Tchuria peat from salty waters and constant flooding will cause eutrophication, here located freshwater puddles and its species will be destroyed.

Conclusions and recommendations

Conclusions:

1. In the frames of dissertation work was created database of World Red List (IUCN Red List) habitats of global status-spreading of species in freshwater puddles with floral global status, about identified basic floral community.
2. There are revealed species of freshwater puddles being in danger with corresponding IUCN categories and criteria, exact area of spreading is defined.
3. There are revealed species of coast dunes being in danger with corresponding IUCN categories and criteria, exact area of spreading is defined. 10 species of flora of freshwater ponds and 11 species flora of sand dune;
4. During analysis of relevee PC ord program showed:

   - *Cakilete maritima* subsp. *euxinae* with pan euxinae pioneer species poor floral community.

   - From Grigoleti to Anaklia Mediterrenean plant community - *Cakile euxina -Salsola tragus.*

   - South-East euxinae plant community *Sileno euxinae-Anthemetum euxinae* on the stable non-fixed dunes.

   On the previously known list grouping areas around Black Sea was added Kolkheti Black Sea coast dune.
5. There is established location of species of flora of Georgia protected by Bern's convention: *Salvinia natans, Marsilea quadrifolia, Typha minina.*
6. During field researches was revealed new species of Flora of Georgia: *Eryngium bourgatii,Sisyrinchium californicum,Cleome gynanda.*
7. Flora of coastal sand dunes includes: 191 species and subspecies (36 species of monocotyledoneae, 151 species of dicotyledoneae, one species of gymnocarpae and three species of fern) 49 family (Monocotyledoneae 5 family, dicotyledoneae 42 family) and 135 genera of Monocotyledoneae 28 Genera, dicotyledoneae 105 Genera, one gymnocarpae and one Ferns
8. Flora of freshwater ponds includes: with 2 families, 2 genus and 2 species; angiospermae: dicotyledonea- with 6 families, 8 genus and 11 species. Monocotyledonea are presented

with 10 families, 21 genus and 33 species. Totally in the freshwater pondss are registered 46 species with 19 families and 28 genus.

9. Data about spreading of habitats and species were given to the EUNIS habitat's commission of Georgia.
10. Check list of flora of coast sandy dunes and freshwater ponds are included in the previously prepared document for nomination of world natural inheritance Kolkheti over-saturates and woods", in scientific document presented in UNESCO.
11. Identification of freshwater ponds as habitat that is important for conservation, will help to:

    a) give basic and full information to the recipient of decision, on the national as well as global level, as to protect and preserve freshwater puddles having global status;

    b) for habitat and species biodiversity monitoring;

    c) financial support of private companies as to reduce risks, that makes influence on the bio-diversity;

    d) attraction of conservative investment, from such donor organisations as: CEP – collaboration of critical eco-systems, GEF- global environmental protection fund and so on;
12. Establishment of exact location of coast sandy dune's ancient Meditteranean Sea floral species and floral society has special value for studying of Kolkheti floral history.
13. Species revealed to be in danger during field researches is given to the commission of rare and endangered species of flora and fauna of Georgia, for the renewed red list-"herbs and grassy";
14. In the yard of Kolkheti National Park's administration was made artificial freshwater ponds and species of global red list: *Marsilea quadrifolia* და *Salvinia natans* were subordinated to *ex-situ* conservation.

Recommendations:

1. For the protection and management of endangered species it is necessary to:

    a) to make strict and active environmental protection actions;

    b) creation of local protected territories, as:

    - Awarding of the status of live nature monument to Kobuleti Cholokhi sandy dunes and in this way to give in the frames of Kobuleti protected area;

- *Marsilea quadrifolia* awarding conservative status to the only area of these species spreading, protected by Bern's convention, emerald network and European Union(EUNIS);

- Awarding of protected status to left outfall of river Tchorokhi freshwater ponds.

- On the territory of Kulevi terminal, with domination of Salvinia (*Salvinia* covers) on freshwater pondss should be awarded protected status and should be in the frames of Kolkheti National Park.

- It is necessary to make *ex-situ* conservation of freshwater puddles floral species in Batumi Botanical Garden, in the protected territories of Kolkheti (in the Kolkheti National Park and Kobuleti protected areas) and for this aim to make artificial freshwater puddles.

2. Anaklia-Tchuria coast dune, as special geological production for Kolkheti and endangered species should be listed in Kolkheti National Park and in the management plan, as territories being outside protected areas with special bio-diversity.
3. Proceeding of identifed habitat's conservation management plan, that means: abiotic and biotic factors, types of habitats and their status, flora and fauna.
4. On the territory of Kolkheti National Park in the wild form are remained coast sandy dunes and with the conservation of freshwater puddles flora of the species of red list and with the development of eco-touristic infrustructure will be increased environmental protection awareness and development of eco-tourism will be supported.

Published Scientific articles:

1. **Bulbuli Boqvadze**, Izolda Matchutadze, 2016, A study of Freshwater pond taxa Marsilea quadrifolia & Salvinia natans in Kolkheti Lowland Black Sea coastline, International Journal of Curent Research IJCRR Science Healthcare. SCi Journal Impact Factor 4.06;
2. **Bulbuli Bolqvadze,** Izolda Matchutadze, Nino Davitashvili, 2016, Study of freshwater Pond taxa Marsilea quadrifolia & Salvinia natans in Kolkheti Lowland Black Sea Coastline Bulletin of the Georgian National Academy of Science, ISSN -0132-1447. vol 10, no, 2, 2016, pp. 111-115 ;
3. Dmytro Iakushenko, Izolda Matchutadze, Alla Tokaryuk, Volodymyr Solomakha, **Bulvuli Bolqvadze,2016,** Coastal dune vegetation of Georgia (the Caucasus), 25th International Meeting of the European vegetation Survey;
4. Izolda Matchutadze, Tamar Bakuradze,Tamar Tcheishvili, **Bulbuli Bolqvadze** , 2015, Vegetation of Colchis Mires, Science publishing Group Earth ScienceVol. 4 Issue 5-1, pp.73-78;
5. **Bolqvadze B**., Emerald Network Habitats of Kolkheti Lowland, 2015, Instruments for medaling Black Sea River Basins: Research Proceeding for Guria Region of Georgia EU project
6. Matchutadze I., **Bolqvadze B**., Jakeli J, 2014, Kolheti refugee-Habitat and speceis biodiversity (Georgia). 1st annual International conference on Biodiversity Future of biodiversity conservation with in the sustainable developments goals, Colombo Sri Lanka;
7. Izolda Matchutadze, Tamar Bakuradze, Mamuka Gvilava, **Bulbuli Bolkvadze** and David Baratashvili, 2013, Coastal Sand Dunes and freshwater ponds in Kolkheti –Threatens and needs for conservation Nova science publisher SeriesOceanography Ocean Engineering Binding ISBN: 978 1 62808-092-6 pp. 195-216;
8. **Bolqvadze B**., Matchutadze I., 2013, The necessity of *ex-situ* conservation of freshwater pond species in Batumi Botanical Garden. International conference the role of Botanical Garden for ex-situ conservation**,** Aniversary bulletin pp.76-80.