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FLORISTIC DIVERSITY OF MACROPHYTES IN KAZACHYA BAY (THE CRIMEA, THE BLACK SEA)

Nataliya Afanasiyevna Mylchakova, Valentina Gennadiyevna Ryabogina
SBE "Institute of the South Marine Biology named after Kovalevsky A.O.",
2, Nakhymova av., the city of Sevastopol, RF, 299011
milchakova@gmail.ru

Introduction

Study of macrophyte flora in Kazachya Bay has taken almost forty years, though species composition of macroalgae and higher plants inhabited its territory, including water area, adjacent to the state wildlife preserve, has been published in recent years [1 – 4, 8 – 10]. This work presents an annotated list of macrophyte flora in Kazachya bay, based on inspection of published information and hydrobotanic surveys (1997 – 2007), allowing for nomenclatural changes. A comparative ecological and floristic analysis of the long-term changes in macrophyte flora has been made within the whole bay water area [1]. The research objective is to reveal cozoological importance of macrophyte flora in Kaachya bay and to ground increasing the wildlife preserve territory.

Results and discussion

105 species present macrophyte flora of Kazachya bay: Chara– 1, Ulva latissima – 28, Porphyra gen. – 50, Phaeophyceae – 20, flowering plants – 6 (Table).

Ulva latissima group is marked out by *Bryopsis hypnoides*, *B. plumosa*, *Chaetomorpha crassa*, *Cladophora liniformis*, *Cladophoropsis membranacea*, *Ulva intestinalis*, developed everywhere and not found out before.

Table

Macrophyte species composition of Kazachya bay (1967-2007)

Taxon	Type of vegetation	Period	
		1967-1987	1997-2007
1	2	3	4
Charophyta			
Chara aculeolata F.T. Kütz. in H. Reichenbach	A*	+	+
Chlorophyta			
Acrochaete viridis (Reinke) R. Nielsen (= *Entocladia viridis* Reinke)	A	+	+
Acrosiphonia arcta (Dillw.) Gain (= *A. centralis* (Lyngb.) Kjellm.)	Sw	-	+
Bolbocoleon piliferum Pringsh.	A	+	-
Bryopsis corymbosa J. Ag.	Ss	-	+
B. hypnoides Lamour.	A	-	+
B. plumosa (Huds.) C. Ag.	Sw	-	+
Chaetomorpha aerea (Dillw.) Kütz.	A	+	+
Ch. crassa (C. Ag.) Kütz.	A	-	+
Ch. linum (O.F. Müller) Kütz. (= *Ch. chlorotica* (Mont.) Kütz.)	A	+	+
Chlorochytrium cohnii E.P. Wright (= *Chlorocystis cohnii* (E.P. Wright) L. Reinhard)	?	+	-
Cladophora albida (Nees) Kütz.	A	+	+

Cl. dalmatica Kütz.	A	+	-
Cl. laetevirens (Dillw.) Kütz.	A	+	+
Cl. liniformis Kьtz.	A	-	+
Cl. sericea (Huds.) Kütz.	A	+	+
Cl. siwaschensis C. Meyer	A	-	+
Cl. vadorum (Aresch.) Kütz.	A	+	+
Cladophoropsis membranacea (Hofm. Bang ex C. Ag.) Børg.	Ss	-	+
Codium vermilara (Olivi) Delle Chiaje	P	-	+
Pedobesia simplex (Menegh. ex Kütz.) M.J. Wynne & Leliaert (= *Derbesia lamourouxii* (J. Ag.) Soland.)	Ss	+	-
Phaeophila dendroides (P.L. Crouan & H.M. Crouan) Batt.	A	+	-
Pringsheimiella scutata (Reinke) Marschew.	A	+	+
Rhizoclonium riparium (Roth) Harv. (= Rh. implexum (Dillw.) Kütz.)	A	-	+
Ulothrix implexa (Kütz.) Kütz.	A	-	+
Ulva clathrata (Roth) C. Ag. (= *Enteromorpha clathrata* (Roth) Grev.)	A	+	+
U. intestinalis L. (= *Enteromorpha intestinalis* (L.) Link.)	A	-	+
U. rigida C. Ag.	P	+	+
Ulvella lens P.L. Crouan & H.M. Crouan	A	-	+
Rhodophyta			
Acrochaetium secundatum (Lyngb.) Näg. (= *Kylinia virgatula* (Harv.) Papenf.)	A	+	+
Antithamnion cruciatum (C. Ag.) Näg.	A	+	+
Apoglossum ruscifolium (Turn.) J. Ag.	P	+	+
Callithamnion corymbosum (J.E. Smith.) Lyngb.	A	+	+
Ceramium arborescens J. Ag.	A	-	+
C. ciliatum (Ell.) Ducl.	Ss	+	+
C. deslongchampsii Chauvin ex Duby (= Ceramium strictum (Kütz.) Rabenh.)	A	+	+
C. diaphanum (Lightf.) Roth	A	-	+
var. *elegans* (Roth) Roth (= *Ceramium elegans* (Roth) Ducl.)	Ss	-	+
var. *tenuissimum* Roth (= *Ceramium tenuissimum* (Roth) Aresch.)	A	-	+
C. virgatum Roth (= *C. rubrum* (Huds.) Ag.)	A	+	+
C. pedicellatum C. Ag.	A	-	+
Chondria capillaris (Huds.) M.J. Wynne (= *Ch. tenuissima* C. Ag.)	A	+	+
Ch. dasyphylla (Wood.) C. Ag.	A	-	+
Chroodactylon ornatum (C. Ag.) Basson (= *Asterocytis ramosa* (Thwaites) Gobi ex F. Schmitz)	Ss	-	+
Colaconema daviesii (Dillw.) Stegenga (= *Acrochaetium davesii* (Dillw.) Näg.)	A	-	+
Corallina elongata J. Ellis & Soland. (= *C. mediterranea* Aresch.)	A	+	+
C. *officinalis* L.	P	-	+
Dasya baillouviana (Gmel.) Mont. (= *D. elegans* (G. Martens) C. Ag.)	Ss	+	-
D. hutchinsiae Harv. (= *D. arbuscula* Harv.)	Ss	-	+
D. pedicellata (C. Ag.) C. Ag.	Ss	-	+
Erythrodermis traillii (Holmes ex Batters) Guiry & Garbary (= *Phyllophora traillii* Holmes ex Batters)	P	+	+
Erythrotrichia carnea (Dillw.) J. Ag.	Ss	+	+
Eupogodon apiculatus (C. Ag.) P.C. Silva (= *Dasyopsis apiculata* (C. Ag.) A. Zin.)	P	+	+
Gelidium crinale (Hare ex Turner) Gaillon	P	+	+
G. spinosum (S.G. Gmel.) P.C. Silva, Basson & Moe	P	+	+

(= *G. latifolium* Bornet ex Hauck)			
Gracilaria dura (C. Ag.) J. Ag.	P	-	+
G. gracilis (Stackh.) M. Steentoft, L.M. Irvine & W.F. Farnham (= *G. verrucosa* (Huds.) Papenf.)	P	+	+
Haliptilon virgatum (Zanard.) Garbary & H.W. Johansen (= *Corallina granifera* Ell. et Soland.)	P	-	+
Hydrolithon farinosum (J.V. Lamour.) D. Penrose & Y.M. Chamberlain (= *Fosliella farinosa* (J.V. Lamour.) M.A. Howe; *Melobesia farinosa* J.V. Lamour.)	A	+	+
Jania rubens (L.) Lamour.	P	+	+
Laurencia coronopus J. Ag.	P	+	+
L. obtusa (Huds.) Lamour.	P	+	+
Lomentaria clavellosa (Turn.) Gail.	A	+	+
Nitophyllum punctatum (Stackh.) Grev.	P	+	+
Osmundea hybrida (A.P. de Candolle) K.W. Nam (= *Laurencia hybrida* (A.P. de Candolle) T. Lestiboudois)	P	+	-
O. pinnatifida (Huds.) Stackh. (= *Laurencia pinnatifida* (Huds.) Lamour.)	P	+	+
Palisada perforata (Bory de Saint-Vincent) K.W. Nam (= *Laurencia papillosa* (Forsk.) Grev.; *Chondrophycus papillosus* (C. Ag.) Garbary et Harper)	P	+	+
Phyllophora crispa (Huds.) P.S. Dixon (= *Ph. nervosa* (DC.) Grev.)	P	+	+
Phymatolithon lenormandii (J.E. Aresch.) W.H. Adey (= *Lithothamnion lenormandii* (J.E. Aresch.) Foslie)	P	+	+
Pneophyllum confervicola (Kütz.) Y.M. Chamberlain (= *Melobesia minutula* Foslie)	A	-	+
Pneophyllum fragile Kьtz. (= *Melobesia lejolisii* Rosan.)	A	-	+
Polysiphonia breviarticulata (C. Ag.) Zanard.	Ss	-	+**
P. denudata (Dillw.) Grev. ex Harv.	A	+	-
P. elongata (Huds.) Spreng.	P	+	+
P. fucoides (Huds.) Grev. (= *P. nigrescens* (Huds.) Grev., *P. violacea* (Roth) Spreng.)	A	-	+
P. opaca (C. Ag.) Moris et De Not.	P	-	+**
P. pulvinata (Roth) Spreng.	Ss	-	+**
P. subulifera (C. Ag.) Harv.	A	+	+
Rubrointrusa membranacea (Magnus) S.L. Clayden & G.W. Saunders (= *Audouinella membranacea* (Magn.) Papenf.)	P	+	-
Spermothamnion strictum (C. Ag.) Ardiss.	P	+	+
Stylonema alsidii (Zanard.) K.M. Drew (= *Goniotrichum elegans* (Chauv.) Zanard.)	P	-	+
Ochrophyta			
Cladostephus spongiosus (Huds.) C. Ag.	P	+	+
Corynophlaea umbellata (C. Ag.) Kütz.	Ss	+	+
Cystoseira barbata (Stackh.) C. Ag.			
var. *barbata*	P	+	+
f. *repens* A.D. Zinova & Kalugina	P	+	+
C. *crinita* Duby	P	+	+
Dictyota dichotoma (Huds.) Lamour.	Ss	-	+
D. linearis (C. Ag.) Grev.	Ss	+	-
D. fasciola (Roth) J.V. Lamour. (= *Dilophus fasciola* (Roth) Howe)	Ss	+	+
D. spiralis Mont. (= *Dilophus spiralis* (Mont.) Hamel)	Ss	+	+
Ectocarpus siliculosus (Dillw.) Lyngb. (= *E. confervoides* Le Jolis)	Sw	+	+

E. fasciculatus Harv.	Sw	+	-
Eudesme virescens (Carm. ex Berkeley) J. Ag.	A	+	+
Feldmannia irregularis (Kütz.) G. Hamel	Ss	-	+**
Giraudia sphacelaroides Derb. et Sol.	A	+	-
Myriactula rivulariae (Suhr) Feldm.	Ss	+	+
Myriotrichia repens Hauck	A	-	+
Nereia filiformis (J. Ag.) Zanard.	P	+	+
Padina pavonica (L.) Thivy in W.R. Taylor	Ss	+	+
Scytosiphon lomentaria (Lyngb.) Link (= *S. simplicissimus* (Clemente) Cremades)	Sw	+**	+
Sphacelaria cirrosa (Roth) C. Ag.	P	+	+
Stilophora tenella (Esper) P.C.Silva in P.C. Silva, Basson & Moe (= *S. rhizodes* (Ehrh.) J. Ag.)	Ss	+	+
Zanardinia typus (Nardo) P.C. Silva in W. Greuter (= *Z. prototypus* Nardo)	P	+	+
Angiospermae			
Ruppia maritima L.	P	+	+
Ruppia cirrosa (Petagna) Grande (= *R. spiralis* L.)	P	+	+
Stuckenia pectinata (L.) Börner (= *Potamogeton pectinatus* L.)	P	+	+
Zannichellia palustris L. (= *Z. major* (Hartman) Boenn. ex Reichenb.)	P	+	+
Zostera marina L.	P	+	+
Zostera noltii Hornem.	P	+	+
Всего: 105		73	97
Notes: * – P – perennial, A – annual, Sw – seasonal winter, Ss – seasonal summer; ** – data of other scientists [2 – 4]			

Species diversity of *Ceramium* and *Polysiphonia genus* and some coralline red algae has been increased in comparison with last century 60-70th [5, 6]. Besides floristic changes, a number of species with short vegetation cycle has increased (Fig.) especially it concerns seasonal summer and annual macroalgae (from 16,9 up to 20,2% and from 40 up to 42,7%). At the same time perennial species decreased their contribution in the ecosystem (from 38,5 down to 32,6%) causing deterioration of ecological conditions.

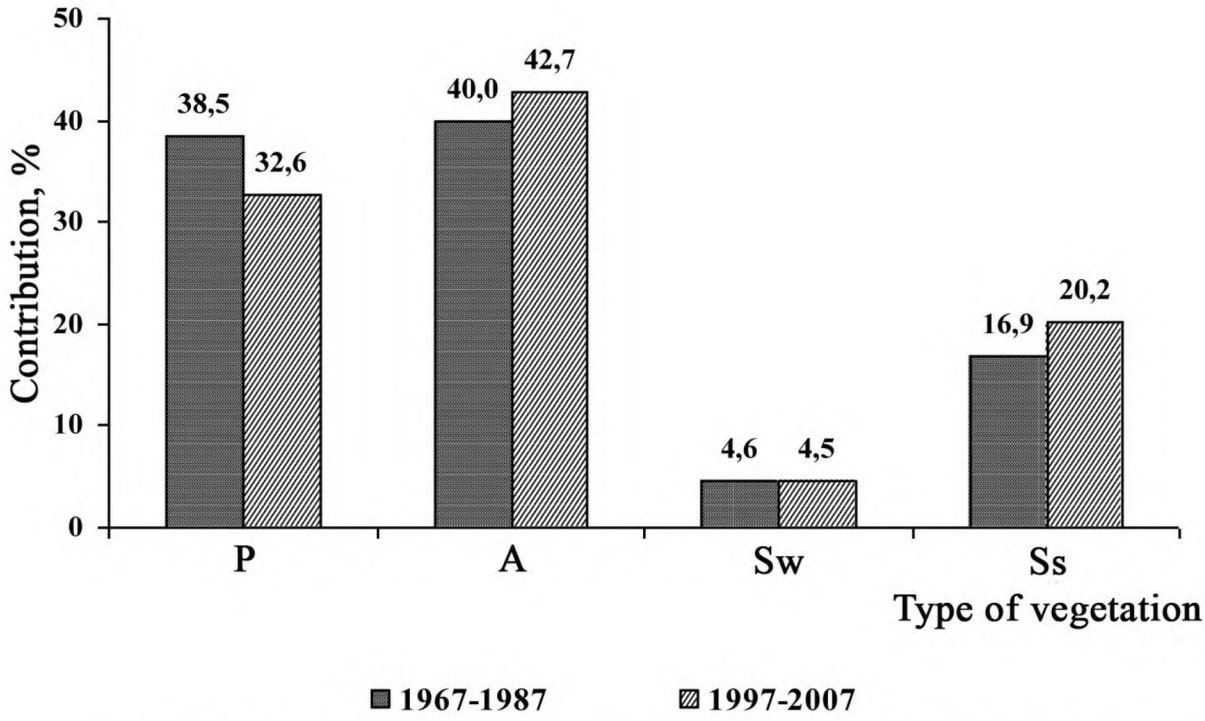

Fig. Long-term changes in contribution ratio of species with different vegetation type within algal flora, Kazachya bay (1967 – 2007)

Algal flora contains 16 rare and protected in the Black Sea species [7, 11, 12] as follows: 4 species of Ulva latissima (*Cladophora dalmatica, Cl. vadorum, Cladophoropsis membranacea, Codium vermilara)*, 7 Porphyra gen. (*Chroodactylon ornatum*, *Eupogodon apiculatus*, *Laurencia coronopus*, *Osmundea hybrida*, *O. pinnatifida, Phyllophora crispa*, *Stylonema alsidii*) and 5 Phaeophyceae (*Cladostephus spongiosus*, *Cystoseira barbata, C. crinita*, *Dictyota dichotoma*, *Stilophora tenella*). Moreover *Zostera marina* and *Z. Noltii* are protected and included into the Black Sea Red Data Book [12].

Therefore 17,1% of macrophytes in Kazachya bay are protected species that emphasises originality of this water body and its nature conservation significance. Results of ecological and floristic analysis have been included into scientific basis concerning wildlife preservation territory increasing due to bay water area and its status change into general biological [1]. Actual task is to develop effective natural conservation measures aimed at maintenance of the unique flora within the wildlife preserve, a centre of biological organization "Gerakleisky" belonged to the Crimean maritime ecological system [9].

Conclusions

1. 105 species present macrophyte flora of Kazachya bay: Chara– 1, Ulva latissima – 28, Porphyra gen. – 50, Phaeophyceae – 20, higher plants – 6.
2. 18 macrophyte species of the Black Sea basin are protected (17,1%), one of them, *Zostera marina* was included into Berne Convention (1979).
3. In recent decades in algaflora of Kazachya bay a number of species with short vegetation cycle has increased especially it concerns seasonal summer and annual macroalgae (from 16,9 up to 20,2% and from 40 up to 42,7%). At the same time perennial species decreased their percentage in the ecosystem (from 38,5 down to 32,6%) causing deterioration of ecological conditions.

4. Taking into consideration importance of Kazachya bay flora, it was recommended to change wildlife preserve status and make it general biological, increase its territory due to water area and work out a management-plan for development of the protected object.

Gratitude

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Milchakova N.A., Ryabogina V.G. Floristic diversity of macrophytes in Kazachya bay (the Crimea, the Black Sea) // Bull. of the State Nikit. Botan. Gard. – 2015. – № 114. – P. 16-22

The article presents an annotated list of macrophytes in Kazachya bay water area, which is going to be included into the state general zoological wildlife reserve "Buhta Kazacha". Species composition of macroalgae and higher plants corresponds to archives (1967 – 1980), published information and results of hydrobotanical surveys (1997-2007), according to actual taxonomic inspection and nomenclatural changes. It was pointed a cozoological importance of macrophyte flora in Kazacha bay. This work contains a checklist of rare macroalgae and discussion relative to increasing the reserve territory due to adjacent water area.

Key words: *macrophytes, species composition, long-term dynamics, rare species, wildlife preserve, Kazachya bay, the Black Sea.*

PLANT BIOCHEMISTRY

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BIOLOGICALLY ACTIVE SUBSTANCES OF CUPRESSUS TORULOSA D. DON

Nadezhda Yurjevna Marchuk, Anfisa Yevgenjevna Paliy

Nikitsky Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, Yalta, urban village Nikita
marchuk_n@i.ua

Introduction

Essential oil is a complicated mixture of terpenoids and other components, isolated out of different parts of a plant; essential oils are used extensively in food, aromatic and pharmaceutical industries. As synthetic chemical substances are quite dangerous for health, usage of natural oils is getting popular that causes further flora investigation [10].

Bhutan Cypress (*Cupressus torulosa* D. Don, sin. *Cupressus tonkinensis* Silba, Himalayan Cypress) is an evergreen tree by height 40 m [8]. Preferable soil is limestone. It is a frost-resistant plant. For the Crimea this species was introduced by seeds from Hamburg in Nikitsky Botanical Gardens (NBG) in 1842. In the end of the XX century it was introduced on the Black sea Coast of the Caucasus. It belongs to category of park trees that`s why it`s mostly spread in the regions with sufficient amount of precipitation: south of France, Portuguese, Spain, north of Italy [3].

The objective of our researches was to study biologically active substances being contained in *Cupressus torulosa* D. Don for further usage in medicine. With this purpose a dynamic of total content of essential oils, phenol compounds and ascorbic acid in needles and cones during annual vegetation cycle was investigated, as well as component composition of essential oil having a maximum content of substances mentioned-above.

Objects and methods of the research

The researche was carried out at the laboratory of Biochemistry, biotechnology and virology of plants in NBG-NSC in 2013. Needles and cones of *Cupressus torulosa* D. Don were chosen as an analyzing material, collected within Arboretum of NBG-NSC.

Determination of an essential oil mass concentration was conducted by its distillation with water vapor out of a row material and further measurement of volume. Content of oil was expressed in volume weight percentage in terms of absolutely dry material [2]. The essential oil composition was determined by chromatograph Agilent Technology 6890 with mass spectrometric sensor 5973. Water heater HP-1 by length 30 m, inside diameter is 0,25 mm. Thermostat temperature was coded in range of 50°C - 250 °C with velocity 4°C /min. Injector