

HALOPHYTIC VEGETATION OF THE SOUTHERN COAST OF THE PECHORA BAY

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The article presents the results of geobotanical studies of coastal halophytic vegetation found on the southern coast of the Pechora Bay of the Barents Sea. The classification is identified in the framework of the ecological-phytocenotic (dominant) approach, and represented by 11 plant associations, including 2 subassociations, belonging to 10 formations. The syntaxa are identified on the basis of 94 original geobotanical relevés; the plot sites were laid out in the communities homogeneous in composition and structure. In the article, the classification is limited to two leading syntaxonomic units: 1. “formation” – distinguished by edifier plant; 2. “association” – distinguished by the dominant species of the upper and lower storey, which were defined as the “diagnostic” category. To distinguish between communities of different biotopes, the following vegetation categories were used in the classification: beaches, saline and brackish marshes, brackish waterbodies in marshes, ecotone zones between marsh and dwarf-shrub tundra. On sandy beaches, plant communities of two associations were identified: *Leymetum arenarii honckeniosum diffusae* and *Leymetum arenarii lathyretosum japonicii*. Saline marshes are covered with halophytic vegetation of the next associations: *Caricetum subspathaceae potentillosum egedae*, *Caricetum glareosae potentillosum egedae*, *Festucetum rubrae potentillosum egedae*, *Caricetum mackenziei*. The communities of associations *Rumexeta aquaticus*, *Glycerietum fluitantis*, *Arctophiletum fulvae* are typical of brackish marshes. Small brackish lakes are occupied by *Hippuridetum tetraphyllae* communities. In the ecotone zones between marsh and dwarf-shrub tundra, *Salicetum reptantis parnassiosum palustris* communities are found. The syntaxa described for marshes within the dominant approach were compared with the data on previously published syntaxa of the marshes of the Bolshezemelskaya tundra, identified within the floristic approach. The communities of *Glyceridetum fluitantis* association were described for the first time for the Pechora Bay, namely at the mouth of the Khylichuyu River. Since these communities are rare in the tundra zone of the Nenets Autonomous Okrug, we recommend to put them under protection within the territory of the Pakhanchensky Nature Reserve. Classification of the vegetation of marshes and beaches at the mouth of the Dresvyanka River is given for the first time. The article expands information on the composition and structure, ecology and distribution of communities of beaches of the *Leymeta arenarii* formation, of march communities of the *Caricetum subspathaceae*, *Caricetum glareosae*, *Festucetum rubrae potentillosum egedii*, and *Hippuridetum tetraphyllae* associations.

Keywords: halophytic coastal vegetation, classification, habitat, tidal estuary, Pechora Bay

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REFERENCES

- Adam P. 1993. Saltmarsh Ecology. Cambridge. 476 p.
Babina N.V. 2002. Vegetation the halophytes of the western coast of the White Sea. – Vegetation of Russia. 3: 3–21 (In Russ.).
<https://doi.org/10.31111/vegrus/2002.03.3>.

- Bakker J.P. 2014. Ecology of salt marshes. 40 years of research in the Wadden Sea. Leeuwarden the Netherlands. 53 p.
- Bliss L.C., Svoboda J. 1984. Plant Communities and Plant Production in the Western Queen Elizabeth Islands. — *Holarctic Ecol.* 7 (3): 325–344.
<https://doi.org/10.1111/j.1600-0587.1984.tb01137.x>
- Dubyna D.V., Dzyuba T.P. 2009. Syntaxonomic diversity of vegetation of the Dnieper mouth region III Class Phragmito-Magnocaricetea Klika Klika et Novak 1941. Orders Magnocaricetalia Pignatti 1953 and Nasturtio-Glycerietalia Pignatti 1953. — *Vegetation of Russia*. 13: 15–36 (In Russ.).
<https://doi.org/10.31111/vegrus/2009.14.15>
- Ellenberg H., Weber H.E., Düll R., Wirth W., Werner W., Paulißen D. 1992. Zeigerwerte von Pflanzen in Mitteleuropa. 2 Aufl. Scripta Geobot. 18. P. 1–258.
- Golub V.B., Sokolov D.D., Sorokin A.N. 2003. Primoskie rastitel'nye soobshchestva Kandalakshskogo zapovednika i prilgayutshchikh territoriy [Coastal plant communities of Kandalaksha reserve and adjacent territories] — *Zapovednoye delo*. 11: 68–86. (In Russ.).
- Grokhlina T.I., Khanina L.G. 2015. O komp'yuternoy obrabotke geobotanicheskikh opisaniy po ekologicheskim shkalam [On computer processing of geobotanical descriptions on ecological scales]. — In: *Matematicheskoye modelirovaniye v ekologii: Materialy 4-yatsional'noy nauch. konf. s mezhdunarodnym uchastiyem*. Pushchino. P. 63–64 (In Russ.).
- International Plant Names Index. Available at: <http://www.ipni.org/index.html/> (accessed 27.04.2021).
- Kafanov A.I., Ivanova M.B., Koltypin M.V. 2004. Sostoyaniye uzuchennosti litorali rossiiskikh dal'nevostochnykh morey [The state of knowledge of the intertidal of the Russian Far Eastern seas]. — *Biologia morya*. 30 (4): 320–330 (In Russ.).
- Kaplin P.L., Leont'ev, O.K., Lukianova S.A., Nikiforov L.G. 1991. Berega [Coasts]. Moscow. 479 p. (In Russ.).
- Korolyova N.E., Chinenko S.V., and Sortland E.B. 2011. Community marches, beaches and the coastal floodplain ephemerum Murmansk, Terskiy and kandalakshskiy East coast (Murmansk oblast'). — *Phytodiversity of Eastern Europe*. 9: 26–62 (In Russ.).
- Korchagin A.A. 1935. Rastitel'nost' morskikh allyuviyev Mezenskogo zaliva i Cheshskoy guby (luga i lugovyye bolota) [Vegetation of marine alluvium of the Mezen Bay and of the Cheshskii Bay (meadows and meadows marshes)]. — *Tr. Botanicheskogo in-ta AN SSSR. Ser. 3. Geobotanika*. T. 2. P. 223–333 (In Russ.).
- Lavrinenko O.V., Lavrinenko I.A. 2018. Classification of salt and brakish marshes vegetation of the Bolshezemel'skaya tundra (Barents Sea coastal). — *Phytodiversity of Eastern Europe*. 12 (3): 82–143 (In Russ.).
<https://doi.org/10.24411/2072-8816-2018-10028>
- Lavrinenko O.V., Petrovskii V.V., Lavrinenko I.A. 2016. Local flora of the Islands and the South-Eastern coast of the Barents Sea. — *Bot. Zhurn.* 101 (10): 1144–1190 (In Russ.).
<https://doi.org/10.1134/S0006813616100033>
- Leont'ev O.K., Nikiforov L.G., Saf'yanov G.A. 1975. Geomorfologiya morskikh beregov [Geomorphology of sea coast]. Moscow. 336 p. (In Russ.).
- Leskov A.I. 1936. Geobotanical sketch of coastal meadows Malozemelsky coast of the Barents Sea. — *Bot. Zhurn.* 88 (2): 96–116 (In Russ.).
- Martynenko V.A., Gruzdev B.I., Kanev V.A. 2008. Lokal'nye flory tayozhnoy zony Respubliki Komi [Local flora of the taiga zone of the Komi Republic]. *Syktvykar*. 76 p. (In Russ.).
- Matveeva N.V. 1998. Zoning in the vegetation cover of the Arctic. St. Petersburg. 220 p.
- Matveeva N.V., Lavrinenko O.V. 2011. Vegetation marshes North-East of the Malozemelskaya tundra. — *Vegetation of Russia*. 17–18: 45–69 (In Russ.).
<https://doi.org/10.31111/vegrus/2011.17-18.45>
- Miskevich I.V. 1998. Hidrologo-gidrokhimicheskaya kharakteristika ust'ya reki Dresvyanki (Pechorskaya guba Barentseva morya) [Hydrological-hydrochemical characteristics of the mouth of the river Dresvyanka (Pechorskaya Guba, Barents sea)]. — In: *Evropeyskiy Sever Rossii: proshloye, nastoyashchee, budushchee*. Arkhangel'sk. P. 110–115 (In Russ.).
- Miskevich I.V., Moseev D.S., Bryzgalov V.V. 2014. Issledovaniya ekosistem estuariy rek Chizha i Chyosha na poluoostrove Kanin [A study of the ecosystems of the estuaries of the rivers Chizha and Chyosha on the Kanin Peninsula]. *Arkhangel'sk*. 108 p. (In Russ.).
- Miskevich I.V., Moseev D.S., Samokhina L.A. 2011. Kompleksnaya ekspeditsiya "Po sledam Pomorov" [Complex expedition "In the footsteps of the Pomors"]. *Arkhangel'sk*. 100 p. (In Russ.).
- Molenaar J.G. 1974. Vegetation of the Angmagssalic district Southeast Greenland. I. Litoral vegetation — *Meddel. Gronland*. 187 (1). 79 p.
- Moseev D.S. 2015. Rastitel'nye soobshchestva poberezhniya Pechorskoy guby Barentseva morya mezhdru ust'yami rek Khylychuyu i Dresvyanka [Vegetation communities of the Pechora Bay coast of the Barents Sea between the mouths of the Khylychuyu and Dresvyanka rivers]. — *Trudy Arkhangel'skogo tsentra Russogo geograficheskogo obshchestva*. Arkhangel'sk. 3: 266–276 (In Russ.).
- Moseev D.S. 2016. Sukcessii primorskikh rastitel'nykh soobshchestv akkumulyativnykh beregov Cheshskoy guby Barentseva morya (na peimere estuaria reki Chyosha) [Succession of coastal plant communities of accumulative shores of the Cheshskii Bay the Barents Sea lip (by the example of the Chyosha river estuary)]. — In: *Kompleksnyye issledovaniya prirody Shpicbergena i prilgayushchego shelfa*. Murmansk. P. 284–290 (In Russ.).
- Moseev D.S. 2017. Nekotorye osobennosti razvitiya marsevykh beregov Belogo i Barentseva morey [Some peculiarities of the development of the main shores of the White Sea and the Barents Sea]. — In: *Morskaya (Shkola) geologiya*. Moscow. P. 245–249 (In Russ.).
- Moseev D.S., Sergiyenko L.A. 2016. Vegetation cover of brackish tidal mouths of small rivers of the South-East of the Dvin Bay of the White Sea. — *Uchenye zapiski PetrGU*. 2 (155): 25–37 (In Russ.).
- Moseev D.S. 2019. Rastitel'nost' antropogennykh mestobitaniy v cherte ust'ya reki Dresvyanka (Pechorskaya

- guba) [Vegetation of anthropogenic habitats within the mouth of the dresvyanka river (Pechora Bay)]. – In: *Ecologicheskie problemy promyshlennykh gorodov*. Saratov. P. 305–309 (In Russ.).
- Moseev D.S., Sergienko L.A. 2020. Coastal vegetation of the river estuaries of the Kanin peninsula. – *Vegetation of Russia*. 39: 47–74 (In Russ.).
<https://doi.org/10.31111/vegrus/2020.39.47>
- Nauchno-prikladnoy spravochnik po klimaty SSSR. Mno-goletnie dannye. Arkhangelsk and Vologda regions, Komi ASSR. Kniga 1. Mnogoletniye dannye [Scientific and applied guide to the climate of the USSR. Arkhan-gelsk and Vologda regions, Komi ASSR. Book 1. Multi-year data]. 1989. Ser. 3. Parts 1–6. Vol. 1. Leningrad. 484 p. (In Russ.).
- Neshataev V.Yu. 2001. Proekt of the All-Russian code of phytosociological nomenclature. – *Vegetation of Rus-sia*. 1: 62–70 (In Russ.).
<https://doi.org/10.31111/vegrus/2001.01.62>
- Neshataeva V.Yu., Neshataev V.Yu., Korablev A.P., Kuz'mina E.Yu. 2014. Vegetation of coastal salt marshes of the gulf of Korf (Olutorsky district, Kamchatka territory). – *Bot. Zhurn.* 99(8): 868–894 (In Russ.).
<https://doi.org/10.1134/S1234567814080023>
- Nordhagen R. 1954. Studies on the vegetation of salt and brackish marshes in Finmarc (Norway). – *Vegetatio*. 5: 381–394. <https://doi.org/10.1007/BF00299592>
- Ogorodov S.A. 2003. Berega [Coasts]. – In: *Pechorskoe more sistemnye issledovaniya: gidrofizika, gidrologia, optika, biologiya, khimia, geologiya, ekologiya, sotsio-ekonomicheskie problemy*. Moscow. 502 p. (In Russ.).
- Oksanen J., Blanchet F., Friendly M. et al. 2017. *Vegan: Community Ecology Package*. R package version 2.4–4.
- Rebristaya O.V. 2013. *Flora poluostrova Yamal. Sovremen-noye sostoyanie i istoria formirovaniya* [Flora of the Yamal Peninsula. Modern state and history of the formation]. St. Petersburg. 312 p. (In Russ.).
- R Core Team (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical.
- Rieley J., Page S. 1990. Salt marshes and sand dunes. *Ecology of plant communities. A phytosociological account of the British vegetation*. New York. 178 p.
- Safronova I.N., Yurkovskaya T.K. 2015. Zonal regularities of vegetation cover on plains of European Russia and their cartographic representation. – *Bot. Zhurn.* 100 (11): 1121–1141 (In Russ.).
<https://doi.org/10.1134/S0006813615110010>
- Sekretareva N.A. 2004. *Sosudistye rastenya Rossiiskoy Arktiki i sopredelnykh terrytoriy* [Vascular plant of the Russian sector of the Arctic and adjacent territories]. Moscow. 131 p. (In Russ.).
- Sergienko L.A. 2008. *Flora i rastitel'nost' poberezhnykh Ros-siyskoy Arktiki i sopredel'nykh terrytoriy* [Flora and veg-etation of the coasts of the Russian Arctic and adjacent territories]. Petrozavodsk. 225 p. (In Russ.).
- Shishov L.L., Sokolov I.A. 1989. Genetic classification of the USSR soils. – *Pochvovedenie*. 4: 112–120 (In Russ.).
- Sorokin A.N., Golub V.B. 2007. Plant communities of the Union Matricarion maritimi all. nov. on the shores of the Northern seas of European Russia. – *Phytodiversity of Eastern Europe*. 2: 3–16 (In Russ.).
- Thannheiser D. 1975. Biobachtungen zur Küstenvegetation auf der westlichen kanadischen Arctis-Archipel. – *Polarforsch.* 45(1): 116.
- Thannheiser D., Hellfritz K.-P. 1989. Die Vegetation der Salzwiesen auf den Quenn Charlotte Islands (Westkanada). – *Essener. Geogr. Arbeiten*. Paderborn. 17: 153–175.
- Thannheiser D. 1991. Die Küstenvegetation der arktischen und borealen Zone. – *Ber. d. Reinh.-Tüxen-Ges.* 3: 21–42.
- The Plant List. Available at: <http://www.theplantlist.org/> (accessed 09.04.2020).
- Tzvelev N.N., Probatova N.S. 2019. *Grasses of Russia*. Moscow. 646 p. (In Russ.). Species and communities in extreme environments. *Festschrift towards the 75th Anniversary and a Laudatio in Hnor of Academician Yuri Ivanovich Chernov*. 2009. Moscow; Sofia. 494 p. (In Russ.).
- Wickham H. 2016. *ggplot2: Elegant Graphics for Data Analysis*. New York.
https://doi.org/10.1007/978-3-319-24277-4_9