Submission of Scientific Information
to Describe Areas Meeting Scientific Criteria for
Ecologically or Biologically Significant Marine Areas

Title/Name of the area: Taman Bay

Abstract

Taman Bay is a shallow semiclosed marine Sea of Azov lagoon without any source of the constant river inflow. It is a unique sea area in the Russian Black Sea and Sea of Azov coast with primary production depends of seagrasses. Biomass of bottom vegetation varies strongly and can exceed 5000 g wet w./m^2, while the macrozoobenthos biomass - 1500 g/m^2. Up to 1 000 000 birds stops on the Bay going through the season migration. The Taman bay wetlands are the wintering area of many species of waterfowl. The site has a significant value as a place of reproduction of waterbird species listed in the Red Book of the Russian Federation and Krasnodar territory. The increase of anthropogenic press (pollution, eutrophication and hydrotechnical building) could lead to negative consequences. The ecosystem of the Bay shows some resilience capacity and a quasi-stable regime.

Introduction

Taman Bay is a shallow semiclosed marine Sea of Azov lagoon without any source of the constant river inflow. It is a unique sea area in the Russian Black Sea and Sea of Azov coast with primary production depends of seagrasses. The north shallowest part of the Bay (Dinskoj Bay) is an important wetland, listed as candidate for the Ramsar Convention List (Krivenko, 2000) and bird area (Bukreev, et.al., 2009). The high anthropogenic press (pollution, eutrophication and hydrotechnical building) could lead to negative consequences to the Bay ecosystem. In the other hand the Bay benthic species mainly euribiontic, therefore the ecosystem is resilient to the impacts (Nesis, 1956).

Location

Taman Bay is a shallow bay of the lagoon type situated between the Sea of Azov and the Black Sea lying to the north of the Taman peninsula (Fig. 1). It opens to the Kerch strait and is classified as a Sea of Azov part (Marine Atlas, 1953). It is isolated from the Kerch strait in the west by the spits Chushka and Tuzla. The Taman Bay is situated in the area of humid subtropical climate (Cfa) of Köppen climate classification (Kottek, et. al., 2006; Peel et.al., 2007; Ulbrich et.al., 2012).

Feature description of the proposed area

Taman bay (Fig.1) is the shallow marine basin without the permanent source of freshwater inflow. It area is about 350 km^2. The maximum depth does not exceed 6 m; the prevailed depths are equal to 4.6-4.8 m (Ignatov, Chistov, 2003). Taman Bay is partly isolated from the Kerch Strait by the Chushka spit and Tuzla spit (Dam) and due to regional currents

(Nesis, 1956, Ovsienko et al., 2008) its water exchange is rather slow. The Bay is divided into two parts by the shallow ridge (the former bay-bar) with mean depth is equal to 1-2 m (Krylenko et. al., 2017). It is the extension of the Rubanova cape in the north and Markitantskaja spit in the south. The partial isolation of the Bay and its shallowness are the factors determining its hydrological regime. The circulation type changed at least twice during the last hundred years (Ivanov, et.al., 2004). The five periods could be-defined (Matishov et al., 2008):

1. The Tuzla spit was a natural barrier for Black Sea current entry to the Bay till 1925.
2. Since 1925 after Tuzla spit destruction by heavy storm and before 1950th.
3. The high salinity and low euthrophication period during 1950th.
4. The lower salinity period during 1956-1975.
5. The high salinity and low euthrophication period during 1970th.
6. The lower salinity period during 1980-2003.
7. The after Tuzla dam construction.

The modern water circulation pattern (after dam construction) in the Bay is of predominately anticyclonic type (Ovsiyenko et al, 2008). It facilitates the accumulation of the suspended matter and pollutants in the central parts of the Bay. Salinity in the Bay is determined primarily by the direction of flow in the Strait (waterflow from Black Sea or Azov) and varies from 13 to 19 ‰ (Ovsiyenko et al, 2008; Al'tman, 1991). The Taman Bay freezes over during cold winters and remains open in the mild winter conditions. It is potentially a stagnant basin especially in its eastern part separated from the western larger part characterized by greater hydrodynamic activity by the sill.

The Taman Bay is situated at the Kerch-Taman mud volcanoes' high activity area at the border of the Crimean and Caucasus orogeny zones. It is potentially oil-and-gas bearing (Shnyukov, et.al. 1986). The coast between the Tuzla spit and the Taman village characterized by abrasion-denudation relief with cliffs of 15-30 m height. It is flatten at the rest of the Bay. The rare scarps situated near Sennoi and Garkushi villages are the historical remains of the ancient Greece polices Phanagoria and Patrasys or denudation forms with soil slip. Taman Bay shore structures and bottom consist of the quaternary sediments (Zenkovich, 1958; Ignatov, Chistov, 2003; Skiba et.al., 1975). The main part of the Bays' bottom is flat and consist of sandy mud with mollusks shells remains.

The Taman Bay is a unique area in the Azov-Black Seas region of Russian Federation due to dense *Zostera spp.* seagrass meadows. Eelgrass, *Z. marina* is the main primary producer of the Bay and the most important ecosystem engineer species. Biomass of bottom vegetation varies strongly and can exceed 5000 g wet w./m^2. The meadows are the spawning site for the various commercial and game fish species. The other main source of primary production is *Phragmites* sp, *Stuckenia pectinata*, *Chara* sp. The ultrashallow northern (Dinskoi Bay) and eastern shore zones of the Bay vegetated by *Phragmites* sp. crops (fig 2.) And the important bird areas "Taman" location is connected to *Phragmites* sp. crops and salt marshes along the south-eastern "inner" part of Chushka spit (Krivenko, 2000).

Bivalves and polychaetes are dominant macrozoobenthic groups in the Taman Bay. The most abundant species of macrozoobenthic assemblages are bivalves *Cerastoderma glaucum, Anadara kagoshimensis, Barnea candida, Mytilus galloprovincialis* and *Nephthys*

hombergii (Golovkina, Nabozhenko, 2012; Spiridonov et al., 2016). The macrozoobenthos biomass varies from 12 in *Charales* sp. shallow habitat to 1500 g/m^2 in *Zostera* sp. belt (Spiridonov et al., 2016; Kolyuchkina, unpubl.) The abundance varies from 15 at most shallow sites with nearly monospecies *Hydrobia acuta* assemblages to 60000 spec/m^2 in ultrashallow habitat at reed (*Phragmites* sp.) wetlands along the eastern coast of Chushka spit (Spiridonov et al., 2016).

Bivalve *Anadara kagoshimensis* is the invasive species from the western Pacific (Simakova et al., 2013). Another invaders, bivalve predator whelk *Rapana venosa* and *Mnemiopsis leidyi*, appears not to be abundant in the Taman Bay (Golovkina, Nabozhenko, 2012; Spiridonov et al., 2016; Biryukova, 2016) in contrast to adjacent Kerch Strait (Fashuk et al., 2012) and Black Sea (Bondarev et al., 2013). This makes the Bay not only an important wetland, listed as a candidate for the Ramsar Convention List (Krivenko, 2000), but also a prospective area for comparative studies of alien species biology.

Up to 1000 000 birds stops on the Bay going through the season migration. The Taman bay wetlands are the wintering area of many species of waterfowl. Its importance increases during the cold winters when the other wetlands and lakes of the Azov region become iced. The number of waterfowls varied from 8 000 ind. (in 2005) to 49 500 ind, during the midwinter inventory (Tilba et.al., 2006). During the previous period (1967-1972) the number of wintering waterbirds achieved 250 000 ind.

The site has a significant value as a place of reproduction of waterbird species listed in the Red Book of the Russian Federation and Krasnodar territory: the common shelduck (*Tadorna tadorna*), Oystercatcher (*Haematopus ostralegus longipes*), sea plover (*Charadrius alexandrinus*), little tern (*Sterna albifrons*). On the islands along the inner part of Chushka spit the big colonies of Common Cormorant (*Phalacrocorax carbo)* in total number of 750 pairs, of Common Tern (Sterna hirundo) - 300 pairs, Sandwich Tern (Thalasseus sandvicensis) - 300 pairs are situated (Tilba et.al., 2006).

The Taman Bay and the surrounding area are the habitat and wintering spot for a number of common, rare and protected species of birds (Tilba et.al., 2006):

Black-throated Diver (*Gavia arctica*). Regular occurrence during the migrations in small numbers in the winter.

White-tailed Eagle (*Haliaeetus albicilla*). Regularly wintering species.

Demoiselle crane (*Anthropoides virgo*). Nesting species adjacent territories.

Greate Bustard (*Otis tarda*). Nesting species in adjacent territories.

Little Bustard (*Tetrax tetrax*). Recorded in winter nearshore.

Oystercatcher (*Haematopus ostralegus*). Common breeding species; rare, irregular wintering species.

Eurasian Curlew (*Numenius arquata*). Regular occurrence in winter.

Black-headed gull (*Ichthyaetus ichthyaetus*). Occasionally observed in winter.

The resident population of bottlenose dolphin (*Tursiops truncatus*) inhabits the water area of Taman and Dynskoy bay and adjustment Kerch straight (Gladilina et al., 2016).

Feature condition and future outlook of the proposed area

The benthic ecosystem of the Taman Bay has not undergone a dramatic changes

(Golovkina, Nabozhenko., 2012) comparing to the ecosystem of the Black Sea (Chikina, Kucheruk, 2005), Sea of Azov (Matishov et al., 2008) and the Kerch Strait (Panov et al., 2011; Fashuk et al., 2012). In a greater time scale, in spite of significant changes of climate, sea level hydrological regime the present dominant species in the benthic communities such as *Cerastoderma glaucum* and *Abra ovata* persisted over last 6000 years (Fouache et al., 2005). It may be concluded that the Taman Bay ecosystem is characterized by the presence of quasi-stable regime. As a result of critical events, instead of a regime-shift, a change in the abundances of the species is observed, with a successful return to the initial state when the disturbance decreases (Nesis, 1956).

The area is under significant anthropogenic pressure: Tuzla dam construction and changes in hydrological regime during XX century due to Don and Kuban rivers discharge control lead to changes in currents of the Bay (Ovsienko et al., 2008; Matishov et al., 2008); the 2007 oil spill and constant local anthropogenic pollution (Belyaev et al., 2009) are dangerous for the birds and fishes, but benthic communities show a certain level of resistance (Spiridonov et al., 2016). The climate change (aridization) is also a prominent factor for the Taman Bay ecosystem functioning, but not as dramatically as for the Azov Sea (Matishov et al., 2008). Shipping in the adjacent Kerch Strait is the major actual and potential threat that includes permanent chronic pollution and fuel and hydrocarbon cargo spills, such as the MS Volgoneft 139 spill in November 2007 (Oil spill accident in the Kerch…, 2011; Kolyuchkina et al., 2012). This area is especially vulnerable to these impacts, as it is home to important biological phenomena, including season stop of seabirds and fish spawning sites. Other threats include municipal discharges and growing tourism that may lead to increase nutrient loading.

Assessment of the area against CBD EBSA Criteria

CBD EBSA Criteria (Annex I to decision IX/20)	**Description** (Annex I to decision IX/20)	**Ranking of criterion relevance** (please mark one column with an X)			
		No information	**Low**	**Medium**	**High**
Uniqueness or rarity	Area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features.				x
The Taman Bay is tectonically active area with a number of mud volcanoes. This makes the Bay a unique shallow water area for studies of biological processes associated with mud volcanoes activity and a valuable site for educational tourism. The Taman Bay is the only place on the Russian Azov and Black Sea coast where the eelgrass					

Zostera marina forms extensive meadows. Two invaders causing the ecosystem shifts in Black and Azov seas benthic predator *Rapana venosa* and planctonic predator *Mnemiopsis leidyi*, appears to be rare in the Taman Bay (Golovkina, Nabozhenko, 2012; Spiridonov et al., 2016; Biryukova, 2016) in contrast to the adjacent Kerch Strait (Fashuk et al., 2012) and the Black Sea (Bondarev et al., 2013). This makes the Bay not only an important wetland, but also a prospective area for comparative studies of alien species biology. Some rare species are present in the Bay: bivalve *Loripes lucinalis* and *Irus irus* (Golovkina, Nabozhenko, 2012). The *L. lucinalis*, *Zostera* spp. and chaemotrophic bacteria form a unique three-component symbiosis (van der Heide et al., 2012). Some species known as endemic species of the Black Sea – Azov basin are present in the Bay, i.e. polychaete *Eteone picta* (Kiseleva, 2004; Syomin, 2011).					
Special importance for life-history stages of species	Areas that are required for a population to survive and thrive.				X
The Taman Bay is a critical habitat for eelgrass (*Zostera marina*) that supports abundant population of this species, highly important for maintaining coastal ecosystem. As a productive shallow area the Bay plays an important role as a spawning and nursery area for several fish species. The importance of the Taman Bay for waterfowl has been long time recognized. Up to 1000 000 birds stopover in the Bay during seasonal migrations. The Taman Bay wetlands are the wintering area of many species of waterfowl. Its importance increases in cold winters when the other wetlands and lakes of the Azov region becomes iced. According to midwinter censuses the number of waterfowls varied from 8 000 (in 2005) to 49 500 (Tilba et.al., 2006). During the previous period (1967-1972) the number of wintering waterbirds achieved 250 000. Wintering of some species is of particular interest: Black-throated Diver (*Gavia arctica*), Eurasian Curlew (*Numenius arquata*). On the islands along the inner part of Chushka spit significant colonies of Common cormorant (*Phalacrocorax carbo)*, with a total number of 750 pairs, of Common tern (Sterna hirundo) - 300 pairs, Sandwich tern (*Thalasseus sandvicensis*) - 300 pairs are located (Tilba et.al., 2006). Other important bird species nesting in the adjacent territory include Demoiselle crane (*Anthropoides virgo*), Greate bustard (*Otis tarda*), Little bustard (*Tetrax tetrax*)					
Importance for threatened, endangered or declining species and/or habitats	Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species.			x	
This is an important nesting site for waterbird species listed in the Red Data Books of the					

Russian Federation and the Krasnodar Region: common shelduck (*Tadorna tadorna*), oystercatcher (*Haematopus ostralegus longipes*), sea plover (*Charadrius alexandrinus*), little tern (*Sterna albifrons*) (Tilba et.al., 2006). Some other endangered shore birds, including great black-headed gull *Ichthyaetus ichthyaetus*, white-tailed eagle (*Haliaeetus albicilla*) (Red Data Book of the Russian Federation)occur in the area in winter(Tilba et.al., 2006).					
Vulnerability, fragility, sensitivity, or slow recovery	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.			x	
Climate change at a regional scale influenced water circulation pattern, horizontal transfer and vertical mixing, pelagic and benthic ecosystem structure, biodiversity, biological production, and pollution level (Vinogradov et al., 2000; Llope et al., 2011). Climatic changes and shipping development facilitate alien species introductions, which in some cases become real invasions with far reaching consequences (Bologa et al., 1995; Zaitsev, Oztürk, 2001). Geologically young ecosystems with low species diversity such as those in the Black Sea and the Sea of Azov are generally vulnerable to these changes. The benthic basis of the Taman Bay ecosystem appears to have a quasi-stable regime owing to the dominance of species that are tolerant to a wide range of environmental characteristics (Nesis, 1956; Spiridonov et al., 2016). Their populations may decline in response to environmental stress but have a potential to recover (Nesis, 1956; Kolyuchkina et al., 2016). However, the ecosystem of the Taman Bay is vulnerable to particular impacts. Ship accidents and oil spills in the neighboring Kerch Strait have been shown to have a significant short term effect on the ecosystem even if a moderate portion of spill enters the Bay, as it has happened after the Volgoneft 139 wrecking in 2007 (Kolyuchkina et al., 2012; Spiridonov et al., 2016). However, biodegradation of oil pollution was rapid (Sapozhnikov et al., 2013), yet in 2009 no traces of oil spill As the Bay is a seasonal stopover of water and coastal birds their concentrations are extremely vulnerable to oil spills. Water birds were particularly affected by the black oil spill after wrecking MS Volnoneft 139 in November 2007 (Matishov et.al., 2013). Declining of the reed area will lead to changes of birds migration paths. Hydrotechnical construction, like the Tuzla dam or the Kerch Strait bridge, could lead to circulation changes in the Bay. As a result the eutrophication, enrichment of organic carbon, increasing pollution load and/or changes hydrological regime of stagnation Bay waters witp potential to suffocation, siltification and degradation of *Zostera* meadows. This also could lead to changes of fish migration paths, than fish will avoid Taman Bay. Although the Taman Bay ecosystem shows some resilience capacity to eutrophication (see Naturalness) further increase of recreation and tourism may lead to higher nutrient load and a serious threat to water transparency and eelgrass meadows.					
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity.				X

The bottom vegetation of Taman and Dinskoy Bay is formed by highly productive dense meadows of *Zostera* spp. *Stuckenia pectinata*, *Zannichellia* sp., *Ruppia* sp., *Lamprothamium papulosum* and *Chara* spp. Only the *Zostera marina* L. meadows (inhabiting the depth range 2-3.5 m) are perennial. The biomass of eelgrass may be as high as 300 - 850 g dry w. /m^2 (ca. 3000- 7000 g wet w. /m^2) (Simakova, unpubl.). The biomass of shallow water (0.5 – 2 m depth) macrophyte communities of Taman bay exceeds 300 g dry w. /m^2 in midsummer. This organic matter is produced annually during vegetation season and degrades in winter (Simakova, unpubl.) These rates correspond to the maximum of bottom vegetation biomass values of the Black sea (Milchakova, 1999).					
Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.		x		
The total number of macrobenthic animal species found in the Taman Bay in 2003-2013 comprised just 30% (Kolyuchkina et al., 2016) of the macrozoobenthic fauna (329 species) listed for the Sea of Azov (Volovik et al., 2010). The Bay ecosystem includes at least eight biotopes types (fig. 2, Belyaev et al., 2009) and macrozoobenthic assemblages are distinguished by the abundance of particular species, and to less extent by species composition (Kolyuchkina et. al., 2016).					
Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.		x		
The shores of the Taman Bay have been populated since Paleolitic time. Since 6th century BC the area had been a centre of Greek colonization. The polices of Patrasis, Kepoi, Phanagoria and Hermonasa became important harbors and trade spots. Later they became part of the Kingdom of Bosporus which was conquered by the Kingdom of Pontus which was an important regional power until it was defeated by the then global power of Rome. After that the cities became its satellite states and a trade partners since 10 AD. As the main sediments of the Taman Peninsula shores are sand and clay, and natural limestone is limited to few spots (Fouache et al., 2005) the antique economic life has created a unique seascape of the Taman Bay with nearly all hard substrates being of cultural origin i.e. either ancient Greek stone constructions such as ancient piers (Kuznetsov, 2013), or pottery fragments or stone brought as the ship ballast brought from Crimean Peninsula. The civilization of most ancient cities on the Taman Bay shores ended by the 9-10th century AD, but the town of Taman (formerly Hermonasa, subsequent names are Tamatarkha, Samkerts Tmutorokan, and Taman) persisted under the rule of subsequently Khazars, Russian princes, Genovese, Tatars, and finally the Ottoman Empire. However until the region became part of the Russian Empire in late 18th century, the population was unstable. In the last two centuries Taman Peninsula has been an area of intensive agriculture, and later industrial development. Currently the Bay is under the significant anthropogenic pressure. The main impact is related to the shoreline transformation, coastal protection and landscaping near the towns of Taman and Sennoi, Chuska spit and Tuzla spit. The hydrological regime of the Bay changed owing to the artificial enlargement of Tuzla spit. There is an agglomeration of towns and villages on					

the shores that leads to soil erosion and nutrients inflow into the Bay. Several settlements discharge their sewages and wastes in to the Bay. The Bay is situated near the oil trading port (Port-Caucaz) and neighbors to the Kerch strait with intensive ship traffic. On the other hand the northern part of the Bay and the inner part of the Chushka spit including reed (*Phragmites* spp.) crops remain relatively undisturbed. Eelgrass meadows appear to be healthy. Although significant eutrophication is expected, summer nutrient concentrations in the Taman Bay are lower than in the neighboring Kerch Strait (Sapozhnikov et al., 2013), that suggests an effective mechanism of nutrient removal. Thus ecosystem of the Bay shows some resilience capacity and a quasi-stable regime.

References

Al'tman E. N. Hydrodynamics of the Kerch Strait // Gidrometeorologiya i gidrokhimiya morey SSSR. – T. 4. – 1991. P. 291-324. [in Russian]

Belyaev N.A., G.A. Kolyuchkina, E.S. Shapovalova and U.V. Simakova. Investigations of long-term effects of November 2007 Kerch strait black oil spill // Proceedings of the ninth international conference on the mediterranean coastal environment. 2009. Volume 2. (editor - Erdal Ozhan). p. 1107 - 1112.

Biryukova S . Macrozoobenthos communities of littoral part of the Azov sea Taman bay //Nauchnyy al'manakh stran Prichernomor'ya. – 2016. – №. 4 (8). P, 32-39.

Bologa A. S., Bodeanu N., Petran A., Tiganus V., Zaitsev Yu.P. Major modifications of the Black Sea benthic and planktonic biota in the last three decades // Bulletin de l'Institut océanographique, Musée océanographique, Monaco. 1995. P.85-110.

Bondarev I. P. Dynamics of the dominant species of modern facies of the Black Sea//Geologiya i poleznyye iskopayemyye Mirovogo okeana. – 2013. – №. 3 (33) [in Russian]

Bukreyev S. A. et.al. Key ornithological territories of international significance in the Caucasus ecoregion//Importart bird areas of Russia. M.: Soyuz okhrany ptits Rossii. – 2009. – T. 3. –302 p. [in Russian]

Chikina M. V., Kucheruk N. V. Long-term changes in the structure of coastal benthic communities in the Northeastern part of the Black sea: influence of alien species // Oceanology. – 2005. – T. 45.

Fashhuk D.Ja., Flint M.V., Kucheruk N.V. et al. Geography of macrozoobenthos of the Kerch Strait: Dynamic of distribution, structure and indicators of development // Izvestia RAN. Seria geographicheskaya 3. 2012. P. 94-108. [in Russian]

Fouache E., Porotov A., Müller C., Gorlov Y. BolokhovskaiaN., Kaitamba M. 2005. Relative sea-level changes throughout the last 6000 years on the Taman Peninsula (Black Sea, Azov Sea, Russia): a geoarchaeological study // Revista Geomorphologica, 7:P. 7 – 20.

Gladilina E. et al. Individual movements between local coastal populations of bottlenose dolphins (Tursiops truncatus) in the northern and eastern Black Sea //Journal of the Marine Biological Association of the United Kingdom. – 2016. – P. 1-7.

Golovkina E. M., Nabozhenko M. V. Contemporary condition of benthic communities of Kerch strait (the Russian sector) and gulfs of Taman peninsula //Vestnik Yuzhnogo nauchnogo tsentra. – 2012. – T. 8. – №. 2. – P. 53-61.

van der Heide T. et al. A three-stage symbiosis forms the foundation of seagrass ecosystems //science. – 2012. – T. 336. – №. 6087. – P. 1432-1434.

Ignatov Y. I., Chistov S. V. Ecological-geomorphological assessment of the coast and the bottom of the Kerch Strait in connection with the solution of transport problems. //Ekologicheskaya bezopasnost' pribrezhnoy i shel'fovoy zon. – 2003. – T. 8. – P. 163 - 174 [in Russian]

Ivanov V. A., Ignatov Y. I., Chistov S. V. Origin, history of development and dynamics of the Tuzla spit //Ekologicheskaya bezopasnost' pribrezhnoy i shel'fovoy zon. – 2004. – T. 10. – P. 198-206. [in Russian]

Kiseleva M. I. Polychaete worms (Polychaeta) of the Black and Azov Seas // Apatity: Kol'skiy nauchn. tsentr. – 2004. 409 p.

Kolyuchkina G. A. et al. Long-term effects of Kerch Strait residual oil-spill: hydrocarbon concentration in bottom sediments and biomarkers in Mytilus galloprovincialis (Lamarck, 1819) //Turk. J. Fish. Aquat. Sci. – 2012. – T. 12. – P. 461-469.

Kolyuchkina G.A., Spiridonov V.A., Kozlovskiy V.V., Simakova U.V., Basin A.B Long-term changes in the macrozoobenthos of the Taman Gulf of the Azov Sea: analysis of repeated surveys in 1955, 2008 and 2013 //Materialy V mezhdunarodnoy nauchno-

prakticheskoy konferentsii «Morskiye issledovaniya i obrazovaniye». 19-22 oktyabrya 2016 g., Moskva, MGU. S. 324-328.
Kottek M. et al. World map of the Köppen-Geiger climate classification updated //Meteorologische Zeitschrift. – 2006. – T. 15. – №. 3. – P. 259-263.
Krivenko V. G. Wetlands in Russia //Wetlands on the Ramsar Shadow List. – 2000. – T. 3.
Krylenko M., Kosyan R., Krylenko V. Lagoons of the Smallest Russian Sea //The Diversity of Russian Estuaries and Lagoons Exposed to Human Influence. – Springer International Publishing, 2017. – P. 111-148.
Kuznetsov V. 2013. "We confirmed the words of Plutarch" Interview with the leader of the Phanagorian Archeological Expedition. http://lenta.ru/articles/2013/11/19/phanagoria/ 19.11.2013. [in Russian]
Llope, et.al. Overfishing of top predators eroded the resilience of the Black Sea system regardless of the climate and anthropogenic conditions // Global Change Biology, 17(3). 2011. P. 1251-1265.
Matishov G. G. et. al, Long-term changes in the bottom communities of the Sea of Azov in connection with the nature of sedimentation and the hydrological regime // Okeanologiya. – 2008. – T. 48. – №. 3. – P. 425-435. [in Russian]
Matishov G. G., Inzhebeykin YU. I., Savitskiy R. M. The impact on the environment and the biota of oil spills in the Kerch Strait in November 2007// Vodnyye resursy.– 2013. –T. 40.– №. 3.– P. 259.
Marine Atlas / ed. Isakov I.S. Izdaniye glavnogo shtaba voyenno-morskikh sil. T. III. 1953. P. 72. [in Russian]
Nesis K.N. (1956) Donnaja fauna Kerchenskogo proliva. Magister work. M: Moskovskij tehnologicheskij institut rybnogo hozjajstva. [in Russian]
Milchakova N. A. On the status of seagrass communities in the Black Sea //Aquatic Botany. – 1999. – T. 65. – №. 1. – P. 21-31.
Oil spill accident in the Kerch Strait in November 2007. Commission for the protection of the Black Sea against pollution. chief ed. Alexander Korshenko. Moscow. Nauka. 2011.284 p.
Ovsiyenko S.N., Fashchuk D.YA., Zapera S.N. et.al.. Storm on November 11, 2007 in the Kerch Strait: Chronicle of Events, Mathematical Modeling and Geo-Environmental Analysis//Tr. GOIN. 2008. Vyp. 211. P. 308-340. [in Russian]
Panov B. N. et. al.. Oceanographic assessment of the consequences of modern anthropogenic impact on the ecosystem of the Kerch Strait //Uchenyye zapiski Tavricheskogo natsional'nogo universiteta im. VI Vernadskogo. Seriya «Geografiya. – 2004. – T. 24. №1 – P. 109-120. [in Russian]
Peel M. C., Finlayson B. L., McMahon T. A. Updated world map of the Köppen-Geiger climate classification //Hydrology and earth system sciences discussions. – 2007. – T. 4. – №. 2. – P. 439-473.
Sapozhnikov V.V. Arzhanova N.V., Lapina N.M., Agatova A.I., Torgunova N.I., Zozulya N.M., Bondarenko L.G., Vishevsky S.L., Radchenko S.V., Roi V.I., Stolyarski S.I, Polonsky V.E. 2013. Complex ecological studies in Kech Strait and Taman bight after oil spill (2007 – 2010) // Trudy VNIRO, 150. P. 6 –77 [in Russian].
Shnyukov Y. F., Sobolevskiy Y.V., Gnatenko G.I. at.al.. Mud volcanoes of the Kerch-Taman region. Kiyev: Nauk. dumka, 1986. 152 s. [in Russian]
Simakova U.V., Lutaenko K.A., Neretina T.A., Kolyuchkina G.A. The alien Bivalve Anadara kagoshimensis in the Black sea region: genetic analysis/ The 4th Bi-annual Black Sea Conference: 28-31 October 2013, Constanta, Romania Black Sea – Challenges towards good environmental status: abstracts book/ Commission on the protection of the Black Sea against pollution, Ministry of Environment and Climate changes, Romania National Institute for Marine Research and Development, Romania. –

Constanta: Editura Boldas, 2013. p. 104-105.
Skiba S. I., Shcherbakov F. A., Kuprin P. N. To the paleogeography of the Kerch-Taman region in the Late Pleistocene and Holocene // Okeanologiya. – 1975. – T. 15. – №. 5. – P. 862-867. [in Russian]
Spiridonov V.A., Kolyuchkina G.A., Belyaev N.A., Basin A.B.., Kozlovsky V.V. Contemporary state of the macrozoobenthos of the Taman Bay ultrashallow zone //Oceanology. 2016. V. 56. № 2. P. 266-277.
Syomin V.L. Ecological features of the polychaetes of the Sea of Azov and the estuaries of its Russian coast. abstract of PhD thesis of biol. sc. Murmansk: MMRC. 2011. 25 p. [in Russian]
Tilba P. A., Mnatsekanov R. A., Krutolapov V. A. Tamanskiy and Dinskoy bay of the Black sea //Vodno-bolotnyye ugod'ya Rossii. Vodno-bolotnyye ugod'ya Severnogo Kavkaza. – 2006. – T. 6. – P. 71-74.
Ulbrich U. et al. Synoptic climatology of the Mediterranean and trends //The Climate of the Mediterranean Region. From the Past to the Future. Elsevier, Amsterdam, The Netherlands. http://dx. doi. org/10.1016/B978-0-12-416042-2.00005-7. – 2012.
Vinogradov M.Y., et.al. Massovoye razvitiye grebnevika Beroe ovata (Eschscholtz) u severo-vostochnogo poberezh'ya Chernogo morya // Okeanologiya, Vol 1. 2000. P.52-55. [in Russian]
Volovik S.P., Korpakova I.G., Barabashin T.O. at al. Fauna of the water and near water ecosystems of the Azov-Black sea basin. Krasnodar: FGUP AzNIRH. 2010. 249 p.
Zenkovich V. P. Shores of the Black and Azov Seas. – Gos. izd-vo geogr. lit-ry, 1958. [in Russian]
Zaitsev Yu., Ozturk B. 2001. Exotic species in the Aegean, Marmara, Black, Azov and Caspian seas. Zaitsev Yu., Ozturk B. (Eds). Published by Turkish Marine Research foundation, Istanbul, Turkey. 267 pp.

Maps and Figures

Figure 1 Taman Bay location and main geographical denominations

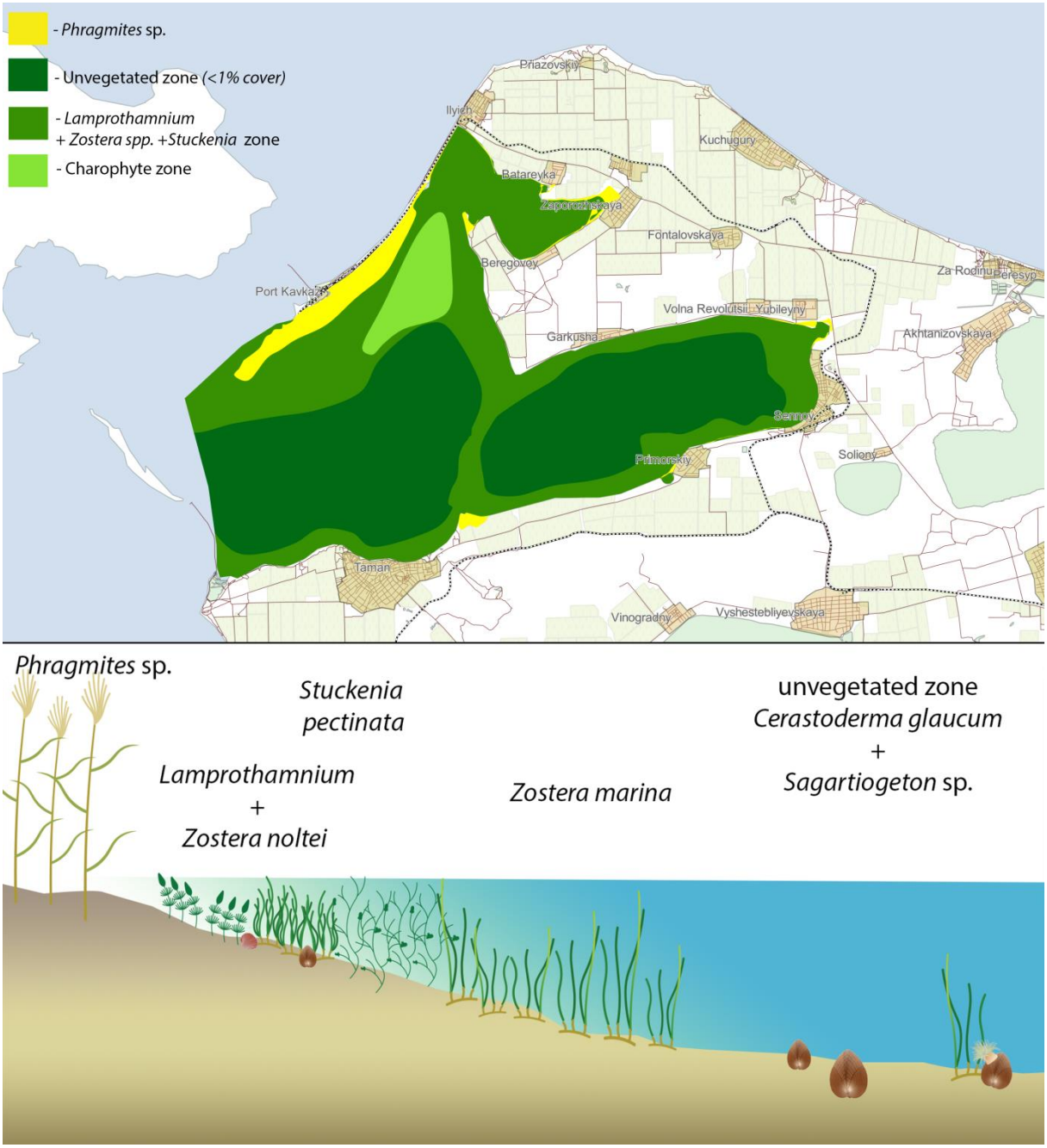

Figure 2 Taman bay bottom vegetation types map and vertical distribution

Rights and permissions