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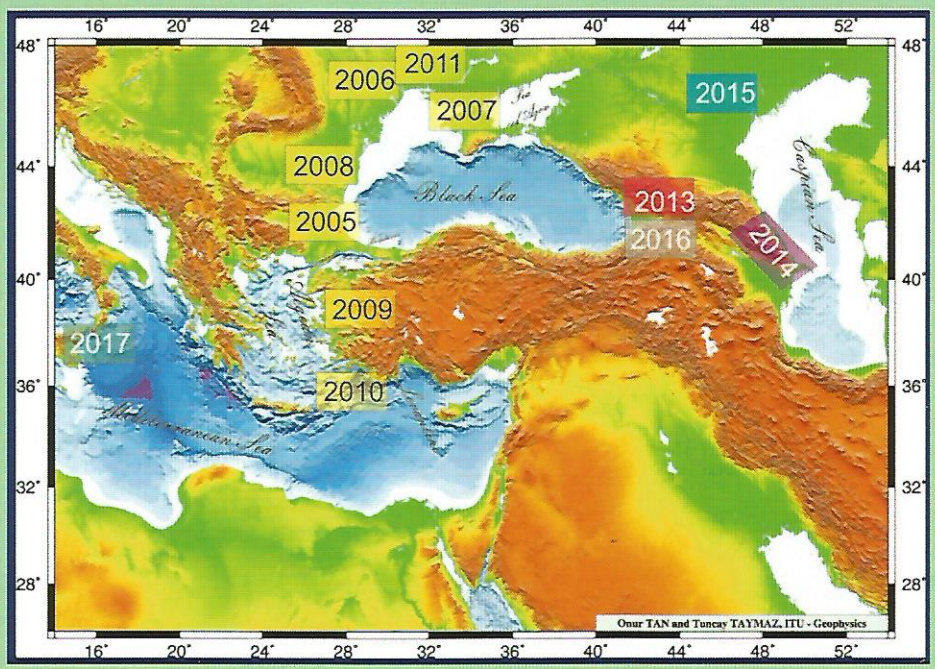

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BIODIVERSITY OF THE VOLGA RIVER DELTA MOLLUSKS IN THE HOLOCENE

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The characteristic feature of the Caspian Sea is its unstable sea level. During the Holocene, it has been fluctuating within a range of almost 50 meters from the Mangyshlak regression to the maximal stage of the Novocaspian transgression. The existing material on sea-level fluctuations allows us to conclude that the main reason for Caspian instability is the climate. At present, the role of human impact has increased greatly. The modern biodiversity of the Caspian Sea and the Volga delta simply reflects a complicated history of paleo-Caspian transgressions and regressions and, recently, human activity. The Holocene Caspian history includes the Mangyshlak regression and several stages of the Novocaspian transgression. The Mangyshlak basin formed about 9.8–6.15 ky ago. The level of this lake was –80 m (Mayev, 2006). Its waters used to cover only depressions of the Middle and Southern Caspian. The Novocaspian transgression maximum emerged approximately 5–6 thousand years ago. The sea level was –19 to –20 m. In the 20th century, it has been fluctuating within the range of almost four meters, approximately from –25 m in the beginning of the century to –29 m in 1977. At the end of the 20th century, sea level soared, and in the beginning of the 21st century, it began to drop again. The Caspian Sea level fluctuations have influenced the development of the Volga delta and the biodiversity of its water basins.

In spite of its geological youth, the Volga delta is a territory with a complex development and very dynamic hydrological and lithodynamic processes. The dominating regime is active accumulation of diverse deltaic deposits. These processes are especially active within the avandelta and the seaward part of the delta. The seaward delta is the youngest land formation of the Volga mouth. It is represented by a low, partly flooded kultuk-delta plain, split by numerous river arms and separated from the avandelta, located to the south, by a migrating marginal sea-land zone. The low plain was recently the bottom of the kultuks, separated by erosional troughs. Its surface is composed of modern kultuk and deltaic sediments that overlie more ancient deltaic and avandeltaic formations. The avandelta is the most dynamic and actively re-forming river-mouth structure of the Volga. It has a southward sloping surface and is composed of deltaic deposits that change facies into shallow-water deposits of the North Caspian Sea. The shoal of the avandelta is characterized by a wide distribution of hygrophytic plants that are closely connected to the silt, silty sand, and siltstone lithofacies. At the depth of 1.5–2 m, the plants disappear, and the sediments become sandier and sorted.

The water salinity is not stable; it changes from 0.5 to 3–5‰ due to Volga runoffs. Many unique Caspian species rarely occur in this part of the Caspian because of low water salinity. Almost all the waters of northern part can be regarded as an oligohaline ecosystem. Factors defining the geographic distribution of mollusks include: salinity, ground and related gas regime of the benthic layer, and distribution and population of the major benthos consumers. Deltaic water bodies of different size and configuration, with diverse hydrological and hydrochemical regimes, and possessing various bottom sediments, are inhabited by different mollusks. The predeltaic part of the Volga is characterized by sandy grounds, relatively deep environments, and current activity. In the psammophilic biocoenosis that inhabits it, there are

rare *Dreissena* among the mollusks. Active branches, pits ("yamas"), and reaches are characterized by silty, sandy grounds with pelo-reophilic biocoenoses of *Sphaerium*, *Viviparus*, *Dreissena*, and *Unio*. Former branches, bays, inlets with a stagnant environment and muddy grounds are inhabited by pelophilic biocoenoses with *Sphaerium*, *Viviparus*, *Anodonta*, and *Unio*.

Grounds covered with macrophytes are occupied by phytophilic biocoenoses. Shallow-water swamps and bogs are characterized by mixed pelophilic-phytophilic molluscan assemblages. Long and narrow ilmens between Baer knolls with muddy lifeless grounds are occupied by single *Unio* and *Anodonta*. Rushy shore fronts are inhabited by abundant terrestrial forms; *Planorbis*, *Physa*. *Dreissena polymorpha*, *Anodonta complanata*, *Sphaerium corneum*, *Pisidium*, *Viviparus viviparus*, and *Valvata piscinalis* are on muddy grounds of bigger ilmens; rare small *Unio pictorum* are on sandy grounds. In shallow-water rushy ilmens with mud and plant remnants, the mollusks *Planorbis* and *Lymnea* occur only in nearshore rushy areas. The poloi zone with plants, hosts a nearshore assemblage with *Lymnea* and *Planorbis*. The lower part of the delta branches with silty, sandy grounds covered with macrophytes is habited by freshwater mollusks: *Dreisena polymorpha*, *Dr. bugensis*, *Theodoxus*, *Viviparus*, *Hydrobia*, *Valvata*, and *Lithoglyphus*; rare Caspian euryhaline species: *Monodacna edentula*, *Adacna laeviuscula*, and *Hypanis plicatus*.

All Caspian species inhabiting the Volga delta are strongly euryhaline (tolerate salinities between 0.3–12‰) and oxiphilic; they prefer silty, sandy grounds and weak currents. *Monodacna colorata* migrated to the Volga delta from Volga reservoirs where it had been previously acclimatized. Kultuks with sandy, silty grounds are characterized by the freshwater mollusks *Unio pictorum*, *Anodonta complanata*, *Viviparus viviparus*, *Valvata piscinalis*, *Sphaerium corneum*, *Pisidium*, *Dreissena polymorpha*, and the euryhaline Caspian mollusks *Monodacna edentula* and *Adacna laeviuscula*. The freshwater prodeltaic area is habited by the freshwater species *Unio pictorum*, *Anodonta complanata*, *Viviparus viviparus*, *Valvata piscinalis*, *Sphaerium corneum*, *Pisidium*, *Dreissena polymorpha*, and euryhaline Caspian mollusks. The slightly brackish-water zone with silty, sandy sediments is characterized by abundant *Dreissena polymorpha*, far less abundant *Monodacna edentula* and *Adacna laeviuscula*. Sandy ground with detritus is characterized by the same molluscan composition but lower abundances. *M. edentula* and *Ad. laeviuscula* predominate in the brackish-water zone.

Comprehensive research of the Damchik section (Astrakhan' Biosphere Reserve) conducted by the authors allowed us to obtain interesting data on the recent history of the modern seaward part of the delta and avandelta of the river Volga. The Holocene malacofauna of the delta includes all modern species except for those that penetrated from the Azov and Black Sea basins by anthropogenic means. The distribution of mollusks in Holocene water bodies of the Delta was similar to that of the modern one. This is the basis for paleoenvironmental reconstructions. The malacofaunistic analysis revealed that the fauna forms specific combinations that characterize different hydrological and eco-facies environments of sedimentation.

During the Mangyshlak regression, the Volga River delta was located at the latitude of the Agrakhan spit. This resulted in active erosion. Two wide channels were formed in the central and eastern parts of the Volga-Akhtuba valley that served as pathways for river discharge. The sequence of deposits with different types of mollusk characterized the water basin changes during the Holocene. The sequence of deposits reflects three large stages of delta development in accordance with Caspian Sea level changes. The small-scale deposit gradation reflects the unstable sea-level condition during each stage (Yanina et al., 2011).

The modern Caspian ecosystem is the result of long-term biological evolution. For a long time, all levels of biodiversity formed and interacted naturally without human influence. The development of human civilization resulted in a strong anthropogenic impact, which interferes with the natural course of events. Humankind has become a powerful external factor destabilizing the processes of the Caspian ecosystem.

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