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# EXPANSION OF THE RANGE OF A NEW INVASIVE SPECIES, *MYTILUS GALLOPROVINCIALIS* (BIVALVIA: MYTILIDAE), IN THE CASPIAN SEA

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The article reports the finding of an invasive species: a bivalve, atypical for the native fauna of the Dagestan coast of the Middle Caspian. Based on conchiological features, this species was identified as *Mytilus galloprovincialis* (Lamarck, 1819). In the autumn of 2024, single living individuals of this new invasive species were recorded on the Dagestan coast of the Middle Caspian near the Samur River mouth and in the Karaman-7 area. In the winter of 2025, those were registered in the Dagestanskie Ogni beach vicinity. In March 2025, 29 mussel shells were found in storm surges on the coast, near the border of Dagestan and Azerbaijan. Most likely, the invader entered the Caspian Sea from the Sea of Azov–Black Sea basin *via* the Volga–Don Canal with ballast waters. Further monitoring of invasions of new molluscs on the Dagestan coast of the Russian sector of the Caspian Sea is needed.

**Keywords:** invasive species, mussel, Dagestan coast, Russian sector of the Caspian Sea

To date, the registered Caspian Sea fauna covers 34 bivalve species [Identification Keys, 2013, Wesselingh et al., 2019].

Adaptation and naturalization of invasive hydrobionts often occur against the backdrop of destabilization of local fauna populations. Therefore, forecasting the consequences of unwanted invasions is currently one of the pressing problems for researchers of the Caspian Sea.

In recent decades, cargo transportation from the Sea of Azov–Black Sea basin along the Volga–Don Canal to the Makhachkala commercial port has intensified significantly in the Dagestan region of the Caspian Sea [Rossiya, 2025]. The active exploitation of the northern invasion corridor contributed to a rise in the influx of invaders into the Caspian Sea basin. Thus, within a short period of time (2013 to 2024), phytoplankton representatives [dinophytes *Ceratium tripos* var. *balticum*], bivalves [*Corbicula fluminalis* (O. F. Müller, 1774) and *C. fluminea* (O. F. Müller, 1774)], a crustacean [the oriental river prawn *Macrobrachium nipponense* (De Haan, 1849)], a North American polychaete of the genus *Marenzelleria* (Mesnil, 1896)], and fish [*Pseudorasbora parva* (Temminck et Schlegel, 1846) and *Hemiculter leucisculus* (Basilewsky, 1855)] penetrated the Dagestan region of the Caspian Sea and successfully acclimatized there [Khlopkova et al., 2023].

*Mytilus galloprovincialis* (Lamarck, 1819) quickly colonizes new water bodies, and this fact is a typical example of a mollusc distribution after an accidental anthropogenic invasion into different areas of the World Ocean and the formation of a range in Asia, North America, South Africa, and Europe. Until recently, this mussel inhabited only the areas of the Black Sea, Sea of Azov, and Sea of Japan. With the development of sea and river transport, the range of this mollusc has expanded significantly [Lutaenko, Kolpakov, 2016; Minakova et al., 2024; Shamionova, 2023].

## MATERIAL AND METHODS

During seasonal hydrobiological surveys (September 2024 to March 2025) focused on benthos, large molluscs were found, previously not recorded on the Dagestan coast of the Caspian Sea (Fig. 1).

Laboratory processing was performed by generally accepted methods [Metody izucheniya, 1990]. Molluscs were identified down to the species level based on their main conchiological features. The length (L), height (H), and convexity of two valves (D) were measured with a caliper, with an accuracy of 0.1 mm. To characterize the shape of the shell, the coefficients of elongation (H/L) and convexity (D/H) were calculated.


**Fig. 1.** Schematic map of the first findings of *Mytilus galloprovincialis* in the Caspian Sea. The red arrows indicate the spots where invasive mussels were registered on the Dagestan coast of the Caspian Sea in September–October 2024 and February–March 2025 (authors' data). The triangles indicate the spots where mussels were recorded in May–August 2023 [Minakova et al., 2024; Shamionova, 2023]

The individual age of mussels was estimated by growth retardation rings (growth marks) on the shell surface and by the corresponding dark concentric areas (those are clearly visible in thin-valved mytilids when a valve is viewed through the light), as well as by marks on muscle imprints – in accordance with common methods [Selin, Lysenko, 2006; Zolotarev, 1989].

## RESULTS AND DISCUSSION

The specimens we found in 2024 were identified as *M. galloprovincialis*. The invasive mollusc differs (Fig. 2) in the general shell habitus from a mytilid *Mytilaster lineatus* (Gmelin, 1791) which settled in the Caspian Sea back in the 1920s. Both the mussel and the mytilaster are characterized by a thin-walled (fragile) equal-valve unequal-sided shell with an apex located terminally. The valves are connected at the dorsal part by an external ligament [Metody izucheniya, 1990; Mitilidy Chernogo morya, 1990]. Yearlings of the above-mentioned species, up to 10 mm in size, are poorly distinguishable.

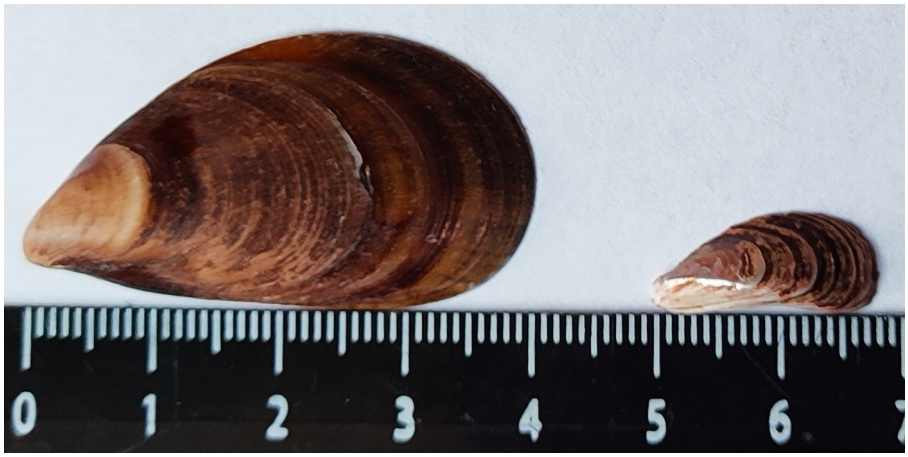


**Fig. 2.** *Mytilus galloprovincialis* and *Mytilaster lineatus*, invasive species of the Dagestan coast of the Caspian Sea

The differences between these two species are observed primarily when comparing the shell sizes of large specimens. Specifically, the shell length of juveniles we recorded ranged 13 to 42 mm (adult mussels grow up to 100–140 mm). Importantly, in the Caspian Sea, the mytilaster grows only up to 15–20 mm (in the Black Sea, up to 25 mm) [Aligadzhiev, Osmanov, 2023; Mitilidy Chernogo morya, 1990; Zevina, 1972].

The mussel shell is quadrangular-wedge-shaped, while the mytilaster shell is wedge-shaped: triangular to irregularly quadrangular [Mitilidy Chernogo morya, 1990]. *M. galloprovincialis* shell is more flattened and wider (H/L is 0.56–0.67; D/L is 0.46–0.58). *M. lineatus* shell, compared to the mussel one, is strongly elongated (H/L is 0.4–0.55) and more convex (D/L is 0.97–1.0).

In the mussel, the keel is weakly expressed. In the mytilaster, the keel bend is well expressed (see Fig. 2); it separates the wide dorsal area from the narrow ventral one (flat or concave). The mussel periostracum is black-blue (in surf specimens) or reddish-brown (in silt specimens). The mytilaster periostracum is brown-lilac. The nacreous layer of the mussel endostracum is thin, with a blue tint; sometimes, it is undeveloped. The mytilaster has a more developed and durable nacreous layer, with a lilac tint.

The hinge area of *M. galloprovincialis* is significantly reduced. It is represented by several small tooth-like tubercles (up to 7) under the apex on the ventral edge. In *M. lineatus*, the hinge teeth are located on the dorsal edge [Mitilidy Chernogo morya, 1990].

During autumn surveys, the first single specimens of the new invader were recorded in two samples from different coastal areas. In September 2024, on the Samur River coast, not far from the border with Azerbaijan, a single mussel was noted in a sample from a *Dreissena polymorpha andrusovi* (Pallas, 1771) biocenosis. The coordinates of the site of this finding are N41.5524°, E48.2905°. The salinity there is 7‰. The sediment in the sampling area is mostly silted sand. Sizes of the mussel shell were as follows: L = 32 mm; H = 20 mm; and D = 14 mm. The age of the mollusc was about a year. Another specimen was registered in October in the Karaman-7 area (N43.0651°, E47.2818°). The salinity there is 7‰. Sizes of the mussel shell were as follows: L = 38 mm; H = 22 mm; and D = 18 mm. The age of the specimen was two years. The periostracum was reddish-brown.

In February 2025, 2 ind. were found on a beach near the Dagestanskie Ogni village. Sizes of the larger mussel shell were as follows: L = 37 mm; H = 21.5 mm; and D = 15 mm. The periostracum was brown.

During spring surveys (March 2025), near the border with Azerbaijan, in storm-washed mytilaster shells, 29 mussel shells were recorded, with the length ranging 24 to 40 mm and with fresh ligament (Fig. 2).

Previously, in the spring and summer of 2023, this invasive mussel was already noted on the Azerbaijan coast of the Caspian Sea [Shamionova, 2023]. At the same time, a new species was reported from the border of the Northern and Middle Caspian by researchers from the Volga–Caspian branch of the VNIRO (CaspNIRKh). They confirmed the reliability of the morphological identification by molecular genetic methods [Minakova et al., 2024].

*M. galloprovincialis* is a common inhabitant of the Black Sea; at a salinity of 13–22‰, shells of this mollusc are characterized by noticeable annual growth rates. One of the reasons for the small size of the mussels we found may be the low salinity in the surveyed sites: 7‰ (at the lower end of their tolerant range). At 13‰, in the Kazakh Bay, the largest individuals for the Caspian Sea were registered [Minakova et al., 2024].

The distribution of the Black Sea mussel in the Caspian Sea will be driven primarily by such factors, as the salinity range, features of sediments, and competition with fouling organisms: both native species (*Dreissena*) and invaders (*Mytilaster* and *Balanus* representatives).

Thus, the acclimatization of the mytilaster in the Caspian Sea occurred under conditions of fierce competition with the native species of the genus *Dreissena* (as a result, two ones, *Dreissena caspia* and *D. elata*, were completely displaced and became extinct). At the intersections of their ranges, strained biotic relationships are observed: those include competition for food and substrate. Closer to a shore, the mytilaster predominates, while deeper, *Dreissena* representatives prevail [Aligadzhiev, Osmanov, 2023]. Most likely, a similar pattern of competitive relations should be expected, first of all, with the mytilaster (a representative of the same family).

The mytilaster cannot spread north of Makhachkala (into the zone of silty sediments). Researchers report occurrence of this mollusc on silted sands and its absence on silts [Aligadzhiev, Osmanov, 2023]. Usually, the Black Sea mussels are foulers of hard substrates, but they can inhabit silty sediments as well attaching to empty shells of dead molluscs. This provides some advantage in competitive relations.

High fertility and rapid maturation in the absence of natural enemies can also mediate quick and successful acclimatization of the Black Sea mussels in the Caspian Sea. For the Caspian Sea mytilaster, the fertility value is 0.02–0.14 million eggs *per* year. The fertility of the mussel is higher: 0.2–10 million eggs *per* each clutch. The lifespan of the mytilaster is 2–4 years. The mussel lives longer, 6–9 years, and matures early, in 6–8 months (or when its shell length reaches 18–28 mm). Interestingly, this hydrobiont produces more and more eggs with age [Biologiya, 1989; Mitilidy Chernogo morya, 1990; Zolotarev, 1989].

Under conditions of climate change and due to the absence of natural predators (the rapa whelk, starfish, rays, and cod), the mussel can successfully and quickly acclimatize in new biotopes of the Caspian Sea.

Meanwhile, the consequences of the invasion of this species can also be negative. Fouling molluscs attach to a hard substrate with a byssus and form druses. In the Caspian Sea, a rapid rise in biomass of fouling organisms (along with that of barnacles, the mytilaster, and *Dreissena* species) may result in failures of hydraulic structures of the oil industry [Minakova et al., 2024; Shamionova, 2023].

**Conclusions.** An expansion of the *Mytilus galloprovincialis* range was established, as indicated by the displacement of sites where this new invader is found. The records of different-aged individuals provide evidence for the beginning of the formation of the mollusc population. Naturalization of this invader may govern the displacement of endemic species (*Didacna* and *Dreissena* representatives) and the ones that invaded earlier (*Abra* and *Mytilaster* ones) in the Caspian Sea while competing for habitat and food. This will result in a simplification of the biocenosis structure and a decrease in its resistance to external factors. To assess the consequences (those can be positive, neutral, or negative), regular monitoring of invasions of new molluscs on the Dagestan coast of the Russian sector of the Caspian Sea is required.

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# РАСШИРЕНИЕ АРЕАЛА НОВОГО ВСЕЛЕНЦА, *MYTILUS GALLOPROVINCIALIS* (BIVALVIA: MYTILIDAE), В КАСПИЙСКОМ МОРЕ

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В статье сообщается об обнаружении нетипичного для нативной фауны дагестанского побережья Среднего Каспия вида — двустворчатого моллюска, идентифицированного на основе конхиологических признаков как *Mytilus galloprovincialis* (Lamarck, 1819). На дагестанском побережье Среднего Каспия единичные живые особи нового инвазивного вида зарегистрированы осенью 2024 г. вблизи устья реки Самур и в районе Карамана-7, а также зимой 2025 г. в районе пляжа Дагестанские Огни. В марте 2025 г. обнаружено 29 раковин мидий в штормовых выбросах на побережье, вблизи границы Дагестана и Азербайджана. Вероятнее всего, вселенец проник в Каспийское море из Азово-Черноморского бассейна через Волго-Донской канал с балластными водами. Необходим дальнейший мониторинг инвазий новых моллюсков на дагестанском побережье российского сектора Каспийского моря.

**Ключевые слова:** инвазивный вид, мидия, дагестанское побережье, российский сектор Каспийского моря