



Commercially Important Marine Macroinvertebrates of the Turkish Seas

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ABSTRACT

This study identifies the economically important benthic invertebrate species occurring in the Turkish seas, evaluating their taxonomic distribution, utilization patterns, economic significance, conservation status, and the contribution of non-indigenous species based on an extensive literature review. A total of 93 economically valuable macro invertebrate species were documented along the Turkish coasts, comprising 40 Mollusca, 33 Crustacea, 6 Cnidaria, 5 Echinodermata, 5 Porifera, and 4 Polychaeta species. Geographically, the Aegean Sea and the Mediterranean Sea exhibited the highest species richness followed by the Sea of Marmara, whereas the Black Sea harboured comparatively fewer species. The primary utilization of these organisms is for human consumption, alongside secondary applications as live bait, aquaculture inputs, aquarium trade specimens, jewellery and ornamental materials, cosmetics, biotechnology products, and bioremediation agents. Mollusca and Crustacea represent the foundational groups for the Turkish fisheries sector regarding production volume and export value, whereas sea cucumbers, natural sponges, the red indigenous species -including *Rapana venosa*, *Magallana gigas*, *Pinctada radiata*, *Sepioteuthis lessoniana*, and *Portunus segnis*- have established themselves as economically viable resources in Turkish waters. Conversely, certain economically significant species, such as *Corallium rubrum*, *Lithophaga lithophaga*, *Paracentrotus lividus*, and commercially valuable marine sponge species, are protected under domestic and international conservation frameworks. Collectively, these findings underscore the substantial economic potential of Türkiye's macro invertebrate resources while emphasizing the critical need for sustainable management, continuous monitoring, and effective conservation strategies to ensure their long-term utilization.

Review Article

Introduction

Marine invertebrates represent one of the oldest natural resources utilized by humanity, and the historical bond between human societies and marine ecosystems has played a fundamental role in shaping terrestrial civilizations. Archaeological findings demonstrate that prehistoric coastal communities consumed bivalve molluscs, marine snails, and other benthic invertebrates as food prior to the advent of finfish fisheries. Shell middens discovered across numerous settlement sites reveal that these organisms have been an integral part of human existence for thousands of years (Meehan, 1982). Beyond serving merely as a source of nourishment, their shells were utilized in the fabrication of ornaments, jewellery, and various tools, thereby becoming an essential component of the social and cultural identities of early human communities (Baysal & Yelözer, 2023).

Today, marine invertebrates constitute significant biological resources not only for traditional fishing activities but also for the food industry, aquaculture, biotechnology, medicine, pharmaceuticals, chemistry, and cosmetics. Bioactive compounds derived particularly from gastropods, bivalves, cephalopods, sea cucumbers, and sea urchins are gaining increasing importance in biomedical research due to their anticancer, antiviral, antimicrobial, and anti-inflammatory properties (Shahidi & Santhiravel, 2022).

The escalation of food demand driven by global population growth, coupled

with intensifying capture pressure on wild stocks, necessitates the development of novel approaches in fisheries management. In this context, the “Blue Transformation” approach introduced by the Food and Agriculture Organization of the United Nations (FAO) serves as the cornerstone of sustainable production policies. According to FAO data for 2022, global capture and aquaculture production reached 223 million tonnes, with aquaculture surpassing capture fisheries in volume for the first time in history to become the largest component of aquatic animal production (FAO, 2024). This shift is regarded as a major milestone for the conservation and sustainable utilization of wild stocks.

With its 8,592 km coastline and four distinct marine systems exhibiting contrasting hydrographic characteristics, Türkiye represents one of the richest yet most sensitive biodiversity hubs in the Eastern Mediterranean Basin. The semi-enclosed, low-salinity structure of the Black Sea, the two-layered hydrographic system of the Sea of Marmara, the high habitat heterogeneity of the Aegean Sea, and the oligotrophic character of the Mediterranean Sea play decisive roles in determining the distribution and population dynamics of economically important invertebrate species. Taxonomic studies conducted in recent years indicate an increase in the number of reported invertebrate species in Turkish seas, accompanied by a notable rise in non-indigenous species records and climate-induced distributional shifts. Given these diverse ecosystem attributes, Turkish seas offer substantial commercial potential in terms of benthic invertebrate fauna.

Research conducted on macroinvertebrates of economic significance in

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Turkish seas has primarily focused on stock assessment, population biology, gear selectivity, habitat destruction, and the impacts of environmental pressures (Aydın, 2008; Deval, 2009, 2019; González-Wangüemert et al., 2014). When regional differences are taken into account, studies on the striped Venus clam, *Chamelea gallina* (Linnaeus, 1758), one of the commercially important bivalve species in the Black Sea and the Sea of Marmara, have primarily focused on the impacts of hydraulic dredge fisheries on benthic habitats and clam stocks. These studies have emphasized the necessity of establishing minimum legal landing sizes and implementing seasonal fishing closures to ensure the sustainable exploitation of the species (Deval, 2009). Similarly, although the invasive veined rapa whelk [*Rapana venosa* (Valenciennes, 1846)], which established itself in the Black Sea during the 1940s, exerts considerable predation pressure on native mussel and oyster beds, it has over time evolved into an economically vital commercial resource due to its high export value (Sağlam & Düzgüneş, 2008). In the Aegean and Mediterranean Seas, characterized by high salinity and rich biological diversity, studies addressing the population dynamics of high-value benthic species come to the fore. Investigations into shrimp fisheries in these waters have evaluated the competition between invasive shrimp species—principally the non-indigenous *Penaeus (Marsupenaeus) japonicus* Spence Bate, 1888—and native species, as well as their growing prominence in commercial catches (Özcan et al., 2008). Furthermore, the stock structures and population characteristics of the deep-water rose shrimp [*Parapenaeus longirostris* (Lucas, 1846)], the blue and red shrimp [*Aristeus antennatus* (Risso, 1816)], and other commercial penaeids have been examined in detail (Deval & Kapisir, 2016). Research on cephalopods has focused on the reproductive biology, growth patterns, and habitat conservation of *Sepia officinalis* Linnaeus, 1758, *Loligo vulgaris* Lamarck, 1798, and *Octopus vulgaris* Cuvier, 1797, demonstrating the ecological and economic significance of this group in the Eastern Mediterranean ecosystem (Salman et al., 1999). Investigations into sea cucumbers [*Holothuria (Holothuria) tubulosa* Gmelin, 1791 and *Holothuria (Roweothuria) poli* Delle Chiaje, 1824], whose export potential has grown rapidly in recent years, have concentrated on population density, genetic diversity, and the impacts of overexploitation on wild stocks (Aydın, 2008, 2016; González-Wangüemert et al., 2014).

According to 2025 data from the Turkish Statistical Institute (TURKSTAT), Türkiye's total fishery and aquaculture production stood at 1,037,019 tonnes, comprising 626,591 tonnes from aquaculture and 410,428 tonnes from capture fisheries (TURKSTAT, 2026). In contrast, the production of economically valuable invertebrates relies overwhelmingly on wild capture operations. This dependency underscores the necessity of scientific research aimed at the sustainable management and effective conservation of these resources.

Today, these natural assets face numerous threats, including overfishing, illegal harvesting, habitat loss, coastal development, marine pollution, microplastics, climate change, and pressure from invasive alien species. Invertebrates of economic importance are not merely commercial seafood commodities; they are key components essential to ecosystem functioning and the continuity of marine food webs. Consequently, the sustainable management of stocks requires the continuation of scientific monitoring programs, the implementation of ecosystem-based fisheries management, and the effective spatial planning of marine protected areas. In this study, macroinvertebrate species of economic significance in Turkish seas were evaluated in light of current taxonomic knowledge, and their systematic positions, biological characteristics, zoogeographic distributions, production metrics, and economic values were analysed.

Material and Methods

In this study, a comprehensive literature review was conducted to elucidate the current status of marine macroinvertebrate species of economic significance in Turkish seas. Within the scope of the research, the taxonomic statuses of the species, their distributions in Turkish seas, production volumes, capture and aquaculture statuses, and areas of economic utilization were analysed.

The data utilized in this study were compiled through the evaluation of national and international scientific publications, books, theses, technical reports, and official statistics published by relevant institutions. In determining production data, current statistics published by the Turkish Statistical Institute (TURKSTAT) and the Ministry of Agriculture and Forestry, General Directorate of Fisheries and Aquaculture, were principally taken as the baseline.

To supplement data regarding certain economic species with limited information in the literature or those not reported under distinct categories in official statistics, interviews were conducted with sector representatives and local fishers engaged in the harvesting, collection, or trade of these species. Information obtained from these interviews was evaluated by cross-referencing

it with literature data. Finally, the scientific names and systematic classifications of the species were reviewed in accordance with up-to-date taxonomic sources, and scientific nomenclatures were updated to reflect recent taxonomic revisions.

Results and Discussion

As a result of the literature reviews and investigations conducted, a total of 93 economic invertebrate species belonging to six systematic groups (Porifera, Cnidaria, Polychaeta, Crustacea, Mollusca, Echinodermata) are present in Turkish seas (Table 1).

When the systematic groups were examined, the highest number of species was recorded in Mollusca with 40 species. Mollusca emerges as the dominant taxonomic group in the study area, accounting for a significant proportion of the total species richness. This group is followed by Crustacea with 33 species, and together, both groups represent the highest diversity within the benthic fauna. These groups are followed, respectively, by Cnidaria (6 species), Porifera and Echinodermata (5 species each), and Polychaeta (4 species) (Figure 1). The obtained findings indicate that the economically important macroinvertebrate species evaluated within the scope of this study are heavily concentrated in the groups Mollusca and Crustacea, whereas the remaining groups are represented by lower species richness.

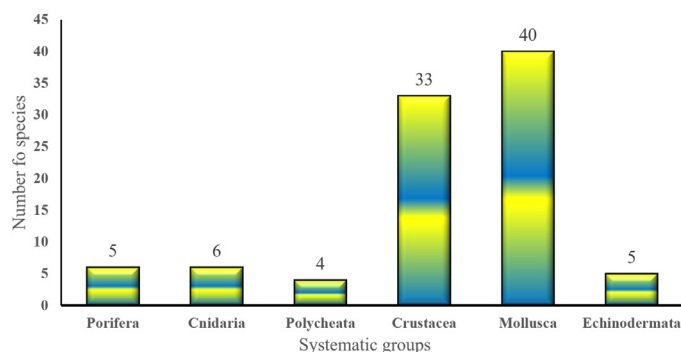


Figure 1. Proportional distribution of economically important invertebrates in Turkish seas by systematic groups.

When the proportional distribution of species belonging to systematic groups across Turkish seas is examined, it is observed that the vast majority of species are concentrated in the Mediterranean Sea, the Aegean Sea, and the Sea of Marmara (Figure 2). Species belonging to the groups Porifera and Echinodermata are distributed exclusively in the Mediterranean, Aegean, and Marmara seas, whereas these groups were found to be unrepresented in the Black Sea. In contrast, the groups Cnidaria, Polychaeta, Crustacea, and Mollusca are represented in all four of our seas, exhibiting the widest geographical distribution. It is particularly noteworthy that Polychaeta and Mollusca species are represented in higher proportions in the Aegean and Marmara seas, while Crustacea species show higher representation in the Mediterranean and Aegean seas. Overall, the Mediterranean and Aegean seas stand out as the richest regions in terms of economically important marine invertebrate species, whereas the species diversity and representation rate in the Black Sea remain more limited compared to the other seas (Figure 2).

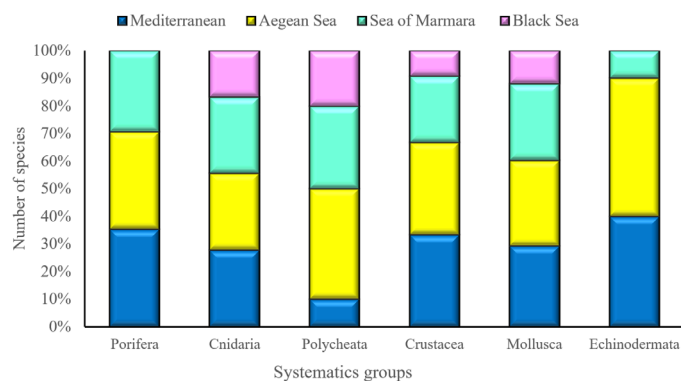


Figure 2. Distribution of species counts belonging to systematic groups across Turkish seas.

Table 1. Turkish common names and distributions of economically important invertebrates in Turkish seas.

		Mediterranean	Aegean	Marmara	Black Sea
Turkish common names	Porifera				
Bal peteği	<i>Hippospongia communis</i> (Lamarck, 1814)	+	+	+	
Fil Kulağı /İpsator	<i>Spongia (Spongia) lamella</i> (Schulze, 1879)	+	+		
Türk Fincanı	<i>Spongia (Spongia) mollissima</i> Schmidt, 1862	+	+	+	
Banyo Süngerisi	<i>Spongia (Spongia) officinalis</i> Linnaeus, 1759	+	+	+	
Çumaha/Çımaha	<i>Spongia (Spongia) zimocca</i> Schmidt, 1862		+		
	Cnidaria				
Deniz Güllü	<i>Actinia equina</i> (Linnaeus, 1758)	+	+	+	+
Saçalan, Deniz Şakayığı	<i>Anemonia viridis</i> (Forsskål, 1775)	+	+	+	
Deniz Anası	<i>Aurelia aurita</i> (Linnaeus, 1758)	+	+	+	+
Kırmızı Mercan	<i>Corallium rubrum</i> (Linnaeus, 1758)	+	+		
Siyah Mercan	<i>Parantipathes larix</i> (Esper, 1788)			+	
Dantelli Deniz Anası	<i>Rhizostoma pulmo</i> (Macri, 1778)	+	+	+	+
	Polychaeta				
Boru Kurdu	<i>Diopatra neapolitana</i> Delle Chiaje, 1841		+		
Kırmızı Kurt	<i>Hediste diversicolor</i> (OF Müller, 1776)		+	+	+
Kum Kurdu	<i>Ophelia bicornis</i> Savigny, 1822		+	+	+
Peri Kurdu	<i>Perinereis cultrifera</i> (Grube, 1840)	+	+	+	
	Crustacea				
Dev Kırmızı Karides	<i>Aristaeomorpha foliacea</i> (Risso, 1827)	+	+		
Mavi-Kırmızı Karides	<i>Aristeus antennatus</i> (Risso, 1816)	+	+		
Mavi Yengeç	<i>Callinectes sapidus</i> Rathbun, 1896	+	+	+	+
Çağanoz/Çingene Yengeci/Tırnak	<i>Carcinus aestuarii</i> Nardo, 1847	+	+	+	+
Taş Yengeci	<i>Eriphia verrucosa</i> (Forsskål, 1775)	+	+	+	+
Avrupa Istakozu	<i>Homarus gammarus</i> (Linnaeus, 1758)		+	+	
Örümcek Yengeci	<i>Maja squinado</i> (Herbst, 1788)	+	+	+	+
	<i>Metapenaeus affinis</i> (H. Milne Edwards, 1837)		+		
Benekli Karides	<i>Metapenaeus monoceros</i> (Fabricius, 1798)	+	+		
Şahin Karidesi	<i>Metapenaeus stebbingi</i> Nobili, 1904	+			
Norveç Istakozu/Langust	<i>Nephrops norvegicus</i> (Linnaeus, 1758)		+	+	
Teke-Çalı Karidesi	<i>Palaemon serratus</i> (Pennant, 1777)	+	+	+	+
Böcek / Dikenli Istakoz	<i>Palinurus elephas</i> (Fabricius, 1787)		+	+	+
Derin Su Pembe Karidesi	<i>Parapenaeus longirostris</i> (Lucas, 1846)	+	+	+	
Yeşil Kaplan Karidesi	<i>Penaeus (Eopenaeus) semisulcatus</i> De Haan, 1844	+	+	+	
Kahverengi Karides	<i>Penaeus (Farfantepenaeus) aztecus</i> Ives, 1891	+	+		+
	<i>Penaeus (Farfantepenaeus) subtilis</i> Pérez Farfante, 1967	+			
	<i>Penaeus (Fenneropenaeus) merguensis</i> De Man, 1888	+			
Japon -Kuruma Karidesi	<i>Penaeus (Marsupenaeus) japonicus</i> Spence Bate, 1888	+		+	
	<i>Penaeus (Marsupenaeus) pulchricaudatus</i> Stebbing, 1914	+	+	+	
Jumbo Karides	<i>Penaeus (Melicertus) kerathurus</i> (Forsskål, 1775)	+	+	+	
	<i>Penaeus (Oleopenaeus) hathor</i> Burkenroad, 1959	+	+		
Asker Karides	<i>Plesionika edwardsii</i> (Brandt, 1851)	+	+		
Asker Karides	<i>Plesionika heterocarpus</i> (A. Costa, 1871)	+	+	+	
Asker Karides	<i>Plesionika martia</i> (A. Milne-Edwards, 1883)	+	+		
Asker Karides	<i>Plesionika narval</i> (Fabricius, 1787)	+	+	+	
Benekli -Yüzücü Yengeç	<i>Portunus segnis</i> (Forsskål, 1775)	+	+	+	
Büyük Ayı Istakozu	<i>Scyllarides latus</i> (Latreille, 1803)	+	+	+	
Küçük Ayı Istakozu	<i>Scyllarus arctus</i> (Linnaeus, 1758)	+	+	+	
Cüce Ayı Istakozu	<i>Scyllarus pygmaeus</i> (Spence Bate, 1888)	+	+	+	
	<i>Solenocera membranacea</i> (Risso, 1816)	+	+	+	

Table 1. Turkish common names and distributions of economically important invertebrates in Turkish seas (Continued)

	<i>Trachysalambria palaestinensis</i> (Steinitz, 1932)	+	+		
Mamun	<i>Upogebia pusilla</i> (Petagna, 1792)	+	+	+	+
	Mollusca				
Pürtüklü Kalp Midyesi	<i>Acanthocardia tuberculata</i> (Linnaeus, 1758)	+	+	+	+
Küçük Kalamar	<i>Alloteuthis media</i> (Linnaeus, 1758)	+	+	+	
Nuh'un Gemisi	<i>Arca noae</i> Linnaeus, 1758	+	+	+	+
Dikenli madya	<i>Bolinus brandaris</i> (Linnaeus, 1758)	+	+	+	
Cılalı Kum Midyesi	<i>Callista chione</i> (Linnaeus, 1758)	+	+	+	
Lagün Kalp Midyesi	<i>Cerastoderma glaucum</i> (Bruguière, 1789)	+	+	+	+
Kum Midyesi- Cık Cık	<i>Chamelea gallina</i> (Linnaeus, 1758)	+	+	+	+
Kum Şırlanı	<i>Donax trunculus</i> Linnaeus, 1758	+	+	+	+
Daire Midyesi	<i>Dosinia exoleta</i> (Linnaeus, 1758)	+	+	+	+
Benekli Ahtapot	<i>Eledone cirrhosa</i> (Lamarck, 1798)	+	+	+	
Misk Ahtapotu	<i>Eledone moschata</i> (Lamarck, 1798)	+	+	+	
Kılıç Midyesi	<i>Ensis ensis</i> (Linnaeus, 1758)	+	+	+	+
Deniz Kulağı	<i>Haliotis tuberculata</i> Linnaeus, 1758	+	+		
Madya	<i>Hexaplex trunculus</i> (Linnaeus, 1758)	+	+	+	
Kısa Yüzgeçli Kalamar	<i>Illex coindetii</i> (Vérany, 1839)	+	+	+	
Hurma Midyesi	<i>Lithophaga lithophaga</i> (Linnaeus, 1758)	+	+	+	
Forbes Kalamarı	<i>Loligo forbesii</i> Steenstrup, 1856	+	+		
Kalamar	<i>Loligo vulgaris</i> Lamarck, 1798	+	+	+	
Pembe Kum Midyesi	<i>Mactra corallina</i> (Linnaeus, 1758)		+		
Kum Midyesi	<i>Mactra stultorum</i> (Linnaeus, 1758)	+	+	+	+
Pasifik İstiridyesi	<i>Magallana gigas</i> (Thunberg, 1793)	+	+	+	
Alacalı Tarak	<i>Mimachlamys varia</i> (Linnaeus, 1758)	+	+	+	+
Sakallı Midye	<i>Modiolus barbatus</i> (Linnaeus, 1758)	+	+	+	+
Akdeniz (Kara) Midyesi	<i>Mytilus galloprovincialis</i> Lamarck, 1819	+	+	+	+
Ahtapot	<i>Octopus vulgaris</i> Cuvier, 1797	+	+	+	
Avrupa İstiridyesi	<i>Ostrea edulis</i> Linnaeus, 1758	+	+	+	+
Tarak	<i>Pecten jacobaeus</i> (Linnaeus, 1758)	+	+	+	+
İnci İstiridyesi	<i>Pinctada radiata</i> (Leach, 1814)	+	+		
Uzun Kollu Ahtapot	<i>Pinnoctopus macropus</i> (Risso, 1826)	+	+	+	
Deniz Salyangozu	<i>Rapana venosa</i> (Valenciennes, 1846)		+	+	+
Zarif Mürekkep Balığı	<i>Rhomboscion elegans</i> (Blainville, 1827)	+	+	+	
Orbigny Mürekkep Balığı	<i>Rhomboscion orbignyanum</i> (A. Férussac, 1826)	+	+	+	
Akivades	<i>Ruditapes decussatus</i> (Linnaeus, 1758)	+	+	+	
Yabancı Akivades	<i>Ruditapes philippinarum</i> (AAdams & Reeve, 1850)		+	+	
Mürekkep Balığı	<i>Sepia officinalis</i> Linnaeus, 1758	+	+	+	
Büyük Yüzgeçli Kalamar	<i>Sepioteuthis lessoniana</i> R. P. Lesson, 1831	+			
Sülünes	<i>Solen marginatus</i> Pulteney, 1799	+	+	+	+
Ok Kalamarı	<i>Todarodes sagittatus</i> (Lamarck, 1798)	+	+	+	
Eblana Kalamarı	<i>Todaropsis eblanae</i> (Ball, 1841)	+	+	+	
Kidonya	<i>Venus verrucosa</i> Linnaeus, 1758	+	+	+	
	Echinodermata				
Deniz Hıyarı	<i>Holothuria (Holothuria) mammata</i> Grube, 1840	+	+		
Deniz Hıyarı	<i>Holothuria (Holothuria) tubulosa</i> Gmelin, 1791	+	+		
Deniz Hıyarı	<i>Holothuria (Platyperona) sanctori</i> Delle Chiaje, 1823	+	+	+	
Deniz Hıyarı	<i>Holothuria (Roweothuria) poli</i> Delle Chiaje, 1824		+		
Deniz Kestanesi	<i>Paracentrotus lividus</i> (Lamarck, 1816)	+	+		

When the origin-based distribution of the economically important marine invertebrate species evaluated within the scope of the study was examined, it was determined that the vast majority of the species consist of native species (Figure 3). Of the total 93 species, 75 (81%) are native, whereas 18 (19%) are non-indigenous (exotic) species. The fact that non-indigenous species constitute approximately one-fifth of the total species count reveals that biological invasions have attained a significant share in the invertebrate fauna utilized economically in Turkish seas. This situation indicates that anthropogenic introduction mechanisms—particularly Lessepsian migrations via the Suez Canal, as well as maritime transport and aquaculture activities—significantly influence the species composition in Turkish seas.

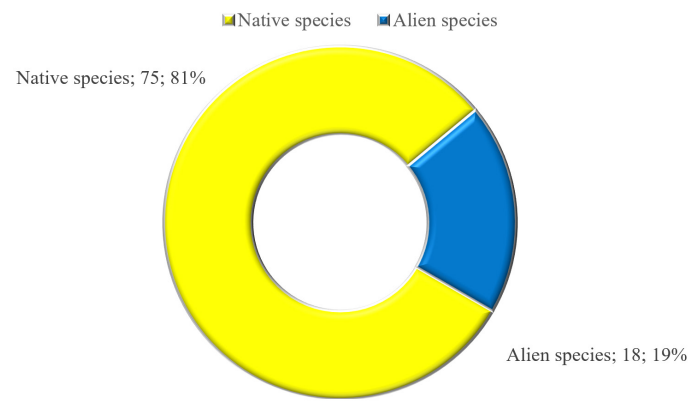


Figure 3. Numbers and proportions of native and non-native economically important species detected in Turkish seas.

An examination of the distribution of economically significant invertebrate species reported in fisheries statistics across Turkish seas reveals that the Aegean Sea harbours all species groups, exhibiting the highest species richness (Table 3.2). Similarly, the Mediterranean Sea hosts numerous economic species; however, certain taxonomic groups, such as crawfish, sea snails, and sea cucumbers, are absent. The Sea of Marmara displays a species diversity comparable to that of the Aegean Sea, though it contains a limited number of species in specific groups. Conversely, the Black Sea exhibits the lowest diversity in terms of economically important invertebrate species. Cephalopods such as octopuses, cuttlefish, and squids, as well as mantis shrimp (*Squilla mantis*) and sponges, were determined to be absent in this basin. Nevertheless, several economic taxa—including white clam, lobster, shrimps, Mediterranean mussel, oyster, scallop, jellyfish, and sea snail—are distributed within the Black Sea (Table 2). The lower species richness in the Black Sea compared to other seas can be attributed to its low salinity and distinct hydrographic characteristics. In contrast, the role of the Aegean Sea as a biogeographic transition zone between the Mediterranean and Marmara seas, combined with its diverse habitat types, enables the representation of all economically important invertebrate species within this region.

A comparison of wild-caught invertebrate production volumes in Turkish seas between 1970 and 2024 reveals that the Black Sea ranked first in total production, accounting for 1,943,636 tonnes (Figure 4). This basin was followed by the Mediterranean Sea with 1,648,685 tonnes.

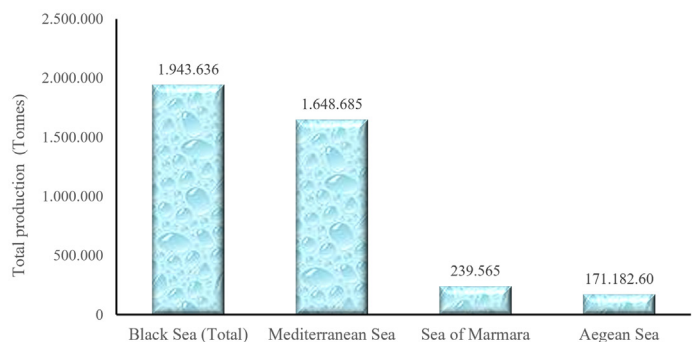


Figure 4. Distribution of invertebrate fisheries landings across Turkish seas between 1970 and 2024.

The Sea of Marmara and the Aegean Sea ranked third and fourth, with

production figures of 239,565 tonnes and 171,182.6 tonnes, respectively. The prominent dominance of the Black Sea and the Mediterranean Sea in total production stems from the intensive harvesting of high-economic-value mollusc and crustacean species in these basins (Figure 4). The high contribution of the Mediterranean and Black seas to total production can be attributed to the intensive capture of crustaceans, molluscs, and other economic invertebrates, as well as to extensive fishing grounds and seasonal stock sizes. Conversely, lower production values in the Sea of Marmara and the Aegean Sea can be considered a consequence of fishing pressure, stock status, the structural dynamics of fishing activities, and regional ecological variations.

An examination of the capture production of economically important marine invertebrates in Türkiye for 2024 and 2025 reveals that total production stood at 32,394.4 tonnes in 2024 and 31,902.5 tonnes in 2025, representing a decrease of approximately 1.5% (Table 3). In both years, the highest catch volume belonged to the striped Venus clam (*Chamelea gallina*), with production increasing from 16,680 tonnes to 17,953 tonnes. The striped Venus clam was followed by the veined Rapa whelk (*Rapana venosa*) and the Mediterranean mussel (*Mytilus galloprovincialis*).

Table 2. Species included in production statistics (in English and Turkish names) and their distribution in Turkish seas.

SPECIES (Eng-lish-Turkish)	AEGEAN	LEVAN-TINE	MARMA-RA	BLACK SEA
Octopus (Ahtapot)	+	+	+	-
Cuttlefish (Sübye)	+	+	+	-
Striped Venus Clam (Beyaz Kum Midyesi)	+	+	+	+
Spiny Lobster (Böcek)	+	+	+	-
Norway lobster (Deniz Kereviti)	+	-	-	-
Veined Rapa Whelk (Deniz Salyangozu)	+	-	+	+
European Lobster (İstakoz)	+	+	+	+
Squid (Kalamar)	+	+	+	-
Shrimps [Karidesler (Jumbo, Pembe, Karab-iga etc.)]	+	+	+	+
Oyster (İstiridye)	+	+	+	+
Scallop (Tarak)	+	+	+	+
Jellyfish (Deniz anası)	+	+	+	+
Crabs (including Blue Crab) Pavurya / Yengeç (Mavi Yengeç dahil)	+	+	+	+
Sea Cucumber [Deniz Hıyarı (Deniz Patlı-canı)]	+	-	+	-
Mediterranean Mussel [Midye (Kara Midye)]	+	+	+	+
Sponge (Sünger)	+			
Other invertebrates (Diğer Omurgasızlar*)	+	+	+	+

Other Invertebrates*: Sea urchins, starfish, or certain arthropods with commercial value that are rarely harvested; derived from TURKSTAT 2024 and 2025 data and TURKSTAT MEDAS.

Table 3. Capture production data (tonnes/year) of selected seafood items (crustaceans, molluscs) in Turkish seas for 2024 and 2025.

Crustaceans and molluscs (Turkish and English)	2024	2025
Ahtapot - Octopus	243,5	277,6
Aktivades (Kum midyesi) - Carpet shell	5,7	5,0
Beyaz kum midyesi - Striped venus	16 680,0	17 953,0
Böcek - Spiny lobster	0,1	0,1
Deniz hıyarı - Sea cucumber	1 220,0	545,0
Deniz kereviti - Norway lobster	0,5	0,6
Deniz salyangozu - Sea snail	6 961,6	6 526,8
Dev kırmızı karides - Giant red shrimp	648,0	644,0
Erkek karides - Speckled shrimp	15,1	16,8
İstakoz - European lobster	1,2	1,7
Jumbo karides - Green tiger prawn	724,0	653,7
Kalamerya - Squid	401,4	374,3
Kara midye - Mediterranean mussel	1 534,3	542,6
Karabiga karides - Caramote prawn	87,1	80,1
Mavi yengeç - Blue crab	4,2	3,7
Mavi-kırmızı karides - Blue and red shrimp	347,0	357,0
Mürekkep balığı - Cuttle fish	645,3	602,1
Pavurya - Common shore crab	1,1	3,9
Pembe karides (Çimçim) - Deep water rose prawn	2 646,1	3 156,7
Diğer - Other	228,2	162,8

Compiled based on TURKSTAT Fisheries Data (2025). Data regarding giant red shrimp, blue and red shrimp, striped Venus clam, and sea cucumber are obtained from the administrative records of the Ministry of Agriculture and Forestry.

While decreases were observed in the production of veined Rapana whelk, Mediterranean mussel, sea cucumber, squid, cuttle-

fish, jumbo shrimp, and caramote prawn, increases were recorded in the production of deep-water rose prawn (*Parapenaeus longirostris*), octopus, crab, European lobster, Norway lobster, and striped Venus clam.

The grooved carpet shell (*Ruditapes decussatus*) was not featured in the 2025 production statistics. Overall, despite a slight decline in total production, the increase in striped Venus clam and certain shrimp species indicates that fishing activities concentrated on high-economic-value target species (Table 3).

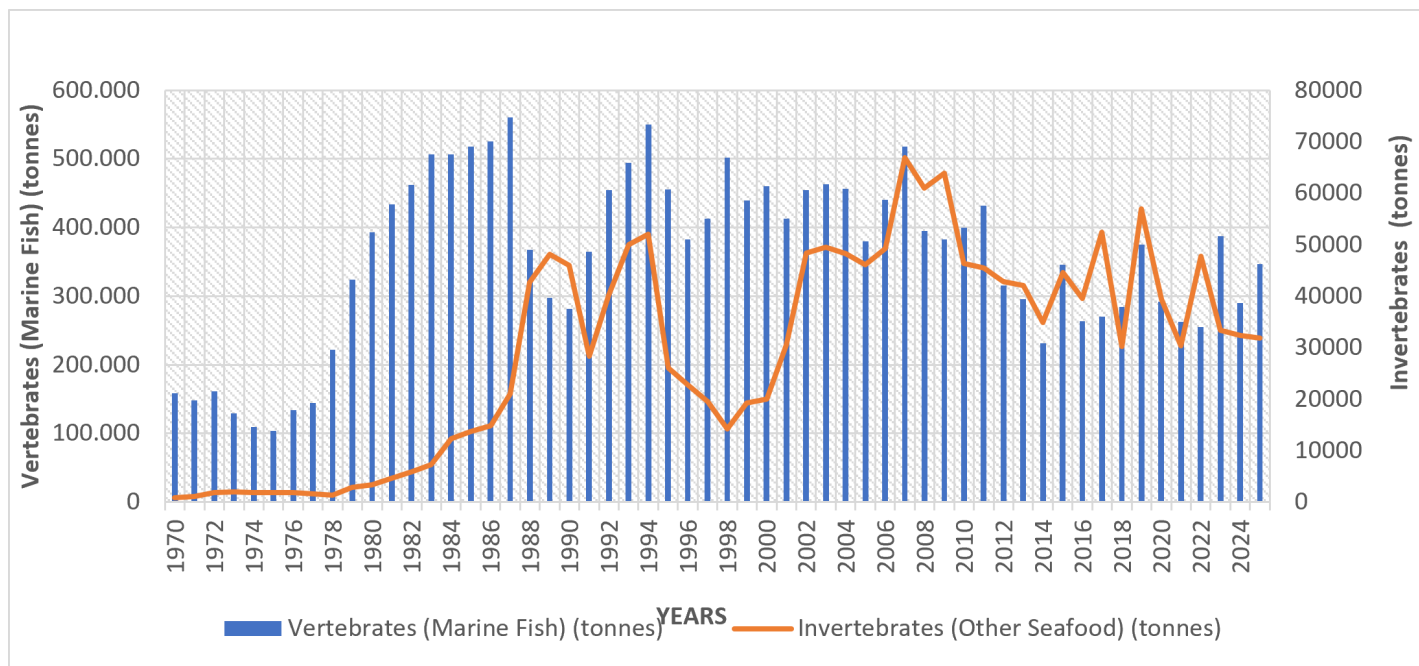
Fisheries production in Türkiye exhibits significant variations over the years (Figure 5). Vertebrate production increased rapidly starting from the late 1970s, reaching its peak in 1996 at approximately 570,000 tonnes. In subsequent years, production volume followed a fluctuating course, stabilizing between 300,000 and 400,000 tonnes in the recent period. Conversely, invertebrate fisheries production showed a marked increase from the late 1980s onwards, peaking at approximately 67,000 tonnes in 2008, before fluctuating between roughly 30,000 and 50,000 tonnes in following years. These results indicate that long-term variations in both production groups are influenced by stock status, fishing pressure, environmental conditions, and fisheries management practices (Figure 5).

Discussion

A total of 93 marine invertebrate species of economic importance have been identified in Turkish seas. Among these, 13 species (*Spongia officinalis*, *Spongia lamella*, *Spongia mollissima*, *Hippospongia communis*, *Corallium rubrum*, *Actinia equina*, *Parantipathes larix*, *Hediste diversicolor*, *Perinereis cultrifera*, *Diopatra neapolitana*, *Ophelia bicornis*, *Carcinus aestuarii*, and *Palaemon serratus*) are not directly consumed as human food. The remaining 80 species are utilized for food consumption.

Among the non-edible species, bath sponges are utilized as raw materials in the chemical industry and as glazing agents in the porcelain industry, in addition to their traditional use as bath sponges. Other non-edible species are predominantly used as live bait or in bait production for fisheries. Furthermore, 18 of the 80 economically important edible species consist of non-native (exotic) species introduced into Turkish seas. This highlights that non-native species have reached a significant share within the economic invertebrate fauna of Turkish seas and are increasingly contributing to the fisheries and aquaculture sectors.

Globally, natural bath sponges of commercial value are represented by nine species belonging to the genus *Spongia* (*S. obliqua*, *S. officinalis*, *S. barbara*, *S. anclotea*, *S. sterea*, *S. graminea*, *S. cheiris*, *S. lamella*, and *S. zimocca*) along with two subspecies (*S. barbara dura* and *S. graminea tampa*), and four species belonging to the genus *Hippospongia* (*H. gossypina*, *H. lachne*, *H. kerion*, and *H. communis*). Among these, *Spongia officinalis*, *S. lamella*, *S. zimocca*, and *Hippospongia communis* are naturally distributed in both the Mediterranean Basin and Turkish seas. Due to their ecological importance and the pressure exerted on their

**Figure 5.** Production quantities of marine vertebrates and invertebrates in Türkiye between 1970 and 2025.

populations by overfishing, these species have been placed under international protection under the Barcelona Convention and the Bern Convention (Evçen, 2021). Natural bath sponges are widely used in the cosmetics, healthcare, and cleaning industries owing to their high water-retention capacity, durability, and biological structure, making them high-value marine products in the international market. However, their slow growth rates, limited natural distribution, and sensitivity to environmental changes necessitate their sustainable utilization and effective conservation.

Among the economically important Cnidaria species in Turkish seas are *Corallium rubrum* (red coral), *Parantipathes larix* (black coral), *Actinia equina* (beadlet anemone), *Anemonia viridis* (snakelocks anemone), *Aurelia aurita* (moon jellyfish), and *Rhizostoma pulmo* (barrel jellyfish). Among these, red coral (*C. rubrum*), black coral (*P. larix*), and beadlet anemone (*A. equina*) are not consumed as food; red and black corals are utilized for decorative purposes, primarily in jewellery and ornaments, whereas *A. equina* is mostly used in scientific research and the aquarium trade. Conversely, *A. viridis*, *A. aurita*, and *R. pulmo* are consumed as food, with *A. aurita* and *R. pulmo* in particular contributing to the national economy through exports to Far Eastern countries (Omori & Nakano, 2001). In recent years, the expanding use of jellyfish in the food, cosmetic, and biotechnology sectors has further increased the economic value of these species.

Polychaetes (Annelida) play crucial roles in the functioning of marine benthic ecosystems and constitute a group of marine invertebrates that has drawn significant economic attention in recent years due to expanding commercial and biotechnological applications. Beyond their ecological functions—such as organic matter decomposition, sediment bioturbation, and contributions to nutrient cycling—numerous polychaete species are utilized as live bait, raw material for aquaculture feed, decorative aquarium trade items, and in bioremediation and environmental monitoring studies (Scaps, 2002; Giangrande et al., 2018). Reusing the biomass obtained from filter-feeding polychaetes cultivated particularly in Integrated Multi-Trophic Aquaculture (IMTA) systems as feed raw material contributes to waste utilization and enhances the economic value of these organisms within the framework of the sustainable blue economy. Recent studies demonstrate that biomass obtained from species such as *Sabella spallanzanii* can be successfully incorporated into fish feed, thereby highlighting the significant potential of polychaetes in terms of the circular bioeconomy (Giangrande et al., 2018; Arduini et al., 2023). Approximately 32 polychaete species of economic importance have been defined globally, eight of which are naturally distributed in the Mediterranean (Gambi et al., 1994). In Turkish seas, the primary species of economic value are reported as *Diopatra neapolitana*, *Hediste diversicolor*, *Perinereis cultrifera*, and *Ophelia bicornis* (Dağlı et al., 2005; Doğan et al., 2007). These species are predominantly used as live bait in recreational fishing and provide substantial economic contributions to coastal fisheries. Among them, *Diopatra neapolitana* forms dense populations in the Gulf of İzmir and is considered the polychaete species with the highest economic value in Türkiye (Dağlı et al., 2005). However, the long-term exposure of natural populations to intensive fishing pressure raises significant concerns regarding stock sustainability. The global polychaete industry is reported to reach an annual production volume of approximately 121,000 tonnes (Clark, 2017). Nevertheless, while the culture production and international trade of taxa such as *Alitta virens*, *Arenicola defodiens*, *Marphysa* spp., and *Perinereis aibuhitensis* are expanding rapidly, the reliance of economic activities in Türkiye primarily on wild harvest from natural stocks poses a major limitation. Rising demand intensifies fishing pressure on wild populations, necessitating the development of sustainable management strategies. Therefore, developing controlled propagation techniques for native polychaete species of high economic value, preparing stock management plans, and investigating their integration into sustainable aquaculture systems like IMTA stand out as priority topics.

Owing to its high filtration capacity and biomass production, *Sabella spallanzanii* emerges as a key species that can be evaluated both in bioremediation applications and as a valuable by-product in IMTA systems (Parisi et al., 2017; Arduini et al., 2023). Recent studies on using biomass derived from these species as a protein source in fish feed demonstrate that polychaetes are transitioning from being organisms harvested solely as live bait from wild stocks into alternative biological resources evaluated within the circular bioeconomy.

Economically important crustaceans (Crustacea) along the coasts of Türkiye largely consist of species belonging to the order Decapoda. Decapods perform essential tasks in the functioning of benthic ecosystems through their roles in the food web and bioturbation activities, while also ranking among fishery resources of high commercial value (Boudreau & Worm, 2012; Fanjul et al., 2015). Shrimps constitute the most economically important decapod group in Turkish seas. Among these, the deep-water rose shrimp (*Parapenaeus longirostris*),

deep-water red shrimps (*Aristaeomorpha foliacea* and *Aristeus antennatus*), and green tiger prawn (*Penaeus semisulcatus*) stand out as the primary commercial species. Additionally, species such as *Penaeus kerathurus* and *Penaeus japonicus* hold regional or potential economic significance. Among crabs, the blue crab (*Callinectes sapidus*) is one of the highest economic value species in Türkiye, contributing significantly to lagoon and coastal fisheries. The Lessepsian migrant *Portunus segnis* holds regional economic potential in the Eastern Mediterranean. Among lobsters, *Nephrops norvegicus*, *Scyllarides latus*, *Palinurus elephas*, and *Homarus gammarus* possess high market value, although their commercial catch in Türkiye remains limited. Certain small decapods (*Palaemon serratus* and *Upogebia pusilla*) hold economic value not through direct food consumption, but primarily as bait in line fishing. Overall, the decapod species with the highest commercial importance along Turkish coasts are *P. longirostris*, *A. foliacea*, *A. antennatus*, *P. semisulcatus*, and *C. sapidus*, whereas many other species represent regional fisheries, bycatch, or potential resources for future exploitation. Consequently, the economic importance of decapods must be evaluated holistically by considering their market value alongside stock status, catch volume, spatial distribution, and ecosystem impacts.

The identification of 40 economically important Mollusca species in this study reveals that the Turkish coasts possess significant potential in terms of both biodiversity and fisheries economics. The composition of 55% Bivalvia, 35% Cephalopoda, and 10% Gastropods indicates that the majority of commercially exploited molluscs in Türkiye comprise bivalves and cephalopods. Similarly, studies conducted across the Mediterranean Basin report that a major proportion of species with high economic value is concentrated in the classes Bivalvia and Cephalopoda (Bettoso et al., 2016; Carducci et al., 2020). The high species richness observed in the Mediterranean (38 species) and Aegean Sea (39 species), alongside a markedly lower richness in the Black Sea (13 species), aligns with the biogeographic characteristics of Turkish seas. The Mediterranean and Aegean Seas are recognized as regions with the highest Mollusca diversity due to higher temperatures and salinity, habitat heterogeneity, abundance of rocky and hard substrates, and their role as entry points for Lessepsian migrations. In contrast, the low salinity and distinct hydrographic structure of the Black Sea limit the distribution of numerous marine mollusc species (Gogaladze et al., 2021). The identified non-native species (*Rapana venosa*, *Magallana gigas*, *Pinctada radiata*, *Ruditapes philippinarum*, and *Septoteuthis lessoniana*) underscore the economic magnitude of biological invasions in Turkish seas. Particularly, *Rapana venosa*, despite being an invasive species in the Black Sea, has become one of Türkiye's most important mollusc export commodities, demonstrating that invasive species can be transformed into economic benefits through appropriate management strategies (Sağlam et al., 2009). Likewise, several non-native bivalve species introduced via aquaculture activities and maritime transport are now integrated into commercial production and consumption chains. Nevertheless, the potential negative ecological impacts of non-native species should not be overlooked; the monitoring and management of these species should be addressed within an ecosystem-based fisheries management framework (Cranford et al., 2012). The fact that a significant portion of economically exploited species holds national or international protection status reflects a delicate balance between sustainable utilization and biodiversity conservation. In particular, the protection of *Lithophaga lithophaga* under international conventions, along with the management of species such as *Ostrea edulis*, *Donax trunculus*, *Ruditapes decussatus*, and *Octopus vulgaris* via national regulations, highlights the necessity of controlling fishing pressure. Similarly, management tools such as closed seasons, minimum allowable catch sizes, and marine protected areas are widely implemented across European Union and Mediterranean countries to conserve benthic invertebrates of high economic value (Guidetti & Boero, 2004).

In a literature review (González-Wangüemert et al., 2014) covering the Mediterranean overall, nine out of 61 identified holothurian species possess commercial importance. These economically valuable species are *Holothuria tubulosa*, *H. poli*, *H. mammata*, *H. sanctori*, *H. forskali*, *H. arguinensis*, *Parastichopus regalis*, *P. tremulus*, and *Apostichopus japonicus*. Native to East Asia, *Apostichopus japonicus* was documented in 2024, first in the Sea of Marmara and subsequently in the Aegean Sea. Holding high commercial value, this species is also categorized as “Endangered” on the IUCN Red List. Across the Mediterranean Basin, *Holothuria poli*, *Holothuria tubulosa*, *Holothuria mammata*, and *Holothuria (Platyperona) sanctori* are among the most heavily traded species. While the emerging export-oriented commercial value of sea cucumbers has intensified fishing pressure on these species in recent years, it places the sustainable management of wild stocks—particularly of *Holothuria tubulosa* and *H. mammata*—into sharp focus (Aydin, 2008). Conversely, the economic exploitation of species such as *H. poli* and *H. sanctori* remains at a more limited scale due to their biological characteristics and population densities. Among sea urchins, the sole species of

economic importance, *Paracentrotus lividus*, is in demand in local and international markets due to its high nutritional value; however, its protection status and vulnerability to climate change and invasive species pressure necessitate sustainable management. Furthermore, the absence of species-specific production statistics for sea urchin harvesting in Türkiye complicates the assessment of stock status and fishing pressure. This situation highlights the urgent need to establish regular stock monitoring programs and species-specific fisheries data for both sea cucumbers and sea urchins.

Conclusion

Turkish seas harbor a broad diversity of benthic invertebrates spanning from Porifera to Echinodermata, with these groups constituting vital biological resources that directly contribute to the national economy. Utilized across diverse sectors—including food, commercial fisheries, aquaculture, live bait production, ornamental items and jewelry, the aquarium trade, biotechnology, and cosmetics—these species represent essential components of Türkiye's economy. While Mollusca and Arthropoda form the most prominent groups in terms of economic volume and export capacity, sea cucumbers, sea urchins, sponges, and certain Cnidaria species stand out due to their high unit value. Furthermore, the class Polychaeta draws attention as a benthic invertebrate group whose economic significance is expected to expand in the future, particularly through its growing applications in live bait production, aquaculture, and bioremediation.

Nevertheless, evaluating economic importance solely on the basis of catch volume or species richness remains insufficient. The economic value of species must be assessed holistically, taking into account market demand, intended usage, export potential, biological traits, and ecological roles. Within this framework, species such as *Rapana venosa*, *Parapenaeus longirostris*, *Holothuria tubulosa*, *Diopatra neapolitana*, and *Corallium rubrum* emerge as primary economic resources for Türkiye, whereas certain native species with high commercial potential, such as *Haliotis tuberculata*, appear to remain underutilized. Moreover, the economic prominence gained by non-native species, such as *Magallana gigas*, *Pinctada radiata*, *Sepioteuthis lessoniana*, and *Portunus segnis*, necessitates the simultaneous evaluation of their potential impacts on benthic ecosystems. The economic exploitation of non-native species does not imply that their potential adverse ecological impacts are eliminated; therefore, monitoring and management strategies must be conducted in parallel (Özcan Gökçek et al., 2020).

One of the most critical deficiencies highlighted by this study is the paucity of species-specific data regarding production, catch volume, fishing effort, first-sale price, and market statistics for many economically important benthic invertebrates. The practice of recording existing statistics predominantly under higher taxonomic categories hinders the accurate assessment of the true economic contributions and stock statuses of individual species. Consequently, collecting species-specific biological, ecological, and economic data through standardized methodologies, establishing national monitoring programs, and developing comprehensive databases are of paramount importance for future research.

In conclusion, Turkish seas represent one of the most critical regions in the Mediterranean Basin regarding benthic invertebrate biodiversity and economic potential. To preserve this potential for future generations, it is imperative to implement scientifically sound stock management practices, effectively execute conservation measures, advance aquaculture and biotechnological applications for high-value native species, manage invasive species through ecosystem-based approaches, and support long-term monitoring initiatives. These strategies will not only contribute to the conservation of Türkiye's marine biological resources but also enable the sustainable enhancement of the economic benefits derived from these resources within the framework of the blue economy.

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