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Diversity of Porifera along the coasts of Türkiye

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Abstract: This study compiled data on the distribution of sponge species on the coasts of Türkiye. The checklist consists of 183 species belonging to 52 families, 16 orders, and 3 classes. The orders Haplosclerida (32 species), Poecilosclerida (28 species), Tetractinellida (26 species), Dictyoceratida (21 species), and Suberitida (18 species) have the highest numbers of species found in the region. The Aegean coast has the highest number of sponge species (155 species), followed by the Sea of Marmara (84 species), the Levantine coast (50 species), and the Black Sea coast (24 species). Among the species, *Niphates toxifera* and *Paraleucilla magna* are alien species. A total of 12 sponge species listed as endangered or threatened according to the Barcelona Convention or Bern Convention are found in the region.

Key words: Sponges, Porifera, eastern Mediterranean, Aegean Sea, Levantine Sea, checklist

1. Introduction

Sponges are among the most important taxonomic groups of the Mediterranean benthos in terms of species richness, representing 12.4% of the total number of species recorded among metazoans (Coll et al., 2010). Sponges also have a very high endemism rate (about 40%) among Mediterranean benthic taxa (Pansini and Longo, 2003; Pronzato, 2003).

Since the 13th edition of the Systema Naturae (Linnaeus, 1789), which was the first study on Mediterranean sponges, the number of studies on Mediterranean sponge fauna has increased steadily. In terms of faunistic studies, sponge biodiversity in the Mediterranean decreases from west to east (Evcen et al., 2023b). According to the World Porifera Database,[1] the Mediterranean sponge fauna is represented by 780 species, of which 680 species belong to the class Demospongiae, 56 species belong to Calcarea, 13 species belong to Homoscleromorpha, and 31 species belong to Hexactinellida. The majority of these species have been reported from the western Mediterranean (west of the Tunisian–Sicilian Strait) and the Adriatic Sea (about 600 species) (Evcen et al., 2023b). In the eastern Mediterranean (the Aegean Sea and the Levantine Sea), 313 sponge species have been reported to date (Evcen et al., 2023b).

The oldest information about sponges on the coasts of Türkiye was given by Spratt and Forbes (1847), who mentioned the presence of sponges on the coasts of Fethiye, Bodrum, and the Cilician Basin without naming them. The first taxonomic study of sponges along the coasts of Türkiye was carried out by the Italian naturalist Colombo (1885), who reported 5 species (*Leucandra aspera* (Schmidt, 1862), *Geodia cydonium* (Linnaeus, 1767), *Suberites domuncula* (Olivi, 1792), *Petrosia* (*Petrosia*) *ficiformis* (Poiret, 1789), and *Siphonochalina coriace* Schmidt, 1868) in the Çanakkale Strait. Later, Ostroumoff (1896) listed 31 sponges from different depths in the Sea of Marmara and the İstanbul Strait. Sponge diversity in the Sea of Marmara was later studied by Demir (1954), Caspers (1968), and Topaloğlu (2001a). In the Aegean Sea, Sarıtaş (1972, 1973, 1974) found a total of 50 sponge species in İzmir Bay. Yazıcı (1978) studied some sponge species collected around Gökçeada (northern Aegean Sea). Sponge species were also reported in faunistic and ecological studies on the Aegean Sea coast of Türkiye (Geldiay and Kocataş, 1972; Gökalp, 1974; Kocataş, 1978; Dalkılıç, 1982; Ergüven et al., 1988; Katagan et al., 1991; Ergen et al., 1994; Cinar and Ergen, 1998; Kocak et al., 1999; Topaloğlu, 2001b; Çinar et al., 2002; Evcen and Çınar, 2015; Gözcelioğlu et al., 2011; Gözcelioğlu et al., 2015; Özalp, 2019; Çinar et al., 2020b; Evcen and Çınar, 2020; Evcen and Çınar, 2024).

[1]de Voogd NJ, Alvarez B, Boury-Esnault N, Cárdenas P, Díaz MC et al. (2024). World Porifera Database. Website https://www.marinespecies.org/porifera [accessed 28 May 2024].

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There have been four main studies on the sponges of the Black Sea coast of Türkiye. Bacescu et al. (1971) reported 13 species in the prebosphoric zone and Topaloğlu et al. (2013) found 2 species on the coast of İğneada. Evcen et al. (2016) recorded 5 species (*Chalinula renieroides*, *Haliclona* (*Halichoclona*) *fulva*, *H*. (*Rhizoniera*) *rosea*, *Hymedesmia* (*Hymedesmia*) *pansa*, and *Ircinia variabilis*) off the mouth of the Kızılırmak River. All of these species were given as new records for the Black Sea sponge fauna, and 3 of them (*Chalinula renieroides*, *H*. (*R*.) *rosea*, and *H*. (*H*.) *pansa*) were given as new records for the Turkish marine fauna. Finally, Evcen et al. (2023a) reported 5 sponge species (*Crambe crambe*, *Halichondria* (*Halichondria*) *bowerbanki*, *Dysidea incrustans*, *Dysidea fragilis*, and *Aplysilla sulphea*) collected from mussel beds (*Mytilus galloprovincialis*) at one locality on the Black Sea coast of Türkiye, off the coast of Bartın Province.

The first detailed study on the sponge fauna of the Levantine coast of Türkiye was conducted by Evcen and Çınar (2012), who recorded a total of 29 sponge species from different depths and biotopes. Evcen and Çınar (2012) also provided a checklist of sponge species reported from Turkish coasts. In the same year, Gözcelioğlu and Ceylan (2011) and Gözcelioğlu et al. (2011) reported nearly 30 sponge species from the Mediterranean coast of Türkiye.

Evcen and Çınar (2012) and Topaloğlu and Evcen (2014) provided checklists of sponges for the coasts of Türkiye, reporting 116 and 131 sponge species, respectively. Evcen et al. (2023b) also provided a comprehensive list of sponges distributed along the coasts of the Aegean Sea and the eastern Mediterranean. In a recent study by Evcen and Çınar (2024), 114 sponge species were found on the Aegean coast of Türkiye, of which 9 species were new to the eastern Mediterranean, 10 species new to the Aegean Sea, and 16 species new to the coasts of Türkiye.

The aim of this study is to summarize the available information on the diversity of Porifera on the coasts of Türkiye.

2. Materials and methods

The checklist of marine sponges reported from the coasts of Türkiye was prepared by the compilation of data in all available literature until May 2024. This checklist is exclusively based on the previous checklists prepared by Evcen and Çınar (2012), Topaloğlu and Evcen (2014), and Topaloğlu et al. (2016). Only reports from the territorial waters of Türkiye were considered. The maritime boundary between the Levantine Sea and the Aegean Sea was accepted as a straight line passing between the Dalaman River and Rhodes. The species reported from the Çanakkale and İstanbul straits were added to the Sea of Marmara, as these straits are strongly influenced by brackish Black Sea waters and have two-layered water masses typical of the Sea of Marmara. As the first records of species up to 2014 were given in the 2014 checklist (Topaloğlu and Evcen, 2014), in this updated study, the species reported in the seas before 2014 are represented with "+" unless a missed reference (e.g., Nikitin, 1948; Demir and Okuş, 2010) in the past is being specified.

All species names were cross-checked and some names were updated according to the World Porifera Database.[2] The first records of species after 2014 were included in the species list together with their depth and habitat preferences according to data compiled both before and after 2014. Species whose presence in the area appeared questionable were also listed and discussed.

3. Results

3.1. Species list

A total of 183 sponge species are presented in this study for the Turkish coasts, 24 of which were reported from the Black Sea, 84 from the Sea of Marmara, 155 from the Aegean Sea, and 50 from the Levantine coast of Türkiye (Table; Figure 1). This numerical difference is closely related to the number of taxonomic studies carried out on the Turkish coasts rather than the actual state of sponge biodiversity. For example, while 22 papers on sponges were published for the Aegean coast of Türkiye, only 7 papers were published for the Levantine coast of Türkiye. Therefore, current studies are insufficient to understand the true sponge diversity in the region and increased scientific efforts will undoubtedly contribute to a better understanding of sponge diversity on the coasts of Türkiye. The class Demospongiae accounted for the majority of species (167 species, comprising 90% of the total number of species) found in the region, while the class Calcarea was represented by 15 species (8%) and Homoscleromorpha by 4 species (4%) (Figure 2). No species belonging to the class Hexactinellida have been found on the coasts of Türkiye. However, Ostroumoff (1896) reported a hexactinellid species (*Farrea* sp.) at the genus level at a depth of 640 m off Sivriada in the Sea of Marmara. This class is represented by 5 species in the Mediterranean Sea.[3] The Mediterranean Sea has long been considered a very poor habitat for hexactinellid sponges due to the relatively high temperature (approximately 13 °C) of its deep waters (Boury-Esnault et al., 2015). The calcareous sponges reported from the Turkish coast are

[2] de Voogd NJ, Alvarez B, Boury-Esnault N, Cárdenas P, Díaz MC et al. (2024). World Porifera Database. Website https://www.marinespecies.org/porifera [accessed 28 May 2024].

[3] de Voogd NJ, Alvarez B, Boury-Esnault N, Cárdenas P, Díaz MC et al. (2024). World Porifera Database. Website https://www.marinespecies.org/porifera [accessed 28 May 2024].

Table. Checklist of sponge species from the coasts of Türkiye. *: Alien species; **: endemic to the Mediterranean Sea; ***: endemic to the eastern Mediterranean Sea. Numbers in cells indicate references in the footnote. BS: Black Sea; SM: Sea of Marmara; AS: Aegean Sea; LS: Levantine Sea; DR: depth range (I: 0–10 m; II: 11–50 m; III: 51–100 m; IV: 101–200 m; V: 201–400 m; VI: 401–600 m; VII: >600 m); H: habitat (Hs: hard substratum, including rocky ground, stones, etc.; Ss: soft substratum, including sandy mud, etc.); PS: protected species (BR: Barcelona Convention, BE: Bern Convention).

TAXON	**BS**	**SM**	**AS**	**LS**	**DR**	**H**	**PS**
PHYLUM PORIFERA							
CALCAREA							
Order: Leucosolenida							
Family: Amphoriscidae							
**Paraleucilla magna* Klautau, Monteiro and Borojevic, 2004		13	22, 26		I, II	Hs	
Family: Sycettidae							
Leucandra aspera (Schmidt, 1862)		+	+, 23, 26		I-III	Hs	
Sycon ciliatum (Fabricius, 1780)	+	+, 14	22, 26		I-III	Hs	
Sycon elegans (Bowerbank, 1845)			8, 23, 26		I-II	Hs	
Sycon raphanus Schmidt, 1862		+, 14	+, 5, 8, 22	+	I,II	Hs	
Sycon setosum Schmidt, 1862	+				II	Hs	
Sycon quadrangulatum (Schmidt, 1868)			23		II	Hs	
Sycon tuba Lendenfeld, 1891	+	+			III	Hs	
Ute glabra Schmidt, 1864		+			II	Hs	
Family: Leucosoleniidae							
Leucosolenia variabilis (Haeckel, 1870)		+			I	Hs	
Order: Clathrinida							
Family: Leucaltidae							
Ascandra contorta (Bowerbank, 1866)		14			I	Hs	
***Leucetta solida* (Schmidt, 1862)			26		I	Hs	
Family: Clathrinidae							
Clathrina coriacea (Montagu, 1814)			+, 19, 23, 26		I-II	Hs	
Clathrina clathrus (Schmidt, 1864)			8, 18, 19, 23, 26	+	I	Hs	
Clathrina reticulum (Schmidt, 1862)			+		II	Hs	
HOMOSCLEROMORPHA							
Order: Homosclerophorida							
Family: Oscarellidae							
Oscarella lobularis (Schmidt, 1862)		+, 24	8, 18, 26	+	I-II	Hs	
Family: Plakinidae							
Corticium candelabrum Schmidt, 1862			8, 19, 26		I-II	Hs	
***Plakina bowerbanki* (Sarà, 1960)			19		II	Hs	
Plakina monolopha Schulze 1880			+, 8, 19, 26		I-II	Hs	
DEMOSPONGIAE							
Order: Tetractinellida							
Family: Tethyidae							
Tethya aurantium (Pallas, 1766)		+, 14, 24	+, 5, 8, 18, 26	+	I-II	Hs	BR
Family: Timeidae							
Timea fasciata Topsent, 1934			+		I	Hs	
Timea mixta (Topsent, 1896)			+, 26		I-II	Hs	

Table. (Continued.)

Timea stellata (Bowerbank, 1866)		+, 14	+, 26		I-II	Hs	
Family: Pachastrellidae							
Triptolemma simplex (Sarà, 1959)			26		II	Hs	
Family: Ancorinidae							
***Ancorina cerebrum* (Schmidt, 1862)		+	+		III	Hs	
Dercitus (*Stoeba*) *plicatus* (Schmidt, 1868)			+, 26		I-II	Hs	
Holoxea furtiva Topsent, 1892			+		I	Hs	
Stelletta grubii (Schmidt, 1862)			+, 26		I	Hs	
***Stelletta stellata* Topsent, 1893			+		I-II	Hs	
Stelletta dorsigera Schmidt, 1864			+, 26		II	Hs	
Stryphnus ponderosus (Bowerbank, 1866)			+		III	Hs	
Family: Theneidae							
Thenea muricata (Bowerbank, 1858)		+, 14	+, 26		III-VII	Hs	
Family: Geodidae							
Erylus discophorus (Schmidt, 1862)			+, 8, 19, 26	+	I	Hs	
Geodia cydonium (Jameson, 1811)		+, 3, 24	+, 3, 6, 8, 26	3	I-III	Hs	BR
Geodia conchilega Schmidt, 1862		+	+, 8		I	Hs	
***Geodia tuberosa* Schmidt, 1862		+			I	Hs	
Penares euastrum (Schmidt, 1868)			+		III	Hs	
Penares helleri (Schmidt, 1864)			+, 19, 26		I	Hs	
Family: Calthropellidae							
Calthropella stelligera (Schmidt, 1868)			+		I	Hs	
Family: Thoosidae							
Alectona millari Carter, 1879			8, 12, 26	+	I	Hs	
***Delectona madreporica* Bavestrello, Calcinai, Cerrano, Sarà, 1997			8, 12		I	Hs	
***Thoosa mollis* Volz, 1939			8, 12, 26		I	Hs	
Family: Tetillidae							
Craniella cranium (Müller, 1776)			+		III	Hs	
***Levantiniella levantinensis* (Vacelet, Bitar, Carteron, Zibrowius and Pérez, 2007)			26		I-II	Hs	
Family: Samidae							
***Samus anonymus* Gray, 1867			+		I	Hs	
Order: Clionaida							
Family: Clionidae							
Diplastrella bistellata (Schmidt, 1862)		+	18, 26	+	I-II	Hs	
Spirastrella cunctatrix Schmidt, 1868		+	+, 5, 8, 12, 18, 19, 21, 26	+, 21	I-II	Hs	
Cliona celata Grant, 1826		+, 14, 24	+, 5, 8, 19, 21, 26	+, 21	I-III	Hs	
Cliona vermifera Hancock, 1867			+		I	Hs	
Cliona schmidti (Ridley, 1881)			+, 19, 20, 26	+, 21	I-II	Hs	
Cliona viridis (Schmidt, 1862)		+, 24	+, 8, 11, 26	21	I-II	Hs	
***Cliona janitrix* Topsent, 1932			8, 12		I	Hs	
Dotona pulchella mediterranea Rosell and Uriz, 2002			8, 12, 26		I-II	Hs	
***Volzia albicans* (Volz, 1939)			8, 12, 26		I-II	Hs	

Table. (Continued.)

Cliothosa hancocki (Topsent, 1888)			+		I	Hs	
Family: Placospongiidae							
Placospongia decorticans (Hanitsch, 1895)			+		I	Hs	
Order: Suberitida							
Family: Suberitidae							
Aaptos aaptos (Schmidt, 1864)		+	+, 26		I-III	Hs	
Protosuberites denhartogi Van Soest and de Kluijver, 2003		+	+		I-II	Hs	
Rhizaxinella elongata (Ridley and Dendy, 1886)		14	10, 26		I-IV	Hs	
Rhizaxinella pyrifera (Delle Chiaje, 1828)		+	+, 26		I-IV	Hs	
Suberites carnosus (Johnston, 1842)	+	+, 11			I-III	Hs	
Suberites domuncula (Olivi, 1792)	1, +	+, 24	+, 17		I-V	Hs	
Suberites ficus (Johnston, 1842)		+	6, 26		I-III	Hs	
Suberites massa Nardo, 1847		+	26		II	Hs	
Terpios gelatinosus (Bowerbank, 1866)			8, 10, 19, 26		I-II	Hs	
Pseudosuberites sulphureus (Bowerbank, 1866)			26		II	Hs	
Family: Halichondriidae							
Axinyssa digitata (Cabioch, 1968)			10, 11, 26		I-II	Hs	
Axinyssa aurantiaca (Schmidt, 1864)			11		II	Hs	
***Ciocalypta carballoi* Vacelet, Bitar, Carteron, Zibrowius and Perez, 2007			5, 26	+	I-II	Hs	
Ciocalypta penicillus (Schmidt, 1862)		+, 14			I-III	Hs	
Halichondria (Halichondria) bowerbanki Burton, 1930	+		26		I-III	Hs	
**Halichondria* (*Halichondria*) *contorta* (Sarà, 1961)			11		I-II	Hs	
Hymeniacidon perlevis (Montagu, 1818)		+, 17	+, 26		I-III	Hs	
Halichondria (*Halichondria*) *panicea* (Pallas, 1766)		+	+		I	Hs	
Order: Polymastiida							
Family: Polymastiidae							
Polymastia penicillus (Montagu, 1814)		14	26		I-III	Hs	
Order: Haplosclerida							
Family: Chalinidae							
Chalinula limbata (Montagu, 1818)		+	26		I-II	Hs	
Chalinula renieroides Schmidt, 1868	+	14	26		I-II	Hs	
**Dendrectilla tremitensis* Pulitzer-Finali, 1983			+		II	Hs	
Ulosa digitata (Schmidt, 1866)			+, 26		II	Hs	
**Haliclona alba* (Schmidt, 1862)	+	+			I-II	Hs	
**Haliclona flavescens* (Topsent, 1893)				+	II	Hs	
**Haliclona palmata* (Schmidt, 1862)	1				II	Hs	
**Haliclona poecillastroides* (Vacelet, 1969)			18		II	Hs	
**Haliclona* (*Gellius*) *dubia* (Babic, 1922)			+		I-II	Hs	
Haliclona (*Gellius*) *fibulata* (Schmidt, 1862)		+	+, 26		I	Hs	
Haliclona (*Haliclona*) *simulans* (Johnston, 1842)			+, 26		I-II	Hs	
Haliclona (*Halichoclona*) *fulva* (Topsent, 1893)	13	14	8, 18, 19, 21, 26	+	I-II	Hs	
Haliclona (Halichoclona) fistulosa (Bowerbank, 1866)			26		II	Hs	
Haliclona (*Reniera*) *aquaeductus* (Schmidt, 1862)	+	+			VII	Hs	

Table. (Continued.)

Haliclona (*Reniera*) *cinerea* (Grant, 1826)		+, 14	+, 26		I-II	Hs	
Haliclona (*Reniera*) *cratera* (Schmidt, 1862)	+		+	+	I	Hs	
Haliclona (*Reniera*) *mediterranea* Griessinger, 1971		+, 3	3, 5, 26	+, 3	I-III	Hs	
Haliclona (*Soestella*) *mucosa* (Griessinger, 1971)			19, 26		II	Hs	
Haliclona (Soestella) mamillata (Griessinger, 1971)			26		II	Hs	
Haliclona (*Rhizoniera*) *grossa* (Schmidt, 1864)	+				II	Hs	
Haliclona (*Rhizoniera*) *rosea* (Bowerbank, 1866)	13		26		I-II	Hs	
******Haliclona* (*Rhizoniera*) *sarai* (Pulitzer-Finali, 1969)		14	11, 19, 26	+	I-III	Hs	
Haliclona (Rhizoneira) indistincta (Bowerbank, 1866)			26		I-II	Hs	
Dendroxea lenis (Topsent, 1892)			19, 26		II	Hs	
Family: Niphatidae							
*******Niphates toxifera* Vacelet, Bitar, Carteron, Zibrowius and Pérez, 2007				23	II	Hs	
******Pachychalina rustica* Schmidt, 1868		+			II	Hs	
Family: Phloeodictyidae							
Calyx nicaeensis (Risso, 1826)			5, 8, 18, 26	+	I-II	Hs	
Siphonodictyon infestum (Johnson, 1889)			8, 12, 26		II	Hs	
Family: Callyspongiidae							
Siphonochalina coriacea Schmidt, 1868		+			I-II	Hs	
Family: Petrosiidae							
Petrosia (*Petrosia*) *ficiformis* (Poiret, 1789)			+, 3, 5, 8, 18, 19, 26	+, 3, 21	I-IV	Hs	
Petrosia (Petrosia) clavata (Esper, 1794)	1				II	Hs	
******Petrosia pulitzeri* (Pansini, 1996)		+					
Order: Bubarida							
Family: Desmanthidae							
Desmanthus incrustans (Topsent, 1889)			26		V	Hs	
Family: Dictyonellidae							
******Acanthella acuta* Schmidt, 1862		+	+, 6, 8, 11, 18, 19, 26	+	I-III	Hs	
Dictyonella incisa (Schmidt, 1880)			+, 11, 26		I-II	Hs	
Dictyonella marsilii (Topsent, 1893)			26		I-II	Hs	
Dictyonella obtusa (Schmidt, 1862)		+	26		I-II		
Dictyonella plicata (Schmidt, 1880)		+			I-III	Hs	
Order: Axinellida							
Family: Axinellidae							
Axinella cannabina (Esper, 1794)		+	+, 5, 6, 8, 18, 19, 26	+	I-III	Hs	BR
Axinella damicornis (Esper, 1794)		+	+, 5, 6, 8, 19, 24, 26	+	I-III	Hs	
Axinella polypoides Schmidt, 1862		+, 3, 14	+, 5, 6, 8, 19, 21, 26	+, 3, 21	I-III	Hs	BE, BR
Axinella pumila Babic, 1922			+		II	Hs	
Axinella verrucosa (Esper, 1794)			+, 11, 19, 26	+	I-III	Hs	
Family: Stelligeridae							
Stelligera stuposa (Ellis and Solander, 1786)		15			II	Hs	
Paratimea oxeata Pulitzer-Finali, 1978			26		II	Hs	
Raspailia (*Raspailia*) *viminalis* Schmidt, 1862		10, 14	+, 26		II-III	Hs	

Table. (Continued.)

Raspailia (*Parasyringella*) *agnata* (Topsent, 1896)		14			II	Hs	
Order: Poecilosclerida							
Family: Mycalidae							
Mycale (*Aegogropila*) *contarenii* (Martens, 1824)		+	+	+	I-III	Hs	
Mycale (*Aegogropila*) *rotalis* (Bowerbank, 1874)			+, 26	+	I-III	Hs	
Mycale (*Aegogropila*) *tunicata* (Schmidt, 1862)			+		I-III	Hs	
Mycale (*Mycale*) *lingua* (Bowerbank, 1866)		24	8, 26	+	I-II	Hs	
Mycale (*Carmia*) *macilenta* (Bowerbank, 1866)			+		I-III	Hs	
Mycale (*Mycale*) *massa* (Schmidt, 1862)		+	+, 19, 26	+	I-III	Hs	
Family: Myxillidae							
Myxilla (*Myxilla*) *prouhoi* (Topsent, 1892)			+		II-III	Hs	
Myxilla (*Myxilla*) *rosacea* (Lieberkühn, 1859)			+		I-III	Hs	
Myxilla (*Myxilla*) *incrustans* (Johnston, 1842)			19		II	Hs	
Family: Coelosphaeridae							
Lissodendoryx (*Anomodoryx*) *cavernosa* (Topsent, 1892)			+		I	Hs	
Family: Crambeidae							
Crambe crambe (Schmidt, 1862)	+	14, 24	+, 5, 6, 8, 18, 19, 21, 26	+	I-III	Hs	
Family: Hymedesmiidae							
Hymedesmia (*Hymedesmia*) *anatoliensis* Gözcelíoglu, Van Soest, Alvarez and Konuklugíl, 2015			11		II	Hs, Ss	
Hymedesmia (*Hymedesmia*) *pansa* Bowerbank, 1882	13				II	Hs, Ss	
Hemimycale columella (Bowerbank, 1874)			+, 8, 19	+	I-II	Hs	
Phorbas armatus (Schmidt, 186		+			II	Hs	
Phorbas fictitius (Bowerbank, 1866)		+, 24	19, 21, 26	+, 21	I-II	Hs	
Phorbas plumosus (Montagu, 1818)			8, 26	+	I-II	Hs	
Phorbas tenacior (Topsent, 1925)		24	8, 18, 19, 21, 26	+, 21	I-II	Hs	
Family: Crellidae							
Crella (*Crella*) *elegans* (Schmidt, 1862)		+			IV	Hs	
Crella (*Pytheas*) *fusifera* Sarà, 1969			+		II	Hs	
Crella (Grayella) pulvinar (Schmidt, 1868)			26		II	Hs	
Family: Acarnidae							
Acarnus tortilis Topsent, 1892			+		I-II	Hs	
Family: Tedeniidae							
Tedania (*Tedania*) *anhelans* (Lieberkühn, 1859)		+	+, 26		I-II	Hs	
Family: Microcionidae							
Clathria (*Clathria*) *coralloides* (Olivi, 1792)		24	+		II	Hs	
Clathria (Clathria) compressa		24			II	Hs	
Clathria (*Microciona*) *strepsitoxa* (Hope, 1889)		+	+		I-III	Hs	
Clathria (*Thalysias*) *jolicoeuri* (Topsent, 1892)			+		II	Hs	
Family: Desmacellidae							
Desmacella inornata (Bowerbank, 1866)				+	I	Hs	
Order: Agelasida							
Family: Agelasiidae							
Agelas oroides (Schmidt, 1862)		+, 3	+, 5, 8, 15, 19, 26	+, 3	I-III	Hs	

Table. (Continued.)

Family: Hymerhabdidae							
Hymerhabdia intermedia Sarà and Siribelli, 1960			26	+	I	Hs	
Prosuberites longispinus Topsent, 1893			26		II	Hs	
SUBCLASSIS KERATOSA							
Order: Dictyoceratida							
Family: Irciniidae							
Ircinia dendroides (Schmidt, 1862)			26	+	II	Hs	
Ircinia variabilis (Schmidt, 1862)	13	+, 14, 21, 24	+, 8, 19, 26	+	I-II	Hs	
Ircinia oros (Schmidt, 1864)			16, 19 26	+	II	Hs	
Ircinia retidermata Pulitzer-Finali and Pronzato, 1981			26		II	Hs	
Sarcotragus foetidus Schmidt, 1862		+, 14	+, 4, 8, 18, 19, 26	+	I-II	Hs	BR
Sarcotragus spinosulus Schmidt, 1862		+	+, 7, 15, 21, 26	+	I-II	Hs	
Family: Dysideidae							
Dysidea avara (Schmidt, 1862)		+, 24	+, 5, 8, 18, 19, 26		I-III	Hs	
Dysidea fragilis (Montagu, 1818)	+, 25	+, 14	+, 8, 19, 22, 26	+	I-III	Hs	
Dysidea incrustans (Schmidt, 1862)	25	+, 14	26		I-II	Hs	
Dysidea pallescens (Schmidt, 1862)		+			II	Hs	
Dysidea tupha (Martens, 1824)	1		+		I	Hs	
Pleraplysilla spinifera (Schulze, 1879)		14	+, 8, 18, 19, 21, 26		I-II	Hs	
Family: Thorectidae							
Scalarispongia scalaris (Schmidt, 1862)		14	+, 26	+	I-II	Hs	
Cacospongia mollior Schmidt, 1862		+	26		I-III	Hs	
Fasciospongia cavernosa (Schmidt, 1862)		+	19, 26		I-II	Hs	
Hyrtios collectrix (Schulze, 1880)				+	II	Hs	
Family: Spongiidae							
Hippospongia communis (Lamarck, 1814)		+	+, 15, 26		II-III	Hs	BR, BE
Spongia (Spongia) officinalis Linnaeus, 1759	+	+, 3, 14, 24	+, 18, 26	+, 3	I-III	Hs	BE, BR
Spongia (*Spongia*) *nitens* (Schmidt, 1862)		14	26		II	Hs	
Spongia (Spongia) lamella (Schulze, 1879)			8, 26		II	Hs	BE, BR
Spongia (*Spongia*) *virgultosa* (Schmidt, 1868)			+, 26		II	Hs	
Spongia (Spongia) zimocca Schmidt, 1862			26		II	Hs	BE, BR
Order: Verongida							
Family: Aplysinidae							
Aplysina aerophoba Nardo, 1843		+, 14, 24	+, 5, 8, 18, 19, 26	+	I-III	Hs	BR
Aplysina cavernicola (Vacelet, 1959)			9, 19, 26		I-IV	Hs	BR, BE
Family: Ianthellidae							
Hexadella pruvoti Topsent, 1896			19		II	Hs	
Hexadella racovitzai Topsent, 1896		24	19, 26		II	Hs	
Order: Dendrocetatida							
Family: Darwinellidae							
Aplysilla sulfurea Schulze, 1878	25	14	19, 26		II	Hs	
Order: Chondrosida							
Family: Chondrosiidae							

Table. (Continued.)

Chondrosia reniformis Nardo, 1847		24	+, 4, 8, 12, 18, 19, 21, 26	+, 21	I-II	Hs	
Family: Chondrillidae							
Halisarca dujardinii Jonston, 1842	+		26		II	Hs	
Chondrilla nucula Schmidt, 1862			3, 5, 8, 18, 19, 21, 24, 26	3	I-II	Hs	

+ for the reference, see Topaloğlu and Evcen (2014), 1. Nikitin, 1948; 2. Eryılmaz, 1997; 3. Öztürk et al., 2004; 4. Okuş et al., 2007; 5. Demir and Okuş, 2010; 6. Altuğ et al. 2011; 7. Eryalçın-Topçu et al., 2013; 8. Evcen, 2013; 9. Yokeş and Demir 2013; 10 Topaloğlu and Evcen, 2014; 11. Gözcelioğlu et al., 2015; 12. Evcen and Çınar, 2015; 13. Evcen et al., 2016; 14. Topaloğlu et al., 2016; 15. Topaloğlu, 2016; 16. Chianese et al., 2017; 17. Longo et al., 2017; 18. Özalp, 2019; 19. Çınar et al., 2019; 20. Çinar et al., 2020a; 21. Çinar et al., 2020b; 22. Evcen and Çınar, 2020; 23. Evcen et al., 2020; 24. Özalp et al., 2022; 25. Evcen et al., 2023a; 26. Evcen and Çınar, 2024.

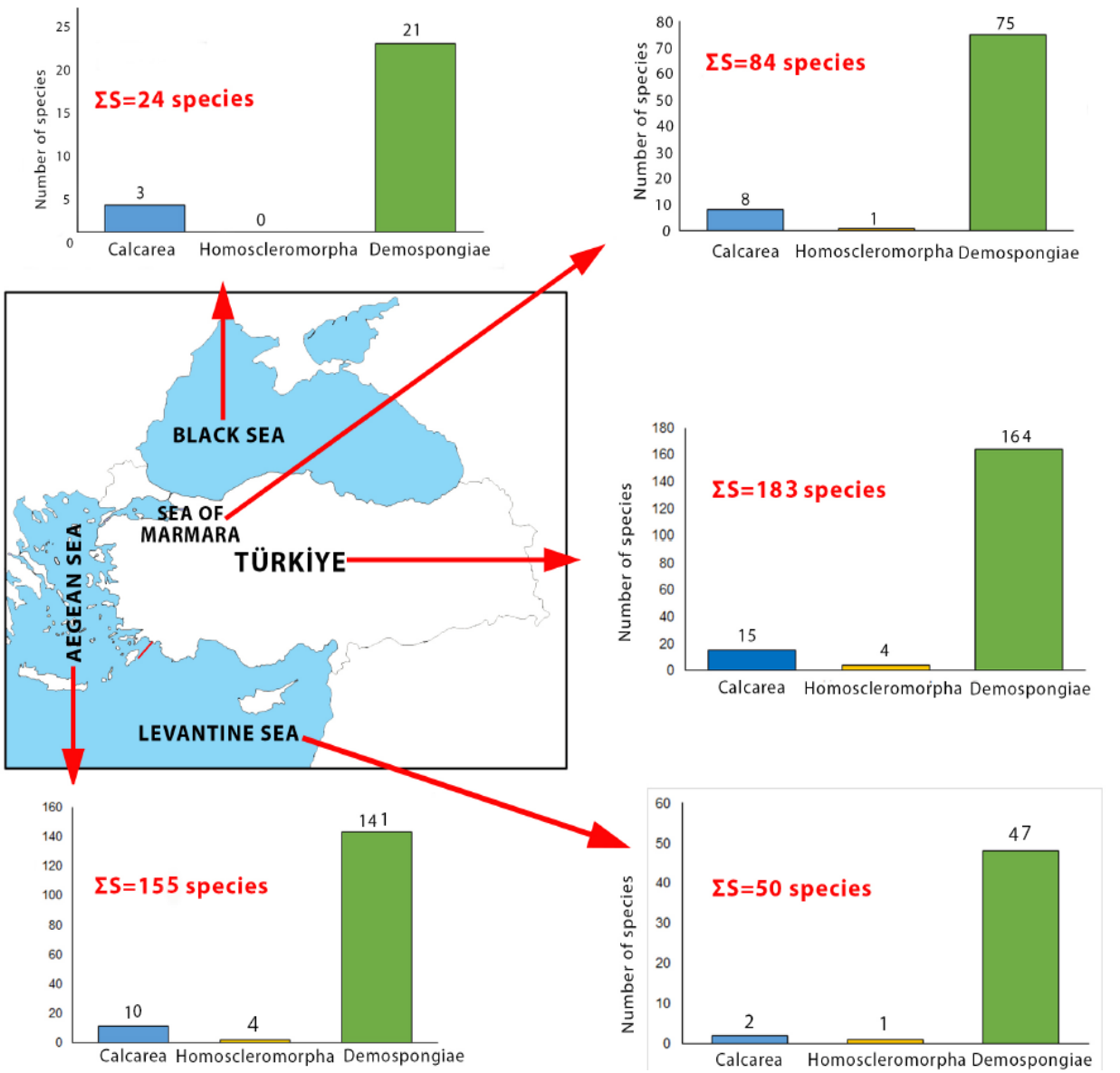

Figure 1. Numbers of sponge species along the coasts of Türkiye. ΣS indicates the total number of species of Porifera.

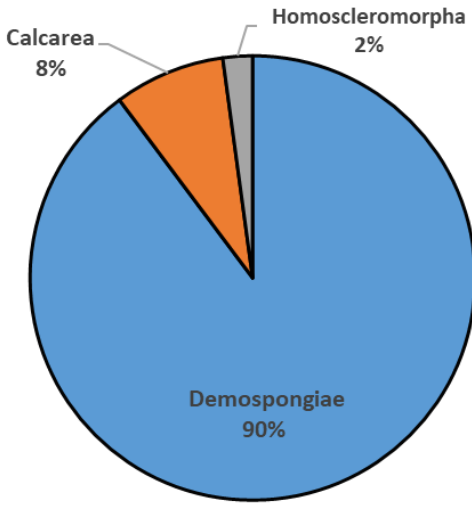

Figure 2. Distribution of sponge species according to classes on the coasts of Türkiye.

poorly represented (only 15 species), as some specific habitats in intertidal, subtidal, and cave environments may not have been adequately explored in the region. This class is represented by 56 species in the entire Mediterranean Sea[4] and about 650 species in the world's oceans (Van Soest et al., 2012), representing about 8% of the world's sponge species (Van Soest et al., 2012).

Among the orders, Haplosclerida (32 species), Poecilosclerida (28 species), Tetractinellida (26 species), Dictyoceratida (21 species), and Suberitida (18 species) had the highest numbers of species in the region (Figure 3). The order Poecilosclerida is also represented by a high number of species in the world's oceans (Van Soest et al., 2012).

The families with high numbers of species on the coasts of Türkiye are Chalinidae (24 species, comprising 12% of the total number of species), Suberitidae (10 species, 5%), Clionidae (10 species, 5%), Sycettidae and Halichondriidae (each 8 species, 5%), Ancorinidae and Hymedesmidae (each 7 species, 4%), and Irciniidae, Mycalidae, Dysideae, Geodidae, and Spongiidae (each 6 species, 3%) (Figure 4).

3.2. Protected species

Studies on the conservation of Mediterranean sponge species are quite limited. In recent years, studies on the conservation status of Mediterranean sponge species have been initiated by the International Union for Conservation of Nature (IUCN). Gerovasileiou et al. (2018) investigated the distribution patterns, population trends, threats and regional extinction risk assessments, and regional conservation statuses of 20 sponge species in the Aegean Sea using the IUCN Red List criteria. Twenty sponge species (*Aplysina* sp., *Axinella canabina*, *A. polypoides*, *Axinyssa michaelis*, *Cosciondermа sporadense*, *Geodia cydonium*, *Hemiastrella aristorelina*, *Hippospongia communis*, *Hymedesmia anatoliensis*, *Iricinia paucifilementosa*, *Petrobiona massiliana*, *Phorbas posidoni*, *Sarcotragus foetidus*, *S. pipetta*, *Spongia lamella*, *S. officinialis, S. zimocca*, *Tethya aurantium*, *T. citrina*, and *Topsentia vaceleti*) are currently protected by legislation (Bell et al., 2015). On the coasts of Türkiye, 11 sponge species are listed as endangered or threatened species and regulated under the 1979 Bern Convention[5] or the 2013 Barcelona Convention.[6] In addition, bath sponge fishing has been restricted by various legal regulations in many countries bordering the Mediterranean Sea. For example, after the outbreak of a devastating disease in 1986, sponge fishing was banned on all coasts of Türkiye, which continued until 2017, when only one local site on the northern Aegean coast (between Bababurnu and Gökçeada Island) was opened for sponge fishing between September and August.

3.3. Endemic species

Among the species listed on the Turkish coasts, 22 species are endemic to the eastern Mediterranean and 2 species

[4]de Voogd NJ, Alvarez B, Boury-Esnault N, Cárdenas P, Díaz MC et al. (2024). World Porifera Database. Website https://www.marinespecies.org/porifera [accessed 28 May 2024].

[5]Bern Convention (1979). Bern - Convention on the Conservation of European Wildlife and Natural 218 Habitats [online]. Website http://conventions.coe.int/Treaty/en/Treaties 219 /Html/104.htm [accessed 29 May 2024].

[6]Barcelona Convention (2013). Barcelona - Convention for the Protection of the Mediterranean Sea 215 against Pollution Signed 16 February 1976 [online]. Website http://195.97.36.231 216 /dbases/webdocs/BCP/BCP_eng.pdf [accessed 29 May 2024].

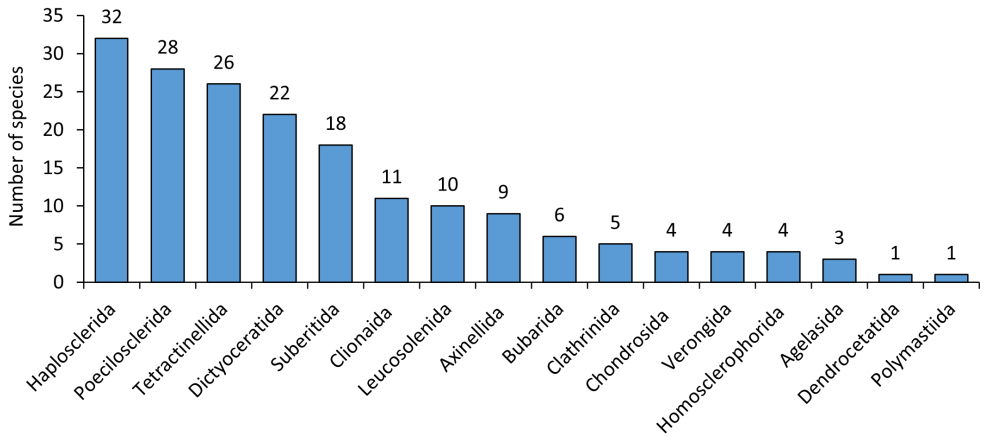

Figure 3. Numbers of species of orders on the coasts of Türkiye.

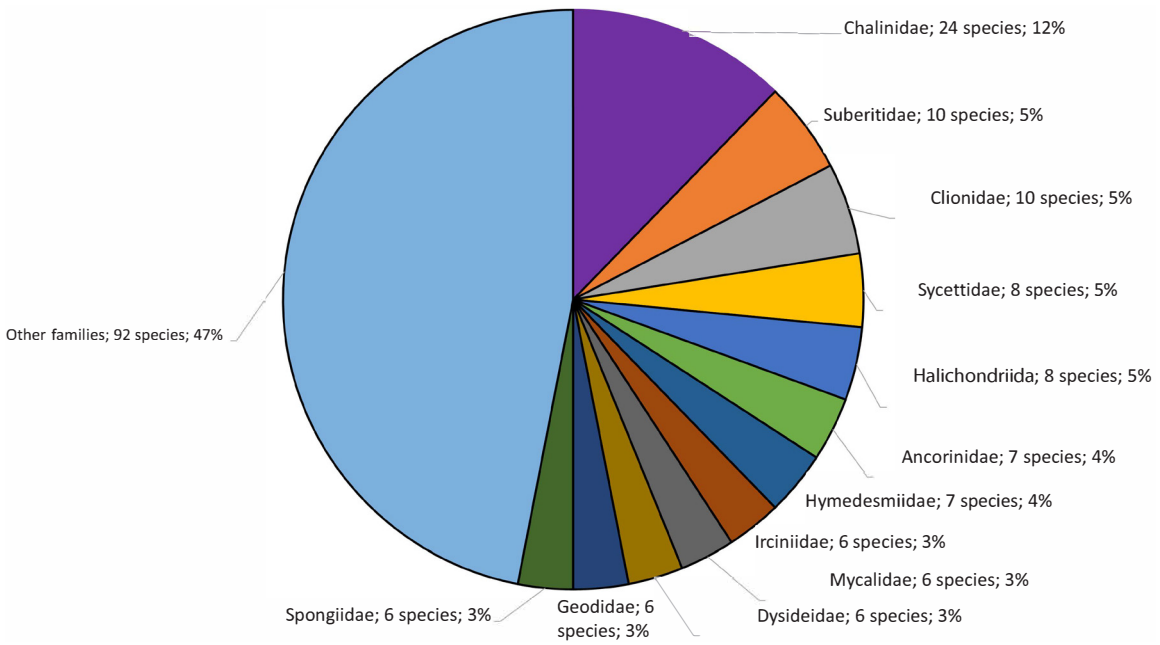

Figure 4. Percentages of families in terms of the numbers of species on the coasts of Türkiye.

(*Ciocalypta carballoi* and *Niphates toxifera*) are endemic to the Mediterranean (Table). Endemism richness can be interpreted as the specific contribution of a region to global biodiversity. In addition, endemic species highlight the importance of conserving genetic resources on a global scale (Kier et al., 2009). For this reason, it is important to implement conservation plans for endemic sponge species in the region.

3.4. Alien species

Since the opening of the Suez Canal and its continuous expansion (Zenetos and Galanidi, 2020), a significant number of alien species have been introduced into the Mediterranean Sea. These species have exerted immense pressure on the native fauna of the Mediterranean ecosystem and caused adverse biotic changes (Çinar et al., 2011; Zenetos et al., 2012; Çinar, 2013; Çinar et al., 2021). Nearly 1000 alien species have been reported from the Mediterranean Sea (Zenetos et al., 2018), and the number of alien species in the region is increasing steadily. For example, 215 established/casual alien species were known along the coasts of Turkey in 2005 (Çinar et al., 2005), but the number increased to 539 in 2020 (Çinar et al., 2021). Today, six sponge species (*Haliclona* (*Halicholona*) *vansoesti*, *Geodia micropuntata*, *Amphimedon chloros*, *Niphates toxifera, Negombata corticata*, and *Paraleucilla magna*) appear to be alien to the Mediterranean Sea (Longo et al., 2007; Zammit et al., 2009; Guardiola et al., 2012; Evcen and Çinar, 2020; Evcen et al., 2020; Katsanevakis et

al., 2020; Bertolino et al., 2022, Gözcelioğlu et al., 2022). Four of these species (*G. micropuntata*, *A. chloros*, *N. toxifera*, and *P. magna*) were also reported from the eastern Mediterranean (Tsurnamal, 1969; Ilan et al., 1994; Vacelet et al., 2007; Ulman et al., 2017; Evcen et al., 2020).

4. Discussion

A total of 183 species belonging to 52 families, 17 orders, and 3 classes constitute the current diversity of Porifera on the Turkish coasts. Although the majority of the species included in the current checklist were already known as elements of the Turkish fauna, they were not included in the previous checklist compiled by Topaloğlu and Evcen (2014). With this study, species reported in 10 overlooked studies before 2014 were added to the list. In addition, four sponge species were excluded from the checklist because their presence in the region is considered doubtful.[2] These species are *Halichondria* (*Eumastia*) *sitiens* from the Sea of Marmara (Caspers, 1968), *Petrosia* (*Strongylophora*) *vansoesti* (Evcen and Çinar, 2012) and *Terpios fugax* (Özalp, 2019) from the Aegean Sea, and *Sarcotragus fasciculatus* (Gözcelioğlu et al., 2015) from the Levantine Sea.

Reports of sponge species from the Turkish coasts show a sharp increase in the years 1885–1900 and 1970–1980 (Figure 5). Colombo (1885) and Ostroumoff (1894, 1896) were the main contributors in the first period, whereas Sarıtaş (1972, 1973, 1975) contributed much in the second period. In addition, in recent years, Topaloğlu (2001), Evcen and Çinar (2012, 2015, 2024), and Topaloğlu et al. (2016) made significant contributions to the augmentation of the number of species.

The sponge list compiled for this study is the most comprehensive list for the Turkish coasts to date. A comprehensive study involving 313 sponge species on the eastern Mediterranean coast (Levantine Sea and Aegean Sea) was previously undertaken by Evcen et al. (2023). However, as mentioned in that study, there is a large gap in our knowledge of sponge species richness on the Black Sea and Levantine coasts. In the Aegean Sea, research on sponge fauna is particularly concentrated on the coasts of Greece (Voultsiadou et al., 2016). However, many species reported from the Greek coast of the Aegean Sea have not yet been found along the Turkish coast. Considering that the coasts of Türkiye and Greece are part of the same ecological region (Spalding et al., 2007), further studies on sponges in the Turkish seas are needed to record these species as elements of the Turkish fauna. In addition, future studies should pay more attention and devote more efforts to different environments (coralligenous habitats, underwater caves, and the deep sea) to reveal the true diversity pattern of sponges in the region.

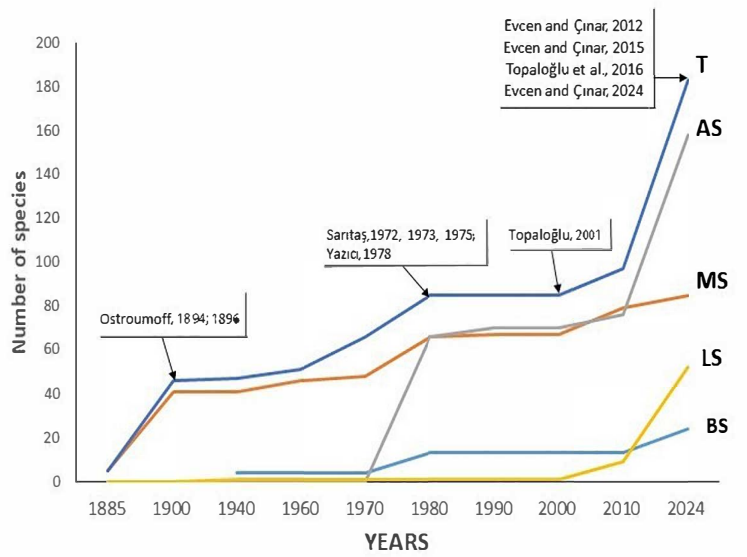

Figure 5. Numbers of reported Porifera species according to years and the authors with major contributions.

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