

## Contributions to the Eastern Mediterranean Opisthobranchia (Mollusca: Gastropoda) Fauna of Turkey

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**Abstract:** Studies of Opisthobranchia diversity in the Eastern Mediterranean Sea are scarce. In the present study Opisthobranchia species collected along the Mediterranean and Aegean coasts of Turkey in 2004 and 2005 were evaluated. Samples were taken from Çanakkale Strait and the northern coast of Gelibolu Peninsula in the northern Aegean Sea, and from Bodrum, Bay of Fethiye, Kaş, and Adrasan along Turkey's Mediterranean coast. Sampling was carried out by means of scuba diving. In some locations a bottom dredge sampler was used. In all, 321 individuals were collected, representing 30 species from 7 orders. Among the sampled species, 8 are new taxonomical records for Turkish coasts: *Trapania lineata*, *T. maculata*, *Diaphorodoris papillata*, *D. luteocincta*, *Limacia clavigera*, *Chromodoris elegantula*, *Hypselodoris orsinii*, and *Phyllidia flava*. Some of these species, however, were previously recorded in photographs from Turkey taken by amateur divers and underwater photographers.

**Key Words:** Opisthobranchia, Eastern Mediterranean, Turkey, Fethiye, Çanakkale, Kaş, Adrasan, Bodrum

### Doğu Akdeniz'deki Opisthobranchia (Mollusca: Gastropoda) Faunasına Türkiye'den Katkılar

**Özet:** Doğu Akdeniz Opisthobranchia çeşitliliği ile ilgili çalışmalar az miktarda bulunmaktadır. Bu çalışmada, Türkiye'nin Ege ve Akdeniz kıyılarında 2004 ve 2005 yıllarında bulunan Opisthobranchia türleri değerlendirilmiştir. Örnekler, Kuzey Ege'de Çanakkale Boğazı ve Gelibolu Yarımadası'ndan, Akdeniz'de Bodrum, Fethiye Körfezi, Kaş ve Adrasan'dan toplanmıştır. Örneklemeler tüplü dalışlarla gerçekleştirilmiştir. Bazı bölgelerde dip tarama kepçesi de kullanılmıştır. Toplam olarak bulunan 321 birey, 7 takıma ait 30 türü temsil etmektedir. Belirlenen türler arasında Türkiye kıyıları için yeni taksonomik kayıt olan 8 tür vardır: *Trapania lineata*, *T. maculata*, *Diaphorodoris papillata*, *D. luteocincta*, *Limacia clavigera*, *Chromodoris elegantula*, *Hypselodoris orsinii* ve *Phyllidia flava*. Bununla birlikte, bu türlerin bir kısmı daha önce Türkiye'den amatör dalgıçlar ve sualtı fotoğrafçıları tarafından fotoğraflarla kaydedilmiştir.

**Anahtar Sözcükler:** Opisthobranchia, Doğu Akdeniz, Türkiye, Fethiye, Çanakkale, Kaş, Adrasan, Bodrum

### Introduction

Few studies have investigated the distribution and diversity of Opisthobranchia in the Eastern Mediterranean Sea, especially when compared to the Western and Central Mediterranean. A recent comprehensive study from the Iberian Peninsula, with an annotated and updated checklist has been published (Cervera et al., 2006). The boundary of the Eastern Mediterranean region is considered to be 20° E, including the Aegean Sea

(central area of the Eastern Mediterranean) (Barash and Danin, 1982). Relatively few publications have appeared on the opisthobranchs of the Aegean Sea, although this basin is rich in islands and bays, and seems to be an environment adequate for them to thrive in (Barash and Danin, 1988). Some taxonomical studies were performed with specimens collected from the shores of Greece and the former Yugoslavia (Thompson, 1988; Thompson and Jaklin, 1988; Thompson et al., 1990). Most of the

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published Eastern Mediterranean Opisthobranchia records come from the coast of Israel (Barash and Danin, 1971, 1982; Barash and Zenziper, 1984). Molluscan species along Turkey's coasts are represented with great diversity, including many alien species, especially along the eastern parts of the Mediterranean coast (Çınar et al., 2005). Some reports of the migration of Indo-Pacific opisthobranch species through the Suez Canal have been published in the recent years (Çevik and Öztürk, 2001; Çınar et al., 2006; Yokeş, 2006). Records of shelled opisthobranch species are rarely reported from general Mollusca inventories, but include records from İstanbul Strait, and the Marmara and Black seas (Demir, 2003). One previous study specifically focused on the diversity of

Opisthobranchia from the coasts of Turkey (Swennen, 1961).

In the present study opisthobranch species collected from the Western Mediterranean and northern Aegean coasts of Turkey between 2004 and 2005 were assessed. Samples were collected from 2 areas in the northern Aegean Sea (Çanakkale Strait and the northern coast of Gelibolu Peninsula), and from 4 areas along the Mediterranean coast (Bodrum, Bay of Fethiye, Kaş, and Adrasan) (Figure 1). The aim of this study was to provide updated data on Opisthobranchia diversity along Turkey's coasts by describing the distribution of species collected from some parts of Turkey's Aegean and Mediterranean coasts.

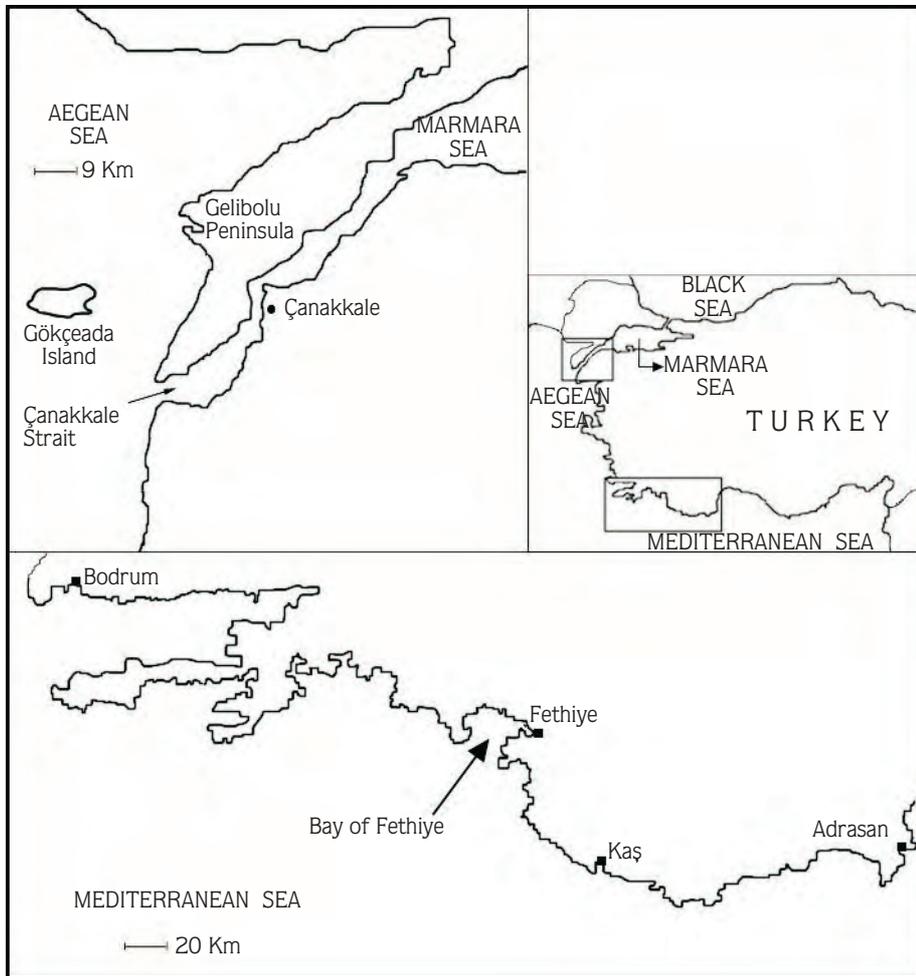


Figure 1. Sampling localities along the northwestern (Aegean) and southwestern (Mediterranean) coasts of Turkey.

## Materials and Methods

Sampling was conducted primarily by means of scuba diving. At all sampling localities a team of 2 divers made observations along transects of approximately 30 m. The direction and length of the transects were designated according to depth, bottom characteristics, and scuba limits; however, the transects were usually parallel to the shore. All dives were made during daylight hours and the maximum depth was 60 m. Most of the opisthobranch specimens were measured and photographed in situ, but were not collected; only unidentified and new recorded species were collected for classification. Unidentified specimens were photographed in their natural habitat, then placed in a plastic jar and brought to the laboratory for examination. Animals were preserved in a solution of 5% formaldehyde and seawater. Before placement in the preservation solution the animals were anesthetized with a solution consisting of 72 g/l of MgCl<sub>2</sub>. While collecting samples at Gelibolu Peninsula and in Çanakkale Strait, a bottom dredge sampler was used in addition to scuba diving. By dredging, shelled opisthobranch specimens were collected from depths of 10-25 m.

The species were identified in the laboratories of Hacettepe University, Department of Biology, and the materials were deposited at the zoology museum of the same department. Families and higher taxa were ordered according to the annotated and updated checklist of the opisthobranchs from Spain and Portugal, given by Cervera et al. (2006); however, species level identification was performed according to older literature (Provot-Fol, 1954; Schmekel, 1970; Thompson, 1976; Schmekel and Portmann, 1982; Thompson and Brown, 1984; Cattaneo-Vietti et al., 1990; García-Gómez, 2002).

In order to evaluate abundance and species richness of the 5 study regions, some numerical analyses were performed. Cluster analysis with the Bray-Curtis similarity measure and multivariate analysis (MDS) were used to detect statistical differences between regions. The data were in binary form and were not transformed. Canonical correspondence analysis (CCA) was used to show relationships between the 30 identified species and environmental variables (months), and depth represented the supplementary variable (Leps and Smilauer, 2003). For these analyses PAST v.1.68, MVSP v.3.12, and CANOCO v.4.51 for Windows were used.

## Results

In total, 321 specimens belonging to 30 species were recorded between 2004 and 2005. These 30 species belong to 7 orders: 1 species in Architectibranchia, 3 species in Cephalaspidea, 2 species in Sacoglossa, 1 species in Anaspidea, 2 species in Umbraculacea, 1 species in Pleurobranchaea, and 20 species in Nudibranchia. Nudibranchia was the most represented taxon in this study and included species from 2 suborders. Distribution of the species along Turkish coasts and the study areas are summarized in the Table. Systematic accounting of the species recorded during this study is given below. The term "specimen" in this list is used for samples collected or counted alive; others are marked as shells.

Order: ARCHITECTIBRANCHIA Haszprunar, 1985

Family: Acteonidae D'Orbigny, 1835

Genus: *Acteon* Montfort, 1810

*Acteon tornatilis* (Linnaeus, 1758)

Material: Çanakkale Strait, 18.07.2005, 20 m depth, 1 shell collected by dredging.

Distribution: Turkey: Çanakkale Strait, Aegean Sea, Marmara Sea (Demir, 2003), and Black Sea (Butakov et al., 1997). Eastern Mediterranean: Syria, Israel, Egypt, and Cyprus. Western Mediterranean: Tunisia, Balearic Islands, France, Western Italy, Corsica, Sardinia, Sicily, and Adriatic Sea (Barash and Danin, 1971). Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Cervera et al., 2006).

Order: CEPHALASPIDEA s. s. Mikkelsen, 1996

Family: Retusidae Thiele, 1926

Genus: *Pyrunculus* Pilsbry, 1895

*Pyrunculus hoernesii* (Weinkauff, 1866)

Material: Çanakkale Strait, 18.07.2005, 20 m depth, 1 shell collected by dredging.

Distribution: Turkey: Çanakkale Strait, Aegean Sea, and Marmara Sea (Demir, 2003). Mediterranean: Spain (Cervera et al., 2006).

Family: Cylichnidae Rudman, 1978

Genus: *Cylichna* Lovén, 1846

*Cylichna cylindracea* (Pennant, 1777)

Material: Çanakkale Strait, 18.07.2005, 20 m depth, 1 shell collected by dredging.

Distribution: Turkey: Çanakkale Strait, Aegean Sea, Marmara Sea (Demir, 2003), and Black Sea (Butakov et al., 1997). Eastern Mediterranean: Syria, Lebanon, Israel, and Egypt. Western Mediterranean Sea: Tunisia, Algeria, E. Spain, Balearic Islands, France, W. Italy, Corsica, Sicily, Ionian Sea, and Adriatic Sea (Barash and Danin, 1971). Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Thompson, 1976; Cervera et al., 2006).

Family: Philinidae Gray, 1850

Genus: *Philine* Ascanius, 1772

*Philine aperta* (Linnaeus, 1767)

Material: Çanakkale Strait, 18.07.2005, 20 m depth, 1 shell collected by dredging.

Distribution: Turkey: Çanakkale Strait, Aegean Sea, Antalya (Swennen, 1961), and Marmara Sea (Demir, 2003). Eastern Mediterranean: Israel, Egypt, and Cyprus. Western Mediterranean Sea: Tunisia, Algeria, E. Spain, Balearic Islands, France, W. Italy, Corsica, Sardinia, Sicily, Ionian Sea, and Adriatic Sea (Barash and Danin, 1971). Eastern Atlantic: Portugal, Spain, Madeira, Canary Islands, and Selvagens Islands (Thompson, 1976; Cervera et al., 2006).

Order: ANASPIDEA Fischer, 1883

Family: Aplysiidae Lamarck, 1809

Genus: *Aplysia* Linnaeus, 1767

*Aplysia parvula* Guilding in Mörch, 1863

Material: Bay of Fethiye, 28.03.2004, 8 m depth, 1 specimen, rocky substratum with rich algal vegetation.

Distribution: Turkey: Antalya, İstanbul (Swennen, 1961), Datça (Okuş et al., 2004), and Bay of Fethiye. Eastern Mediterranean: Israel. Pacific: In warm waters, from approximately 40° N latitude to 40° SE (Barash and Danin, 1971). Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Cervera et al., 2006). *Aplysia parvula* may have migrated to the Mediterranean Sea from tropical waters (Bebbington, 1974).

Order: SACOGLOSSA

Suborder: PLAKOBRANCHACEA Rang, 1829

Superfamily: PLAKOBRANCHOIDEA Rang, 1829

Family: Plakobranchidae Rang, 1829 (= Elysiidae Forbes and Hanley, 1851)

Genus: *Elysia* s. l. Risso, 1818

*Elysia timida* (Risso, 1818)

Material: Bay of Fethiye, 23.03.2004, 1 m depth, 1 specimen; 24.04.2004, 1-4 m depth, 10 specimens; 30.05.2004, 2-3 m depth, 2 specimens; rocky substrata with rich algal vegetation.

Distribution: Turkey: Datça (Bozburun Peninsula) (Okuş et al., 2004), Antalya (Swennen, 1961), and Bay of Fethiye. Widely distributed in the Mediterranean from Spain to Israel, including the Atlantic coast of Spain, near Gibraltar Strait (Thompson and Jaklin, 1988; Cervera et al., 2006).

Genus: *Thuridilla* Bergh, 1872

*Thuridilla hopei* (Vérany, 1858)

Material: Bay of Fethiye, 25.04.2004, 3-5 m depth, 5 specimens; 30.05.2004, 2-4 m depth, 3 specimens; rocky substrata with rich algal vegetation.

Distribution: Turkey: Datça (Bozburun Peninsula) (Okuş et al., 2004), Antalya (Swennen, 1961), and Bay of Fethiye. Widely distributed in the Mediterranean from Spain to Israel, including the Atlantic coast of Spain, near Gibraltar Strait (Thompson and Jaklin, 1988; Cervera et al., 2006).

Order: UMBRACULACEA Dall, 1889

Family: Tyloidiidae Gray

Genus: *Tyloдина* Rafinesque, 1814

*Tyloдина perversa* (Gmelin, 1791)

Material: Adrasan (Beşadalar), 20.05.2005, 20 m depth, 1 specimen; rocky bottom with rich algal vegetation and sponges.

Distribution: Turkey: Adrasan and Datça (Okuş et al., 2004). Eastern Mediterranean: Greece, Israel, and Egypt. Western Mediterranean: Sardinia, Palermo, Banyuls, Marseille, and Algeria (Pruvot-Fol, 1954). Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Cervera et al., 2006).

Family: Umbraculidae Dall, 1889

Genus: *Umbraculum* Schumacher, 1817

*Umbraculum umbraculum* (Lightfoot, 1786)

Material: Bay of Fethiye, 27.02.2005, 6 m depth, 1 specimen; inside a small cavity on rocky substratum, sandy-rocky bottom.

Distribution: Turkey: Bay of Fethiye, Antalya (Swennen, 1961), Marmara Sea, Aegean Sea, and Gulf of İskenderun (Çevik and Sarihan, 2004). Eastern Mediterranean: Syria, Lebanon, Israel, and Cyprus. Western Mediterranean: E. Spain, Balearic Islands, France, W. Italy, Corsica, Sardinia, Sicily, Ionian Sea, and Adriatic Sea (Barash and Danin, 1971). Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Cervera et al., 2006).

Superorder: NUDIPLEURA Wägele and Willan, 2000

Order: PLEUROBRANCHACEA Férrusac, 1822

Family: Pleurobranchidae Férrusac, 1822

Subfamily: Pleurobranchinae Férrusac, 1822

Tribe: Pleurobranchini Férrusac, 1822

Genus: *Pleurobranchus* Cuvier, 1805

*Pleurobranchus testudinarius* (Cantraine, 1835)

Material: Adrasan (Beşadalar) 20.05.2005, 20 m depth, 1 specimen; rocky substratum with algal vegetation.

Distribution: Turkey: Adrasan and Datça (Okuş et al., 2004). Eastern Mediterranean: Israel. Western Mediterranean: Algeria, Spain, France, W. Italy, and Sicily (Barash and Danin, 1971). Eastern Atlantic: Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Cervera et al., 2006).

Order: NUDIBRANCHIA Blainville, 1814

Suborder: ANTHOBRANCHIA Minichev, 1970

Family: Onchidorididae Alder and Hancock, 1845

Genus: *Diaphorodoris* Iredale and O'Donoghue, 1923

*Diaphorodoris luteocincta* (Sars, 1870)

Material: Adrasan, 20.05.2005, 9.5 m depth, 1 specimen; under a small cavity, rocky substratum covered with bryozoans, sponges, and algae.

Distribution: Turkey: Adrasan. Western Mediterranean: Spain, France, and Italy. Eastern Atlantic: Portugal, Spain, The Azores, Canary Islands, and Selvagens Islands (Thompson and Brown, 1984; Cervera et al., 2006). According to Cervera et al. (2006), all records before 1988, except those of Ballesteros et al. (1986) and Marín and Ros (1987), refer to the *alba* variety of this species. New record for the coast of Turkey.

*Diaphorodoris papillata* Portmann & Sandmeier, 1960

Material: Bay of Fethiye, 24.04.2004, 6-11 m depth,

3 specimens; Adrasan, 20.05.2005, 7 m depth, 1 specimen; under small cavities, rocky substrata covered with bryozoans, sponges, and algae.

Distribution: Turkey: Bay of Fethiye and Adrasan. Western Mediterranean: Spain, France, and Italy. Eastern Atlantic: Portugal, Spain, and Gibraltar Strait (Cervera et al., 2006). New record for the coast of Turkey.

Family: Goniadorididae H. and A. Adams, 1854

Genus: *Trapania* Pruvot-Fol, 1931

*Trapania lineata* Haefelfinger, 1960

Material: Bay of Fethiye, 24.04.2004, 8 m depth, 1 specimen on the sponge *Chondrosia reniformis* Nardo, 1847; rocky substratum with rich algal vegetation and sponges.

Distribution: Turkey: Bay of Fethiye. Western Mediterranean: From Italy to Spain, Gibraltar Strait, and Sardinia Islands (Schmekel and Portmann, 1982; Cervera et al., 2006). *T. lineata* is an endemic Mediterranean species (Cattaneo-Vietti et al., 1990). New record for the coast of Turkey.

*Trapania maculata* Haefelfinger, 1960

Material: Çanakkale (Gelibolu Peninsula), 19.07.2005, 5-15 m depth, 1 specimen; collected from a cotton bag filled with bryozoan pieces, sponges, and stones covered with algae.

Distribution: Turkey: Çanakkale (Gelibolu Peninsula). North Aegean: Greece (Chalkidiki Peninsula) (Antoniadou, 2005). Western Mediterranean: Spain, France, Italy, and South Tyrrhenian Sea (Cattaneo-Vietti et al., 1990). Eastern Atlantic: British Islands (Brown and Picton, 1976) and Spain (Cervera et al., 2006). New record for the coast of Turkey.

Family: Polyceridae Alder and Hancock, 1845

Genus: *Limacia* O. F. Müller, 1781

*Limacia clavigera* (O. F. Müller, 1776)

Material: Çanakkale (Gelibolu Peninsula), 19.07.2005, 5-15 m depth, 1 specimen; collected from a cotton bag filled with bryozoan pieces, sponges, and stones covered with algae.

Distribution: Turkey: Çanakkale (Gelibolu Peninsula). Western Mediterranean: Morocco, Spain, France, and Italy. Eastern Atlantic: Portugal, Spain, The Azores, Canary Islands, and Selvagens Islands (Thompson and Brown, 1984; Cervera et al., 2006). New record for the coast of Turkey.

Family: Chromodorididae Bergh, 1891

Genus: *Hypselodoris* Stimson, 1855

*Hypselodoris orsinii* (Vérany, 1846)

Material: Çanakkale (Gelibolu Peninsula), 19.07.2005, 10-13 m depth, 12 specimens; rocky substrata with rich algal vegetation and sponges (*Cacospongia* sp.).

Distribution: Turkey: Çanakkale (Gelibolu Peninsula). Western Mediterranean: Spain, France, Italy, and Croatia. Eastern Atlantic: Spain (Cervera et al., 2006). Before Ortea et al. (1996) this species was usually recorded as *Hypselodoris coelestis* (Cervera et al., 2006). New record for the coast of Turkey.

*Hypselodoris picta* (Schultz, 1836)

Material: Bay of Fethiye, 25.07.2004, 6 m depth, 1 specimen; sandy bottom with rich *Acetabularia* and *Posidonia* vegetation; Kaş, 01.05.2005, 16 m depth, 1 specimen; Adrasan, 19.05.2005, 24 m depth, 1 specimen; 20.05.2005, 18-27 m depth, 2 specimens; rocky substrata with rich algal vegetation.

Distribution: Turkey: Bay of Fethiye, Kaş, Adrasan, and Datça (Okuş et al., 2004). Eastern Mediterranean: Israel. Western Mediterranean: Tunisia, Balearic Islands, Spain, France, and Italy. Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Barash and Danin, 1971; Schmekel and Portmann, 1982; Cervera et al., 2006). The systematic status of this group was recently revised and several subspecies were suggested according to different color forms (Ortea et al., 1996; Troncoso et al., 1998; García-Gómez, 2002); however, these subspecies were based on color differences only, and no genetic or molecular studies have been conducted to confirm or reject them (Cervera et al., 2006).

Genus: *Chromodoris* Alder and Hancock, 1855

*Chromodoris purpurea* (Laurillard, 1831)

Material: Kaş, 26.03.2005, 30 m depth, 1 specimen; Adrasan, 20.05.2005, 18-38 m depth, 2 specimens; shaded habitats, rocky substrata.

Distribution: Turkey: Adrasan, Kaş, and Datça (Okuş et al., 2004). Western Mediterranean: Spain, France, and Italy. Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Schmekel

and Portmann, 1982; Cattanaeo-Vietti et al., 1990; Cervera et al., 2006).

*Chromodoris elegantula* (Philippi, 1844)

Material: Adrasan (Beşadalar), 20.05.2005, 48 m depth, 1 specimen.

Distribution: Turkey: Adrasan. Western Mediterranean: France, Malta, and Sicily (Pruvot-Fol, 1954; Cattanaeo-Vietti et al., 1990). *C. elegantula* is an endemic Mediterranean species. New record for the coast of Turkey.

Family: Discodorididae Bergh, 1891

Genus: *Peltodoris* Bergh, 1880

*Peltodoris atromaculata* Bergh, 1880

Material: Bay of Fethiye, 29.05.2004, 4-11 m depth, 2 specimens; 24.07.2004, 5-11 m depth, 20 specimens; 25.07.2004, 5-12 m depth, 15 specimens (1 specimen on *Axinella* sp.); 29.10.2004, 5-13 m depth, 13 specimens; 27.02.2005, 7 m depth, 1 specimen; Kaş, 27.03.2005, 36 m depth, 2 specimens; Bodrum, 16.04.2004, 13-17 m depth, 9 specimens; Çanakkale (Gelibolu Peninsula), 19.07.2005, 10-14 m depth, 7 specimens; Çanakkale Strait, 19.07.2005, 18 m depth, 1 specimen; except for 1 specimen from the Bay of Fethiye, all of the specimens were found on *Petrosia ficiformis* (Poiret, 1789).

Distribution: Turkey: Çanakkale, Bay of İzmir (Geldiay and Kocataş, 1972), Bodrum, Datça (Okuş et al., 2004), Bay of Fethiye, and Kaş. Eastern Mediterranean: Cyprus, Israel, and Egypt. Western Mediterranean: Spain, Malta, France, and Italy. Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Cervera et al., 2006).

Family: Phyllidiidae Rafinesque, 1814

Genus: *Phyllidia* Cuvier, 1797

*Phyllidia flava* (Aradas, 1847)

Material: Çanakkale Strait, 19.07.2005, 18-21 m depth, 6 specimens; all specimens found on the sponge, *Axinella* sp.

Distribution: Turkey: Çanakkale Strait. Western Mediterranean: Present all around the W. Mediterranean (Cattanaeo-Vietti et al., 1990). New record for the coast of Turkey.

Suborder: CLADOBRANCHIA Willan and Morton, 1984

Family: Proctonotidae Gray, 1853

Genus: *Janolus* Bergh, 1884

*Janolus cristatus* (Delle Chiaje, 1841)

Material: Bay of Fethiye, 27.03.2004, 17 m depth 1 specimen (juvenile); 23.04.2004, 11 m depth, 1 specimen; 26.02.2005, 12-19 m depth, 2 specimens; 27.02.2005, 8 m depth, 1 specimen; Kaş, 26.03.2005, 12 m depth, 1 specimen; 30.04.2005, 10-14 m depth, 3 specimens; 01.05.2005, 16 m depth, 1 specimen; rocky substrata with algal vegetation.

Distribution: Turkey: Bay of Fethiye, Kaş, and Datça (Okuş et al., 2004). Western Mediterranean: Present all around the W. Mediterranean (Cattaneo-Vietti et al., 1990). Eastern Atlantic: Portugal, Spain, Madeira, Canary Islands, and Selvagens Islands (Schmekel and Portmann, 1982; Cervera et al., 2006). Because of the difficulty defining the genera *Janolus* and *Antiopella*, they were synonymized, with the former name prevailing (Cervera et al., 2006).

Family: Flabellinidae Bergh, 1889

Genus: *Flabellina* Voigt, 1834

*Flabellina affinis* (Gmelin, 1791)

Material: Bay of Fethiye, 27-28.03.2004, 9-18 m depth, 3 specimens; 23-24.04.2004, 3-11 m depth, 12 specimens; 29.05.2004, 6-11 m depth, 3 specimens; 24.07.2004, 7-9 m depth, 3 specimens; 26-27.02.2005, 9-28 m depth, 8 specimens; Kaş, 26-27.03.2005, 14-30 m depth, 7 specimens; 30.04-1.05.2005, 10-22 m depth, 8 specimens; Bodrum, 16.04.2005, 16-21 m depth, 4 specimens; Adrasan, 19-21.05.2005, 10-26 m depth, 13 specimens; Çanakkale Strait (Gelibolu Peninsula), 19.07.2005, 9-16 m depth, 7 specimens; rocky substrata with rich algal vegetation, on *Eudendrium* sp.

Distribution: Turkey: Çanakkale Strait (Gelibolu Peninsula), and Datça (Okuş et al., 2004), Bodrum, Bay of Fethiye, Kaş, and Adrasan. Western Mediterranean: Present all around the W. Mediterranean. Eastern Atlantic: Portugal, Spain, Canary Islands, and Selvagens Islands (Cervera et al., 2006).

*Flabellina pedata* (Montagu, 1815)

Material: Bay of Fethiye, 23-24.04.2004, 2-7 m depth, 10 specimens; 29.05.2004, 5 m depth, 1 specimen; 24.07.2004, 6-8 m depth, 3 specimens; 26.02.2005, 14 m depth, 1 specimen; Kaş, 27.03.2005, 14 m depth, 1 specimen; 30.04-1.05.2005, 10-18 m depth, 2 specimens; Adrasan, 19.05.2005, 9-16 m depth, 2 specimens; rocky substrata with rich algal vegetation.

Distribution: Turkey: Bay of Fethiye, Kaş, Adrasan, and Datça (Okuş et al., 2004). Western Mediterranean: Spain, France, and Italy. Eastern Atlantic: Portugal, Spain, and The Azores (Cervera et al., 2006).

*Flabellina babai* Schmekel, 1972

*Turkey Records*: Okuş et al., 2004.

Material: Kaş, 27.03.2005, 37 m depth, 1 specimen. On *Eudendrium* sp., rocky substratum with rich algal vegetation.

Distribution: Turkey: Kaş and Datça (Okuş et al., 2004). Western Mediterranean: France and Italy (Schmekel and Portmann, 1982). Eastern Atlantic: Portugal and Spain (Cervera et al., 2006)

*Flabellina ischitana* Hirano & Thompson, 1990

Material: Bay of Fethiye, 28.03.2004, 11-14 m depth, 2 specimens; 23-24.04.2004, 8-12 m depth, 7 specimens; 29.05.2004, 5-8 m depth, 2 specimens; 24-07.2004, 8 m depth, 2 specimens; 26-27.02.2005, 8-16 m depth, 3 specimens; Kaş, 26-27.04.2005, 16-30 m depth, 4 specimens; 30.04-1.05.2005, 12-20 m depth, 3 specimens; Bodrum, 16.04.2005, 15-18 m depth, 2 specimens; Adrasan, 19.05.2005, 14-24 m depth, 4 specimens; rocky substrata with rich algal vegetation

Distribution: Turkey: Bodrum, Datça (Okuş et al., 2004), Bay of Fethiye, Kaş, and Adrasan. *Flabellina ischitana* was originally described from specimens collected from the Gulf of Naples (Hirano and Thompson, 1990). It has also been recorded from Sardinia (Cattaneo-Vietti et al., 1990), the Mediterranean coasts of Spain, and Gibraltar Strait (Cervera et al., 1998). Eastern Atlantic: Portugal and Spain (Cervera et al., 2006)

Family: Facelinidae Bergh, 1889

Genus: *Facelina* Alder & Hancock, 1855

*Facelina rubrovittata* (A. Costa, 1866)

Material: Adrasan, 20-21.05.2005, 5-21 m depth, 5 specimens; rocky substrata with rich algal vegetation and sponges, on *Chondrosia reniformis*.

Distribution: Turkey: Adrasan. Western Mediterranean: Spain, France, and Italy. Eastern Atlantic: Spain (Cervera et al., 2006).

Genus: *Cratena* Bergh, 1864

*Cratena peregrina* (Gmelin, 1791)

Material: Bay of Fethiye, 24.04.2004, 11 m depth, 1 specimen; 29-30.05.2004, 6 m depth, 2 specimens; 24.07.2004, 6-13 m depth, 4 specimens; 26-27.02.2005, 6-14 m depth, 6 specimens; Kaş, 26.03.2005, 18-21 m depth, 2 specimens; Bodrum, 16.04.2005, 19 m depth, 1 specimen; Çanakkale (Gelibolu Peninsula), 14 m depth, 2 specimens; sandy, rocky substrata with rich algal vegetation, on *Eudendrium* sp.

Distribution: Turkey: Çanakkale (Gelibolu Peninsula), Bodrum, Bay of Fethiye, and Kaş. Western Mediterranean: Spain, France, and Italy (Schmekel and Portmann, 1982). Eastern Atlantic: Portugal, Spain, Canary Islands, and Selvagens Islands (Cervera et al., 2006).

Genus: *Caloria* Trinchese, 1888

*Caloria elegans* (Alder & Hancock, 1845)

Material: Bay of Fethiye, 27.03.2004, 2 m depth, 1 specimen; Bodrum, 16.04.2005, 14 m depth, 1 specimen; rocky substrata with rich algal vegetation, on *Chondrosia reniformis* and *Crambe* sp. sponges.

Distribution: Turkey: Bay of Fethiye and Bodrum. Western Mediterranean: Italy and France. Eastern Atlantic: Portugal, Spain, Madeira, The Azores, Canary Islands, and Selvagens Islands (Cervera et al., 2006).

Genus: *Dondice* Marcus, 1958

*Dondice banyulensis* Portmann & Sandmeier, 1960

Material: Kaş, 26.03.2005, 29 m depth, 1 specimen; 01.05.2005, 18-20 m depth, 4 specimens; Adrasan, 19-21.05.2005, 8-25 m depth, 23 specimens; rocky substrata, mostly on *Eudendrium* sp. and under strong currents.

Distribution: Turkey: Kaş and Adrasan. Western Mediterranean: Spain, France, and Italy (Schmekel and Portmann, 1982). Eastern Atlantic: Portugal and Gibraltar Strait (Cervera et al., 2006)

## Discussion

It is estimated that there are more than 500 Opisthobranchia species in the Mediterranean Sea (Sabelli, 1990). Turkey is surrounded by 4 seas with different hydrographical characteristics, and has one of the longest coastlines (8333 km) in the Mediterranean region (Siokou-Frangou et al., 2002). Maritime traffic in the İstanbul and Çanakkale straits, as well as in commercial harbors makes Turkish coasts highly susceptible to invasion by aliens. The proximity of Turkey to the Suez Canal has resulted in dense settlements of Lessepsian migrants, especially in habitats along Turkey's Eastern Mediterranean. Alien species and their roles in the benthic and pelagic ecosystems are increasingly becoming subjects of study in Turkey (Çınar et al., 2005).

Table. Distribution of the species among Turkish seas and the study areas.

Species	Mediterranean Sea	Aegean Sea	Marmara Sea	Black Sea	Adrasan	Kaş	Fethiye	Bodrum	Çanakkale
<i>Acteon tomatis</i>	+	+	+	+					+
<i>Pyrrunculus hoernesii</i>		+							+
<i>Acteon tornatilis</i>	+	+	+	+					+
<i>Pyrrunculus hoernesii</i>		+							+
<i>Cylichna cylindracea</i>	+	+	+	+					+
<i>Philine aperta</i>	+	+	+						+
<i>Aplysia parvula</i>	+	+	+				+		
<i>Elysia timida</i>	+	+					+		
<i>Thuridilla hopei</i>	+	+					+		
<i>Tyrodina perversa</i>	+	+			+				
<i>Umbraculum umbraculum</i>	+	+					+		
<i>Pleurobranchus testudinarius</i>	+	+			+				
<i>Diaphorodoris luteocincta</i>	+				+				
<i>Diaphorodoris papillata</i>	+				+		+		
<i>Trapania lineata</i>	+	+					+		
<i>Trapania maculata</i>		+							+
<i>Limacia clavigera</i>		+							+
<i>Hypselodoris picta</i>	+				+	+	+		
<i>Hypselodoris orsinii</i>		+							+
<i>Chromodoris purpurea</i>	+				+	+			
<i>Chromodoris elegantula</i>	+				+				
<i>Peltodoris atromaculata</i>	+	+					+	+	+
<i>Phyllidia flava</i>		+							+
<i>Janolus cristatus</i>	+				+	+	+		
<i>Flabellina affinis</i>	+	+			+	+	+	+	+
<i>Flabellina pedata</i>	+				+	+	+		
<i>Flabellina babai</i>	+					+			
<i>Flabellina ischitana</i>	+	+			+	+	+	+	
<i>Cratena peregrina</i>	+	+				+	+	+	+
<i>Caloria elegans</i>	+	+					+	+	
<i>Facelina rubrovittata</i>	+				+				
<i>Dondice banyulensis</i>	+				+	+			

In the last decade, the taxonomy of Opisthobranchia was usually ordered according to the classification of mollusks given by Beesley et al. (1998); however, recent studies have differentiated the monophyly and paraphyly of Opisthobranchia, which in the end involves its taxonomical validity. Distinct phylogenetic analyses based on both morphological and molecular characters seem to indicate that opisthobranchs are not monophyletic (Cervera et al., 2006).

The present Opisthobranch-specific study represents the largest sampling activity, in terms of geography and time, from the coasts of Turkey. Nonetheless, due to an insufficient number of sampling dives and limited use of dredge sampling, the total number of the species was not as high as expected. The lack of night sampling is another factor limiting the quantity of identified species. In all, 30 opisthobranch species were recorded, 8 of which are new records for the coast of Turkey (*T. lineata*, *T. maculata*, *D. papillata*, *D. luteocincta*, *L. clavigera*, *C. elegantula*, *H. orsinii*, and *P. flava*). All of the new records belong to the suborder Anthobranchia of the order Nudibranchia, 2 of which are endemic to the Mediterranean Sea (*T. lineata* and *C. elegantula*). Some of the new recorded species were previously reported on Internet forums by amateur divers and underwater photographers from various coasts of Turkey, mainly the Marmara, Aegean, and Mediterranean. Species identification in these reports was primarily based only on photographs without the use of other important data, such as depth, size, and locations, and they were not identified according to any taxonomical methodology or materials kept in museums. Yet these observations are valuable for divers and underwater photographers, and they do provide worthwhile information for scientists (Yokeş and Rudman, 2004). The earliest records of opisthobranch species from Turkish coasts come from Swennen (1961). Swennen recorded 25 species, including *E. timida*, *T. hopei*, *U. umbraculum*, and *A. parvula*, which were also recorded in the present study. His records from the Black Sea (Trabzon) include *Trinchesa foliata* (Forbes & Goodsir, 1839), *Doto pontica* (Swennen, 1961), and *Limapontia capitata* (Müller, 1774).

Among the species recorded in the present study, *F. affinis* was the most ubiquitous species, which was found at all sampling localities (68 individuals); however, this species is very close to *F. ischitana* and it is probable that many earlier records attributed to *F. affinis* along

European coasts before the description of *F. ischitana* should be attributed to the latter species (Cervera et al., 1998). *P. atromaculata* was recorded as the most abundant species (71 individuals) in the present study. It is very common in both the Western and Eastern Mediterranean. In the Bay of Fethiye, *P. atromaculata* was the only species counted on 29-30 October 2004, and in July 2004, 1 specimen was found on *Axinella* sp., while all other specimens were found on *Petrosia ficiformis* (Poiret, 1789).

There has been no research on the community structure and population dynamics of opisthobranchs from Turkey. Field quantitative studies on opisthobranch populations in the Mediterranean Sea are scarce. This is probably due to the fact that the number of specimens is usually low, individuals are small and often cryptic, and, therefore, field work is difficult and time-consuming (Domenech et al., 2002). Nevertheless, numerical data recorded during the present study provide some information about the spatial variability of the species from the 5 collection areas. Cluster analysis (Bray-Curtis similarity measure) and MDS indicated some similarities among the study areas that are consistent with their geographical positions (Figure 2). The ecological differences are mainly due to reduced salinity (25‰ vs. 36‰) and lower winter temperatures in the North Aegean compared to the Mediterranean Sea. Considering Bodrum as a corner separating the Aegean and Mediterranean seas, it would be possible to expect the region of Bodrum to represent the highest diversity, but with only 2 dives, sampling quantities were not sufficient to test this hypothesis. In a biodiversity study carried out by Okuş et al. (2004) with more than 1000 sampling dives in 148 days, 38 opisthobranch species were recorded from Datça-Bozburun Peninsula, which is located in the proximity of Bodrum, but further south.

The maximum number of sampling dives was recorded in the Bay of Fethiye, which is a confined bay with accessible diving facilities in all seasons. Among the 5 study areas, the highest total diving time was in Fethiye (1505 min). In Adrasan, Kaş, Çanakkale, and Bodrum total diving times were, 274, 158, 86, and 75 min, respectively. As such, it is normal to observe greater abundance and diversity levels in the Bay of Fethiye. Vertical distribution and temporal variability of the species were analyzed by CCA (Figure 3). The CCA model was tested by the Monte Carlo permutation test and was

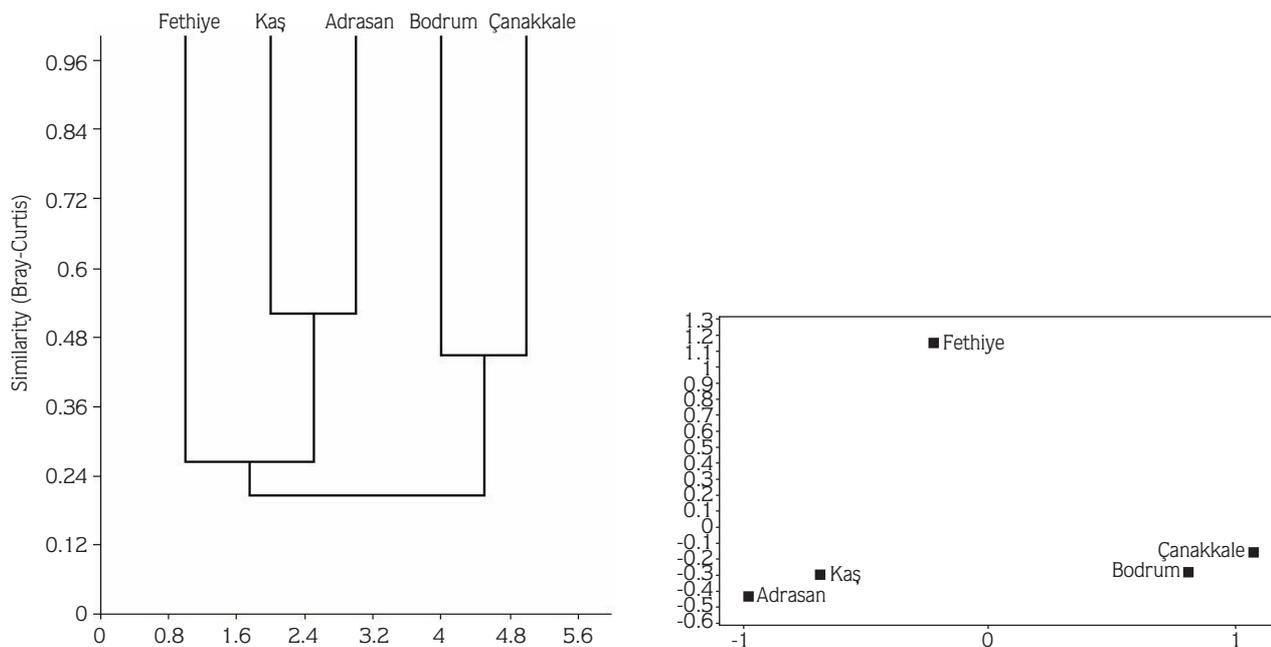


Figure 2. Cluster analysis with the Bray-Curtis similarity measure and multivariate analysis (MDS) of the study areas.

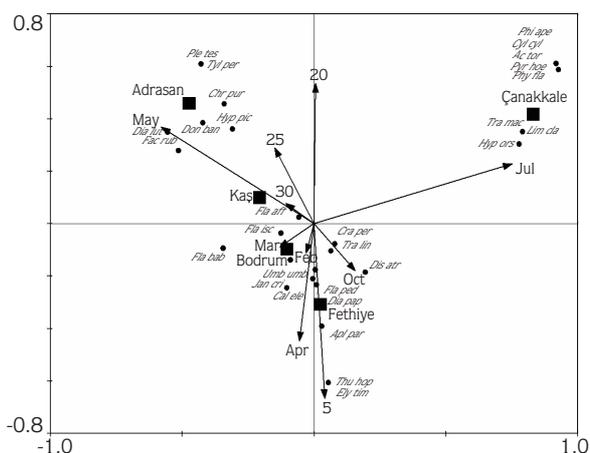


Figure 3. CCA diagram of vertical species distribution and temporal variability.

significant ( $P < 0.05$ ). In this analysis, depths of 10, 15, and 40 m were neglected because of their insignificant values. *Chromodoris elegantula* was the outlier. According to CCA, most of the species were recorded at depths of 5, 20, and 25 m in March, February, and April, respectively. In the diagram, the species distribution observed in May is due to Adrasan sampling.

The number of Opisthobranchia species included in the present study represents a fraction of the actual number of species inhabiting the Aegean and Mediterranean littoral of Turkish coasts. There are very small opisthobranch species, which have been overlooked by divers, underwater photographers, and scientists. Many more opisthobranch species are likely to be found along the coasts of Turkey during properly organized investigations in the future.

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## References

- Antoniadou, C., Koutsoubas, D. and Chintiroglou, C. 2005. Mollusca fauna from infralittoral hard substrate assemblages in the North Aegean Sea. *Belg. J. Zool.* 135: 119-126
- Ballesteros, M., Álvarez, C. and Mateo, B. 1986. Aproximación a la fauna de opistobranquios de la isla de Menorca. *Publicaciones del Departamento de Zoología (Barcelona)* 12: 93-106.
- Barash, A. and Danin, Z. 1971. Opisthobranchia (Mollusca) from the Mediterranean waters of Israel. *Israel Journal of Zoology*, 20: 151-200.
- Barash, A. and Danin, Z. 1982. Mediterranean Mollusca of Israel and Sinai: Composition and distribution. *Israel Journal of Zoology*, 31: 86-118.
- Barash, A. and Danin, Z. 1988. Marine Mollusca at Rhodes. *Israel Journal of Zoology*, 35: 1-74.
- Barash, A. and Zenziper, Z. 1984. On the food of some opisthobranchs found in the Mediterranean waters of Israel, *Levantina* No. 51: 585-598
- Bebbington, A. 1974. Aplysiid species from East Africa with notes on the Indian Ocean Aplysiomorpha (Gastropoda: Opisthobranchia). *Zool. J. Linn. Soc.* 54: 63-99.
- Beesley, P.L., Ross, G.J.B. and Wells, A. (eds.) 1998. Mollusca: the southern synthesis. *Fauna of Australia*. Vol. 5, CSIRO Publishing: Melbourne, Part A xvi pp 1-563, Part B viii pp 565-1234.
- Brown, G.H. and Picton, B.E. 1976. *Trapania maculata* Haefelfinger, a doridacean nudibranch new to the British fauna. *Journal of Conchology*, Lond. 29: 63-65.
- Butakov, E.A., Chuhchin, V.D., Cherkasova, M.B. and Lelekov, S.G. 1997. Determinator of Gastropoda of the Black Sea. IBSS NASU, Sevastopol. 127p
- Cattaneo-Vietti, R., Chemello, R. and Giannuzzi-Savelli, R. 1990. Atlas of Mediterranean Nudibranchs. *La Conchiglia*, Roma, 264 pp.
- Cervera, J.L., Calado, G., Gavaia, C., Malaquias, M.A.E., Templado, J., Ballesteros, M., García-Gómez, J.C. and Megina, C. 2006. An annotated and updated checklist of the opisthobranchs (Mollusca: Gastropoda) from Spain and Portugal (including islands and archipelagos). *Boletín del Instituto Espanol de Oceanografía*, 20: 5-111
- Cervera, J.L., López-González, P.J. and García-Gómez, J.C. 1998. Redescription of the Aeolid Nudibranch *Flabellina ischitana* Hirano and Thompson, 1990 (Gastropoda: Opisthobranchia). *The Veliger* 41: 289-293.
- Çevik, C. and Sarihan, E. 2004. İskenderun Körfezi Mollusca Faunası. *Türk Sucul Yaşam Dergisi* 2: 93-97.
- Çevik, C. and Öztürk, B. 2001. A New Lessepsian Mollusc *Hypselodoris infucata* (Ruppell and Leuckart, 1828) (Gastropoda: Nudibranchia) for the Coasts of Turkey. *Turk J. Zool.* 25: 27-30.
- Çınar, M.E., Bilecenoğlu, M., Öztürk, B., Katagan, T. and Aysel, V. 2005. Alien species on the coast of Turkey. *Mediterranean Marine Science* Volume 6/2, 119-146.
- Çınar, M. E., Bilecenoğlu, M., Öztürk, B. and Can, A. 2006. New records of alien species on the Levantine coast of Turkey. *Aquatic Invasions*, 1: 84-90.
- Demir, M. 2003. Shells of Mollusca Collected from the Seas of Turkey. *Turk J. Zool.* 27: 101-140.
- Domenech, A., Avila, C. and Ballesteros, M. 2002. Spatial and temporal variability of the opisthobranch molluscs of Port Lligat Bay, Catalonia, NE Spain. *J. Moll. Stud.* 68: 29-37.
- García-Gómez, J.C. 2002. Paradigmas de una Fauna Insolita: Los Moluscos Opistobranquios del Estrecho de Gibraltar. *Instituto de Estudios Campogibraltarenos. Serie Ciencias* 20. 397 pp.
- Geldiay, R. and Kocatas, A. 1972. İzmir Körfezi'nin bentosu üzerine preliminer bir araştırma. *Ege Üniversitesi Fen Fakültesi Monografileri Serisi*, 12: 1-34.
- Hirano, Y.J. and Thompson, T.E. 1990. Flabellinid nudibranchs from the Bay of Naples, with a description of a new species, *Flabellina ischitana*. *J. Moll. Stud.* 56: 345-354.
- Leps, J. and Smilauer, P. 2003. *Multivariate Analyses of Ecological Data Using CANOCO*. Cambridge University Press, 269 pp.
- Marín, A. and Ros, J. 1987. Catálogo preliminar de los gasterópodos marinos del sudeste español. *Iberus* 7: 137-145.
- Okuş, E., Sur, H.İ., Yüksek, A., Yılmaz, İ.N., Aslan-Yılmaz, A., Karhan, S.Ü., Öz, M.İ., Demirel, N., Taş, S., Altıok, A., Müftüoğlu, A.E., Gazioğlu, C. and Yücel, Z.Y. 2004. Datça-Bozburun Özel Çevre Koruma Bölgesinin Denizsel ve Kıyısız Alanlarının Biyolojik Çeşitliliğinin Tespiti Projesi. Final Raporu, (Sunulan Kuruluş, T.C. Çevre ve Orman Bakanlığı Özel Çevre Koruma Kurumu Başkanlığı).
- Ortea, J., Valdés, A. and García-Gómez, J.C. 1996. Revisión de las especies atlánticas de la familia Chromodorididae (Mollusca: Nudibranchia) de grupo cromático azul. *Avicennia, Suppl.* 1: 1-165.
- Pruvot-Fol, A. 1954. *Fauna de France. Mollusques opisthobranches*. Paris, Lechevalier, Pp. 460.
- Sabelli, B., Gianuzzi-Savelli, R. and Bedulli, D. 1990. Annotated Checklist of Mediterranean Marine Molluscs. *Societa Italiana di malacologia, Editioni Libreria Naturalistica Bolognese*.
- Schmekel, L. and Portmann, A. 1982. *Opisthobranchia des Mittelmeeres, Nudibranchia und Saccoglossa*. Springer-Lange, 410 p., Germany.
- Schmekel, L. 1970. Anatomie der Genitalorgane von Nudibranchen (Gastropoda Euthyneura) Sonderdruck aus *Pubbl. Staz. Zool. Napoli* 38, 120-217.
- Siokou-Frangou, I., Bianchi, M., Christaki, U., Christou, E., Giannakourou, A., Gotsis-Skretas, O., Ignatiades, L., Pagou, K., Pitta, P., Psarra, S., Souvermezoglou, E., Van Wambeke, F. and Zervakis, V. 2002. Differential carbon transfer along a gradient of oligotrophy in the Aegean Sea (Mediterranean). *J. Mar. Syst.* 33-34, 335-353.

- Swennen, C. 1961. On a collection of Opisthobranchia from Turkey. Zoologische Medelingen, Leiden, 38: 41-75.
- Thompson, T.E. 1976. Biology of Opisthobranch Molluscs, Volume I. The Ray Society, London. 207 p.
- Thompson, T.E. 1988. Eastern Mediterranean Opisthobranchia: Oxynoidae, Polybranchiidae, stiligeridae (Sacoglossa). J. Moll. Stud. 54: 157-172.
- Thompson, T.E. and Brown, G.H. 1984. Biology of Opisthobranch Molluscs, Volume II. The Ray Society, London, 229 p.
- Thompson, T.E. and Jaklin, A. 1988. Eastern Mediterranean Opisthobranchia: Elysiidae (Sacoglossa = Ascoglossa). J. Moll. Stud. 54: 59-69.
- Thompson, T.E., Cattaneo, R. and Wong, Y.M. 1990. Eastern Mediterranean Opisthobranchia: Dotidae (Dendronotoidea), Arminidae and Madrellidae (Arminoidea). J. Moll. Stud. 56: 393-413.
- Troncoso, J.S., Garcia, F.J. and Urgan, V. 1998. Anatomical data on rare *Hypselodoris picta* (Schultz, 1836) (Gastropoda, Doridacea) from the coast of Brazil with description of a new subspecies. Bulletin of Marine Science, 63: 133-141.
- Yokes, M.B. 2006. *Aplysia dactylomela*: an alien Opisthobranch in the Mediterranean. JMBA2 - Biodiversity Records. Published online
- Yokeş, M.B. and Rudman, W.B. 2004. Türkiye Sularında Tespit Edilen Aeoliina (Opisthobranchia, Gastropoda) Türleri; Türkiye için 11 Yeni Kayıt. SBT 2004, 8. Sualtı Bilim ve Teknoloji Toplantısı, Bildiriler Kitabı, İstanbul, s:60-69