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Update of the marine Bivalvia Mollusca checklist in Greek waters

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Species of marine bivalve molluscs identified in the last nine years in the Greek waters have been used to update the checklist published in 1996 (*Fauna Graeciae VII*) by inserting necessary changes and adding new records. The updated version includes 13 new species among which 3 are exotics (non-Mediterranean species), 5 rare, 2 new deep sea and 1 previously considered a fossil species. Also, as a result of new resources, the distributions of preexisting native molluscs have been updated to include new habitat areas. The nomenclature is also up to date based on the CLEMAM Database. Thus 5 species are now excluded either because they are junior synonyms of pre-existing valid species (2) or because of old spurious records (3 species). Additions and corrections of the 1996 checklist have resulted in a total of 308 bivalves in Greek waters.

INTRODUCTION

Research over the last two decades in the Eastern Mediterranean has revealed new geographic areas, new bathymetric zones and new species. A series of checklists and review papers (Koutsoubas et al., 1997; Zenetos, 1997) has revealed an unprecedented variety of marine molluscs. One of these publications was *Fauna Graeciae VII* (Zenetos, 1996) whose aim was to collect in a single publication the records of the bivalves found in Greek waters. Zenetos (1997) examined the correlation between the number of resources in a specific area and the corresponding number of species in that area and suggested that there are many waiting to be investigated. As new resources have been added, new species have been identified in Greek waters. Also, the distribution of the previously identified native species has extended to new geographical areas. This work aims to present the latest update of the bivalve checklist which has been significantly changed since 1995 (last collection date of *Fauna Graeciae VII*) due to recent studies. It also presents the latest findings including exotic species (Zenetos et al., 2004) and the trends in this ever increasing diversity over the last century.

MATERIALS AND METHODS

More than 30 new studies were used to update the checklist of Zenetos (1996). The new species and the new distributions of the previously identified species were compiled from grey literature (unpublished National Centre for Marine Research technical reports and essays, European Union funded research projects) and various other publications from 1996 to 2004. The new resources focus on new geographical areas, habitats (e.g. deep waters: North Aegean Sea), areas with few available references (e.g. Ionian Sea) and areas where more detailed studies have been completed (e.g. Evvoikos Gulf and Saronikos Gulf).

The nomenclature followed in this study is that of Sabelli et al. (1990) updated by the use of the CLEMAM Database (18.6.04).

RESULTS AND DISCUSSION

Nomenclature updates

Many species have undergone nomenclature updates. The 4 proper name changes are from *Chama ruppelli* (Reeve, 1847) to *Pseudochama corbieri* (Jonas, 1846), *Mactra corallina* (Linnaeus, 1758) to *Mactra stultorum* (Linnaeus, 1758), *Scapharca demiri* (Piani, 1981) to *Anadara demiri* (Piani, 1981) and *Abra ovata* (Philippi, 1836) to *Abra segmentum* (Recluz, 1843) (Sabelli et al., 1990; CLEMAM).

Two other species namely *Corbula rosea* (Brown, 1844) and *Loripes desmaresti* (Payraudeau, 1826) have been downgraded as junior synonyms of the valid species *Corbula gibba* (Olivi, 1792) and *Loripes lacteus* (Linnaeus, 1758). Also, the following 3 species have been removed from the list as spurious records: *Cardium indicum* (Lamarck, 1818); *Dosinia discus* (Reeve, 1850); *Pectunculus atticus* (Ralli-Tzelepi, 1946).

Accidental or spurious records

Besides the above mentioned species there are some more records which are currently excluded as accidental or spurious records. These are:

Pinctada margaritifera (L., 1758). The species is a misidentification of the Indo-Pacific *Pinctada radiata* (Zenetos et al., 2003). A shell deposited in the museum collection of the Hellenic Centre for Marine Research, labelled as collected from Lesvos Island, belongs to the species.

Table 1. *New records of bivalvia in Greek waters (1996–2004).*

Species	Distribution area/source
Phaseolus ovatus (Seguenza, 1877) Deep Sea	Northeast Aegean: between Limnos and Imvros, southeast Limnos Basin (Zenetos, unpublished)
Haliris berenicensis (Sturany, 1896) Deep Sea	Northeast Aegean: southeast Limnos Basin, northwest Lesvos (Zenetos, unpublished)
Malvufundus regulus (Forsskal, 1775) Exotic	South Aegean: Simi Island (Giannuzzi-Savelli et al., 2001)
Fulvia fragilis (Forsskal in Niebuhr, 1775) Exotic	South Aegean: Saronikos Gulf: Elefsis Bay (Delamotte & Vardala-Theodorou, 2001); Methana, Poros (Vardala-Theodorou, unpublished)
Mya arenaria (Linnaeus, 1758) Exotic	South Aegean: Saronikos (Zenetos et al., 2003)
Montacuta tenella (Loven, 1846) Rare	North Aegean: Evvoikos: off Larymna (Kallonas et al., 1999)
Litigiella glabra (Fischer, 1873) Rare	Patraikos Gulf (Kallonas et al., 1999) Preveza (Hoeksema et al., 1995) South Aegean: Saronikos (Hoeksema et al., 1995), Petalioi Gulf (Kallonas et al., 1999)
Epilepton clarkiae (Clark W., 1852) Rare	North Aegean: off Larymna Saronikos. Northeast Aegean: between Limnos and Imvros. Ionian Sea: Korinthiakos (Zenetos, unpublished) South Aegean: Petalioi Gulf (Kallonas et al., 1999)
Neolepton sulcatulum (Jeffreys, 1859) Rare	South Aegean: Kritikon: Heraklion Bay (Koulouri et al., 2000)
Pholadidea loscombiana (Goodall in Turton, 1819) Rare	Evvoikos: Chalkida (Vardala-Theodorou, unpuplished)
Anadara corbuloides (Monterosato, 1878) Few records in the Mediterranean	South Aegean: Kritikon Pelagos (Koutsoubas et al., 2000)
Parvicardium trapezium (Celalupo & Quadri, 1996) Few records in the Mediterranean	South Aegean: Rhodes Island (Van Aartsen & Goud, 2000)
Arctica islandica (Linnaeus, 1767) Fossil	North Aegean: Limnos Island (P. Pravlis, personal communication)

However, in the lack of collection date, further details and no follow up, the finding is not recorded herein as valid.

Gregariella subclavata (Libassi, 1859). A synonym of *Gregariella semigranata* (Reeve, 1858). Reported from Kephallonia Island (De Smit & Baba, 2001) but identification is unconfirmed.

Amygdalum politum (Verrill & Smith, 1880). An Amphiatlantic species reported from Kephallonia Island (De Smit & Baba, 2001) but its identification is unconfirmed.

Musculus laevigatus (Gray, 1824). A circumpolar species reported in Kephallonia Island (De Smit & Baba, 2001) but its identification is unconfirmed.

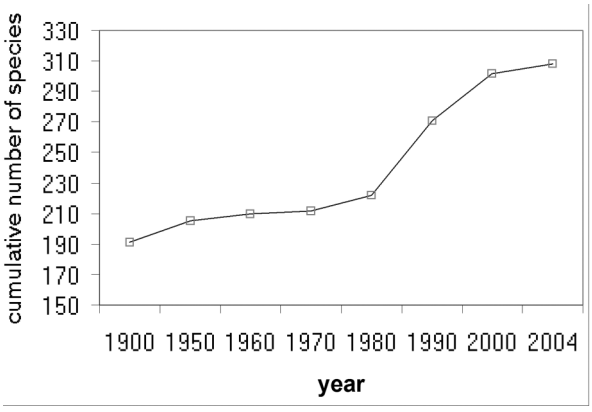

Figure 1. Chronological trend in bivalvia molluscan species diversity (1900–2004).

Lasaea adansoni (Gmelin, 1791). Reported in Kephallonia Island (De Smit & Baba, 2001); its identification is unconfirmed, but according to CLEMAM it is a synonym of *Lasaea rubra*.

Taking into consideration the above mentioned information a total of 295 bivalve species out of the 300 species (Zenetos, 1997) have remained as valid species names. Of those, over 170 have distribution updates. One good example is the finding of *Lutraria magna* (Da Costa, 1778) in Strava Korinthias (Korinthiakos Gulf) in 2002 [one individual at 5 m, muddy substratum with *Pinna nobilis*

Author: Please cite Table 2 in text.

Table 2. *Bivalvia species diversity in the Aegean, Ionian, Libyan and Kythira Seas.*

	1995	2004	Number of new resources
Aegean	276	289	21
North Aegean	212	243	11
South Aegean	258	262	10
Ionian Sea	200	218	6
Sea of Kythira	87	88	1
Libyan Sea	77	77	–
Greek Seas			5
Total	300 (-5)	308	33

Table 3. *Zoogeographical distribution of Bivalvia species in taxonomic order.*

Species in taxonomic order
Solemya togata (Poli, 1795)[1,3,4,5]
Nucula hanleyi (Winckworth, 1931)[1,3,4,5]
Nucula nitidosa (Winckworth, 1930)[1,3,4,5]
Nucula nucleus (Linnaeus, 1758)[1,2,3,4,5]
Nucula sulcata (Bronn, 1831)[1,2,3,4,5]
Nucula (Leionucula) aegeensis (Forbes, 1844)[1,2,3,4,5]
Nucula (Leionucula) corbuloides (Sequenza G., 1877)[1,3,5]
Nucula (Leionucula) tenuis (Montagu, 1808)[1,4]
Nuculana (Lembulus) pella (Linnaeus, 1767)[1,3,4,5]
Nuculana (Jupiteria) commutata (Philippi, 1844)[1,3,4]
Nuculana (Jupiteria) minuta (Müller O.F., 1776)[4]
Phaseolus ovatus (Seguenza, 1877)[3]
Phaseolus pusillus (Jeffreys, 1878)[3,4]
Malletia (Pseudomalletia) obtusa (Sars G.O., 1872)[5]
Yoldia micrometrica (Sequenza G., 1877)[5]
Yoldiella frigida (Torell, 1859)[5]
Yoldiella lucida (Loven, 1846)[3,4,5]
Yoldiella philippiana (Nyst, 1845)[1,3,4]
Yoldiella striolata (Brugnone, 1877)[3]
Arca noae (Linnaeus, 1758)[1,2,3,4,5]
Arca tetragona (Poli, 1795)[1,2,3,4]
**Tetrarca cardissa* (Lamarck, 1819)[4]
Barbatia (Barbatia) barbata (Linnaeus, 1758)[1,2,3,4,5]
Barbatia (Acar) clathrata (De France, 1816)[3,4]
**Barbatia pulchella* (Reeve, 1844)[2,4,5]
Barbatia (Acar) scabra (Poli, 1795)[1,2,3,4,5]
Anadara (Anadara) diluvii (Lamarck, 1805)[2,3,4]
Anadara corbuloides (Monterosato, 1878)[4]
Anadara demiri (Piana, 1981)[3]
Bathyarca frielei (Jeffreys, 1879)[4]
Bathyarca grenophia (Risso, 1826)[1,2,3,4,5]
Bathyarca philippiana (Nyst, 1848)[3,4,5]
Striarca lactea (Linnaeus, 1758)[1,2,3,4,5]
Glycymeris (Glycymeris) bimaculata (Poli, 1795)[1,3,4]
Glycymeris (Glycymeris) glycymeris (Linnaeus, 1758)[1,2,3,4,5]
Glycymeris (Glycymeris) insubrica (Brocchi, 1814)[1,2,3,4,5]
Glycymeris (Glycymeris) pilosa (Linnaeus, 1767)[1,2,3,4,5]
Mytilus (Mytilus) edulis (L., 1758)[3,4]
Mytilus (Mytilus) galloprovincialis (Lamarck, 1819)[1,3,4]
Brachidontes pharaonis (Fischer P., 1870)[3,4]
Mytilaster lineatus (Gmelin, 1791)[1,4]
Mytilaster marioni (Locard, 1889)[1]
Mytilaster minimus (Poli, 1795)[1,3,4,5]
Mytilaster solidus (Monterosato, 1872)[1,3,4]
Gregariella petagnae (Scacchi, 1832)[1,3,4]
Crenella arenaria (Monterosato, 1875)[4]
Crenella decussata (Montagu, 1803)[1]
Modiolarca subpicta (Cantraine, 1835)[1,3,4]
Musculus (Modiolaria) costulatus (Risso, 1826)[1,3,4]
Musculus discors (Linnaeus, 1767)[1,3,4]
Lithophaga lithophaga (Linnaeus, 1758)[1,2,3,4]
Modiolus adriaticus (Lamarck, 1819)[1,3,4]
Modiolus barbatus (Linnaeus, 1758)[1,2,3,4]
Idasola argentea (Jeffreys, 1876)[5]
Modiolula phaseolina (Philippi, 1844)[1,2,3,4]
Dacrydium vitreum (Holboll, 1842)[2,3,4]
Pinna (Pinna) nobilis (Linnaeus, 1758)[1,3,4]
Pinna (Atrina) pectinata (Linnaeus, 1758)[2,3,4,5]
Pteria hirundo (Linnaeus, 1758)[1,3,4]
Pinctada radiata (Leach, 1814)[2,3,4]
Malvufundus regulus (Forsskal, 1775)[4]
Pecten (Pecten) jacobaeus (Linnaeus, 1758)[1,2,3,4]
Aequipecten opercularis (Linnaeus, 1758)[1,2,3,4]
Aequipecten (Argopecten) commutatus (Monterosato, 1875)[3]
Propeamussium fenestratum (Forbes, 1844)[1,3,4]
Pseudamussium clavatum (Poli, 1795)[2,3,4,5]
Pseudamussium septemradiatum (Müller, 1776)[1,3,4]
Cyclopecten hoskynsii (Forbes, 1844)[1,2,4]
Delectopecten vitreus (Gmelin, 1791)[1,3,4,5]
Hyalopecten similes (Laskey, 1811)[1,2,3,4,5]
Lissopecten hyalinus (Poli, 1795)[1,3,4,5]
Palliolum incomparabile (Risso, 1826)[3,4]
Chlamys bruei (Payraudeau, 1826)[4]
Chlamys flexuosa (Poli, 1795)[1,3,4,5]
Chlamys glabra (Linnaeus, 1758)[1,3,4]
Chlamys multistriata (Poli, 1795)[1,2,3,4]
Chlamys (Manupecten) pesfelis (Linnaeus, 1758)[1,2,3,4]
Chlamys proteus (Dillwyn, 1817)[1,3,4]
Chlamys varia (Linnaeus, 1758)[1,3,4]
Lima (Mantellum) hians (Gmelin, 1791)[1,2,3,4]
Lima (Mantellum) inflata (Link, 1807)[1,3,4]
Lima (Lima) lima (Linnaeus, 1758)[1,2,3,4,5]
Limea (Limatulella) loscombi (Sowerby G.B.I., 1823)[1,3,4]
Limea crassa (Forbes, 1844)[2,3,4,5]
Notolimea sarsi (Loven, 1846)[1,2,4]
Limatula gwyni (Sykes,1903)[2,3,4,5]
Limatula subauriculata (Montagu, 1808)[1,2,3,4,5]
Limatula subovata (Jeffreys,1876)[3,4,5]
Spondylus gaederopus (Linnaeus, 1758)[1,2,3,4,5]
Spondylus gussoni (Costa O.G., 1829)[2,3,4]
Anomia ephippium (Linnaeus, 1758)[1,2,3,4]
Pododesmus (Heteranomia) squamula (Linnaeus, 1758)[1,3]
Pododesmus (Monia) patelliformis (Linnaeus, 1761)[1,3,4]
Ostrea adriatica (Lamarck, 1819)[3]
Ostrea edulis (Linnaeus, 1758)[1,2,3,4]
Crassostrea gigas (Thunberg, 1793)[1,3]
Ostreola stentina (Payraudeau, 1826)[3,4]
Neopycnodonte cochlear (Poli, 1795)[3,4]
Ctena (Ctena) decussata (Costa O.G., 1829)[1,2,3,4,5]
Loripes lacteus (Linnaeus, 1758)[1,2,3,4,5]
Megaxinus (Megaxinus) transversus (Bronn, 1831)[1,3,4]
Megaxinus unguiculinus (Pallary, 1904)[1,4]
Lucinella divaricata (L., 1758)[1,2,3,4,5]
Anodontia (Loripinus) fragilis (Philippi, 1836)[1,2,3,4,5]
Myrtea spinifera (Montagu, 1803)[1,2,3,4,5]
Lucinoma boreale (L., 1767)[4F]
Thyasira alleni (Carrozza, 1981)[3]
Thyasira flexuosa (Montagu, 1803)[1,2,3,4,5]
Thyasira granulosa (Monterosato, 1874)[1,3,4,5]
Thyasira sarsi (Philippi, 1845)[1]
Axinulus croulinensis (Jeffreys, 1847)[1,2,3,4,5]
Axinulus cycladius (Wood S., 1848)[Aegean sea]
Leptaxinus eumyarius (Sars M., 1870)[1]
Leptaxinus ferruginosus (Forbes, 1844)[1,3,4,5]
Leptaxinus incrassatus (Jeffreys, 1876)[1,3,4]
Leptaxinus subovatus (Jeffreys, 1881)[1,3]
Diplodonta apicalis (Philippi, 1836)[1,4]
Diplodonta brocchi (Deshayes, 1832)[1,3,4]
Diplodonta orbicularis (Deshayes, 1832)[4F]
Diplodonta rotundata (Montagu, 1803)[1,3,4,5]
Chama bicornis (Gmelin, 1790)[Greek Seas]
Chama circinata (Monterosato, 1878)[2]
Chama (Psilopus) gryphoides (Linnaeus, 1758)[1,3,4]
Pseudochama corbieri (Jonas, 1846)[4]
Pseudochama (Pseudochama) gryphina (Lamarck, 1819)[1,2,3,4]
Galeomma (Galeomma) turtoni (Sowerby G.B.I., 1825)[1,3,4]

(*Continued*)

Table 3. *(Continued).*

Species in taxonomic order
Galeomma (Amphilepida) politum (Deshayes, 1855)[3]
Kellia suborbicularis (Montagu, 1803)[1,3,4]
Bornia geoffroyi (Payraudeau, 1826)[4]
Bornia sebetia (Costa O.G., 1829)[1,3,4]
Lasaea rubra (Montagu, 1803)[1,3]
Scacchia oblonga (Philippi, 1836)[1,3,4]
Hemilepton nitidum (Turton, 1822)[1,3,4]
Litigiella glabra (Fischer, 1873)[1,3,4]
Lepton (Lepton) squamosum (Montagu, 1803)[1,3]
Montacuta substriata (Montagu, 1808)[1,3,4]
Montacuta tenella (Loven, 1846)[3]
Tellimya ferruginosa (Montagu, 1808)[1,3,4,5]
Tellimya phascolionis (Dautzenberg & Fischer H., 1925)[3,4]
Tellimya semirubra (Gaglini, 1992)[4]
Mysella (Mysella) bidentata (Montagu, 1803)[1,3,4,5]
Mysella tumidula (Jeffreys, 1866)[3,4]
Epilepton clarkiae (Clark, 1852)[1,3,4]
Mancikellia pumila (Sowerby J. de C., 1846)[4]
Neolepton obliquatum (Monterosato in Chester, 1897)[1,3,4]
Neolepton sulcatulum (Jeffreys, 1859)[4]
Sportella recondita (Fischer P., 1872)[1]
Turtonia minuta (Fabricius O., 1780)[1,4]
Cardita calyculata (Linnaeus, 1758)[1,2,3,4]
Glans trapezia (Linnaeus, 1767)[1,2,3,4]
Glans (Centrocardita) aculeata (Poli, 1795)[1,2,3,4]
Venericardia antiquata (Linnaeus, 1758)[1,2,3,4,5]
**Venericardia antiquata trapezoidea* (Bucquoy, Dautzenberg, Dollfus, 1892)[1,3,4]
Astarte fusca (Poli, 1795)[2,4]
Astarte sulcata (Da Costa, 1778)[4]
Digitaria digitaria (Linnaeus, 1758)[4,5]
Gonilia calliglypta (Dall, 1903)[3,4]
Goodallia (Goodallia) pusilla (Forbes, 1844)[4]
Goodallia triangularis (Montagu, 1803)[1,2,3,4]
Acanthocardia (Acanthocardia) aculeate (Linnaeus, 1758)[1,2,3,4]
Acanthocardia (Acanthocardia) deshayesi (Payraudeau, 1826)[3]
Acanthocardia (Acanthocardia) echinata (Linnaeus, 1758)[1,3,4]
Acanthocardia (Acanthocardia) mucronata (Poli, 1795)[3]
Acanthocardia (Acanthocardia) paucicostata (Sowerby G.B. II, 1841)[1,3,4,5]
Acanthocardia spinosa (Solander, 1786)[3,4]
Acanthocardia (Rudicardium) tuberculata (Linnaeus, 1758)[1,2,3,4,5]
Fulvia fragilis (Forsskal in Niebuhr, 1775)[4]
Parvicardium exiguum (Gmelin, 1791)[1,2,3,4]
Parvicardium minimum (Philippi, 1836)[1,2,3,4]
Parvicardium ovale (Sowerby G.B. II, 1840)[1,3,4]
Parvicardium roseum (Lamarck, 1819)[3]
Parvicardium scabrum (Philippi, 1844)[1,2,3,4]
Parvicardium scriptum (Bucquoy, Dautzenberg, Dollfus, 1892)[4]
Parvicardium trapezium (Celalupo & Quadri, 1996)[4]
Plagiocardium (Papillicardium) papillosum (Poli, 1795)[1,2,3,4,5]
Laevicardium crassum (Gmelin, 1791)[1,3,4]
Laevicardium oblongum (Gmelin, 1791)[1,3,4]
Cerastoderma edule (Linnaeus, 1758)[1,3,4]
Cerastoderma glaucum (Poiret, 1789)[1,3,4]
**Cardium lamarcki* (Reeve, 1844)[1,3,4]
Mactra glauca (Von Born, 1778)[1,3]
Mactra stultorum (Linnaeus, 1758)[1,2,3,4,5]
Spisula subtruncata (Da Costa, 1778)[1,3,4]
Lutraria angustior (Philippi, 1844)[4F]
Lutraria lutraria (Linnaeus, 1758)[1,3,4]
Lutraria magna (Da Costa, 1778)[1,4F]
Eastonia rugosa (Helbling, 1779)[4F]
Donacilla cornea (Poli, 1795)[1,2,3,4]
Ervilia castanea (Montagu, 1803)[1,3,4]
Solen marginatus (Pulteney, 1799)[1,3,4]
Ensis arcuatus (Jeffreys, 1865)[1,2,3,4]
Ensis ensis (Linnaeus, 1758)[1,3,4]
Phaxas adriaticus (Coen, 1933)[1,3,4,5]
Phaxas pellucidus (Pennant, 1777)[1,3,4]
Tellina tenuis (Da Costa, 1778)[1,2,3,4]
Tellina (Arcopella) balaustina (Linnaeus, 1758)[1,2,3,4]
Tellina (Arcopagia) crassa (Pennant, 1777)[1,3,4,5]
Tellina (Fabulina) fabula (Gmelin, 1791)[1,2,3,4,5]
Tellina (Laciolina) incarnata (Linnaeus, 1758)[1,3,4]
Tellina (Moerella) donacina (Linnaeus, 1758)[1,2,3,4]
Tellina pygmaea (Loven, 1846)[1,3,4]
Tellina (Oudardia) compressa (Brocchi, 1814)[4]
Tellina (Peronidia) planata (Linnaeus, 1758)[1,2,3,4]
Tellina (Peronidia) nitida (Poli, 1791)[1,3,4]
Tellina (Serratina) serrata (Brocchi, 1814)[1,2,3,4]
Tellina (Tellinella) distorta (Poli, 1791)[1,2,3,4]
Tellina (Tellinella) pulchella (Lamarck, 1818)[1,3,4,5]
Macoma (Macoma) cumana (Costa, O.G., 1829)[1,3,4]
Gastrana fragilis (Linnaeus, 1758)[1,3,4]
Donax (Donax) semistriatus (Poli, 1795)[1,3,4]
Donax (Donax) venustus (Poli, 1795)[1,3,4]
Donax vittatus (Da Costa, 1778)[3,4]
Donax (Capsella) variegatus (Gmelin, 1791)[1,3,4]
Donax (Serrula) trunculus (Linnaeus, 1758)[1,2,3,4]
Psammobia (Psammobia) fervensis (Gmelin, 1791)[1,3,4]
Psammobia (Gobraeus) depressa (Pennant, 1777)[1,3,4]
Psammobia (Psammobella) costulata (Turton, 1822)[1,3,4]
Psammobia (Psammobella) tellinella (Lamarck, 1818)[1,3,4]
Scrobicularia cottardi (Payraudeau, 1826)[1,3,4]
Scrobicularia plana (Da Costa, 1778)[1,3,4]
Abra (Abra) nitida (Müller O.F., 1776)[1,2,3,4,5]
Abra (Abra) prismatica (Montagu, 1808)[1,2,3,4,5]
Abra (Abra) segmentum (Recluz, 1843)[1,3,4]
Abra (Abra) tenuis (Montagu, 1803)[1,4]
Abra (Syndosmya) alba (Wood W., 1802)[1,2,3,4,5]
**Abra pellucida* (Brocchi, 1814)
Abra (Syndosmya) longicallus (Scacchi, 1834)[1,2,3,4,5]
Solecurtus multistriatus (Scacchi, 1834)[3,4]
Solecurtus scopula (Turton, 1822)[1,3,4]
Solecurtus strigilatus (Linnaeus, 1758)[1,3,4]
Azorinus (Azorinus) chamasolen (Da Costa, 1778)[1,2,3,4]
Pharus legumen (Linnaeus, 1758)[1,3,4]
Arctica islandica (Linnaeus, 1767)[3F]
Kelliella abyssicola (Forbes, 1844)[1,2,3,4,5]
Coralliophaga lithophagella (Lamarck, 1819)[1,3,4]
Glossus humanus (Linnaeus, 1758)[1,3,4]
Venus (Venus) verrucosa (Linnaeus, 1758)[1,3,4]
Venus casina (Linnaeus, 1758)[1,2,3,4]
Venus nux (Gmelin, 1791)[4F]
Globivenus effosa (Philippi, 1836)[1,2,3,4]
Chamelea gallina (Linnaeus, 1758)[1,3,4,5]
Chamelea radiata (Brocchi, 1814)[1,3,4]
Clausinella brongniartii (Payraudeau, 1826)[1,2,3,4]
Clausinella fasciata (Da Costa, 1778)[1,3,4]
Timoclea (Timoclea) ovata (Pennant, 1777)[1,3,4,5]
Gouldia minima (Montagu, 1803)[1,2,3,4,5]
Dosinia (Dosinia) lupinus (Linnaeus, 1758)[1,2,3,4,5]
Dosinia (Pectunculus) exoleta (Linnaeus, 1758)[1,3,4]
Pitar (Pitar) rudis (Poli, 1795)[1,2,3,4,5]

(*Continued*)

Table 3. *(continued)*.

Species in taxonomic order	
Callista (Callista) chione (Linnaeus, 1758)[1,2,3,4]	*Pandora inaequivalvis* (Linnaeus, 1758)[1,3,4]
Tapes (Ruditapes) decussatus (Linnaeus, 1758)[1,3,4]	*Pandora pinna* (Montagu, 1803)[1,3,4]
Irus irus (Linnaeus, 1758)[1,3,4]	*Lyonsia arenosa* (Müller, 1842)[4]
Paphia aurea (Gmelin, 1791)[1,2,3,4]	*Lyonsia formosa* (Jeffreys, 1882)[3,4]
Paphia lucens (Locard, 1886)[1,3,4]	*Lyonsia norwegica* (Gmelin, 1791)[1,3,4]
Paphia rhomboides (Pennant, 1777)[1,3]	*Thracia convexa* (Wood W., 1815)[1,3,4]
Venerupis pullastra (Montagu, 1803)[1,3,4]	*Thracia (Thracia) corbuloides* (Deshayes, 1830)[1,3,4]
Venerupis senegalensis (Gmelin, 1791)[1,3,4]	*Thracia (Thracia) papyracea* (Poli, 1791)[1,3,4]
Petricola (Petricola) lithophaga (Retzius, 1786)[1,3,4]	*Thracia pubescens* (Pulteney, 1799)[3,4]
Petricola (Lajonkairia) lajonkairii (Payraudeau, 1826)[1,2,3,4]	*Thracia villosiuscula* (McGillivray, 1827)[1,3,4]
Petricola (Lajonkairia) substriata (Montagu, 1808)[1,3,4]	*Thracia (Ixartia) distorta* (Montagu, 1803)[1,3]
Petricola (Petricola) pholadiformis (Lamarck, 1818)[3,4]	*Thracia pholadomyoides* (Forbes, 1844)[3]
Mysia undata (Pennant, 1777)[1,3,4]	*Cochlodesma praetenue* (Pulteney, 1799)[4F]
Mya arenaria (Linnaeus, 1758)[4]	*Clavagella bacillaris* (Deshayes, 1832)[4F]
Sphenia binghami (Turton, 1822)[1,3,4]	*Clavagella melitensis* (Broderip,1835)[Aegean Sea]
Corbula (Varicorbula) gibba (Olivi, 1792)[1,2,3,4,5]	*Poromya granulata* (Nyst & Westendorp, 1839)[2,3,4]
Lentidium (Lentidium) mediterraneum (Costa O.G., 1839)[1,3,4]	*Poromya neaeroides* (Sequenza G., 1877)[5]
Gastrochaena cymbium (Spengler, 1783)[4]	*Halicardia ferruginea* (Di Geronimo, 1974)[1]
Gastrochaena dubia (Pennant, 1777)[1,3,4]	*Haliris berenicensis* (Sturany, 1896)[3]
Hiatella arctica (Linnaeus, 1767)[1,3,4]	*Laevicordia gemma* (Verril, 1880)[1,5]
Hiatella rugosa (Linnaeus, 1767)[1,3,4]	*Verticordia granulata* (Sequenza G., 1870)[4]
Panopea glycimeris (Von Born, 1778)[4F]	*Lyonsiella compressa* (Locard, 1898)[4]
Saxicavella jeffreysi (Winckworth, 1930)[1]	*Cuspidaria (Cuspidaria) cuspidata* (Olivi, 1792)[1,3,4,5]
Pholadidea loscombiana (Goodal in Turton, 1819)[3]	*Cuspidaria elliptica* (Di Geronimo, 1974)[1]
Pholas dactylus (Linnaeus, 1758)[1,3,4]	*Cuspidaria obesa* (Loven, 1846)[5]
Pholas (Pholas) callosa (Cuvier, 1817)[1,3]	*Cuspidaria rostrata* (Spengler, 1793)[1,2,3,4,5]
Barnea candida (Linnaeus, 1758)[1,3,4]	*Cuspidaria (Tropidomya) abbreviata* (Forbes, 1844)[3,4,5]
Teredo navalis (Linnaeus, 1758)[1,3,4]	*Cardiomya costellata* (Deshayes, 1835)[1,2,3,4,5]
Xylophaga dorsalis (Thurton, 1819)[1,4,5]	*Cardiomya striolata* (Locard, 1898)[1,3,4]
Xylophaga praestans (Smith, E.A., 1885)[5]	

Numbers in superscript writing denote major geographical divisions. 1, Ionian Sea; 2, Sea of Kythira; 3, North Aegean Sea; 4, South Aegean Sea; 5, Libyan Sea; *, species with uncertain systematic position, F, fossil only.

(Vardala-Theodorou, unpublished)]. Thus, a species, which was previously recorded only as fossil, is now alive.

Literature update

As a result of updating the bibliography from 116 sources reviewed in 1996 (Zenetos, 1997), the new resources have increased the number of species by 13, including 2 deep sea [*Phaseolus ovatus* (Seguenza, 1877) and *Haliris berenicensis* (Sturany, 1896)], 3 exotic (non-Mediterranean species) [*Malvufundus regulus* (Forskal, 1775), *Fulvia fragilis* (Forskal in Niebuhr, 1775) and *Mya arenaria* (Linnaeus, 1758)], 5 rare (with few records in the Greek waters) [*Epilepton clarkiae* (Clark W., 1852); *Litigiella glabra* (Fischer, 1873), *Neolepton sulcatulum* (Jeffreys, 1859); *Pholadidea loscombiana* (Goodall in Turton, 1819)]; 1 fossil [*Arctica islandica* (Linnaeus, 1767)] and 2 species with few records in the Mediterranean [*Parvicardium trapezium* (Celalupo & Quadri, 1996) and *Anadara corbuloides* (Monterosato, 1878)] (see Table 1).

In the case of *Arctica islandica* (Linnaeus, 1767), shells (most probably fossil/subfossil) were caught in trawls fishing around the Limnos area, northern Aegean (P. Pravlis, personal communication). Their identification was confirmed. However, the species has been recorded as a fossil mainly in Rodos Island, southern Aegean and Lakonikos Gulf, Sea of Kythira (Keraudren, 1967). In the Limnos area Calabrian (lower Pleistocene) sediments have been reported (Papp, 1953), which could justify the species' presence as a fossil. *Arctica islandica* is widely regarded as a characteristic fossil for cold Pleistocene periods. It will be extremely interesting if it is collected alive in the Limnos area, in the future.

Trends in bivalves diversity in the Greek waters over time–space

Figure 1 shows that the increasing trend in bivalvia species recorded in Greek waters is most apparent since 1980, when intensive research, mostly undertaken by Greek scientists, started on the subject and is continuing at an increasing rate. As was shown in Zenetos (1997), there is a strong correlation between the number of studies done in an area, and the bivalve diversity in terms of number of species found.

Originally, 30 regions were selected for a comparison of the number of resources used and the number of species found. The new resources focused on half of these regions resulting in new species distributions. On comparing the number of species found (2004) and the number of references used for the updated version, it is not surprising to see that most of the new species are added in the northern

Aegean since many of the new resources focused on areas within that region (e.g. open north-east Aegean, Strymonikos Gulf, Evvoikos Gulf, Petalioi Gulf).

The compiled inventory of bivalve species and their distributions in the four divisions of the Greek Seas namely Ionian Sea, Sea of Kythira, Aegean Sea and Libyan Sea is presented in Table 3. According to the updated list, the Aegean Sea not only has the largest distribution of species, but it also has the largest increase of species diversity between 1995 and 2004. Of the 33 new references used, 21 focus on specific areas in the Aegean Sea while another 5 focus on broad areas which include the Aegean Sea. This shows the correlation between the number of references and the number of species as was shown in Zenetos (1997). The Aegean Sea now contains 289 species as opposed to 276 species reported in 1996. When dividing the Aegean Sea into north and south, the north has the largest increase from 212 species in 1995 to 243 species in 2004 as opposed to the south Aegean (262 species vs. 258 in 1995). Analogous was the increase in the Ionian Sea where 6 new studies resulted in an increase of 18 species (218 vs. 200 in 1995). Finally, the Sea of Kythira with one local study only, had the smallest increase of new species.

It is noteworthy that research in the deep international water between Rodos and Cyprus has revealed a new species to science, *Lucinoma catzani*, collected from several mud volcanoes at different depths between 1700–2030 m in the Anaximander Mountains (Salas & Woodside, 2002).

Bivalvia and biological invasion in the Greek waters

Eleven of the bivalve species recorded so far from the Greek waters [*Anadara demiri* (Piani, 1981); *Brachidontes pharaonis* (Fischer P., 1870); *Crassostrea gigas* (Thunberg, 1793); *Pinctada radiata* (Leach, 1814); *Malvufundus regulus* (Forskaal, 1775); *Pseudochama corbieri* (Jonas, 1846); *Fulvia fragilis* (Forskaal in Niehbur, 1775); *Petricola pholadiformis* (Lamarck, 1818); *Mya arenaria* (L., 1758); *Gastrochaena cymbium* (Spengler, 1783) and *Teredo navalis* (L., 1758)], are non-indigenous species introduced to the Greek waters mostly via the Suez Canal (Zenetos et al., 2004). Among them three have been recently introduced (see Table 1) while *Teredo navalis* is considered a cryptogenic species.

CONCLUSIONS

The updated checklist of bivalvia fauna (2004) includes 308 species. New findings in the malacofauna of Greek waters have shown that: (a) previously accidental records are now species with established populations; (b) some fossil records are still represented by living organisms; (c) Atlantic and west Mediterranean species may have extended their distribution in the eastern Mediterranean and even boreal species may inhabit the north Aegean Sea; and (d) new species for science are living in the eastern Mediterranean. These findings all lead to the same suggestion: there is still a lot to be discovered.

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