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A CONTRIBUTION TO THE KNOWLEDGE OF BIVALVE SPECIES DISTRIBUTION IN THE INSULAR ZONES OF THE NORTHERN AND PART OF THE MIDDLE ADRIATIC SEA

PRILOG POZNAVANJU RASPROSTRANJENJA ŠKOLJKAŠA (Bivalvia) U OTOČNIM ZONAMA SJEVERNOG I DIJELA SREDNJEG JADRANA

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During biocoenological investigations, from 1961 to 1980, 117 bivalve species were obtained in insular zones of the northern and the part of the middle Adriatic Sea. Specimens were collected by divers, grabs, dredges and bottom trawls. The horizontal and vertical distribution of identified bivalve species is presented in the text and in figures. In the discussion a comparison is made between recent and previous records of some of the bivalve species.

INTRODUCTION

The great diversity of the bottom communities in the Adriatic Sea has attracted many biologists, who have investigated their community structure and distribution for more than a hundred years. Bivalve species of the insular zones are cited in the following publications: Grube (1861, 1864), Lorenz (1863), Brusina (1865, 1866, 1896, 1898, 1907), Stossich, M. (1880, Faber (1883), Carus (1889—1893), Brusina-Matisz (1900), Coen (1933, 1937), Vatova (1942, 1949), Gamulin-Brida et al. (1971), Legac, M. (1974), Zavodnik, D. (1976), Zavodnik, D. and Zavodnik, N. (1978), Zavodnik, D. et al. (1978), Legac, M. and Legac, I. (1979).

The purpose of the contribution is to present the current distribution, both vertical and horizontal, of the living bivalve species encountered in the areas investigated. The list of bivalve can be used in future to document any changes in bivalve populations in the botoom communities due to human activities in the sea.

The bottom samplings and direct observations were carried out by skin and scuba divers, by »mušular« type biological dredges (towed 5—10 min.) (Ga-

METHODS

mulin-Brida et al., 1968), by bottom trawl net (towed about 1 hour), by Van Veen type grabs (covering 0,1 m^2), and Petersen type grabs (covering 0,2; 0,1 and 0,05 m^2). The location of sampling stations is shown in Figures: 1, 2, 3 and 4. The bottom samplings were made by RV »Bios«* and RV »Vila Velebita«** as well as by small boats in the following localities: Kvarner, Rijeka Bay, Bakar Bay, Kvarnerić, Lošinj kanal, Unije kanal, Velebit kanal, Vir Sea, Zadar kanal, Pašman kanal, Srednji kanal, Iž kanal, Murter Sea, and in the coastal zones of Krk, Cres, Lošinj, Rab, Grgur, and Vir Islands from 1961 to 1980. Animals from shalow sandy bottoms of the Rab Island area were collected by digging with a hooked stick (»frangulaš«) which the local population use for collecting the burried bivalve *Solen marginatus*, and which we also used occasionally for digging *Solecurtus strigillatus* and *Ensis ensis*. The other sandy burried species were sampled by knife and small spade (Legac, 1974).

The medio and infralitoral zones were primarily investigated by divers, and occasionally by grabs. The size of the investigated areas covered by divers was different depending on the type of bottoms, distance offshore (to 300 m), and depth (to 45 m).

Material sampled by grabs was processed primarily trough sieves (2 mm mesh size), and elaborated according to standard methods proposed by CIESM's Com. Benthos (1963). All live bivalve species were collected from the bottom material sampled by dredges and trawl. After that they were preserved in 4% neutral formol or 70% alcohol, and later identified to the species level in the laboratory.

RESULTS

The bivalve species collected and identified during recent investigations in insular zones comprise 39 families according to Nordsieck (1969) and Parenzan (1974, 1976). Only species of *Venerupis*, *Tapes*, *Ruditapes* and *Irus* are registered in accordance with recent revision of Tapetinae (Fischer-Piette and Métivier, 1971).

NUCULIDAE Gray, 1824

Nucula nucleus (Linnaeus, 1767) (Fig. 5)

Stations: 31/1, C8, Ri18, Ri20, Ri21, Ri29, Ri44, Ri46, Rb52, 150/2, 153/1, 158/1, 40/1, 52/1, 53/1, 55/1, 73/1, 88/2, 191/1, 200/1, 200/2 205/2, 207/1, D5.
Collection depth: 25—79 m.

Nucula sulcata (Bronn, 1831) (Fig. 5)

Stations: 25/2, GC9, GrC10, C9, RA3, Ri38, Ter9, Ter19, Rb52, 139/1, 153/1, 199/1, 180/1, 181/1, 201/2, 202/3, 203/1, 205/2, V9/1, VV3, VV17.
Collection depth: 25—101 m.
Remark: Specimens were abundant on silty bottom in the deeper island zones, where the investigations were carried out by grabs, dredges and trawls.

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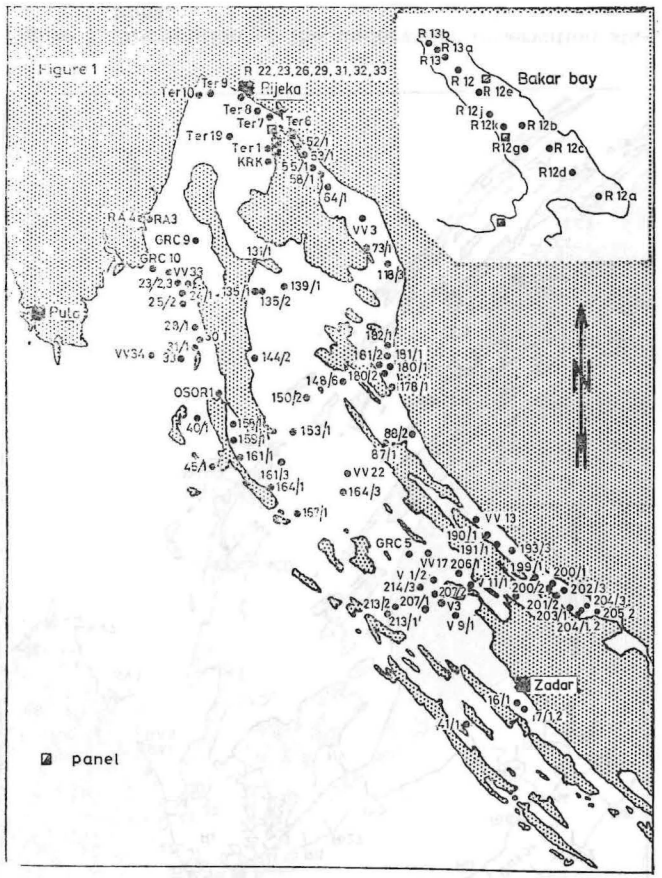

Figure 1. Distribution of the stations sampled by grab and the exposure site of fouling panels.

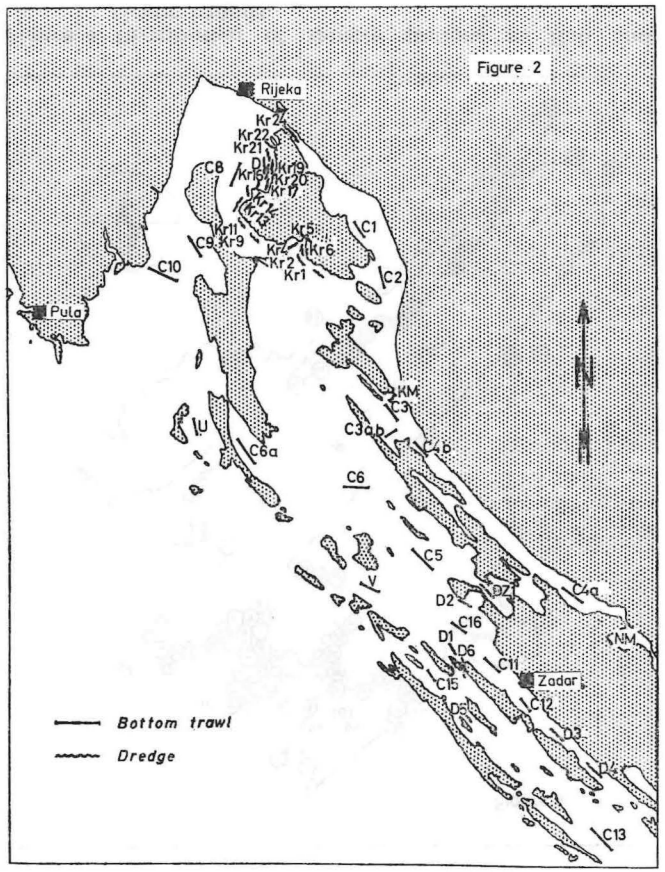

Figure 2. Distribution of the stations sampled by bottom trawl and dredge.

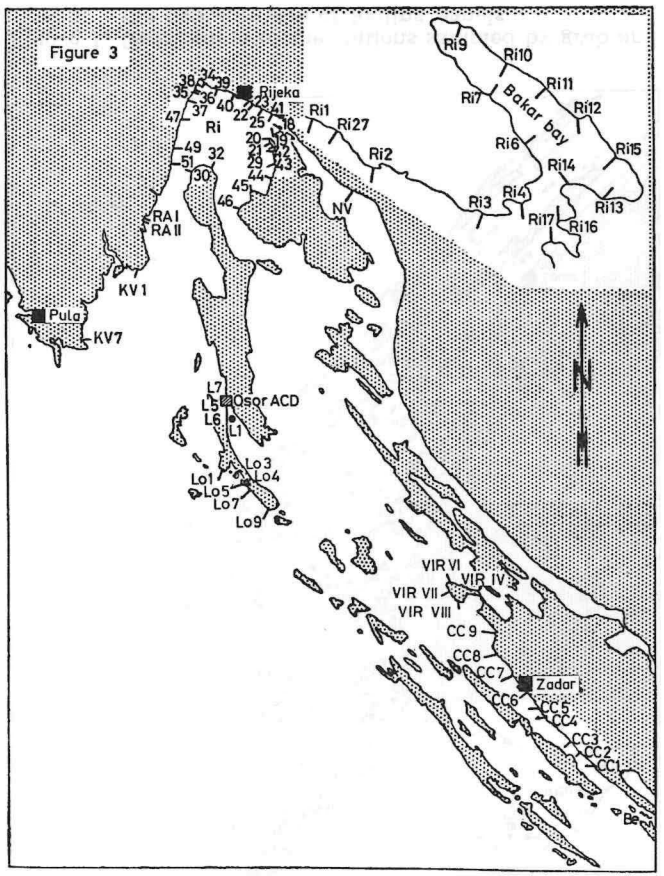

Figure 3. Distribution of the underwater observation stations.

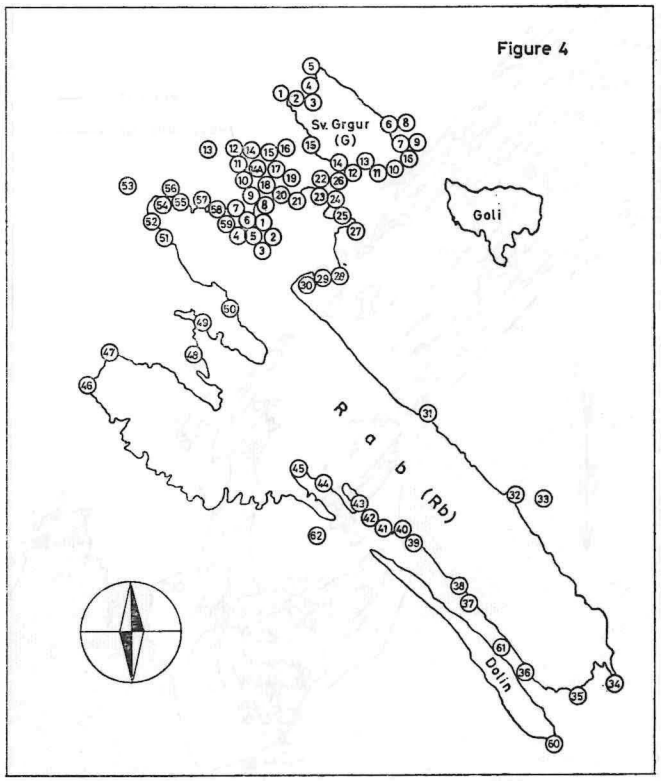

Figure 4. Distribution of sample stations at Rab and Grgur Islands.

Nucula turgida nitidosa (Winckworth, 1930) (Fig. 5)

Stations: D, RA3, R12, R12b, R12c, R12d, R12e, R12g, R12k, R13, Ri19, Ri46, 161/3, V12/1.
Collection depth: 20—68 m.
Remark: Specially were abundant in the central part of Bakar Bay where terrigenous mud is spreaed.

NUCULANIDAE H. and A. Adams, 1858

Nuculana fragilis (Chemnitz, 1784) (Fig. 5)

Stations: 28/1, Ter9, Ter10, R26, Ri18, Rb52, 135/1, 55/1, 64/1, 193/3, 199/1, 204/3, 206/1, 17/2, D5.
Collection depth: 25—65 m.
Remark: Frequent in Velebit Kanal.

Nuculana pella (Linnaeus, 1758) (Fig. 5)

Station: 58/1.
Collection depth: 63 m.

SOLEMYIDAE Gray, 1840

Solemya togata (Poli, 1795) (Fig. 6)

Stations: R23, Rb1, Rb9.
Collection depth: 1—39 m.

ARCIDAE Bronn, 1824

Arca noae (Linnaeus, 1758) (Fig. 6)

Stations: Ri21, Ri29, Ri44, Ri46, Rb18, Rb19, OsorA, Lo1, D2, DZ1, CC1, CC2, CC3, CC4, CC6, CC8, CC9, D3, C12, Be.

Collection depth: 1,5—33 m.

Remark: *Arca noae* occurs on hard bottoms and in the biocoenosis of photophilic algae of our coastal zones. Divers often observed them in meadows of *Posidonia* and *Cymodocea*. The specimens are often attached by their green bysus-plate either on stones or to rhyzomes of *Posidonia* (Zavodnik, pers. comm.). In Zadar kanal local people used to fish this edible bivalve especially before their catastrophic mortality in 1949/1950, when almost all populations along the Adriatic coast were destroyed. Recent observations on the west coast of Istra peninsula indicates that their populations are recovering (H r s - B r e n k o, 1979).

Tetrarca tetragona (Poli, 1795) (Fig. 6)

Station: Rb34.

Collection depth: 22 m.

Remark: Several living specimens were found in one amphora which small part was exposed out of the sand during legal investigations of amphora's locations. Emty shells of this species were often sampled by grabs at various places of the Island zone.

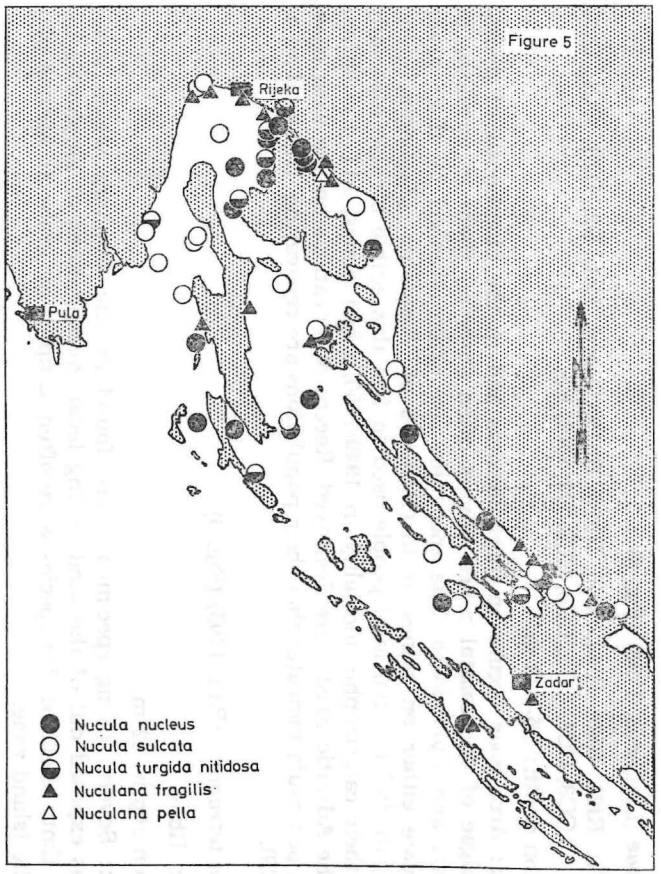

Figure 5. Distribution of bivalvae species.

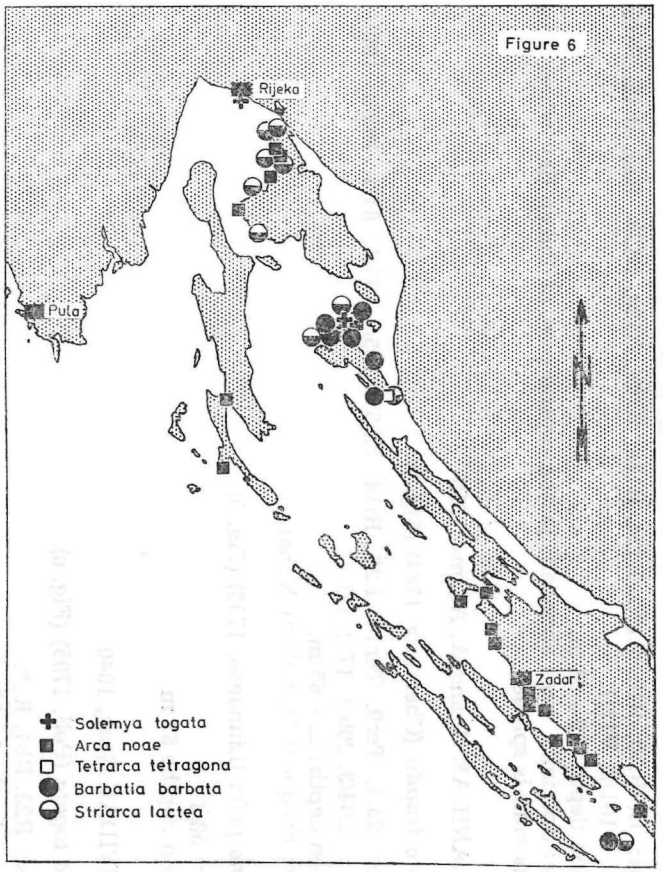

Figure 6. Distribution of bivalvae species.

Barbatia barbata (Linnaeus, 1758) (Fig. 6)

Stations: Rb4, Rb17, Rb19, Rb22, Rb28, Rb32, Rb35, Rb51, Rb52, Rb55, Rb59, G6, G7, C13.
Collection depth: 1,5—3 m (tide), 87 m (trawl).

Striarca lactea (Linnaeus, 1767) (Fig. 6).

Stations: Krk, Kr9, Kr14, Kr20, Ri18, Ri21, Ri29, Rb17, Rb34, Rb51, Rb55, C13,
Collection depth: 1—87 m.
Remark: This species was found on agla *Vidalia volubilis,* and sea grass *Posidonia oceanica.*

GLYCYMERIDAE Newton, 1922

Glycymeris glycymeris (Linnaeus, 1758) (Fig. 7)

Station: 45/1.
Collection depth: 40 m.

Glycymeris pilosa (Linnaeus, 1767) (Fig. 7)

Stations: Rb13, Rb28, G9, D3.
Collection depth: 15—25 m.

Glycymeris bimaculata (Poli, 1795) (Fig. 7)

Station: Rb61.
Collection depth: sample from 23 to 25 m.
Remark: This species was found in gravel which is used as building material. An uncontroled exploitation of this gravel could decimate this bivalve population.

Glycymeris violacescens (Lamarck, 1819) (Fig. 7)

Station: Rb1.
Collection depth: 2 m.
Remark: juvenile.

MYTILIDAE, Rafinesque, 1815

Modiolus barbatus (Linnaeus, 1758) (Fig. 7)

Stations: Ri44, Ri45, Ri46, Kr2, Kr9, Rb17, Rb19, Rb32, Rb34, Rb35, Rb55, Rb57, DZ1, D3, 41/1, Be.
Collection depth: 3—65 m.

Modiolus adriaticus, (Lamarck, 1819) (Fig. 7)

Stations: Ter6, Ri46, Kr22, Kr24, Rb55, DZ1.
Collection depth: 2—50 m.

Mytilaster minimus (Poli, 1795) (Fig. 7)

Stations: KV1, RAI, RAII, Ri1, Ri14, Ri34, Ri35, Ri37, Ri38, Ri39, Ri41, Ri18, Ri19, Ri20, Ri21, Ri29, Ri42, Ri43, Ri44, Ri45, Ri46, Rb55, L1, L5, L6, L7, OsorACD.

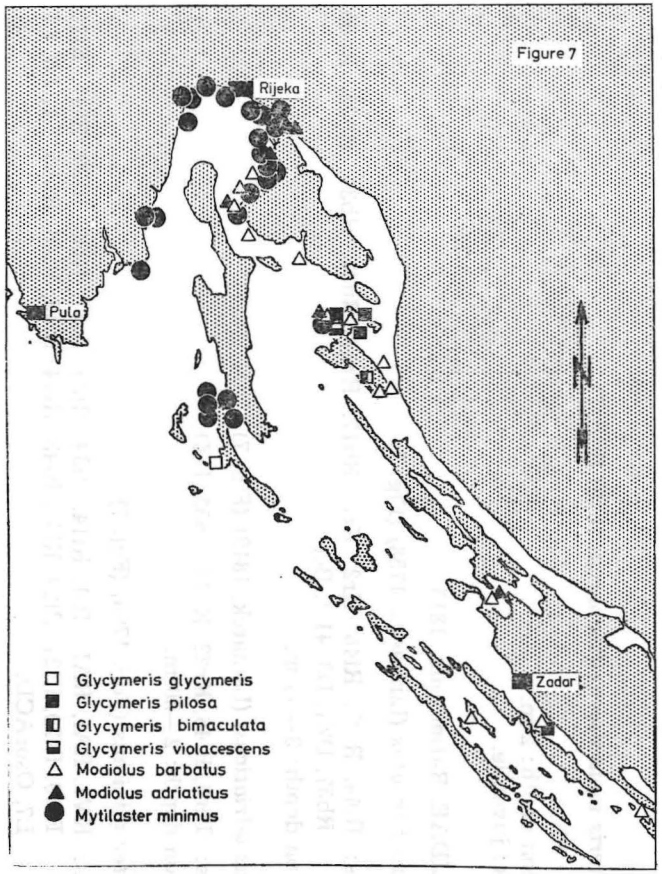

Figure 7. Distribution of bivalvae species.

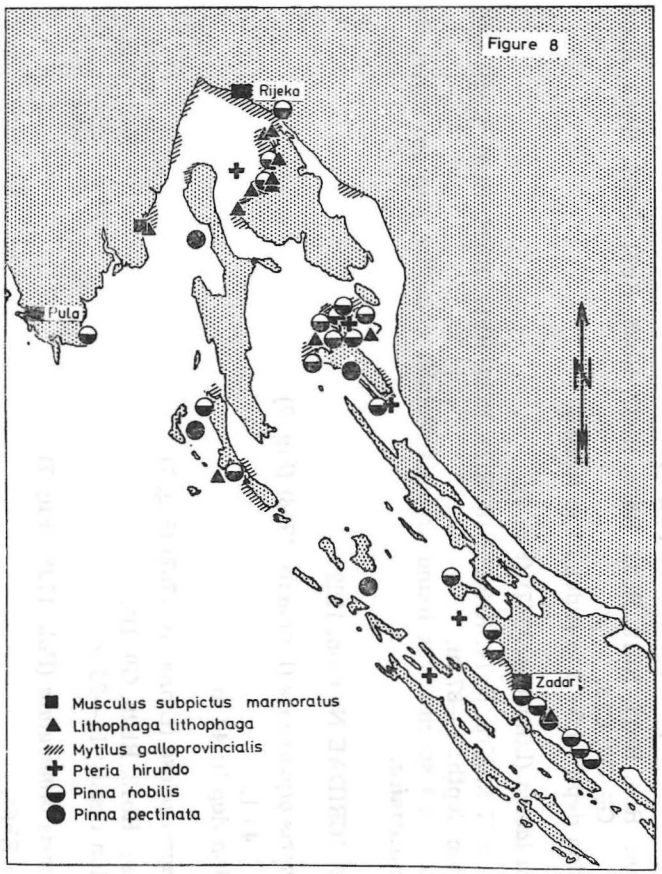

Figure 8. Distribution of bivalvae species.

Collection: depth: tidal zone.
Remark: This species is very frequently found in the holes of the large mussel clumps and in crevices of rocks, especially in exposed localities.

Musculus subpictus marmoratus (Forbes, 1838) (Fig. 8)

Station: RAI.
Collection depth: 10 cm.

Lithophaga lithophaga (Linnaeus, 1758) (Fig. 8).

Stations: RAII, Ri19, Ri20, Ri21, Ri29, Ri43, Ri44, Ri45, Ri46, Rb51, Rb52, Rb54, Grgur Island, Lo1, CC4.
Collection depth: to 2 m.
Remark: The species is wide-spread on limestone rocky shores, and populations at some place are seriously devasted by overfishing by domestic people and tourists. Local authorities prohibite the collection of this species from decimated zones in order to allow *Lihophaga* populations to recover.

Mytilus galloprovincialis (Lamarck, 1819) (Fig. 8)

Stations: RAI, RAII, Ri1, Ri2, Ri4, Ri9, Ri11, Ri12, Ri13, Ri14, Ri16, Ri17, Ri22, Ri23, Ri25, Ri27, Ri29, Ri30, Ri34, Ri35, Ri36, Ri37, Ri38, Ri39, Ri40, Ri41, Ri49, panel (Bakar Bay), Ri18, Ri19, Ri20, Ri21, Ri29, Ri44, Ri46, NV, Rb32, Rb35, Rb52, Rb59, G6, G7, Lo4, Lo5, Lo7, Lo9, L7, CC6, CC7, C11.
Collection depth: tidal zone.

Remark: Usually found near marine fresh water springs where mussel populations extremely abundant. Almost 100% of the bottom is covered by mussels in some areas investigated, such as Crni Vrh in Bakar Bay (Zavodnik et al., 1978).

PTERIIDAE Broderip, 1839

Pteria hirundo (Linnaeus, 1758) (Fig. 8)

Stations: C8, Rb15, KM, C15, C16.
Collection depth: 28—101 m.
Remark: Found on cnidaria *Lytocarpia myriophyllum* and *Antipathes* sp.

PINNIDAE Leach, 1819

Pinna nobilis Linnaeus, 1758 (Fig. 8)

Stations: KV7, Ri7, Ri29, Ri43, Ri44, Rb4, Rb6, Rb9, Rb11, Rb14, Rb15, Rb24, Rb26, Rb28, Rb46, Rb47, Rb48, Rb54, Rb57, Rb58, Rb60, G3, G4, G9, G14, Lo3, L5, Vir VI, CC1, CC2, CC3, CC4, CC5, CC6, CC8, CC9.
Collection depth: 2—25 m.
Remark: This species was previously abuntant along the Adriatic coast, but, unfortunately, because of heavy devastations by divers, especially tourists, *P. nobilis* is now a seriously decimated species. Specimens larger than 1 m in length are almost impossible to find round Rab Island (Legac, 1974). The

findings of a large number of juvenile specimens in Grgur Bay (Grgur Island) and along the Zadar Kanal is encouraging since it indicates that natural recruitment of this species is occuring in the Adriatic. The Croatia Republic Fishery Law prohibits taking this protected species from the sea. The specimens of *P. nobilis* from Zadar Kanal were not so intensive attacked by fouling animals as earlier observed in Rovinj area (Zavodnik, 1967, and pers. communication).

Pinna pectinata (Linnaeus, 1767) (Fig. 8)

Stations: C9, Rb62, U, V.
Collection depth: 47—62 m.

AMUSIIDAE Ridewood, 1963

Palliolum hyalinum (Poli, 1795) (Fig. 9)

Station: D6.
Collection depth: 8 m.

PECTINIDAE Rafinesque, 1815

Peplum clavatum (Poli, 1795) (Fig. 9)

Stations: Rb27, Rb53.
Collection depth: 10—14 m.
Remark: Only empty shells. See remark of *Aequipecten opercularis.*

Aequipecten opercularis (Linnaeus, 1758) (Fig. 9)

Stations: C10, Ri4, Ri9, Ri19, panel (Krk Island, Ri19), Rb34, Rb52, 87/1, C16, C11.
Collection depth: 45—62 m.
Remark: Large numbers of empty shells of *Aequipecten opercularis* and *Peplum clavatum* were found at several diving sites on Rab Island. Due to their unbroken and fresh coloured empty shells, additional living populations had to be close to the diving places.

Chlamys varia (Linnaeus, 1758) (Fig. 9)

Stations: Ri46, Kr4, Kr9, Rb2, Rb4, Rb15, Rb17, Rb19, Rb24, Rb28, Rb34, Rb51, Rb52, Rb55, G6, G10, C4b, C16, D3, D4, C15.
Collection depth: 0,5—74 m.

Chlamys multistriata (Poli, 1795) (Fig. 9)

Stations: Rb17, Rb19, Rb22, Rb34, Rb52, Rb53, Rb56, G10, D1, C15.
Collection depth: 1—65 m.
Remark: Species was found on *Cellaria* sp. (C15).

Manupecten pesfelis (Linnaeus, 1758) (Fig. 9)

Stations: Rb19, Rb53, Rb55, G8.
Collection depth: 2—14 m.

Proteopecten proteus (Solander, 1817) (Fig. 9)

Stations: NM, G16.
Collection depth: 5—25 m.
Remark: Frequently seen at the Zadar and Rijeka fish markets.

Proteopecten griseus (Lamarck, 1819) (Fig. 9)

Stations: Kr2, Rb55, Rb58.
Collection depth: 2—20 m.
Remark: Specimen was found on *Cymodocea nodosa* (Krk Island).

Flexopecten flexuosus (Poli, 1795) (Fig. 9)

Station: D3.
Collection dipth: 15 m.

Pecten jacobaeus (Linnaeus, 1758) (Fig. 9)

Stations: RA II, Ri4, Ri19, Ri44, Rb13, Rb15, Rb16, Rb27, Rb33, Rb53, Rb56, C16.
Collection depth: 12—50 m.

SPONDYLIDAE Gray, 1826

Spondylus gaederopus Linnaeus, 1758 (Fig. 9)

Stations: Ri43, Rb19, Rb32, Rb50, Lo1, Osor C, Osor D, D3.
Collection depth: 2—15 m.

LIMIDAE Rafinesque, 1815

Lima lima (Linnaeus, 1758) (Fig. 10)

Stations: Ri44, Ri46, Rb12, Rb15, Rb17, Rb19, Rb31, Rb32, Rb41, Rb55, G8, G10, C15.
Collection depth: 1—2 and 65 m (trawl).

Mantellum inflatum (Chemnitz, 1784) (Fig. 10)

Stations: Ri18, Ri19, Ri45, Rb55, DZ1, D3, C12, C15.
Collection depth: 1—65 m.

Mantellum hians (Gmelin, 1790) (Fig. 10)

Stations: Ter6, C8, Rb13, Rb17, Rb54, Rb55, 135/2, D3, C12.
Collection depth: 1—68 m.

ANOMIIDAE Rafinesque, 1815

Monia patelliformis (Linnaeus, 1761) (Fig. 10)

Stations: C9, C10, panel (Bakar Bay), Kr13, Kr21, C6, C1, C16.
Collection depth: 7—90 m.
Remark: The species was often found as a fouling element on empty shells of *Glossus humanus, Acanthocardia echinata* and *Calista chione,* on several live *Nephrops norvegicus,* and on one plastic bag.

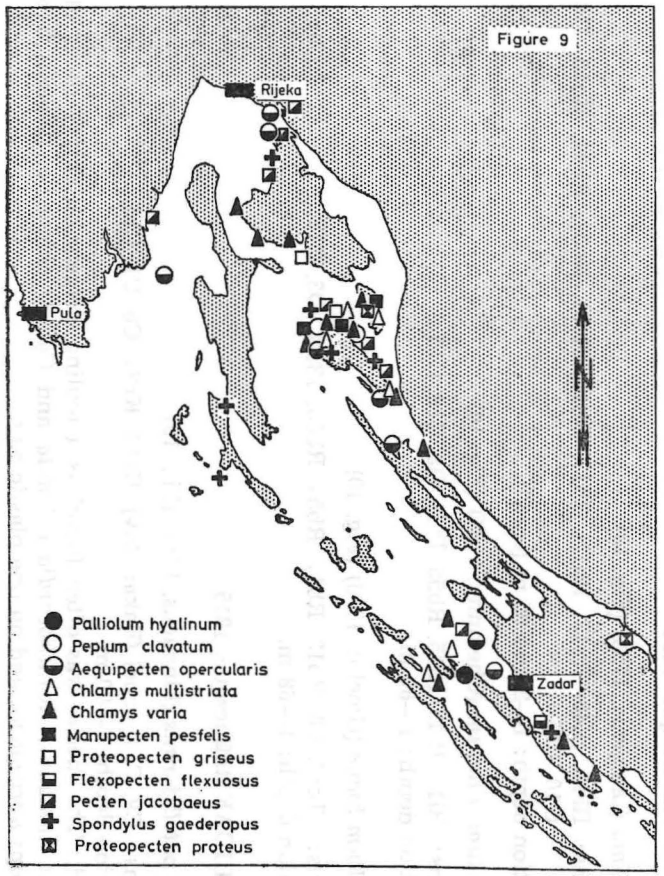

Figure 9. Distribution of bivalvae species.

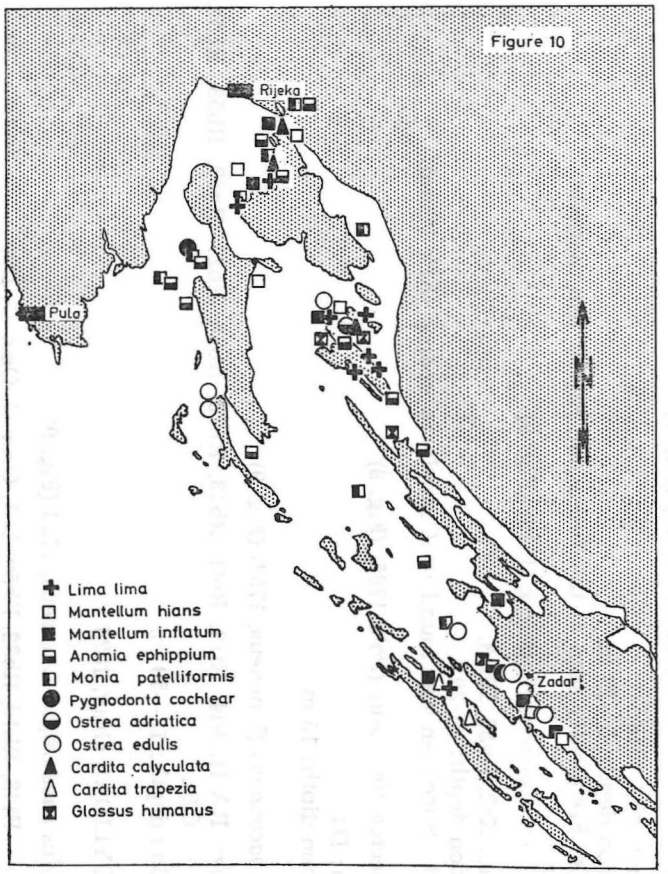

Figure 10. Distribution of bivalvae species.

Anomia ephippium (Linnaeus, 1758) (Fig. 10)

Stations: C9, C10, 24/1, panel (Bakar Bay), Ri20, Ri21, Ri44, Rb2, Rb9, Rb34, C6a, C4b, C5, C11.
Collection depth: 1—74 m.

Remark: This species was observed on *Gourmia vulgata* (Lopar — Rab), on empty bivalve shells of *Glossus humanus, Pina pectinata* and *Acanthocardia echinata* even up to 35 specimens (Vir Sea). About 45 specimens were found on algae *Codium bursa* (Zadar Kanal).

OSTREIDAE Rafinesque, 1815

Pygnodonta cochlear (Poli, 1795) (Fig. 10)

Stations: C9, C11.
Collection depth: 45 and 52 m.

Ostrea edulis Linnaeus, 1758 (Fig. 10)

Stations: Rb9, Rb18, L6, L7, C16, CC4, CC6, CC7.
Collection depth: 2—50 m.
Remark: 10 specimens were attached to plastic bag (Vir Sea, C16).

Ostrea adriatica Lamarck, 1819 (Fig. 10)

Stations: Rb2, Rb8, Rb9, Rb18.
Collection depth: 1—2 m.

Remark: Specimens normally are settled on the snail *Gourmia vulgata,* frequently occuring with small Paguridae. The specimens mentioned as *Ostrea* sp. (L e g a c, 1974) were later determined as to this species.

CARDITIDAE Menke, 1828.

Cardita calyculata (Linnaeus, 1758) (Fig. 10)

Stations: Ri18, Krk, Rb17, Rb19, Rb22, Rb28.
Collection depth: 0,5—17 m.

Cardita trapezia (Linnaeus, 1767) (Fig. 10)

Stations: D5, C15.
Collection depth: both at 65 m.

GLOSSIDAE Gray, 1847

Glossus humanus (Linnaeus, 1758) (Fig. 10)

Stations: Rb28, Rb52, C3a, C3b, C11.
Collection depth: 24 m (Rab Island) and 45—102 m (trawls).

TRAPEZIIDAE Lamy, 1920

Coralliophaga lithophagella (Lamarck, 1819) (Fig. 11)

Station: Rb4.
Collection depth: 1,5 m.

THYASIRIDAE Dall 1900

Thyasira flexuosa (Montagu, 1803) (Fig. 11)

Stations: Ter9, Ter10, Ter19, R22, R23, R29, Rb29, Rb52, 193/3, 202/3, 207/1, 207/2, VV3, VV17, VV33.
Collection depth: 10—75 m.

LUCINIDAE Fleming, 1828

Myrtea spinifera (Montagu, 1803) (Fig. 11)

Stations: D, Ter6, Ter8, Ter10, R22, R23, R26, R12j, R13, R13a, R32, R33. Ri21, Ri29, 161/3.
Collection depth: 28—68 m.

Lucinella divaricata (Linnaeus, 1758) (Fig. 11)

Stations: RA4, Ri18, Ri20.
Collection depth: 17—20 m.

Loripes lacteus (Linnaeus, 1758) (Fig. 11)

Stations: R32, Krk, Rb2, Rb5, Rb29.
Collection depth: 2—34 m.

Loripinus fragilis (Philippi, 1836) (Fig. 11)

Stations: RA4, R22, R23.
Collection depth: 28 and 34 m.

Ctena decussata (O. G. Costa, 1830) (Fig. 11)

Stations: Rb1, Rb6, Rb9, Rb29.
Collection depth: 1—5 m.

LEPTONIDAE Gray, 1847

Lasaea adansoni (Gmelin, 1790) (Fig. 11)

Station: Rb19.
Collection depth: 2 m (on algae).

CHAMIDAE Bronn, 1824

Chama gryphoides Linnaeus, 1758 (Fig. 11)

Stations: Ri18, Ri20, Ri21, Ri29, Ri44, Rb22, Rb28, Rb34, Rb51, Rb52, D3.
Collection depth: 0,5—25 m.

Pseudochama gryphina (Lamarck, 1819) (Fig. 11)

Stations: Ri18, Ri20, Ri21, Ri29, Ri44, Rb9, Rb17, Rb19, Rb22, G10, D3.
Collection depth: 2—15 m.

CARDIIDAE Schweigger, 1820

Laevicardium oblongum (Chemnitz, 1782) (Fig. 12)

Stations: Ri21, Kr1, Kr11, Rb5, Rb12, G12.
Collection depth: 4—34 m.
Remark: Juvenile *Lavicardium* were found on *Cymodocea nodosa* (Krk Island).

Parvicardium exiguum (Gmelin, 1791) (Fig. 12)

Station: Rb19.
Colection depth: 9 m.

Parvicardium minimum (Philippi, 1836) (Fig. 12)

Stations: Rb11, Rb18, Rb23, Rb29.
Collection depth: 2—8 m.

Pervicardium ovale (Sowerby, 1841) (Fig 12)

Stations: panel (Krk Island, Ri29), Rb18.
Collection depth: 0,10—3 m.

Cerastoderma edule (Linnaeus, 1767) (Fig. 12)

Staions: Rb2, Rb3, Rb8, Rb18, Rb25, Rb45.
Collection depth: 0,3—1,5 m.

Papillicardium papillosum (Poli, 1791) (Fig. 12)

Stations: Krk, Ri46, Kr1, Kr2, Kr17, Kr19, Rb18, Rb23, Rb29, 148/6, 87/1, 204/3, D4.
Collection depth: 2—3 m (Rab Island) and 8—94 m.

Rudicardium tuberculatum Linnaeus, 1758 (Fig. 12)

Stations: Ri18, Ri21, Ri29, Kr13, Kr17, Kr19, Rb1, Rb2, Rb3, Rb6, Rb8, Rb9, Rb10, Rb18, Rb20, Rb21, Rb23, Rb25, Rb30, Rb41, Rb42, Rb48, Rb49, G3, G11, G15.
Collection depth: 0,5—14 m.

Acanthocardia aculeata (Linnaeus, 1767) (Fig. 12)

Stations: RA I, Rb7, Rb9, Rb11, Rb12, Rb22, Rb27.
Collection depth: 4—14 m.

Acanthocardia spinosa (Solander, 1786) (Fig. 12)

Statations: RA II, Rb11, G1, G2, G5.
Collection depth: 9—22 m.

Acanthocardia echinata (Linnaeus, 1758) (Fig. 12)

Stations: Ri18, Rb51, 167/1, C6, U, C3a, C3b, V11/1.
Collection depth: 21—102 m.

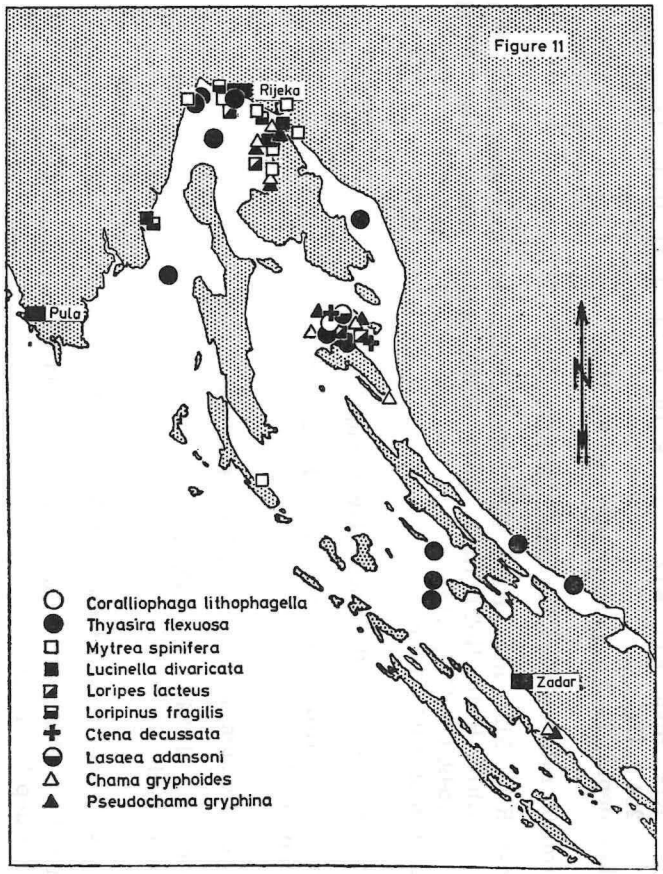

Figure 11. Distribution of bivalvae species.

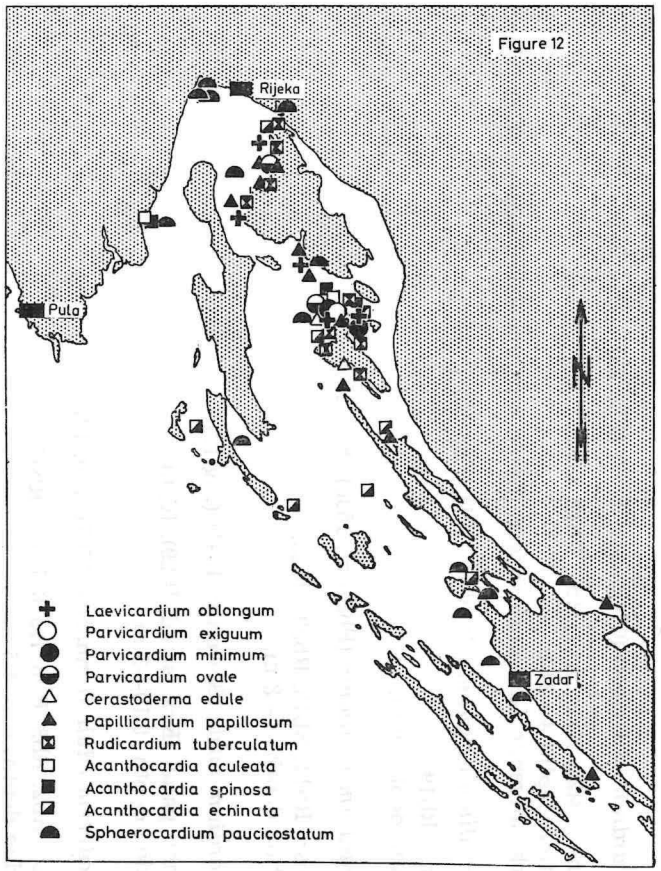

Figure 12. Distribution of bivalvae species.

Sphaerocardium paucicostatum (Sowerby, 1839) (Fig. 12)

Stations: Ra-4, Ri6, Ri39, Ter9, Ter10, R12j, C8, Kr1, Rb5, C6a, C4a, V11/1, C16, DZ1, C11, C12.
Collection depth: 20—45 m.

VENERIDAE Rafinesque, 1815

Gouldia minima (Montagu, 1803) (Fig. 13)

Stations: Ri18, Ri21, Ri46, Kr1, Kr5, Kr9, Kr13, Kr14, Kr16, Kr20, Kr22, Rb34, Rb52.
Collection depth: 4—47 m.

Callista chione (Linnaeus, 1758) (Fig. 13)

Stations: Ri19, Kr1, Rb1, Rb2, Rb3, Rb8, Rb9, Rb10, Rb11, Rb18, Rb20, Rb21, Rb23, Rb25, Rb30, Rb41, Rb48, Rb49, G2, G11, G13.
Remark: The species is the most abundant in sandy shallow water areas of Rab Island.
Collection depth: 0,5—21 m.

Pitar rude (Poli, 1795) (Fig. 13)

Stations: Ri18, Ri20, Ri21, R23, Ri29, Ri44, Ri45, Ri46, R13b, D, Krk, Kr1, Kr2, Rb5, Rb17, Rb29, Rb34, 87/1, 213/1, D5, D3, VV17.
Collection depth: 2,5—68 m.

Dosinia lupinus (Poli, 1791) (Fig. 13)

Stations: Rb18, Rb29.
Collection depth: 2—4 m.

Venus verrucosa Linnaeus, 1758 (Fig. 13)

Stations: Ri32, Rb1, Rb3, Rb10, Rb11, Rb18, Rb38, Rb39, Rb40, Rb42, G2, G3, 87/1, 45/1, 213/1, DZ1, C12.
Collection depth: 0,5—40 m.
Remark: Very frequent at Rab Island. Marketable value.

Chione ovata (Pennant, 1777) (Fig. 13)

Stations: GRC10, Ter7, Ri18, Ri20, Ri21, Rb13, Rb29, 131/1, 180/1, 181/1, 182/1, 213/2, V1/2, D5.
Collection depth: 4—105 m.

Clausinella faciata (Da Costa, 1778) (Fig. 14)

Stations: Ri18, Ri29, Kr1, Rb34, 87/1, D3, D5.
Collection depth: 15—50 m.

Chamelea gallina (Linnaeus, 1758) (Fig. 14)

Stations: Ri18, Ri20, Ri29, Kr17, Rb1, Rb2, Rb3, Rb9, Rb10, Rb18, Rb21, Rb23, Rb25, Rb30, Rb42, Rb43.
Collection depth: 0,5—3 m.

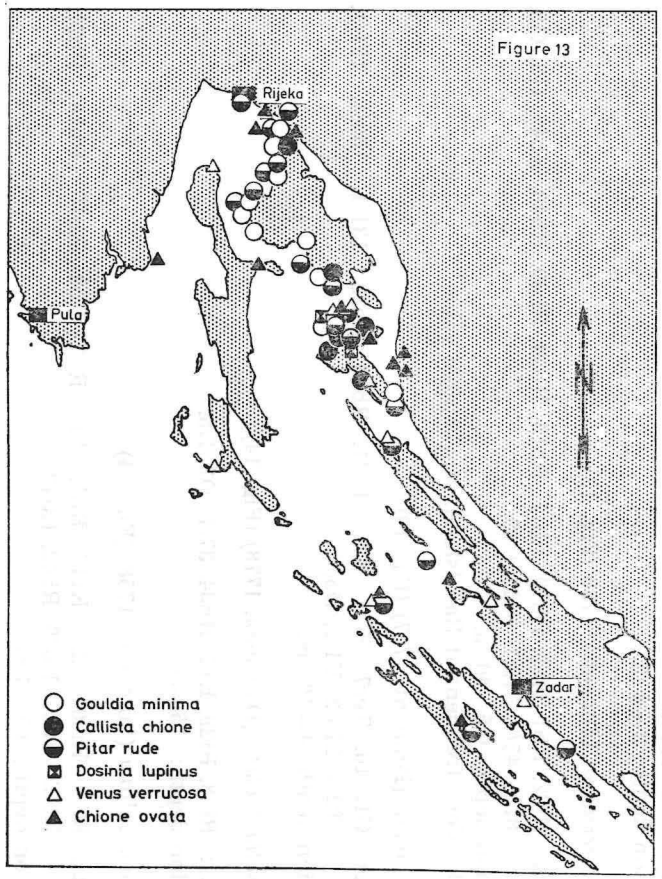

Figure 13. Distribution of bivalvae species.

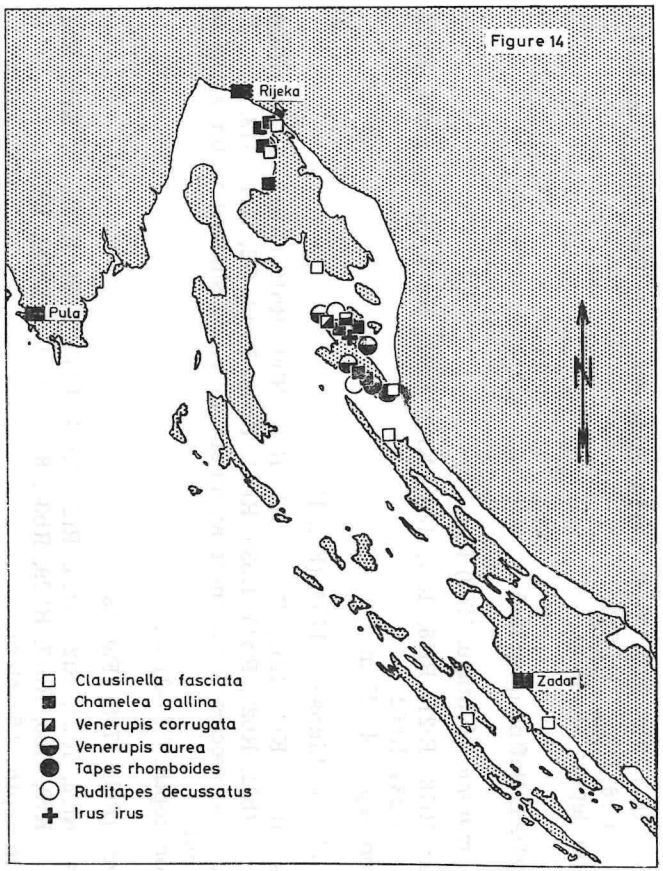

Figure 14. Distribution of bivalvae species.

Venerupis corrugata (Gmelin, ?) (Fig. 14)

Stations: Rb1, Rb6, Rb9, Rb17, Rb39, Rb40.
Collection depth: 0,5—1,5 m.

Venerupis aurea (Gmelin, ?) (Fig. 14)

Stations: Rb1, Rb3, Rb6, Rb9, Rb10, Rb17, Rb18, Rb29, Rb38, Rb39, Rb40, Rb42, Rb43.
Collection depth: 0,5—1,5 m.

Tapes rhomboides (Pennant, ?) (Fig. 14)

Station: Rb34.
Collection depth: 22 m.

Ruditapes decussatus (Linnaeus, ?) (Fig. 14)

Stations: Rb3, Rb6, Rb9, Rb10, Rb17, Rb38, Rb39, Rb40.
Collection depth: 0,5—1,5 m.

Irus irus (Linnaeus, ?) (Fig. 14)

Stations: Rb6, Rb17, Rb19, Rb22.
Collection depth: 0,5—1,5 m.

PETRICOLIDAE D'Orbigny, 1835

Mysia undata (Pennant, 1777) (Fig. 15)

Stations: Ri19, Rb18, Rb23, Rb29.
Collection depth: 2—10 m.

Petricola lithophaga (Retzius, 1786) (Fig. 15)

Stations: Ri20, Rb4, Rb17, Rb55.
Collection depth: 1—1,5 m.

DONACIDAE Fleming, 1828

Donax venustus Poli, 1795 (Fig. 15)

Stations: Rb3, Rb8, Rb9, Rb10, Rb18, Rb21, Rb23, Rb30.
Collection depth: 0,5—4 m.

Remark: The species is very frequent in sandy bottoms round the Lopar peninsula (Rab Island). The other species, *D. trunculus,* was observed, but rarely, in Kvarner and Dalmatia at the and of last century (S t o s s i c h, M., 1880). Now, only occasionally are drifted empty shells found on the sandy beaches of Rab Island (L e g a c, 1974).

SANGUINOLARIIDAE Abbott, 1954

Gari fervensis (Gmelin, 1791) (Fig. 15)

Stationes: Rb18, Rb29.
Collection depth: 2—4 m.

Psammocola depressa (Pennant, 1777) (Fig. 15)

Stations: Rb1, Rb3, Rb9, Rb18.
Collection depth: 1,5—2 m.

Psammocola costulata (Turton, 1819) (Fig. 15)

Station: Ri29.
Collection depth: 11 m.

Azorinus chamasolen (Da Costa, 1778) (Fig. 15)

Stations: 23/2, Ri18, Rb1, Rb6, Rb18, 52/1, 73/1, 118/3, GRC5.
Collection depth: 1,5—72 m.

Solecurtus strigillatus (Linnaeus, 1758) (Fig. 15)

Stations: NV, Rb1, Rb2, Rb3, Rb7, Rb8, Rb9, Rb10, Rb11, Rb12, Rb18, Rb20, Rb21, Rb23, Rb25, Rb30, Rb37, Rb41, G2.
Collection depth: 1—35 m.

TELLINIDAE Blainville, 1824

Arcopagia balaustina (Linnaeus, 1758) (Fig. 16)

Stations: Ri18, Ri29, D, Kr1, Kr2, Kr9, Kr11, Kr13, Rb17, Rb18, Rb23, D4.
Collection depth: 1—68 m.

Gastrana fragilis (Linnaeus, 1758) (Fig. 16)

Stations: Rb2, Rb5.
Collection depth: 1—2 m.

Quadrans serratus (Brocchi, 1814) (Fig. 16)

Stations: R32, R33, Rb34, Rb51, V11/1.
Collection depth: 23—54 m.

Moerella donacina (Linnaeus, 1758) (Fig. 16)

Stations: Rb29, Rb30.
Collection depth: 2—4 m.

Angulus tenuis (Da Costa, 1778) (Fig. 16)

Stations: Rb3, Rb9, Rb18, Rb29.
Collection depth: 2—4 m.

Angulus incarnatus (Linnaeus, 1758) (Fig. 16)

Stations: Rb3, Rb9, Rb18.
Collection depth: 1,5—4 m.

Angulus planatus (Linnaeus, 1758) (Fig. 16)

Stations: Rb2, Rb3, Rb8, Rb9, Rb18, Rb20, Rb23.
Collection depth: 2—4 m.

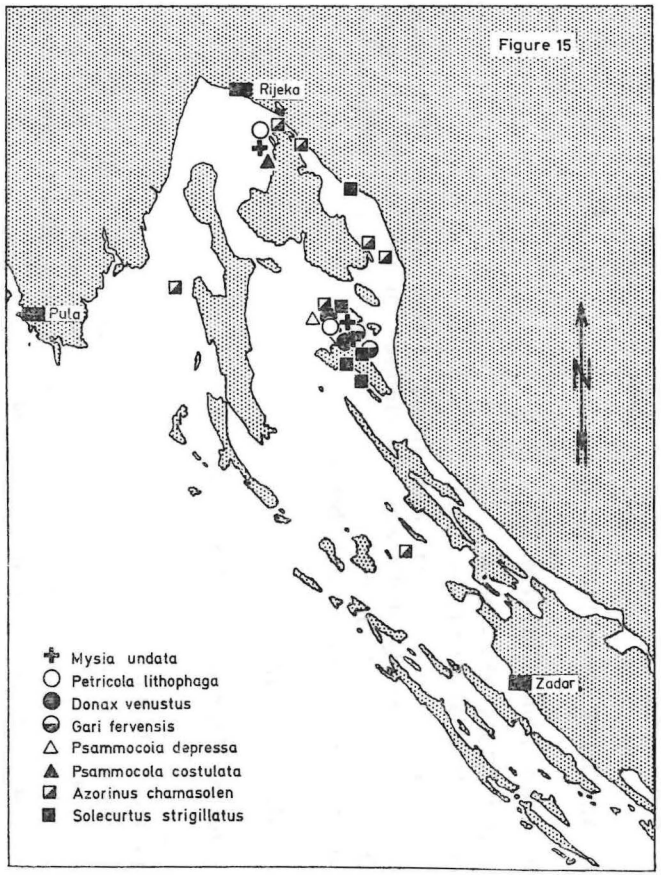

Figure 15. Distribution of bivalvae species.

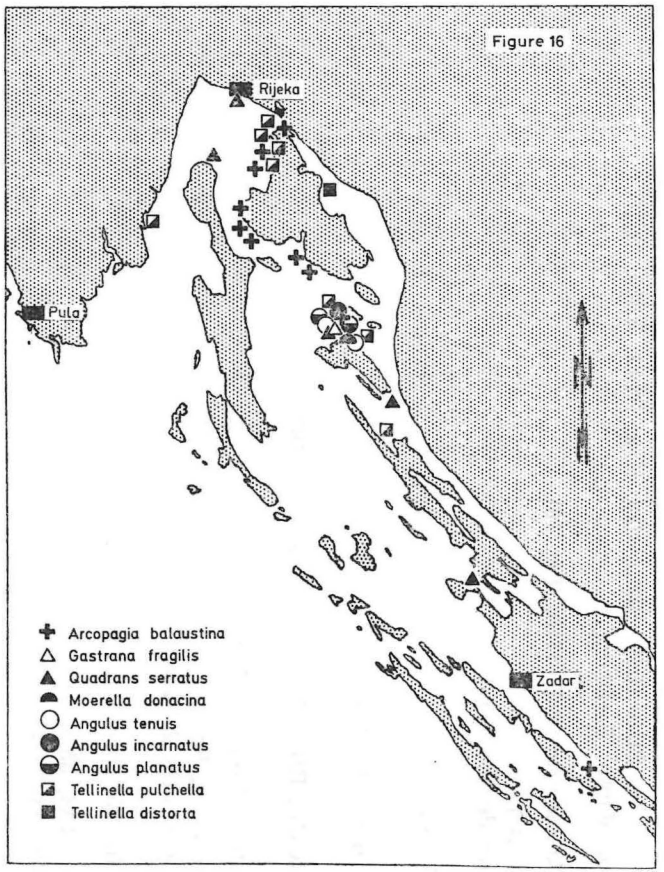

Figure 16. Distribution of bivalvae species.

Tellinella pulchella (Lamarck, 1818) (Fig. 16)

Stations: RA4, Ri18, Ri19, Ri20, Ri29, Krk, Rb12, Rb29, 87/1.
Collection depth: 3—50 m.

Tellinella distorta (Poli, 1795) (Fig. 16)

Station: 64/1.
Collection depth: 39 m.

Tellinella sp. juv.

Station: 204/3.
Collection depth: 28 m.

SCROBICULARIIDAE H. and A. Adams, 1856

Abra tenuis (Montagu, 1803) (Fig. 17)

Stations: Rb29, Rb30.
Collection depth: 2—4 m.

Abra pellucida (Brocchi, 1814) (Fig. 17)

Stations: RA4, 55/1.
Collection depth: 17 and 41 m.

Abra prismatica (Laskey, 1803) (Fig. 17)

Station: 204/3.
Collection depth: 74 m.

MESODESMATIDAE Gray, 1840

Donacilla cornea (Poli, 1791) (Fig. 17)

Stations: Rb17, Rb36, Rb42, Rb54.
Collection depth: tidal zone (0,3—0,5 m).
Remark: The first live specimens were found at Rab Island in 1973, while earlier only drifted empty shells were encountered on the beaches (L e g a c 1974). The species are frequent in large particulate sand and pebbles, but also occurs in fine particulate sandy bottom.

MACTRIDAE Brown, 1824

Mactra corallina (Linnaeus, 1758) (Fig. 17)

Stations: Rb2, Rb23.
Collection depth: 2—4 m.
Remark: Only cut and broken empty shells were found in the sand dredged by ships in several bays of Rab Island. Such uncontroled underwater mining of sand for building material could decimate the existing bivalve populations of *M. corallina* as well as *Glycymeris bimaculata*.

Spisula subtruncata (Da Costa, 1778) (Fig. 17)

Stations: Kr1, Kr22, Rb1, Rb10, Rb18.
Collection depth: 1—34 m.

SOLENIDAE Latreille, 1825

Cultrensis adriaticus Coen, 1933 (Fig. 17)

Stations: 30/1, Ter1, Ter9, Ter 10, R23, Ri39, 135/1, 159/1, 40/1, 55/1, 64/1 190/1, VV17, VV22.
Collection depth: 34—69 m.

Solen marginatus (Pennant, 1777) (Fig. 17)

Stations: Rb1, Rb3, Rb8, Rb10, Rb18, Rb20, Rb21, Rb23, Rb25, Rb30, Rb41, Rb42, Rb43.
Collection depth: 0,5—1,5 m.
Remark: The siphon openings are clearly visible on the surface of the bottom, appearing like an 8 shape.

Ensis ensis (Linnaeus, 1758) (Fig. 17)

Stations: Rb10, Rb18, Rb23.
Collection depth: 0,5—2 m.
Remark: The species is scarser than *Solen marginatus* in Rab Island. Juveniles are numerous.

HIATELLIDAE Winckworth, 1932

Hiatella arctica (Linnaeus, 1767) (Fig. 18)

Stations: 33, R13,R13a, panel (Bakar Bay), Ri18, Ri 20, Ri 29, Ri45, 135/2, C6, Rb12, Rb13, Rb27, Rb56, C11.
Collection depth: 3—90 m.
Remark: The species was found attached by bysus inside holes or rock crevices and on various organisms such as sponge *Ircinia muscarum* and shells of *Pecten jacobaeus.*

Hiatella rugosa (Pennant, 1777) (Fig. 18)

Stations: C9, Kr6, Rb16, Rb19, Rb24, Rb27, Rb28, Rb34, Rb51, Rb53, Rb55.
Collection depth: 2—54 m.

Remark: The species frequently occurs as a fouling element on various organisms such as sponge *Hippospongia communis,* on coral *Cladocora cespitosa,* and on the bivalve shells of *Glossus humanus, Pecten jacobaeus* and *Rudicardium tuberculatum.*

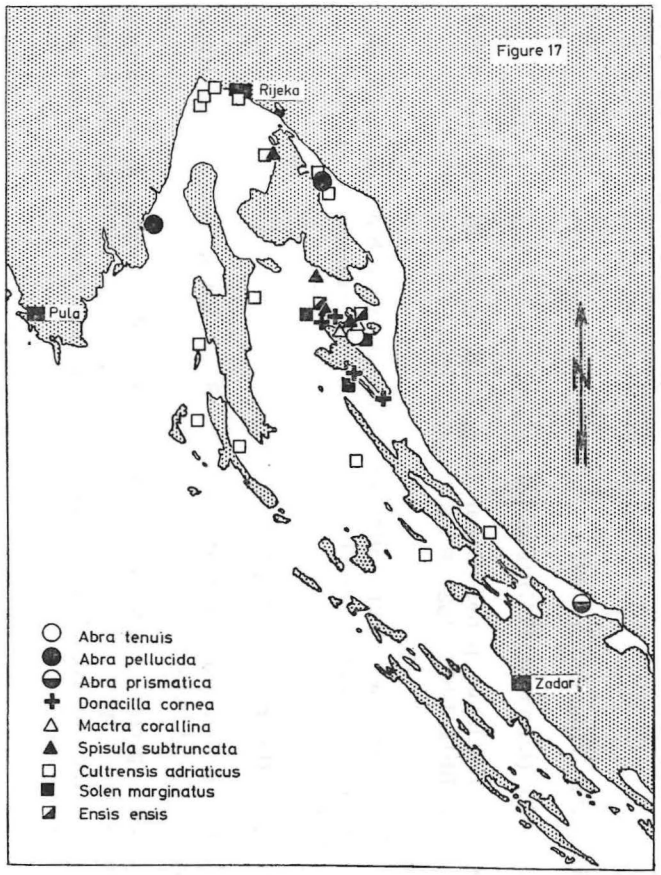

Figure 17. Distribution of bivalvae species.

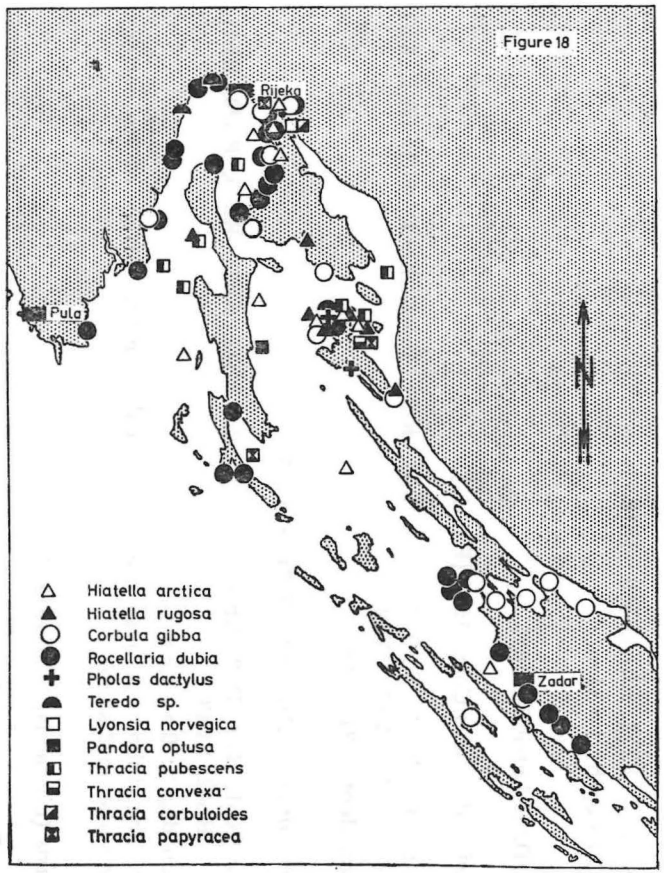

Figure 18. Distribution of bivalvae species.

CORBULIDAE Bronn, 1824

Corbula gibba (Olivi, 1792) (Fig. 18)

Stations: RA3, R22, R23, R31, R12a, R12e, R12j, R12k, R13, R13a, R13b, Kr1, Kr11, Kr14, Kr22, Rb34, Rb52, 200/2, 204/1, 204/2, V11/1, V12/1, DZ1, 17/1, D5.

Collection depth: 7—65 m.

GASTROCHAENIDAE Gray, 1840

Rocellaria dubia (Pennant, 1777) (Fig. 18)

Stations: KV1, KV7, RA I, RA II, Ri2, Ri10, Ri13, Ri15, Ri18, Ri 19, Ri20, Ri21, Ri29, Ri32, Ri36, Ri39, Ri42, Ri44, Ri45, Ri46, Ri49, Ri51, Kr14, Rb4, Rb54, Lo1, Lo3, L1, VirIV, VirVI, VirVII, VirVIII, CC3, CC4, CC5, CC6, CC8.

Collection depth: 1—15 m.

Remark: This abundant species is present on rocky bottoms and isolated stones, even on those which are covered by thin layer (5—10 cm) of sand (Zavodnik, pers. communication).

PHOLADIDAE Rafinesque, 1815

Pholas dactylus Linnaeus, 1758 (Fig. 18)

Stations: Rb6, Rb14A, Rb44.

Collection depth: 0,3—1,5 m.

Remark: The species is present on sandstone and marl rocky bottoms, and also was observed on soft sediments (redsoil — terra rosa) in shallow coastal zone (e. g. Rovinj).

TEREDENIDAE Fleming, 1821

Teredo sp. (Fig. 18)

Stations: Ri36, Ri47, Rb55.

Collection depth: Teredo occures on pieces of wood at all depths.

LYONSIIDAE P. Fischer, 1887

Lyonsia norvegica (Gmelin, 1790) (Fig. 18)

Station: Ter6.

Collection depth: 50 m.

PANDORIDAE Rafinesque, 1815

Pandora obtusa (Leach, 1814) (Fig. 18)

Station: 144/2.

Collection depth: 94 m.

THRACIIDAE E. A. Smith, 1885

Thracia pubescens (Pulteney, 1799) (Fig. 18)

Stations: 23/3, C2, C8, C9, C10, Rb16, C12.
Collection depth: 21—82 m.

Thracia convexa (Wood, 1815) (Fig. 18)

Station: Rb29.
Collection depth: 12 m.

Thracia corbuloides Blainville, 1825 (Fig. 18)

Station: Ter6.
Collection depth: 50 m.

Thracia papyracea (Poli, 1795) (Fig. 18)

Stations: Ri9, Rb29, 161/1.
Collection depth: 12 and 69 m.

DISCUSSION

In investigated areas various biocoenological sampling methods should be used to establish the presence and an abundance of bivalve species in communities being studied. During recent biocoenological investigations only one or two sampling methods were used to collect the bottom organisms from anyone area. For this reason this list of bivalve species is not complete and will be supplemented by future observations.

According to old literature the first check list of bivalve species (Kvarner and Lošinj) was published by Grube (1861, 1864). That list was later extended by several Authors (Lorenz, 1863; Brusina, 1865, 1866, 1898; Stossich, M., 1880 and others). A number of synonyms was found in the older publications which made the comparison between the present and earlier findings difficult. In several cases it was not possible to uncover the current name for several bivalve species noted in the older publications. In addition, in the older publications it is rarely mentioned whether the bivalve species were collected as living specimens or as empty shells. Thus, during recent investigations species were noted, but in a comprehensive check list of bivalve species for the entire Adriatic Sea, Stossich M. (188) cited 159 species for the insular region. No one new bivalve species was discovered among our sampled specimens. On the other hand, a number of species which previously had been cited as »frequent« in the older literature, were not recently found. Thus, according to Stossich. M. (1880), *Dosinia exoleta* was frequent in Kvarner region, but we could not find any live specimens. Likewise, *Proteopecten glaber* was cited as frequent species in Kvarner (Lorenz, 1863), in Zadar region (Brusina, 1866), in Adriatic Sea in general (Stossich M., 1880), and as an important commercial bivalve in Kvarner (Brusina and Matisz, 1900). According to Brusina (1907) *Glycymeris bimaculata* was a frequent bivalve species in the bay near Pag

(Pag Island). The populations of this species could have been decimated, as well as rare *Mactra corallina,* due to intensive mining of sandy bottoms in the bays of Rab Island.

In spite of difficulties in comparing earlier and recent findings, the observations made by Vatova (1942) in Kvarner and Rijeka Bay noted the same distribution of species mentioned about 35 years earlier. This is satisfactory evidence that there have not been major change in seawater environment during the intervenig years. Thus, the presence of bivalve species in existing biocoenosis could be considered as a base line for future changes of bivalve population and their distribution.

Some bivalve species collected during these twenty years of investigations are already cited in several publications (Gamulin-Brida et al., 1971; Legac, 1974; Zavodnik et al., 1978 and others), but these publications did not include the vertical and horizontal distribution of bivalve species collected in the northern and mid-part of the Adriatic Sea.

CONCLUSIONS

One hundred seventeen living bivalve species were collected from the northern and middle part of the Adriatic Sea, between the Istrian Peninsula and Murter Island, together with information on their vertical distribution. A comparison between these collections, and earlier publications, indicate that no new bivalve species were observed, and the check list could be considered a base line for future changes of water environment.

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PRILOG POZNAVANJU RASPROSTRANJENJA ŠKOLJKAŠA (Bivalvia) U OTOČNIM ZONAMA SJEVERNOG I DIJELA SREDNJEG JADRANA

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