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MARINE FAUNA OF MLJET NATIONAL PARK (ADRIATIC SEA, CROATIA). 6. LEPTOCARDIA*

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The lancelet *Branchiostoma lanceolatum* Pallas, 1778, is the only leptocardian species that appears in all the European seas, everywhere in the Mediterranean, in all areas of the Adriatic Sea, and in the Black Sea. Due to the unique environmental conditions Adriatic lancelets were noted most in the northern part of Venice Bay. In other parts of the eastern Adriatic Sea lancelets have been recorded rarely, and always at locally well limited sites. Our records in the Mljet National Park seem to be the first in the island's waters. *Branchiostoma* was located at four stations only, at depths of from 1 to 40 metres.

Key words: *Branchiostoma lanceolatum*, Distribution, Adriatic Sea, Mljet National Park.

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Kopljača *Branchiostoma lanceolatum* Pallas, 1778, jedini je naš predstavnik razreda Leptocardia. Nalazimo je u svim morima Europe, pa tako i kod nas. Najčešća je u sjevernom Jadranu, a drugdje njezina su naselja vrlo ograničena. Našim je nalazima utvrđeno prisustvo ove vrste u posebnim uvjetima podmorja Nacionalnog parka Mljet. Na nju su ronioci naišli na četiri mjesta, na dubinama od 1 do 40 m.

Ključne riječi: *Branchiostoma lanceolatum*, rasprostranjenost, Jadransko more, Nacionalni park Mljet.

INTRODUCTION

In the world's oceans and adjacent seas, the class Leptocardia is represented by seven species (Anonymous, 1989). Out of them, in European east Atlantic waters, just one leptocardian species, the lancelet *Branchiostoma lanceolatum* Pallas, 1778, has been noted (Van der Land, 2001). It was referred to previously by the synonym *Branchiostoma lubricum* Costa, 1834, and *Amphioxus lanceolatus* Yarrell, 1836. In the eastern Adriatic area the lancelet is named anfiosso in Italian (Vatova, 1943), in Slovenian navadna škrgoustka (Sket, 2003), while in Croatian its popular names are bezglavka, kopljača, streličica, and suličica (Vinja, 1986).

Live lancelets are rose yellowish to whitish gray in colour. *Branchiostoma* is a typical cryptobenthic creature living in clean unpolluted environments. It is a typical species of well sorted coarse sands influenced by bottom currents (Pérès & Picard, 1964; Picard, 1965; Gamulin-Brida, 1974). Animals live shallowly buried in the sediment feeding on

* In memory of my wife Nevenka Zavodnik, DSc,. who for fifty five years unselfishly encouraged and followed me on my land and sea adventures. She left us forever on March 16th 2016, at the age of eighty.

microorganims and organic detritus (Anonymous, 2010). When moving, lancelets are very lively and swift. Thus when we were sieving the sediment to extract live animals and shells, the lancelets, fleeing and jumping, immediately attracted our attention. Swimming individuals move in a spiral path. An excellent review of *Branchiostoma* research was created by Drach (1948). From a systematic point of view, the genus belongs to the family *Branchiostomidae*, order *Branchiostomiformes*, class *Leptocardia*, and subphylum *Cephalochordata* (Pavletić, 1965; Van der Land, 2001).

Adult Adriatic Sea lancelets are about six centimetres long and of no economic value (Miličić, 1994). Even in times of starvation, islanders have never considered them a possible supplement to their food (Bakić & Popović, 1983; Zavodnik, 1997).

In its range, *Branchiostoma lanceolatum* has been recorded at depths from 1 to 60 metres. This species is noted in the eastern Atlantic Ocean from Norway to Senegal, along nearly all the Mediterranean coasts, and in western parts of the Black Sea (Zenkevič, 1963; Riedl, 1991; Van der Land, 2001). It was recorded in all parts of the Adriatic Sea from the bays of Trieste and Venice in the north to the Otranto Strait in the south, at 1-23 m deep (Fig. 1) (Gamulin-Brida, 1967, 1974; Požar-Domac *et al.*, 2000; Anonymous, 2010). According to my knowledge, in the previous literature there is no information on the presence of lancelets in waters around Mljet Island, except for the notice by Vidović (1955) on the presence of *Amphioxus* in the Veliko Jezero at a site in Podvrti Bay, in a clayey sandy sediment, at 11-13 metres deep.

On the other hand, there is a good deal of information on the geology and geomorphology of the Mljet Island in past times, and of present National Park territory in particular (Tišljar, 1994; Bognar & Curić, 1995; Cukrov *et al.*, 2011).

The best known marine natural attractions of the National Park are two depressions named Veliko and Malo jezero – Great and Small Lake. The Great Lake without doubt is one of the most researched shallow areas in the Adriatic Sea (Vidović, 1955; Buljan & Špan, 1976; Draganović, 1980; Bralić, 1990; Jasprica *et al*., 1955; Juračić *et al*., 1995; Vučetić, 1995; Orepić *et al*., 1997; Benović *et al*., 2000; Meić *et al*., 2006).

The presence in bottom sediments and geological core samples of fossil shelly micro- and meiofauna (Gušić *et al*., 1995; Sokač & Bajraktarević, 1995; Babić *et al*., 2006) suggests that about six thousand years ago at the places of both the depressions of karst geomorphology there was a fresh water lake (Juračić *et al*., 1995) flooded in the Pliocene period. In the postglacial period, with a global sea-level rise of more than a hundred metres (De Marchi, 1922; Oppitz, 1956; Šegota, 1968; Govorčin *et al*., 2001), ingression of sea water occurred in the two depressions through a shallow channel in the area of the present-day village of Soline, resulting in the formation of two typical marine inlets with depths of 46 and 29 metres (Bralić, 1990). Thus these inlets can be characterized as „karstic marine lakes" (Riedl & Ozretić, 1969; Vaniček *et al*., 2000) and should not be considered „lagoons" as proposed by Wunsam *et al*. (1999).

The lancelet is quite common in Italian coastal waters along the northern part of the Bay of Venice (Vatova, 1949; Rossi & Orel, 1968). In other parts of the Adriatic Sea it appears rather rarely, always in very restricted areas, usually at depths of 1 to 23 metres (Vatova, 1943, 1949; Gamulin-Brida, 1974; Zavodnik & Kovačić, 2000). The possible reason for such distribution pattern is the nature and composition of the sediments deposited on the coastal beaches and in the shallow lagoons of Venice area by the Isonzo, Tagliamento, and other Alpine rivers (Nožina, 1971).

MATERIALS AND METHODS

Research was conducted under the auspices of the Thais Society for Marine Research founded by the students of biology from Croatian high schools in Zagreb and Osijek, in collaboration with researchers from Allschwill, Switzerland, and Flekke, Norway (Vidmar *et al*., 1996; Vidmar & Radiša, 1997). The field work was organized during the summer school-holidays in 1995-1997, and in 2000-2002 when some ichthyologists accompanied the research team. Eleven to fourteen divers took part in each excursion.

The sandy sediment possibly suitable for lancelets was taken by skin or SCUBA divers by means of a Zahtila hand grab and/or domestic bucket (Orepić *et al*., 1997). Sediments from deeper areas were taken by the research vessel *Vila Velebita* of the IRB Rovinj Centre for Marine Research using a modified 0.1 m^2 Van Veen grab.

In the Plavilo Strait (Lovrić & Križovan, 1990), in a search for *Amphioxus* sands, grab hauls were conducted at six stations (MLJ-122 – 127) at distances of half a nautical mile (about 900 m) between them, at depths of 24 to 51 m..

In total 65 diving and 28 grab stations were visited (Fig. 1). Detailed information on marine areas and sampling stations have been published by Kružić (2002), Zavodnik (2003), and Šiletić (2006).

Lancelets were extracted from sediment by sieving through 1.1 mm^2 mesh and preserved in a 6% neutralized formaline solution.

RESULTS

Sandy sediments were collected by divers of the Thais Society at a number of stations within the Mljet National Park from shallow water at many stations, to a maximum of

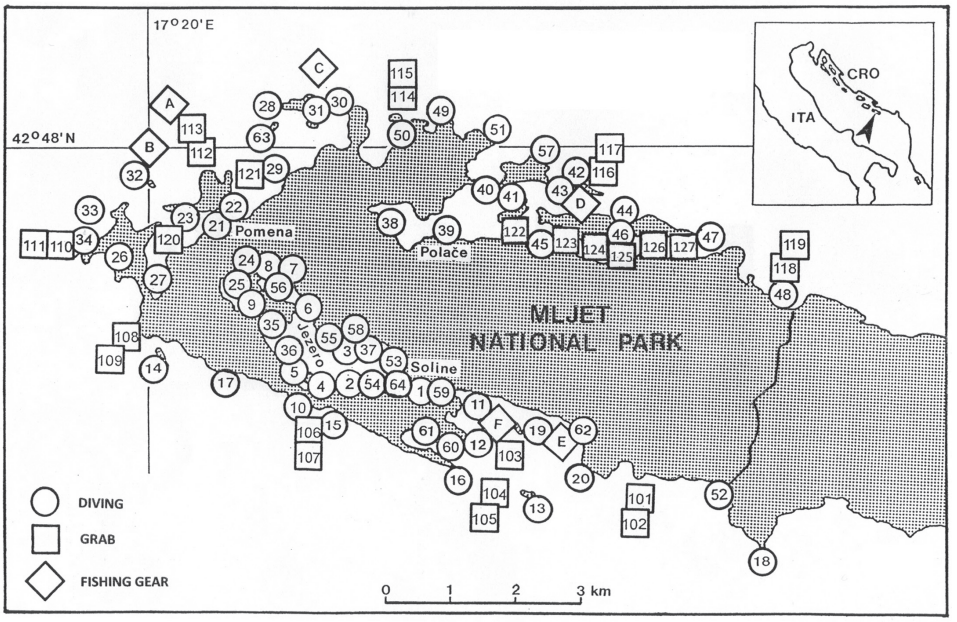

Fig. 1. Research area and stations.

Tab. 1. Base data on stations at which lancelets occurred.

Bottom type acronyms: D – organogenic detritus, shell litter; G – gravel, pebbles; M – mud, silt; R – rock; S – sand. Community codes; Alg; algal associations; Cym – *Cymodocea nodosa* meadow; Det – communities of detrital sand; Pos – *Posidonia oceanica* bed.

Station (MLJ-)	Locality	Depth (m)	Bottom slope	Bottom type	Sample depth (m)	Max. depth surveyed (m)	Number of surveys	Dominant communities
35	Priježba cove	8	gentle	RS	1-2	8	4	Alg, Cym
36	Podvrti cove	42	gentle	RSDM	7	42	2	Alg, Det
52	Procjep cove	65	gentle	GRS	40	42	3	Alg, Pos, Det
56	Njivice cape	9	gentle	RS	3	4	1	Alg, Cym

46 m deep at station MLJ-37, and 50 m outwards the cliff at station MLJ-16. Lancelets were found at four locations only, all in the Veliko Jezero depression: at stations MLJ-35 (Priježba cove), 36 (Podvrti cove), 52 (Procjep cove), and 56 (Njivice cape) (Tab. 1). *Branchiostoma* was not found in any grab hauls by the research vessel because rocky bottoms or unfavourable coralligenous sediments were contacted. The extracted specimens were identified in our field laboratories and in the Rovinj, Centre for Marine Research according to Riedl (1963, 1991), Czihak (1970) and an anonymous artist (2010).

In total, eight yellowish-green coloured specimens of lancelet were studied, originating from fine, well-calibrated sands collected at depths between 1 and 40 metres. Their length varied from 48 – 62 millimetres. Some of the specimens were preserved and are kept in the Centre's study collection.

DISCUSSION AND CONCLUSIONS

The lancelet *Branchiostoma lanceolatum* is the only species of the class *Acrania* in the Adriatic Sea. It is a well distributed cryptobenthic species of shallow coastal areas. Although it is of no economic value (Vinja, 1986; Milišić, 1994), the rich etymology in the languages of the Adriatic coastal states, indicates the interest in and familiarity with the

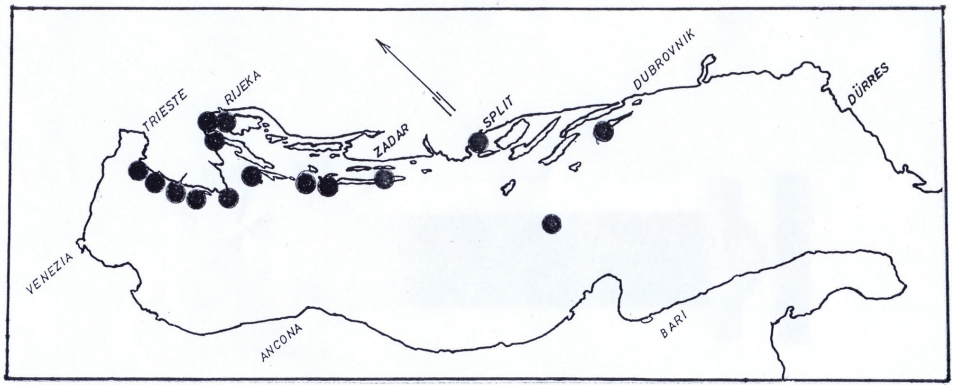

Fig. 2. Finding areas of lancelets in the Croatian sea.

lancelet of local population and sea-farers. The morphology of *Branchiostoma* is discussed in detail in Croatian teaching books such as, for example, were published for Zagreb University by Habdija *et al*. (2004, 2011).

Branchiostoma lanceolatum is a well distributed species in all parts of the Adriatic Sea (Anonymous, 2010), especially here and there along the Croatian littoral (Cori, 1912; Vatova, 1943; Gamulin-Brida, 1967, 1974; Požar-Domac *et al*., 1998; Zavodnik & Kovačić, 2000) (Fig. 2). However, as early as 1885 Carus had reviewed the existing data of lancelet distribution in the Adriatic Sea. In accordance with the results of our research it appears that Mljet Island lancelet populations are not numerous and never reach the densities estimated in *Amphioxus* sands in the Venice Bay, at 15-23 meters depth (Vatova, 1949).

The methodology of our research is described in details in papers by Belamarić *et al*. (1995), Vidmar *et al*. (1996), and Vidmar & Radiša (1997). Information on the hydrology of the Mljet National Park sea was given in papers by Ercegović (1935), Buljan (1958), Buljan & Špan (1976), Benović *et al*. (1995, 2000), Jasprica *et al*. (1995), Juračić *et al*. (1995), Onofri & Marguš (1995), Vaniček *et al*. (2000), Lučić *et al.* (2002) and Babić *et al*. (2011).

Our results on lancelets are the first to have been provided for Mljet Island waters. Although our observations may seem to be somewhat preliminary with regard to lancelet sands, it is obvious that in the area studied there is no reason for them to be specially protected (Draganović, 1980). The *Branchiostoma* environments seem not to be seriously endangered (Bakran-Petricioli, 2007) except with respect to the arrival of invasive alien species, like the green alga *Caulerpa taxifolia* noted recently in the area (Kružić, pers. comm.; Žuljević *et al*., 2011). A more important danger is the constant pollution by domestic waste (Draganović, 1980), and of tourism and related services during the height of the holiday season (Bellan-Santini *et al*., 1994).

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SAŽETAK

Morska fauna Mljetskog Nacionalnog parka (Jadransko more, Hrvatska). 6. Leptocardia.

D. Zavodnik

Jedina vrsta skupine kopljača (Leptocardia) koju nalazimo u Europskim morima jest Branchiostoma lanceolatum. Njezin životni areal obuhvaća more istočnog Atlantika od Norveške do Senegala i gotovo sva područja Sredozemlja sve do zapadnog dijela Crnoga mora. Također je nađena u svim područjima Jadrana, a naročito je česta u području Venecije. Živi na inače vrlo ograničenim mjestima pjeskovitog dna koje je pod utjecajem stalnih pridnenih struja. Kopljača je isključiva vrsta ovakvih staništa gdje živi plitko zakopana u površinskom sloju sedimenta.

Na području otoka Mljeta kopljača nije bila nađena sve do istraživanja studentskog društva ronioca nazvanog „Thais“. Utvrđena je prisutnost te vrste u istraživanom području Nacionalnog parka Mljet, ali uz ograničenost njezinih staništa na samo četiri mjesta u dubinama 1-40 m te vrlo nisku gustoću populacije.