

SEASONALITY IN DIEL CATCH RATE OF LABRIDS IN A SHALLOW-WATER
HABITAT AT DUĆE GLAVA BEACH IN THE EASTERN ADRIATIC

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ABSTRACT

An assemblage of shallow-water fishes was sampled with a small beach seine monthly, during 24-hour periods, between April 2000 and March 2001 at the sandy Duće Glava beach in the eastern Adriatic. Monthly sets of samples were divided into day and night catches to examine the stability of diel differences in assemblage structure over a one-year period. A total of 284 Labrids, mainly juveniles, representing 6 species (Symphodus ocellatus, S. cinereus, S. roissali, S. rostratus and Labrus viridis, L. merula) were sampled during the whole investigation period. Each of these Labrid species had a different pattern of diurnal and seasonal abundance. S. ocellatus was the dominant species throughout the year. The highest increases in number of all Symphodus species were recorded in the summer period. L. viridis, represented by the largest individuals of all sampled Labrids, were not found during the summer and autumn months. S. ocellatus, S. roissali and S. rostratus appeared to be mainly diurnal, while at night more S. cinereus and L. viridis individuals were caught.

Key words: seasonality, day/night differences, Labrids, Adriatic Sea, coastal area

STAGIONALITÀ DI CATTURE GIORNALIERE DI LABRIDI DI ACQUE POCO
PROFONDE IN MARE ADRIATICO

SINTESI

Una comunità ittica di acque poco profonde è stata campionata mensilmente per 24 ore, con l'ausilio di una piccola rete da pesca, tra aprile 2000 e marzo 2001, lungo la costa sabbiosa Duće Glava nell'Adriatico orientale. I campioni mensili sono stati divisi in catture diurne e notturne, al fine di esaminare la stabilità delle differenze giornaliere nella struttura della comunità, durante il periodo di un anno. Un totale di 284 labridi, in prevalenza stadi giovanili di 6 specie (Symphodus ocellatus, S. cinereus, S. roissali, S. rostratus, Labrus viridis e L. merula), sono stati campionati durante l'intero periodo di studio. Ognuna di queste specie di labridi ha mostrato di avere un andamento diverso dell'abbondanza giornaliera e stagionale. S. ocellatus è stata la specie dominante durante tutto l'anno. L'incremento maggiore nel numero di specie di Symphodus si è registrato durante il periodo estivo. L. viridis, rappresentato dagli esemplari più grandi fra tutti i labridi campionati, non è stato trovato durante l'estate e l'autunno. S. ocellatus, S. roissali e S. rostratus sono apparse specie prevalentemente diurne, mentre la gran parte degli individui di S. cinereus e L. viridis è stata catturata durante la notte.

Parole chiave: stagionalità, differenze giorno/notte, labridi, mare Adriatico, area costiera

INTRODUCTION

Several studies have emphasized the role of marine shallow-water habitats (Thiel *et al.*, 1995; Biagi *et al.*, 1998; Nash & Santos, 1998; Guidetti & Bussotti, 2000) as nurseries of a variety of marine fishes. It has been shown that fish assemblage changes over diel periods (Nash, 1986; Wright, 1989; Nash *et al.*, 1994) due to the net avoidance during the daytime (McCleave & Fried, 1975) also due to the real changes in abundance and the assemblage structure (Lasiak, 1984; Nash *et al.*, 1994). Moreover, there is a seasonal change in the species composition, which is also reflected in the diel variations in assemblage structure (Nash, 1986; Wright, 1989).

Only a limited number of previous studies have examined the day/night catches for a whole year (Allen *et al.*, 1983; Nash & Santos, 1998; Dulčić *et al.*, 2004). Diel changes in assemblage composition, which are then superimposed on seasonal changes, could have a profound effect on the perception of a fish assemblage. The diel periodicity of an assemblage, or even the lack of periodicity, is caused by changes in catch of the individual species (Nash & Santos, 1998).

Wrasses (the family Labridae) are the most abundant

and conspicuous fishes on tropical reefs around the world (Choat & Bellwood, 1998). They also comprise an important element of the coldwater fish population in temperate areas, such as Adriatic Sea, and can be found in a wide variety of habitats (Jardas, 1996). Wrasses appear in a diverse range of colours, shapes, and sizes, often varying considerably within species. They belong to the productive and low trophic level species with high ecological efficiency (Dulčić *et al.*, 1997; Wainwright & Bellwood, 2002). Many wrasses are organized into harem-based social systems and hermaphroditism is common (Choat & Bellwood, 1998).

Eighteen species from the Labridae family are found in Adriatic Sea (Jardas, 1996). The *Symphodus* spp. is one of the most abundant genera of Adriatic Labrids, while other species are rarely encountered. Although these species are not commercially interesting, they occupied considerable place in the Adriatic ichthyofauna due their pronounced biodiversity. Labrids are of tropic origin, but due to climate change, future appearance of new Labrid species, together with the increasing abundance of present Labrids as well as their movement to the northern parts of the Adriatic Sea, is expected (Dulčić & Grbec, 2000).

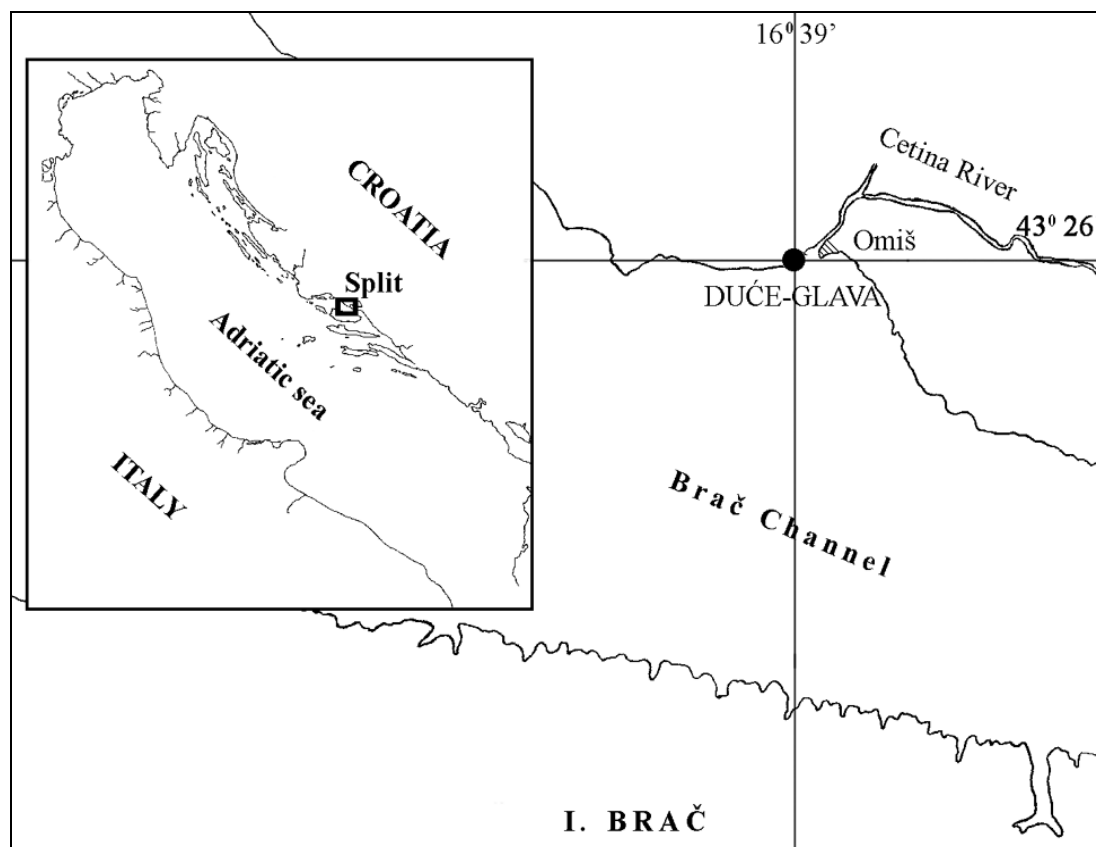


Fig. 1: Map showing the area of Duće-Glava Bay and the Cetina estuary.
Sl. 1: Zemljevid z zalivom Duće Glava v ustju reke Cetine.

This study analyses the day/night changes in catches of shallow-water Labrids over one year period and provides: 1) a description of temporal and seasonal fluctuations of Labrids in a shallow-water with mixed habitats, and 2) a comparison with other subtropical and temperate studies. Results obtained in this study could be useful for gaining a better understanding of Labrid fish community structure in the coastal Adriatic area.

MATERIAL AND METHODS

Duće Glava is a small south-facing sand beach on the Croatian Adriatic coast (approximately 20 km south of Split) near the Cetina river estuary (Fig. 1). The sampling area was sandy and partially overgrown with meadows of *Posidonia oceanica*. The beach is a popular swimming area during the summer.

Samples were collected monthly for 11 consecutive months (April 2000-March 2001). Due to exceptionally bad weather, sampling was not possible in January 2001. Each month, 7 samples were taken at 4-hour intervals with a 22 m beach seine (wings of 7.5 m and central collecting area of 7 m, 4 mm stretch size mesh at the wings reducing to 2 mm in the centre) at depths from 0.1 to 1.5 m. Before each sample, water temperature was measured and is presented as the average of the 7 measurements taken in each 24-hour sampling period. Each sample represents two sets of the net. Temperature was measured with a mercury thermometer, salinity with a laboratory inductive salinometer before each sampling.

Fish were immediately preserved in 4% formaldehyde and identified using Jardas (1996). The total number of individuals and total weight for each species in each haul was obtained. Total lengths (to the nearest 0.1 mm) and individual weights (to the nearest 0.01 g) were measured for each sample. Juvenile fishes were defined as specimens with already formed scales, and were taken as such until the moment of first sexual maturity (Katavić, 1984).

The fish data were analysed using the PRIMER software package (Plymouth Marine Laboratories, UK; Clarke & Warwick, 2001). Data were transformed for presence/absence and the Bray-Curtis similarity matrix was used to generate 2-dimensional ordination plots with the non-metric multidimensional scaling (nMDS) technique (Clarke, 1993). ANOSIM test for the two-way crossed analysis was used for testing differences in species assemblage between seasons and hours (Clarke & Warwick, 2001). Probability value was set at 0.05. Species presented in total sample with less than 5% were omitted from this analysis.

RESULTS

Mean daily temperature over the year (2000-2001) ranged from 12.3 °C in February 2001 to 23.0 °C in July 2000, while salinity ranged from 27.7 in February 2001 to 35.3 in July 2000.

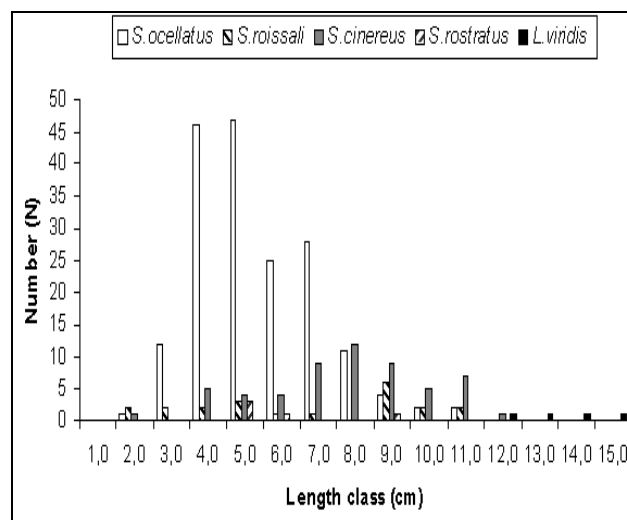


Fig. 2: Labrid representation among length classes at Duće, Adriatic coastal area.

Sl. 2: Ustnače zaliva Duće, razvršćene po različnih velikostnih razredih.

Labrids comprised 284 individuals (1.6%) of total catch (17,414 fish representing 61 species). The Labrid species were: *Symphodus ocellatus* (68.2% of total Labrids), *Symphodus cinereus* (20.1%), *Symphodus roissali* (8.5%), *Symphodus rostratus* (1.8%) and *Labrus viridis* (1.4%). Also, one individual of *Labrus merula* ($L_t = 6.7$ cm; $W_t = 4.04$ g in June at midnight) was found but is, as a single specimen, omitted from further analysis. A Labrid representation among length classes is presented in figure 2. Mostly, *S. ocellatus* individuals belong to middle-length classes from 4.0 to 7.0 cm. *S. roissali* were uniformly distributed through different length classes. The higher number of longer *S. cinereus* individuals from 7.0 to 11.0 cm were recorded, while the longest individuals were those of *L. viridis* belonging in length classes between 12.0 and 15.0 cm with the mean length value of 13.9 cm.

Each of these Labrid species had a different pattern of diurnal and seasonal abundance. Number of Labrids caught per season was the highest in summer (172); it declined in autumn (57), and was the lowest in winter (14). In spring, 40 Labrids (14.1%) were sampled. *S. ocellatus* were the most dominant Labrid species (42.5%) in spring, while *S. roissali* individuals were not observed in that period. The highest increase in the number of all *Symphodus* species was recorded in the

summer period. This trend was specially pronounced for *S. ocellatus* with 193 caught specimens. *L. viridis* was not found at all during summer and autumn. Lower sea temperatures were accompanied by number declination of Labrid species in the Duće area. Seasonal variability was the highest in spring and summer, although there was a large fluctuation in the number of species between those months (Fig. 3). *S. ocellatus* individuals were dominant between April and October. Higher abundance of *S. roissali* specimens was recorded from April to August. *S. cinereus* individuals were almost uniformly distributed throughout the year. The highest number of *S. rostratus* individuals was sampled in June.

The nMDS plots of Labrid samples (Fig. 4) shows there is some difference between them in colder and warmer periods, especially during the spring and winter months. Catches of the analyzed Labrid species showed little variation during the winter. Results of the ANOSIM test for the two-way crossed analysis showed that there was a significant difference in species assemblages among seasons, although correlation was not high ($\rho_{av} = 0.118$, $P = 0.017$).

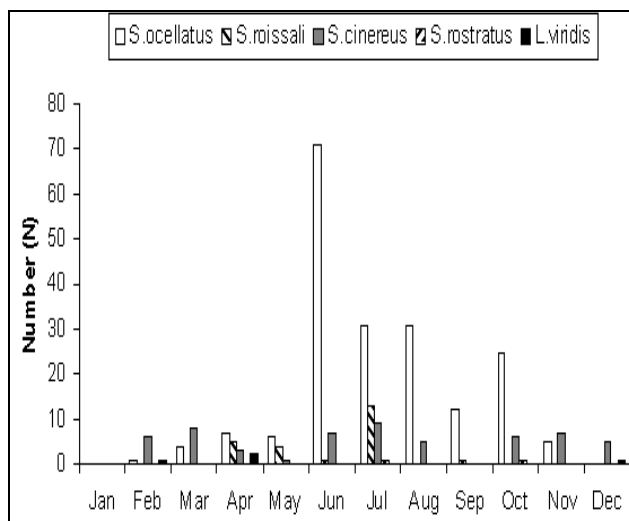


Fig. 3: Monthly distribution of Labrids at Duće, Adriatic coastal area.

Sl. 3: Mesečna rasporeditev ustnač v zalivu Duće.

Over the entire year, slightly more Labrids were caught at day (152) than at night (130). With respect to the number of individuals, *S. ocellatus*, *S. roissali* and *S. rostratus* catches appeared to be mainly diurnal. On the other hand, more *S. cinereus* and *L. viridis* individuals were found in night samples. Diurnal differences in occurrence were more pronounced in *S. roissali* (16/day and 8/night) and *S. cinereus* (19/day and 38/night) species. *S. ocellatus*, as the most dominant species, was also recorded with the highest catch in each of the sub-samples (Fig. 5.). *S. roissali* was not found in samples

taken at midnight while, at the same time, the highest number of *S. cinereus* was recorded.

The nMDS plots of Labrid samples (Fig. 6) shows there is a clearly visible overlapping of the day and night samples. Moreover, the result of ANOSIM test for the two-way crossed analysis showed that there was no significant difference in those catches between day and night samples ($\rho_{av} = 0.118$, $P = 0.017$).

DISCUSSION

Differences in day/night composition of fish catches can have a profound effect on the perception of a fish community (Nash & Santos, 1998). Temporal variation in species abundance pointed out species separation and a partitioning of the habitat along a time axis. The advantage of this time distinguishing is reduction in competition for food and/or space and avoidance of predation (Ross, 1986).

The qualitative dominance of Sparids and Labrids and the quantitative dominance of schooling fish species in the shallow rocky Mediterranean habitats are well known (Guidetti, 2000). The preference by Labrids for substrates colonised by macroalgae has not been known only for the Mediterranean (Garcia-Rubies & Macpherson, 1995), but is a common feature in all temperate waters (Choat & Ayling, 1987). In both papers, it was affirmed that dense algal stands in shallow waters are often colonised by young Labrids, which use the algae for feeding and shelter. Moreover, Guidetti (2000) found that in the Adriatic *S. ocellatus* is one of the most common species in the *P. oceanica* seagrass beds, while *S. roissali* and *S. tinca* were mainly associated with the rocky-algal reef habitats. Structure of fish assemblages associated with some habitats, and thus occurrence of some species, is affected by a large number of inter-playing and, in some cases, superimposed biological interactions (i.e. grazing, predation) and physical factors (i.e. habitat complexity, hydrodynamic forces). The differences in fish species richness and abundance are primarily related to habitat structure (Guidetti, 2000). According to fact that the area of Duće was sandy and partially overgrown with meadows of *P. oceanica*, it was expected to have more *Symphodus* species, which prefer this type of habitats, than other Labrids. The substrate type (Levin, 1991) and depth (Garcia-Rubies & Macpherson, 1995) are two main factors affecting fish recruitment, mortality and growth. Although, Letourner et al. (2003) found that bottom slope was generally more significant than depth. Furthermore, Letourner et al. (2003) suggested that benthic habitat use by fish is clearly non-random, and that differences in habitat at a small spatial scale can affect fish assemblages.

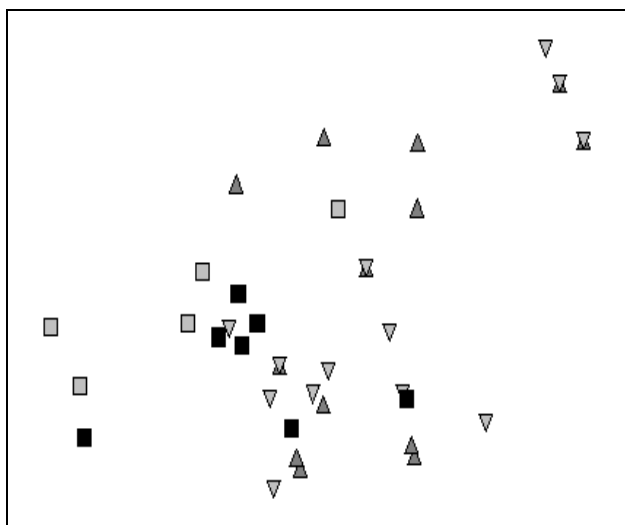


Fig. 4: Non-Metric Multidimensional Scaling (nMDS) ordination plot for Labrids during each season (stress < 0.01): ▲ spring, ▼ summer, ■ autumn, ◆ winter.

Sl. 4: Nemetrično multidimenzionalno skaliranje (nMDS) za ustnače v posameznih letnih časih (pomen < 0,01): ▲ pomlad, ▼ poletje, ■ jesen, ◆ zima.

Symphodus species found in the sampling area were small Labrids (cca. 10 cm), while those from *Labrus* spp. can reach lengths of up to 30 cm (Jardas, 1996). All caught specimens were in the length classes from 2.0 cm to 15.0 cm. The most frequent lengths of occurrence of the analysed Labrids are consistent with the data reported by Jardas (1996). Labrids belonged to resident species that, after metamorphosis, live permanently in the same area, where they also breed (Guidetti & Busotti, 2000; Dulčić *et al.*, 2002). Some temperate wrasse species, such as the *S. ocellatus*, *S. cinereus* and *S. rostratus*, are demersal nest builders. The nests are usually made of plant material and the male guards the eggs after they are deposited (Jardas, 1996). The time periods of occurrence of the analysed Labrid juveniles are consistent with the data reported by Dulčić *et al.* (1997). The highest abundance of all specimens was recorded during the summer (June) and the lowest during the winter (December). *S. ocellatus* were dominant Labrid species in the investigated area. Its juveniles were also one of the four dominant species in the Kornati Archipelago (Dulčić *et al.*, 1997). All species were more numerous during the summer, except *L. viridis*, which was equally found during the spring and winter periods. Discussion about *S. rostratus*, *L. viridis* and *L. merula* differences in day/night catches do not have so much sense owing to their minor percentage in total sample. One of the major reasons for such *Symphodus* spp. occurrence was in the recruitment timing of these species. Moreover, a high abundance in June and July was due to the increase of their juveniles, and this could be correlated

with the spring spawning period (Jardas, 1996) and duration of embryonic development of these species (Dulčić *et al.*, 1997). It seems that in tropical wrasses spawning occurs year-round, while some temperate species obviously restrict spawning to warmer parts of the year (Choat & Ayling, 1987).

Specimens of *Symphodus* spp. were found almost during all months, but with higher abundance from June to October. Biagi *et al.* (1998) observed settlers of *S. cinereus* for only one or two months in the 0-3 m zone of the Italian coastal area, and they supposed that after that they probably moved offshore to deeper waters. On the other hand, settlers of *S. rostratus* were observed at the samples for an extended period after settlement occurred (Biagi *et al.*, 1998), which is in agreement with our results. Segregation of the analysed species, in terms of reducing the possible interspecific competition for food and shelter, was not observed.

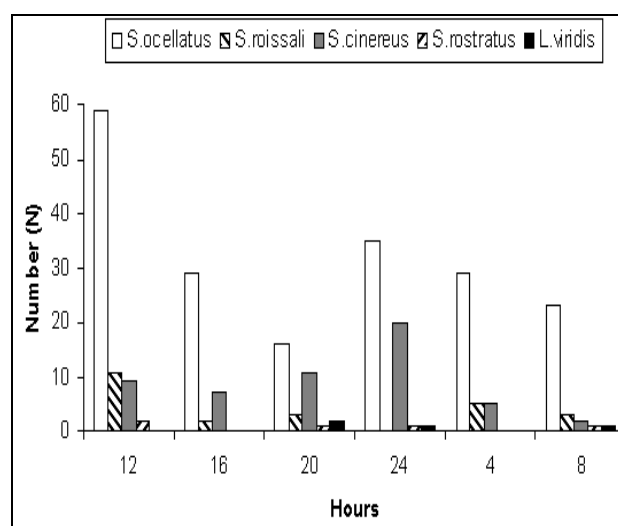


Fig. 5: Labrids representation between different sampling hours at Duče, Adriatic coastal area.

Sl. 5: Razporeditev ustnač v zalivu Duče med posameznimi urami vzorčenja.

In total, more sampled Labrids were found to be diurnal fishes. That fact is probably connected with their usage of algae for feeding and shelter during sunlight. Wrasses are strongly diurnal (only active during the daytime) and, like parrotfishes, many bury themselves in the sand or seek crevices to hide in at night (Choat & Ayling, 1987). *S. ocellatus* and *S. roissali* were mainly diurnal, while at night more *S. cinereus* specimens were found. The night occurrence could be explained as either an increased catchability at night or a movement of these individuals into the analysed area at dusk and leaving at dawn or some combination of both (Nash *et al.*, 1994). However, it is very speculative to pronounce any of those species as diurnal or nocturnal, as only with the

non-destructive method sampling we would be able to assess the real diel aspects of certain species. The highest catches were recorded by sampling in 12 h (82 individuals) and 24 h (59 individuals) periods. However, there was no significant difference in Labrid catches between day and night samples, indicating that one year of investigation is probably not enough or that more frequent sampling is needed. It is well known that the behaviour connected with the day/night light cycle differs between species and that there is often a difference in catchability or vulnerability of species relative to that point (Parsley *et al.*, 1989). In addition, individuals do not see nets at such great distances during night, and therefore capture efficiencies are higher at night. In the Mediterranean *P. oceanica* beds, Harmelin-Vivien (1982) attributed the increased abundance and diversity of the fish fauna at night not only to the immigration of nocturnal macrophagic carnivores from the adjacent reefs, but also to the movements of diurnal planktivores from the water column to the sheltered sites beneath the canopy.

It is apparent from the foregoing discussion that a number of parameters influence the differential distribution of Labrids, especially the occurrence and composition of their juveniles. Their occurrence in the Duće area is surely the result of juvenile preference for relatively shallow and nutrient rich coastal water. Also, those areas provide shelter from possible predators, whose manoeuvrability may be hampered in shallow water (Dulčić *et al.*, 1997).

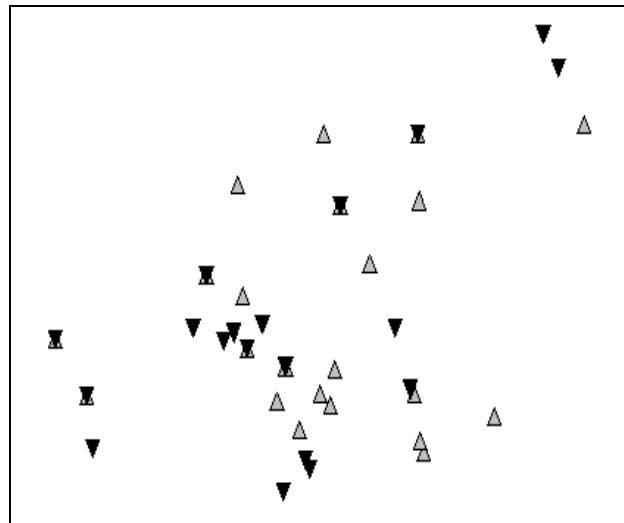


Fig. 6: Non-Metric Multidimensional Scaling (nMDS) ordination plot for Labrids among day and night samples (stress < 0.01): ▲ day, ▼ night.

Sl. 6: Nemetrično multidimenzionalno skaliranje (nMDS) za ustnače med dnevnimi in noćnim vzorcima (pomen < 0,01): ▲ dan, ▼ noć.

The results of the present study provide a basis for establishing the temporal and spatial patterns of occurrence and recruitment of the Adriatic Labrids in coastal area. It is necessary to establish their monitoring due their tropic origin, increasing abundance of the present Labrids as well as their movement to the northern parts of the Adriatic. A further research is also needed due to a reasonable expectation of new Labrid species occurring as a consequence of climate change.

SEZONSKE SPREMEMBE V DNEVNEM ULOVU USTNAČ V PLITVINAH ZALIVA DUĆE GLAVA V VZHODNEM JADRANU

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POVZETEK

Avtorji prispevka so med aprilom 2000 in marcem 2001 vzorčili združbo plitkovodnih rib, ujetih z manjšo mrežo vzdolž peščene obale Duće Glava južno od Splita (vzhodni Jadran). Z namenom, da bi preučili razlike v 24-urnem obdobju v primerjavi s strukturo združbe v enoletnem obdobju, so mesečne zbirke vzorcev razdelili na tiste, ulovljene podnevi, in tiste, ulovljene ponoči. Med celotnim preučevanjem obdobjem je bilo vzorčenih 284 ustnač (z mnogimi mladostnimi osebki med njimi), pripadajočih 6 različnih vrstam (*Symphodus ocellatus*, *S. cinereus*, *S. rois-*

sali, *S. rostratus* ter *Labrus viridis* in *L. merula*). Pri vsaki od teh ustnač je bil ugotovljen drugačen vzorec njihove dnevne in sezone številočnosti. *S. ocellatus* je bila dominantna vrsta prek celega leta. Največji prirastki v številu vseh ustnač iz rodu *Symphodus* so bili zabeleženi v poletnem obdobju. Vrsta *L. viridis*, ki so jo zastopali največji osebk med vsemi vzorčenimi ustnačami, pa v poletnem in jesenskem obdobju sploh ni bila zabeležena. Medtem ko so bile *S. ocellatus*, *S. roissali* in *S. rostratus* videti predvsem dnevne ribe, je bilo ponoči ujetih največ osebkov vrst *S. cinereus* in *L. viridis*.

Ključne besede: sezonskost, dnevno-nočne razlike, ustnače, Jadransko morje, obalno območje

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