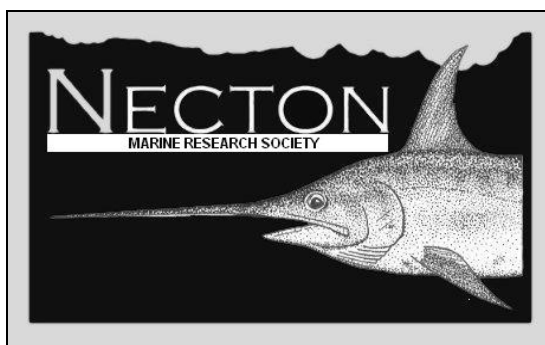


**DELO NAŠIH ZAVODOV IN DRUŠTEV
ATTIVITÀ DEI NOSTRI ISTITUTI E DELLE
NOSTRE SOCIETÀ
ACTIVITIES BY OUR INSTITUTIONS
AND ASSOCIATIONS**

Antonio Celona
NECTON MARINE RESEARCH SOCIETY



La Necton Marine Research Society è nata nel 2001 con lo scopo di creare ed attuare programmi di ricerca volti alla salvaguardia ed alla conservazione dell'ecosistema marino.

La società è formata da biologi marini, naturalisti e sommozzatori, estremamente preparati e di provata esperienza nel campo della biologia marina, provenienti da istituti di ricerca conosciuti in Italia e all'estero. I progetti vengono portati a termine con professionalità ampiamente riconosciuta ed apprezzata, ed i risultati dei progetti sono presentati in convegni e riviste scientifiche internazionali.

La Necton si occupa in modo particolare dello studio della biologia e dell'ecologia dei grandi pelagici, dei rettili marini e dei cetacei. La Necton aderisce all'AGCI pesca (Associazione Generale delle Cooperative Italiane), è consorziata con il Co.Si.Pe (Consorzio Siciliano Pesca) all'interno del quale si occupa dei problemi legati all'impatto degli attrezzi da pesca sulle specie marine protette. È inoltre partner della società cooperativa Bio-tecno per progetti di ricerca, collabora con la Banca Dati Italiana Squalo Bianco, il Fondo Siciliano per la Natura, il Mediterranean Shark Research Group, l'Istituto di ricerca Aquastudio, l'Associazione Asterisco e nel 2005 ha firmato una convenzione con l'Università di Messina, grazie alla quale gli studenti possono compilare le proprie tesi di laurea collaborando ai suoi programmi di ricerca. È registrata all'Anagrafe Nazionale delle Ricerche presso il Ministero dell'Università e della Ricerca Scientifica e Tecnologica. La Necton ha sede legale a Catania, ma è presente anche a Messina con una

sede operativa, attrezzata di un piccolo laboratorio, ed opera in tutto il bacino del Mediterraneo.

La Necton si occupa in modo particolare di:

realizzazione di studi e ricerche sull'ambiente marino e sulle componenti biotiche e abiotiche, realizzazione e gestione di servizi tecnici inerenti alle attività legate al mare, valutazione delle risorse ittiche, ricerca applicata alle attività di pesca, attività di monitoraggio ambientale, valutazioni di impatto ambientale, indagini conoscitive, piani di gestione delle aree marine protette, ricerca applicata all'acquacoltura e alla maricoltura, attività di prelievo di organismi marini a fini scientifici o didattici (compresa la raccolta di organismi per acquari e parchi marini), realizzazione, gestione e promozione di iniziative di recupero ambientale, supporto tecnico/scientifico finalizzato allo studio e alla gestione di aree marine protette, formazione professionale su tematiche legate al mare, divulgazione scientifica, progetti di ecoturismo, organizzazione di campi natura e campi studio, realizzazione e promozione di iniziative di recupero e valorizzazione della cultura e delle tradizioni legate al mare, attività di editoria, progettazione e produzione di strumenti multimediali ed audiovisivi inerenti al mare.

Tra i progetti in atto citiamo: il Progetto Mobula che si occupa della biologia e dell'ecologia della manta, *Mobula mobular* nelle acque siciliane, il Progetto Delphis, che studia l'interazione tra cetacei e pesca ai cefalopodi nei mari Tirreno e Ionio, ed il Progetto Caretta, sulla marcatura e ricattura con sistemi non invasivi della tartaruga marina *Caretta caretta*. Tra i progetti ultimati o in fase di ultimazione ricordiamo il Progetto Xiphias, studio su biologia ed ecologia del pescespada, *Xiphias gladius* nelle acque dello Stretto di Messina, il Progetto SCS, che si occupa della biologia e dell'ecologia dei cetacei stanziali ed in transito nello Stretto di Messina, il Progetto pesca e tradizione, che riguarda l'impatto ecologico e socio economico della pesca tradizionale al tonno rosso, *Thunnus thynnus* nell'area dello Stretto di Messina, il Progetto Research on the Sea, che riguarda la diffusione dei risultati scientifici delle ricerche sui mammiferi marini e tartarughe all'interno delle scuole Nazionali (in collaborazione con Ass. Asterisco), ed il 1st Lampedusa Marine Mammals Workshop, un ciclo di corsi su biologia ed ecologia dei mammiferi marini per studenti universitari tenutosi nell'area dell'Arcipelago delle isole Pelagie.

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Martina Orlando Bonaca
 MICROHABITAT PREFERENCES OF COASTAL
 COMBTOOTH BLENNIES FAUNA (BLENNIIDAE)
 IN THE GULF OF TRIESTE

Ph.D. Thesis

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The combtooth blennies (family Blenniidae) are benthic bottom-dwellers which occur in coastal waters. Nowhere else are these blennies as abundant and diverse as in the Mediterranean Sea, where researchers have found 19 species. Fifteen of them live in the Slovenian sea. Since they are without economic value and they inhabit hard bottoms where the collecting of samples with trawls is impossible, they were poorly known just thirty years ago. Knowledge about these benthic species has increased during the last decades by the use of non-destructive visual census methods, aided by SCUBA. However, the ecological factors affecting their distribution in the environment and their microhabitat preferences remain poorly understood.

Combtooth blennies exhibit male parental care, with territorial males preparing nests in the spring-summer period. They then invite females inside in order to lay eggs. After fertilization the males guard and defend the eggs against predators, until they hatch. Males can be distinguished from females in most species, because they exhibit distinctive colors during the breeding season. Many blennies utilize endolithic holes, which are bored by etching bivalves, like the date mussel *Lithophaga lithopaga* and the smallest *Gastrochaena dubia*. Bigger blennies species prepare their nests in cracks and crevices among boulders.

The aim of the study was to find out differences among blennies species in microhabitat preferences and in the utilization of different endolithic holes as nests during the breeding season. During the period 1998–2005, the blennioid assemblage was studied along the Slovenian coastal sea. The total number of surveys was 286, all conducted diurnally. The methods used were: vertical transects, horizontal transects, all-occurrence sampling, linear cinetransects and the square method. During diving the microhabitat variables of the site where the blenny was found were annotated, in order to understand the ecological demands of blennies during the breeding season. The importance of biotic (vegetation, benthic fauna, floral cover) and abiotic (depth distribution, illumination, bottom type) factors were supposed to be very important in the microhabitat choice. For endolithic species of blennies we searched for possible correlations between a single species and the endolithic hole's parameters (type of shell, width, length, position and inclination of the hole). These observations

were carried out in the natural environment and during laboratory experiments, as well.

During the study period a total of 14 blennies species were recorded in the Slovenian coastal sea, with the use of the above mentioned non-destructive methods. All 14 species were detected using the all-occurrence sampling method, which showed the best results with the lowest sampling effort in terms of number of surveys. The presence of the cryptobenthic species *P. zvonimiri* was confirmed only with the all-occurrence sampling method. The highest number of species was recorded in the first meter of depth, where 10 species were present. The number of species then decreased toward deeper waters.

Four species of blennies showed themselves to be indiscriminate in their microhabitat choice, as they were found in 25 to 50% of the inspected microhabitats. These species include *P. incognitus*, *L. dalmatinus*, *A. sphynx* in *P. rouxi*. Ten species were classified as infrequent, as they were recorded in less than 25% of the microhabitats.

A Canonical Correspondence Analysis (CCA) was carried out in order to determine the distribution and codependence of 13 blennies species with 13 environmental variables. The results show that the structure of the blennies assemblage in the Slovenian sea is affected by a large number of interplaying factors. The bottom composition, depth, benthic flora and fauna, incorporating both biotic and abiotic variables, are some of the factors responsible for the distribution of coastal blennies. Species inhabiting shallow waters showed a high positive correlation with boulders bigger than 2 m, the presence of mussels and cirripeds, and the presence of empty holes excavated by the date mussel. Species inhabiting deeper waters showed a high correlation with precoralligenous formations, which are frequent on a hard bottom below 4 m depth.

During the surveys, 203 individuals from 10 blennies species were recorded in dwelling places, which are mostly used as nests. Small benthic fish are nesting in holes and crevices in order to defend themselves and the fertilized eggs from predators. Holes, which have narrower entrances than crevices, enable the territorial male that is inside to prevent the entry of other males, and thus to defend its hole. Species found in crevices or in places among boulders were only rarely recorded in nests. Species-specific differences in the utilization of holes were found for species that nest in endolithic holes. The results show that some species (*L. dalmatinus* and *A. sphynx*) choose holes that are little larger than their heads, which prevent small males from being dislodged by bigger ones. *L. dalmatinus* was recorded in date mussels' holes, in holes bored by *G. dubia*, and it was the only species also found in holes made by the yellow boring sponge *Clione celata*, which enable the smallest Adriatic blenny to avoid interspecific competition for the hole. Two bigger species (*P. rouxi* and *P. zvonimiri*), which are probably

less exposed to intraspecific competition for holes, also choose holes with an entrance diameter twice as big as their head diameter. *P. zvonimiri* also occupies holes much longer than its body, while the majority of smaller endolithic species dwell in holes that are approximately as long as their body. Species living in shallow waters prefer sunny hole positions, while *P. rouxi* and *P. zvonimiri* were mostly found in the shade of boulders and rocks. *A. sphynx*, which lives in the mediolittoral belt, avoids competition with other species by choosing vertical holes, while other species mostly occupy horizontal holes.

Six males of *P. zvonimiri* and 6 males of *P. incognitus* were used in laboratory experiments. During 6 series of experiments we found a positive correlation between the rank (the dominance) of males and the access to the hole. Our findings confirm the thesis of "wide territoriality", in which a male defends a net of holes and not just one hole in his territory. *P. zvonimiri* predominates over *P. incognitus*. In the natural environment *P. zvonimiri* dwells in a smaller number of microhabitats than *P. incognitus*. For this reason, it has to defend more successfully its own territory and nests than *P. incognitus*, which is a widely distributed species and could find nesting holes in very different microhabitats.

The results of single-species experiments confirm our field observations, in which *P. zvonimiri* and *P. incognitus* males choose the widest available holes. Both species dwell in holes that are longer than their bodies. In two-species experiments, males of *P. incognitus* were forced to occupy the shortest holes, which confirms the dominance of *P. zvonimiri*. During the series of experiments with differently inclined holes in the aquarium, the two dominant males mostly occupied horizontal holes and holes with 135° of inclination.

The dissertation gives new knowledge on the ecology of blennies and also useful information about the ecological conditions of hard bottom microhabitats in the marine coastal area. These kinds of habitats are very important not only for blennies, but also for the whole fish assemblage and benthic flora and fauna.

Janja Francé

THE ECOLOGICAL CHARACTERISTICS
OF PLANKTONIC DINOFLAGELLATES (Dinophyceae)
IN THE GULF OF TRIESTE WITH AN EMPHASIS
ON TOXIC SPECIES

M.Sc. Thesis

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Dinoflagellates are important members of the phyto-

plankton community in the coastal sea. In temperate regions, dinoflagellates achieve maximal abundance in the late spring and summer period. They are generally well adapted to environments with low turbulence and low nutrient concentrations. Their directional swimming ability is one of adaptation strategies to overcome scarce nutrient availability. Diel vertical migrations through the water column allow dinoflagellates an adequate nutrient uptake, as well as to avoid grazing and high light intensities. The ability to actively choose their depth is an important contributing factor to dinoflagellate bloom formation, but differs among different species and under different environmental conditions. Dinoflagellate blooms may sometimes have harmful consequences on marine ecosystem and humans. Among various types of intoxication, two are of major importance in the Gulf of Trieste, as their causative organisms are commonly found in the northern Adriatic. First is diarrhetic shellfish poisoning (DSP), which is caused mainly by various species of the genus *Dinophysis*. Second, and more dangerous, is paralytic shellfish poisoning (PSP) caused by some species of the genus *Alexandrium*. At shellfish farms on the Slovenian coast, DSP occurs almost every year, and results in the ban on shellfish sale. PSP, however, has not been observed in this area thus far, despite the persistent occurrence of *Alexandrium* in water samples. Recently, there has been a growing interest in new toxin types, such as the yessotoxins. They are produced by *Lingulodinium polyedrum* and *Protoceratium reticulatum* regularly found in the phytoplankton community of the Gulf of Trieste.

The aim of the study was to advance the knowledge of dinoflagellate ecology in two ways. In the first place, long-term data were analyzed in order to uncover seasonal occurrence patterns of toxic dinoflagellates and to determine the predictability of succession of most recurrent *Dinophysis* species. Sea water was sampled from 1995 to 2003 and examined with the use of an inverted microscope. Data from different depths at two sampling sites in the vicinity of shellfish farms were compared. Correlations between some environmental parameters and the abundance of toxic species for the year 1997 were investigated as well. The occurrence pattern of most frequent and abundant *Dinophysis* species was analyzed using the STATIS multivariate analysis. Secondly, to assess the ability of the dinoflagellate species to perform active vertical movements, two 24-hour samplings of the water column were carried out. In order to include the entire set of environmental stresses that dictate the organisms' response, sampling in the natural water environment was chosen. Samples were taken at 4-hour intervals at different depths. The first 24-hour sampling was performed in November during a period of a mixed water column, while the second was performed under stratified water column conditions in June. Combining the findings from the two parts of this study, improvements were suggested

for more effective management and mitigation of harmful dinoflagellate blooms.

During the nine year investigation period, 20 species of toxic and potentially toxic dinoflagellates from the Gulf of Trieste were discovered. 16 *Dinophysis* species were present in the water column, predominantly in the second half of the year. They displayed two yearly abundance maxima in the surface layer: the first in late-spring and the second in autumn. In the middle layer, there was no spring peak, and cell abundance increased gradually from June until the autumn peak. Only four *Dinophysis* species were predominant in water samples and showed a clear succession through time: *D. sacculus* is a typical late-spring species that peaks in June. Simultaneously with *D. sacculus*, *D. caudata* appears in water samples, but reaches its maximum in September. *D. rotundata*, which is present in samples throughout the second half of the year, peaks twice, once in June and again in October. Finally, the presence of *D. fortii* is limited to the autumn period. The lowest abundances were observed (<25 cells l^{-1}) for *D. rotundata*, whereas the other three species occasionally attained cell numbers high enough to cause DSP events (from 100 to several 1000 cells l^{-1}).

Generally, the *Alexandrium* species were present in water samples through the whole year. They were most abundant during the spring and early summer period, while their lowest abundance was recorded between August and December. Small species were predominant in the *Alexandrium* genus, except in June, when *A. pseudogonyaulax* prevailed. The seasonal dynamics of *Alexandrium* was similar in the surface and middle water layers, though abundances were slightly lower in the latter. During peaks, the *Alexandrium* species reached abundances as high as several 100 to several 1000 cells l^{-1} . Two other potentially harmful species, *L. polyedrum* and *P. reticulatum*, whose appearance was limited to the late-spring and summer months, reached their maximum abundance in June.

Some statistically significant correlations were found between species abundance and environmental parameters in the surface layer at station 0024 in 1997. Salinity seemed to be the most important environmental factor, as a number of correlations were found between this factor and species abundance. Correlations between salinity and *Dinophysis* were species specific, while for the *Alexandrium* genus correlation was strictly negative in concordance with literature data. As regards cell numbers during peaks, all species of interest showed considerable inter-annual variability, although they had stable seasonal occurrence patterns. This possibly implies the involvement of stochastic processes, such as wind and current driven cell accumulation and specific environmental variations. Harmful outbursts of such organisms are thus not easily predictable in spite of our knowledge of seasonal dynamics.

The 24-hour samplings both under mixed water column conditions in November and stratified water column conditions in June showed the susceptibility of the shallow coastal sea to short-term alterations. Vertical profiles of temperature, salinity, and density in November confirmed the mixed conditions, since the parameters were uniform along the water column. They changed temporarily only within the first two meters due to the passage of a freshwater front. Despite uniform vertical conditions, migration of the dinoflagellate community through the water column was observed. Autotrophic dinoflagellates (the *Alexandrium* and the *Heterocapsa* species) displayed distinctive day-night dynamics: during daylight, cells accumulated in the surface layer, but gathered mostly near the bottom during the night. Species from the mainly heterotrophic genera *Protoperidinium* and *Diplopsalis* altered their vertical position as well, yet these movements did not coincide with the day-night cycle.

Water column conditions were even more variable during the June 24-hour sampling, when water column stratification was repeatedly disturbed and re-established. Vertical movement under such conditions differed substantially between species. Diel vertical migrations were observed for most of the predominating autotrophic dinoflagellates: *Heterocapsa* spp., *Prorocentrum micans*, *P. triestinum*, *Scrippsiella* spp., *Ceratium furca* and *D. sacculus*. By contrast, diel vertical migrations were not observed for the mostly heterotrophic naked dinoflagellates, for the *Protoperidinium* species and phagotrophic *D. rotundata*.

The expected difference between the vertical migrations of dinoflagellates under stratified and mixed water column conditions was therefore not confirmed. In a constantly changing shallow water column environment, dinoflagellates may preserve their movement pattern as a possible advantage in the exploitation of their environment as well as to avoid grazing. Diel vertical migrations are thus more likely an expression of internal rhythms than a response to environmental conditions. The great dissimilarity in the timing and degree of vertical movements among different species and the possible accumulation of cells in thin layers dictate careful planning of a monitoring programme for toxic species. Thus, sampling should be carried out within as many layers as possible. Integrated water samples from layers of the entire water column should be examined for easier, more accurate and more rapid evaluation.

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THE INFLUENCE OF MARICULTURE
ON PLANKTONIC BACTERIAL COMMUNITIES
IN THE PELAGIC ZONE OF PIRAN BAY

B.Sc. Thesis

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The numerous documented negative effects of mariculture on the environment are connected especially to the accumulation of uneaten food and feces in sea water and in/on the sediment. To evaluate the influence of the fishery pollution on heterotrophic planktonic bacterial communities, spatial and temporal differences in the abundance, growth rates and bacterial community structure were studied in the Gulf of Trieste (Northern Adriatic) on 18 October 2005. At the same time, differences in the chemical parameters (total suspended solids (TSS) and nutrient levels) and physical parameters (basic oceanographic parameters) were followed together with 24-hour current measurements.

Sampling was carried out at the stations around the fish cage and along the transect from the cage located inside the Bay of Piran towards the reference station located 5,400 m away in the middle of the Gulf of Trieste. A new sampling system was designed to provide accurate data at different sampling locations. Underwater samplers were constructed in a circle at a distance of 8 m around the operating fish cage (6 locations) and another circle at a distance of 20 m around the fish cage (6 locations). Each bottle (5 l) was fixed on an underwater metal frame, 5 m below the surface. All sampling bottles were opened simultaneously collecting seawater samples at all location around the fish cage. Sampling was performed before feeding and 3 hours after the feeding of the fish. The result for each parameter was expressed as a ratio ($K = C_{\text{bef}}/C_{\text{af}}$) between the values before and after feeding.

Preliminary results showed temporal and spatial distribution of bacterial abundance and growth rates as well as TSS, ammonia and nitrate concentrations, which were related to distance from the fish farm and to pre-feeding and post-feeding conditions. In the vicinity of fish cage, the abundance value of heterotrophic bacteria

was 2.5-times higher comparing with the bacterial abundance at the reference station. Significantly higher (3-times) was also the growth rate of the total bacterial population. High P/B ratio also reflects intensive bacterial metabolic process in the vicinity of the fishery.

Bacterial community compositions along the transect were determined with new molecular methods, such as FISH (*Fluorescent in situ Hybridization*) and DGGE (*Denaturing Gradient Gel Electrophoresis*). Analysis of the bacterial community compositions with FISH method has shown that bacterial groups from subclasses α -, β - and γ -*Proteobacteriae* as well as *Cytophaga-Flavobacteria-Bacteroides* group and *Vibrio* group were present in all the samples along the transect. Although all bacterial groups were present in the water samples along the transect, there was a great difference in percentage of the each group at separate stations. In the centre of the fish cage dominated the group of nitrifying ammonia-oxidizing bacteria, compared to remote stations on the transect, where *Cytophaga-Flavobacteria-Bacteroides* group and *Vibrio* group were predominant. Analysis of the bacterial community compositions with DGGE method has given similar results that also show the presence of various bacterial groups within a particular sample as well as spatial differences along the transect.

Significant decrease in bacterial carbon production was observed with distance from the pollution source according to the radioactive leucine method. The preliminary results of metabolically active bacterial groups, determined with the BrdU-DGGE method, have shown that the same bacterial groups were metabolically active at all stations along the transect.

Measurements of temporal differences in the abundance and growth rates of the total bacterial population were carried out at the stations around the fish cage before and three hours after the feeding of the fish. After the feeding, a significantly higher bacterial carbon production was measured. The results were comparable with the increased ratio between the total suspended solids (TSS) and nutrient levels measured before and after feeding. The increased bacterial carbon production could be due to the higher concentrations of the TSS and nutrient levels in the surrounding of the fishery.