

RECENT CHANGES IN THE ADRIATIC FISH FAUNA - EXPERIENCES FROM SLOVENIA

RECENTNE SPREMEMBE V JADRANSKI RIBJI FAVNI - IZKUŠNJE IZ SLOVENIJE

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ABSTRACT

Some neglected, rare and less known fish species were recorded in Slovenian part of the Gulf of Trieste. Some of them were recorded for the very first time in the area by virtue of performing new approaches and techniques. Other fish species were related to certain processes in the Adriatic Sea, such as bioinvasion and tropicalisation.

IZVLEČEK

Pred kratkim so bile v slovenskem delu Jadrana odkrite nekatere spregledane, redke in manj poznane vrste rib. Nekatere izmed njih so bile sploh prvič potrjene v danem območju spričo uporabe novih pristopov in metod. Druge odkrite ribje vrste pa so povezane s procesoma meridionalizacije in bioinvazije.

1. INTRODUCTION

During the last few decades, the various anthropogenic activities have exposed the Mediterranean marine biodiversity to certain changes. Together with climate change driven phenomena, those activities affect the structure of fauna and flora of the Mediterranean basin. The same applies for Slovenian part of the Adriatic Sea, which comprises the southern part of the Gulf of Trieste. Recently, several new species for the area and many rare or less known species were discovered in the Slovenian sea. In this paper we would like to present the factors, which are to our opinion the main reasons for the increase in species richness of the area.

2. NEW TECHNIQUES OF INVESTIGATION

The increasing number of fish (and invertebrate species, as well) should be attributed to new research approaches and field techniques (Lipej et Dulčić 2004). The observations of marine biodiversity *in situ* allow marine biologists to study coastal fish communities in their native habitats. Nowadays, the marine fauna and flora, and habitat types as well, could be

sampled by non-destructive techniques such as the visual census method (Harmelin 1987, Harmelin-Vivien et Francour 1992). Linear visual transects are generally conducted by pairs of skilled biologists - divers. The use of such techniques allows identifying new species and specially cryptobenthic species, which are generally hidden under stones, in cracks, crevices and cavities in rocky habitats. Such fish species are mainly representatives of coastal fish families such as clingfishes (Gobiesocidae), gobies (Gobiidae) and blennies (Blenniidae) (Table 1).

Table 1: Rare, less-known or non-indigenous fish species recorded recently in Slovenian part of the Adriatic Sea.

Tabela 1: Redke, manj znane in tujevodne vrste rib, pred kratkim ugotovljene v slovenskem delu Jadranskega morja.

	Species	factor	Source
Carcharhinidae	<i>Carcharhinus plumbeus</i>	Increased research effort	Lipej <i>et al.</i> 2000
Dasyatidae	<i>Dasyatis violacea</i>	Meridionalisation?	Mavrič <i>et al.</i> 2004
Terapontidae	<i>Terapon theraps</i>	Lessepsian migration	Lipej <i>et al.</i> 2008c
Poecillidae	<i>Gambusia hoolbroki</i>	Biocontrol	Leiner <i>et al.</i> 1995
Balistidae	<i>Balistes carolinensis</i>	Meridionalisation	Dulčić <i>et al.</i> 1997
Clupeidae	<i>Sardinella aurita</i>	Meridionalisation	Jenko, <i>pers. comm.</i>
Haemulidae	<i>Plectorhincus mediterraneus</i>	Meridionalisation?	Lipej <i>et al.</i> 1996
Gobiesocidae	<i>Apletodon incognitos</i>	New techniques	Lipej <i>et al.</i> 2005
	<i>Millerigobius macrocephalus</i>	New techniques	Lipej <i>et al.</i> 2005
Gobiidae	<i>Pomatoschistus bathi</i>	New techniques	Lipej <i>et al.</i> 2005
	<i>Gobius roulei</i>	New techniques	Lipej <i>et al.</i> 2005
	<i>Thorogobius ephippiatus</i>	Increased research effort	Lipej <i>et al.</i> 2005
Carangidae	<i>Campogramma vadigo</i>	Increased research effort	Dulčić <i>et al.</i> 2003a

3. INCREASED RESEARCH EFFORT

The discovery of new species in Slovenian coastal waters could be further linked to the increased research effort by marine biologists (Table 1). The cooperation between ichthyologists, divers, underwater photographers and especially fishermen offers a great opportunity to monitor the fish fauna of the area. This cooperation was crucial in discovering new species for the area but also for the detection of many rare and less-known fish species. Such a species is for example the pelagic stingray (*Dasyatis violacea*) (Mavrič *et al.* 2004), which inhabits the southwestern areas of the Mediterranean Sea. In Slovenian part of the Adriatic Sea, it feeds mainly on anchovies (*Engraulis encrasicolus*) and red bandfish (*Cepola rubescens*). Many new data also emerged for the bull ray (*Pteromylaeus bovinus*). Some specimens were the heaviest and the largest bull rays ever measured (Dulčić *et al.* 2008a, Lipej *et al.* 2008a). The cooperation between fishermen and ichthyologists has also brought new insights into the significance of the area as a nursery ground for certain species of sharks. The sandbar shark (*Carcharhinus plumbeus*) was considered a rare shark species in the Adriatic Sea in general. Since the Northern Adriatic is actually a nursery ground for this species, as demonstrated by neonates and juveniles with still unhealed umbilical scars (Lipej *et al.* 2000, Costantini *et*

Affronte 2003), the sandbar shark seems to inhabit the area at least seasonally. The rarity of data on the species is probably more related to the rarity of captures than to the real rarity of these sharks (Lipej et al. 2008b).

4. BIOTIC GLOBALISATION

One of the reasons known to cause the increment of species in the area is biotic globalisation. In this respect we can discriminate between two causes: the first is related to the phenomena of meridionalisation (also tropicalisation), the other to bioinvasion.

4.1 MERIDIONALISATION

Meridionalisation is a temperature related factor, which affects the changes in fish species distribution. Some warm water fish species were recorded to spread from southern to northern areas. Such changes in species distribution due to temperature fluctuations were reported for different parts of the Mediterranean (see Francour et al. 1994) and also in the Adriatic Sea (Dulčić et al. 1999, Lipej et Dulčić 2004). Changes in fish distributions are a good indicator of the effect of temperature change, since fishes are unable to regulate their temperature independently of the surrounding water (Stebbing et al. 2002). One of the tropicalisation indicators is the triggerfish (*Balistes carolinensis*), which has been occurring regularly in the Slovenian coastal sea since the 1970s. The other typical faunistic element of tropicalisation is the ornate wrasse (*Thalassoma pavo*), which is slowly approaching the Slovenian coastal sea. In September 2008, it was recorded for the very first time in waters off Pula. In the last decade, there has been an evidence of regular occurrence of the dolphin fish (*Coryphaena hippurus*), a fish species previously considered a Southern Adriatic species. It is also worth mentioning the spreading of the rainbow wrasse (*Coris julis*), initially recorded in Cape Madonna Natural Monument (Piran) in 2000. Nowadays, the species occurs in different habitat types in the biocoenosis of photophilous algae. In September 2006, this species was recorded for the very first time in the Miramare (Trieste) Marine Reserve (Piron et al. 2007). Let us underline that our Italian colleagues have been performing a regular monitoring of the Miramare Natural Reserve for no less than 25 years. According to some biologists, working in the field of marine fisheries, an ongoing trend of species replacement has been noticed by fishermen, evidenced by the decrease in sardine stock *Sardina pilchardus* and increase of *Sardinella aurita* abundance (R. Jenko, pers. comm.). The latter seems to be an indicator of water warming in the Mediterranean Sea (sensu Sabates et al. 2006).

4.2 BIOINVASION

Bioinvasion is a recent process, which could be related to different factors. It refers to a (non-indigenous) newcomer species, which originates from other biogeographical province, and when the area of species distribution is disjunct. One of the main factors (although not the only one) is again the temperature. However, there are different other factors that can facilitate

the introduction such as salinity, other hydrological conditions, unsaturated ecological niches and others (Mavruk et Avsar 2008). The non-indigenous species could have arrived in the new area from the Erythrean province through the Suez Canal. This process is known as Lessepsian migration, named after Ferdinand Marie De Lesseps, a French engineer responsible for the construction of Suez Canal (1859-1869). The temperature is the most important abiotic factor in determining the dispersal of Lessepsian fish. There are many Lessepsian organisms known to occur in the Adriatic Sea, with at least 11 fish species among them (Dulčić et al. 2003b). The last one, *Terapon theraps* was discovered in waters off Piran in July 2007 and is the first record ever of this species in the Mediterranean Sea, as well as the first record of a lessepsian fish migrant in Slovenian waters (Lipej et al. 2008c).

Other important vectors of introduction such as mariculture, ballast waters and ballast sediments are unlikely to deliver new fish species to the area. The only other non-indigenous fish species known to inhabit the Slovenian coastal sea is the mosquito fish (*Gambusia hoolbroki*), which has been intentionally introduced to solve the problem of mosquitoes in the period between the two World Wars.

4.3 OTHER EVENTS

Recently, some unexpected fish species other than above mentioned were recorded in the Slovenian coastal sea. One of such events was related to the occurrence of a basking shark (*Cetorhinus maximus*) in the area. This shark species was considered rare according to some old sources (Brusina 1888). During the last decade, several records of this species have been reported for the Adriatic Sea with most of the data originating from the Northern Adriatic Sea (Lipej et Dulčić 2004). Some other rather rare or less known ocean-dwelling species have also been reported for the area, such as the common sunfish (*Mola mola*) and the slender sunfish (*Ranzania laevis*) (Lipej et al. 2007). The common sunfish could be related to the global sea warming (Dulčić et al. 2008b) as revealed by the analysis of its occurrence and the sea water temperature fluctuations. In 2007, a louvar (*Luvarus imperialis*) was also recorded in the Gulf of Trieste.

5. CONCLUSIONS

The marine biodiversity of the Mediterranean Sea is nowadays facing the structural changes in flora and fauna (sensu Bianchi 2007). Such changes were also recorded in the Adriatic Sea and in its northernmost part. Some neglected fish species were recorded for the very first time by performing new approaches and techniques in the area. Other fish species were related to certain processes in the Adriatic Sea, such as bioinvasion and meridionalisation. Despite the fact that the recent changes in marine biodiversity of the Slovenian coastal sea are not so dramatic than in other areas of the Mediterranean Sea, a regular monitoring of climate change induced modifications in biodiversity have to be established. With a regular and continuous

monitoring of fish fauna in the Slovenian coastal sea, we would be able to answer on a plethora of questions related to the status of newcomers. Only in that way we are likely to get the opportunity to elucidate what impact such species may have on the environment.

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7. LITERATURE

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