

SCIENTIFIC MONITORING OF THE ALIEN FISH AND CRUSTACEANS SPECIES IN THE ADRIATIC SEA (MONTENEGRIN COAST)

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NAUČNO PRAĆENJE ULASKA INVAZIVNIH VRSTA RIBA I RAKOVA U JADRANSKO MORE (CRNOGORSKO PRIMORJE)

Apstrakt

Ljudske aktivnosti, posebno prokopavanje Sueckog kanala, 1869. godine imale su za posledicu prodor, tim novim koridorom vrsta iz Indijskog okeana preko Crvenog mora. Osim toga, poslednju deceniju obeležile su značajne promjene u klimi koju karakterišu vruća i suva ljeta i hladne zime, kao i česte oluje, poplave i šumski požari. Takođe su evidentne temperaturne promjene u morskim ekosistemima, s povećanjem temperature (tropikalizacija) u sjevernom Mediteranu, uključujući i Jadran. To je izazvalo širenje toplivodnih vrsta prema sjeveru Mediterana u područja koja nisu naseljavali prije. Hrvatski i crnogorskih ihtiolozi su kroz naučno-istraživačku saradnju identifikovali i opisali 46 novih vrsta u Jadranu. To su najčešće vrste iz Indo-Pacifika koji su došli na Mediteranu kroz Suecki kanal. Neke vrste stigle su iz istočnog Atlantika kroz Gibraltarski proloz. Osim migrantskih vrsta, nekoliko novih vrsta iz porodice Gobiidae su otkrivene u Jadranu, uglavnom zbog novih ribolovnih alata i tehnika, a nove dubokomorske vrste otkrivene su u ekspedicijama u južnojadranskoj kotlini. Osim riba potvrđeni su i nalazi nekih vrsta dekapodnih rakova, naročito na ušću jadranskih rijeka. Takođe je uočeno širenje areala na sjever Jadrana vrsta koje su nekada dominantno bile prisutne u južnom, toplijem Jadranu, kao što su *Pomatomus saltatrix*. Ove pridošlice, osim što remete ustaljene ekološke odnose, donose i socioekonomske promjene, naročito u mjestima gdje je ribolov tradicionalna djelatnost, kao što su ušća rijeka Bojane i Neretve.

Ključne reči: Jadransko more, alohtone vrste, novi nalaz, dodatni nalaz, klimatske promene
Key words: Adriatic Sea, alien species, new record, additional record, climate changes

INTRODUCTION

So far, 60 fish species from the Red Sea have been registered in the Mediterranean, and those species have been named "lessepsian migrants", after the French developer of the Suez Channel, Ferdinand Lesseps (CIESM 2013). Apart from these, several migrants from the east Atlantic have also been identified in the Mediterranean.

The past decade has been marked by significant changes in climate which caused hot, dry summers, cold winters, storms, floods and forest fires. Those changes have influenced the world's fauna, notably on distribution and spread of certain populations. Temperature changes have also been identified in the marine ecosystems, with an increase in temperature (tropicalization) in the northern Mediterranean, including the Adriatic. This caused the spread of warm-water species northwards, to the areas of the Mediterranean they haven't inhabited before.

Croatian and Montenegrin ichthyologists identified and described 46 new species in the Adriatic, (Lipej and Dulčić, 2010; Dulčić and Dragičević, 2011; Vesna Mačić *et.al.*, 2014). These are mostly species from the Indo-Pacific that came to Mediterranean through the Suez Channel. Some species arrived from the eastern Atlantic through the Gibraltar Straits. The species in question have already been identified in other parts of the Mediterranean, and their presence was now confirmed in the Adriatic, as the northernmost area of the Mediterranean Sea. Beside the migrant species, several new species from the family Gobiidae have been discovered in the Adriatic, mostly due to new fishing gears and techniques used (Pallaoro and Kovačić, 2000). New deep-water species were found and identified in the expeditions to the South Adriatic Pit (Ungaro *et.al.*, 2001).

The aim of the present work is to report additional records of fishes which have until now been regarded as rare or less known and those which have only recently been recorded in the Adriatic Sea for the first time.

MATERIAL AND METHODS

Several species have been registered in Montenegrin waters which were previously unknown to fishermen. They have informed the Institute of Marine Biology about them, and the specimens were brought to the Laboratory where the identification as well as morphometric characteristics analysis were performed in accordance with the certain identification keys. Total lengths (TL) were measured using fish measuring board (precision of 1 mm), measuring tape (precision 1 mm) and digital caliper (precision 0.01 mm). Weight (W) was measured using a high precision (0.01 g) electronic balance, Sartorius Extend ED 4202S.

The first catch of the previously unknown species, occurred on 5 January, 2008, in front of Budva, at a depth of 80 meters, when Blunthead puffer, *Sphoeroides pachygaster* (Müller & Troschel, 1848) was caught with the trammel net (Fig. 1). The analysis of specimens in the Laboratory showed that it was a female, with length of TL = 45 cm and weight of 1480 g. In February of that year at the Great Sand beach, Bluespotted cornethfish, *Fistularia commersonii*, (Ruppel, 1838), was found (TL = 71 cm, W= 350 g). (Fig 1). Two

subsequent repeated findings of this species were recorded in November and December 2013. One specimen was caught in a gillnet called polandara near Tivat in the Boka Kotorska Bay, while second was caught with a spear gun near Budva (Joksimovic, et. al., 2008; Dulčić, et. al., 2014).



Figure 1. Species *Sphoeroides pachygaster* and *Fistularia commersonii* caught in the Montenegrin coast.

On 9th June 2011 a specimen of *Tylosurus acus imperialis* (Rafinesque, 1810), Agujon needlefish (Fig. 2), was caught in front of St. Nikola Island, Budva (Montenegro) in shallow waters (6.5 m depth). The fish was found still alive, entangled in a gillnet for bonito (“polandara”) with a 42 mm diamond mesh size. On 26 June 2014, a specimen of *T. acus imperialis* (Fig. 2) was caught in front of Platamuni, Budva (Montenegro) in shallow waters (6.5 m depth) (Dulčić, et al., 2014b). One specimen of the Dusky spinefoot, *Synganus luridus* (Rüppell, 1829), (TL = 17.4 cm, W = 83.75 g) was captured in Bigova Bay on 7 September 2014 with a trammel net (Fig. 3). In the Adriatic Sea, this species was caught and recorded three times previously, in Piran Bay and Mljet Channel in 2010 and in Konavle in 2011 (Đurović et. al., 2014). The first finding of Blue runner, *Caranx crysos* (Mitchill, 1815) in Montenegrin waters was provided by a fisherman from Ulcinj on 1 March 2013 (Dulčić et al., 2014a) (Fig. 3). The new specimen was caught by beach seine called srdelara on 9 December 2013 near settlement Orahovac near Kotor in Boka Kotorska Bay. Considering the information that juveniles and adults have been recorded in the area of the whole eastern Adriatic, it seems that *C. crysos* established its population in the Adriatic (Dulčić et al., 2014b).



Figure 2. Species *Tylosurus acus imperialis*, caught in the Montenegrin coast.



Figure 3. Species *Siganus luridus* i *Caranx crysos* caught in the Montenegrin coast.

First documented record of the *Callinectes sapidus* (Rathbun, 1896), American blue crab, occurrence was in December 2013 in the Boka Kotorska Bay, where two adult male specimens were caught by gillnet called polandara at a depth of 15 m on sandy-mud bottom in Tivat Bay (Kapiris *et al.*, 2014), (Figure 4). A single adult female specimen of the Northern brown shrimp, *Farfantepenaeus aztecus*, a species native to the western Atlantic coasts, was caught by a "bukvara" gillnet at a depth of 20-25 m on sandy-mud bottom in Boka Kotorska Bay (Southern Adriatic Sea) on 19 September 2013 (Marković *et al.*, 2014). Total length of carapace was 48 mm CL and total length was 200 mm TL.

RESULTS AND DISCUSSION

Studies that have been carried out in the last decade have shown that 46 new fish species have been recorded in the Adriatic Sea, so the total number of species in the Adriatic is now above the 450, compared to the previous checklist which listed 407 species (Dulčić and Dragicevic, 2011, Jardas 1996).

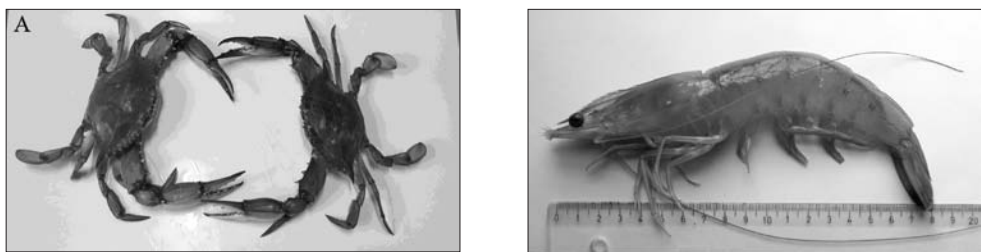


Figure 4. Species *Callinectes sapidus* i *Farfantepenaeus aztecus* caught in the Montenegrin coast.

Active migrations in the Mediterranean Sea through the Suez Canal make the entrance of species from the Red Sea possible, resulting in a total of 13 Lessepsian migrants species, of which nine in the Adriatic. Current global climate changes have an impact on changes in the marine ecosystem. As a signal of these changes, a spreading of thermophilic species in the northern parts of the Mediterranean was observed, as well as in the Adriatic Sea as its northern part. Expansion of the southern Adriatic species, such as *Pomatomus saltatrix* into

the northern part of Adriatic was also observed. Their arrival and occupation of ecological niches, certainly affects the local, indigenous species. These newcomers, in addition to disrupting the established ecological relationships, may also cause socio-economic changes, especially in areas where fishing is a traditional activity. Increased biomass of *P. saltatrix* threatens the catches of mullet species at the mouth of the Neretva River.

The presence of adult males of *C. sapidus* in Boka Kotorska Bay suggests that this species may have established a population like in the neighbouring areas of Albania (Beqiraj & Kashta, 2010) and Croatia (Dulčić *et al.*, 2011), but the presence of ovigerous females and juveniles are also necessary to prove this theory, so further research should be undertaken.

This is the first record of *Farfantepenaeus aztecus* in the Adriatic Sea (Olivera Marković *et al.*, 2014) but second in the Mediterranean (Deval *et al.* 2010) where few individuals from the Gulf of Antalya were collected. These authors considered ship ballast waters as the most likely vector for its introduction in the Mediterranean. The caught individuals would have entered the spawning period (and the theoretical individuals in the rest of the population might have spawned), and it can be expected that the populations will spread and find their specific niche in the ecosystem of the Adriatic.

CONCLUSIONS

The dynamics of living organisms and complex mutual relationship of nature and living creatures once again demonstrate the unpredictability of the natural processes. Caution is required when attempting to interpret these situations and their relations to the global climate changes, which will undoubtedly influence the life on Earth.

These and similar findings require cooperation of the scientists from all countries of the Adriatic, so that potential new findings would be promptly identified and information regarding them exchanged. It is also necessary to continually inform the fishermen about the species whose spread to the Adriatic is expected in the near future, as they are the first to have the opportunity to come into contact with new species, as was the case with the species discussed.

ACKNOWLEDGEMENTS

The authors would like to thank Mr. Ilija Rafailović, Miko Boljević, Slavko Petroviću, Dejan Đurović, Nikola Lazarević, who provided the alien specimens for study. The authors would like to give special thanks to prof. Bayram Öztürk, University of Istanbul, for his useful comments on the manuscript. This work has been supported by the Ministry of Science of Montenegro and HERIC project through the BIO-ICT Centre of Excellence (Contract No. 01-1001). Authors also thank to the Ministry of Science of Croatia and Ministry of Science of Montenegro which helped the realization of this research program through bilateral scientific cooperation between the Croatian and Montenegrin part of the project ADRIA.

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