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A list of Y-O-Y fish species found in the littoral shallows of the Neretva and Mala Neretva estuaries (Eastern Adriatic, Croatian coast)

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Young-of-the-Year (Y-O-Y) fish in the littoral shallows of the Neretva and Mala Neretva estuaries comprises a highly diverse fish community composed of 68 species representing 28 families. Gobiidae represent the most diverse family followed by Sparidae, Mugilidae and Soleidae. Moreover, more than 64.7% (44 species) of the Y-O-Y species caught are among the species that form the main targets for commercial fisheries in the southern Adriatic.

Key words: Young-of-the-Year fish, estuaries, Neretva, Mala Neretva, Eastern Adriatic

INTRODUCTION

Numerous studies have been published on fish populations in lagoons, estuaries and coastal regions in many parts of the world and most of them emphasize that these systems act as important nursery areas for marine fish, thereby supporting important fisheries (WHITFIELD, 1994; LAEGDSGAARD & JOHNSON, 1995; see DULČIĆ *et al*., 1997). The high productivity of these areas enable young-of-the-year fish (Y-O-Y; fish produced from the current year's spawning) to be supported at high densities while mainly occupying shallow waters (THIEL *et al*., 2003). The establishment of the role of very shallow waters in littoral areas as recruitment areas and larval refuges for some fish species is an important objective for management purposes and fisheries enhancement (DULČIĆ *et al*., 2002).

The estuaries of the Neretva and Mala Neretva support important commercial fisheries

(BARTULOVIĆ, 2003) and exhibit rich ichthyoplankton communities (DULČIĆ, 1993). Despite the economic importance and the consequential great impact, no documentation has at yet been published on Y-O-Y fish community composition and structure. The objective of this study, therefore, is to provide a status list on Y-O-Y species richness in the littoral shallows of the Neretva and Mala Neretva estuaries that can be used as comparative documentation in future studies particularly when further changes in the community structure are anticipated in the future.

MATERIAL AND METHODS

The present study was carried out in the estuaries of the Neretva (43^{0}01'32'' N; 17^{0}26'44'' E) and Mala Neretva (43^{0}00'82'' N; 17^{0}28'26'' E) situated on the south-eastern Adriatic coast. The Neretva river is 218 km long, with a source located deeply in the hinterland of Bosnia and Herzegovina. Its discharge into the Adriatic Sea has created a vast delta whose surface area covers a total of 170 km^2. The Neretva river stretches through two countries, Croatia and Bosnia and Herzegovina, 30% of it belonging to the latter. Average monthly temperatures vary from 8 ^{o}C in February to 24 ^{o}C in August. Salinity varies from 4 to 21 in winter, while from 21 to 24 in summer. The sampled habitat types mainly comprised very shallow areas with relatively high water transparency, with clean sandy bottoms. The mouth of the Mala Neretva River is closed by a dam that prevents the inflow of salt water into the upper agricultural part of the estuary. The sampling site was downstream from the dam, where marine conditions dominate, although the inflow of freshwater and polluted water pumped from the agricultural complex is constant. This leads to daily and seasonal changes of temperature and salinity at the sampling site. Average monthly temperatures varied from 9 ^{o}C in February to 25 ^{o}C in August. The winter temperatures were affected by the inflow of freshwater that was colder (7.4 ^{o}C) than the seawater (11.4 ^{o}C) during this period. Salinity varied from 4 to 38 during the winter but, due to the low freshwater inflow, only from 30 to 38 in the summer. The sampled habitat types mainly comprised very shallow areas with relatively low transparency, with sandy and sandy-muddy bottoms overgrown by meadows of *Cymodocea nodosa* and *Zostera noltii*.

As part of a larger study (Project "Systematic study of the Adriatic sea as a basis for sustainable development of the Republic of Croatia") to examine the effects of human activities on fish communities of the estuarine areas, Y-O-Y catches were carried out from January 2003 to February 2005 (seasonal sampling periods, eight samplings per site). At each site specimens were collected using two types of sampling methods: a) qualitative – quantitative sampling using a 50 m long beach seine, and b) qualitative sampling using a quadrangular hand net along the shoreline. The sampled habitat types mainly comprised very shallow areas with relatively low water transparency, with seagrass meadows not occurring in very dense patches while displaying the soft dominant substrate (muddy and muddy-sandy sediments). Y-O-Y individuals were identified to species level in the laboratory although large specimens (total length >50 mm) were identified *in situ* and released thereafter. Some individuals of each species were preserved and deposited in the ichthyological collection of the Institute of Oceanography and Fisheries in Split.

RESULTS AND DISCUSSION

Young-of-the-Year in the littoral zone of the investigated areas comprises a highly diverse fish community composed of 68 species representing 28 families listed according to IUCN 2006 (Table 1).

Gobiidae represent the most diverse family followed by Sparidae, Mugilidae and Soleidae. Moreover, more than 64.7% (44 species) of the Y-O-Y species caught are among the species that form the main targets for commercial fisheries in the southern Adriatic. This fact emphasises

Table 1. List of taxa collected from sampling sites in littoral shallows of the Neretva and Mala Neretva river estuaries from January 2003 to February 2005

Family	Species	Conservation status IUCN (2006)
Poecilidae	*Gambusia holbrooki* (Girard, 1846)	NE
Ameiuridae	*Ameiurus nebulosus* (Le Sueur, 1819)	NE
Salmonidae	*Salmo trutta* (Linnaeus, 1758)	NE
Cyprinidae	*Cyprinus carpio* (Linnaeus, 1758)	NE
	Carassius auratus gibelio (Bloch, 1783)	NE
	Leuciscus svallize (Heckel and Kner, 1858)	VU
Clupeidae	*Sardina pilchardus* (Walbaum, 1792)	NE
	Alosa fallax (Lacepède, 1803)	NE
Engraulidae	*Engraulis encrasicolus* (Linnaeus, 1758)	NE
Anguillidae	*Anguilla anguilla* (Linnaeus, 1758)	NE
Belonidae	*Belone belone* (Linnaeus, 1761)	NE
Syngnathidae	*Syngnathus acus* (Linnaeus, 1758)	NE
	Syngnathus typhle (Linnaeus, 1758)	NE
	Nerophis ophidion (Linnaeus, 1758)	NE
Gadidae	*Gaidropsarus mediterraneus* (Linnaeus, 1758)	NE
Serranidae	*Serranus cabrilla* (Linnaeus, 1758)	NE
Moronidae	*Dicentrarchus labrax* (Linnaeus, 1758)	NE
	Dicentrarchus punctatus (Bloch, 1792)	NE
Pomatomidae	*Pomatomus saltator* (Linnaeus, 1766)	NE
Carangidae	*Trachinotus ovatus* (Linnaeus, 1758)	NE
	Lichia amia (Linnaeus, 1758)	NE
Mullidae	*Mullus barbatus* (Linnaeus, 1758)	NE
	Mullus surmuletus (Linnaeus, 1758)	NE
Sparidae	*Sparus aurata* (Linnaeus, 1758)	NE
	Diplodus annularis (Linnaeus, 1758)	NE
	Diplodus vulgaris (E Geoffroy Saint-Hilaire, 1817)	NE
	Diplodus puntazzo (Cetti, 1777)	NE
	Lithognathus mormyrus (Linnaeus, 1758)	NE
	Pagellus acarne (Risso, 1826)	NE
	Sarpa salpa (Linnaeus, 1758)	NE
Labridae	*Symphodus cinereus* (Bonnaterre, 1788)	NE
	Symphodus doderleini (Jordan, 1891)	NE
	Symphodus ocellatus (Forskål, 1775)	NE
	Symphodus roissali (Risso, 1810)	NE
Trachinidae	*Echiichthys vipera* (Cuvier, 1829)	NE
Gobiidae	*Gobius niger* (Linne, 1758)	NE
	Gobius cobitis (Pallas, 1814)	NE
	Gobius fallax (Sarato, 1889)	NE
	Gobuis geniporus (Valenciennes, 1837)	NE
	Knipowitschia panizzae (Verga, 1841)	NE
	Pomatoschistus marmoratus (Risso, 1810)	NE
	Pomatoschistus pictus (Malm, 1865)	NE
	Zosterisessor ophiocephalus (Pallas, 1811)	NE
Callionymidae	*Callionymus risso* (Le Suer, 1814)	NE
	Callionymus pusillus (Delaroche, 1809)	NE
Blenniidae	*Lipophrys pavo* (Risso, 1810)	NE

Table 1. Cont'd

Family	Species	Conservation status IUCN (2006)
	Parablennius gattorugine (Brünnich, 1768)	NE
	Parablennius sanguinolentus (Pallas, 1811)	NE
	Parablennius tentacularis (Brünnich, 1768)	NE
Ophidiidae	*Ophidion rochei* (Müller, 1845)	NE
Mugilidae	*Mugil cephalus* (Linnaeus, 1758)	NE
	Chelon labrosus (Risso, 1826)	NE
	Liza ramado (Risso, 1810)	NE
	Liza aurata (Risso, 1810)	NE
	Liza saliens (Risso, 1810)	NE
	Oedalechilus labeo (Cuvier, 1829)	NE
Atherinidae	*Atherina boyeri* (Risso, 1810)	DD
	Atherina hepsetus (Linnaeus, 1758)	NE
Triglidae	*Chelidonichthys lucernus* (Linnaeus, 1758)	NE
Bothidae	*Bothus podas* (Delaroche, 1809)	NE
	Arnoglossus laterna (Rafinesque, 1810)	NE
Pleuronectidae	*Pleuronectes platessa* (Linnaeus, 1758)	NE
	Platichthys flesus (Linnaeus, 1758)	NE
Soleidae	*Solea solea* (Linnaeus, 1758)	NE
	Solea aegyptica (Chabanaud, 1927)	NE
	Pegusa impar (Bonnett, 1831)	NE
	Synapturichthys kleinii (Risso, 1827)	NE
	Pegusa lascaris (Risso, 1810)	NE

*NE, not evaluated; VU, vulnerable; DD, deficient data

the importance of the shallow water habitats as a nursery ground for the fish. Shallow water areas also provide suitable food, shelter and a reduction of predation that has been well-documented all over the world (see DULČIĆ *et al*., 1997). The information on vulnerable species could be vital for further conservation studies to be carried out at the same locality. The endemic species *Leuciscus svalizze* is rare in the lower Neretva and it occurrs accidentally during high water levels of the river Neretva caused by heavily rain, while *Atherina boyeri* is a very common species in the investigated area. Such coastal lagoons support important commercial fisheries and exhibit a rich ichthyoplankton community (OLIVA-PATERNA *et al*., 2006). MATIĆ-SKOKO *et al*. (2007) found 47 species, belonging to 17 families in the Zrmanja river estuary (Adriatic Sea) indicating that this area is a very important nursery ground and a support for commercial fisheries. OLIVA-PATERNA *et al*. (2006) reported a highly diverse fish community composed of 45 species representing 30 genera and 19 families in the meso-saline coastal lagoon in Mar Menor (Iberian Peninsula). According to several accounts, estuaries provide essential nursery habitats for approximately two-thirds of the economically important fish species along the East Coast of the United States, both for recreational and commercial fisheries (BOESCH & TURNER, 1984).

Preliminary results from this study could be useful in gaining quantitative information on abundance, growth and survival of Y-O-Y from the surveyed areas in order to derive appropriate evaluations and recommendations for potential recovery management programmes and, over the long term, assist in the decision of whether fisheries enhancement measures make sense or

if environmental quality control of pollution input will have to be dealt with as a management priority. Following this study, we recommend further work to elucidate what aspects may influence the distribution and abundance of Y-O-Y in the littoral shallows of surveyed areas. The present study may also serve as a comparative species richness index against which future accounts may be assessed. Effective long-term management of this investigated area for optimizing benefits to all fish and wildlife resources will require an adaptive management strategy based on continued monitoring and periodic adjustment over the next few years.

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Popis mlađi riba ulovljenih u plitkom litoralnom području ušća Neretve i Male Neretve (istočni Jadran, hrvatska obala)

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SAŽETAK

Sastav ribljih vrsta, mlađ starosti 0^+ u plitkim litoralnim područjima ušća Neretve i Male Neretve, pokazuje izrazito visoki stupanj raznolikosti jedne riblje zajednice i zastupljen je sa 68 vrsta razvrstanih u 28 porodica. Porodica glavoča Gobiidae je najzastupljenija i za njom slijede ljuskavke Sparidae, cipli Mugilidae te listovi Soleidae. Štoviše, čak 44 vrste pripadaju onim ribljim vrstama koje imaju gospodarski značaj u ribarstvu južnog Jadrana.

Ključne riječi: mlađ riba, ušća, Neretva, Mala Neretva, istočni Jadran