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Scarcity of parasite assemblages in the Adriatic-reared European sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*)

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ABSTRACT

The shaping forces of parasite community structure still is the main subject in the ecological parasitology whilst community predictability and repeatability showed that hardly a generally applicable role is ever going to be assessed. Defining and describing parasite communities can be very useful from the epizootiological point, in order to help in the assessment of the medical and economical impact of certain parasitosis, moreover when hosts are economically valuable species. Since parasite assemblages in reared European sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*) in Adriatic cage systems can play an important role in the economic feasibility of the rearing process, we evaluated their character through assessing diversity indices, nestedness of parasite communities and their differences in respect to season and composition, as well as fish growth. We observed colonization of a new monogenean species (*Furnestinia echeneis*) and general impoverishment of parasites populations over time in the Adriatic-reared fish parasite assemblages. Parasite assemblages differed significantly between seasons for both fish species, while species richness, evenness, diversity indices and nestedness of parasitic communities in the sea bream showed to be significantly higher compared to those in the sea bass. Such characteristics define parasite communities of both Adriatic-reared fish as species poor although structured and ordered assemblages.

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1. Introduction

Previously almost neglected, in the last decade fish parasites have gained almost a central role in the research and understanding of spatial and temporal variations in species diversity. Since it is known that they are strongly affected by variety of ecological and evolutionary processes and thus prone to shifts in population structure, they are frequently subjected to ecological modeling that represents a good framework for incorporation of empirical and theoretical work (see Poulin, 1998; Poulin and Morand, 2004; Thomas et al., 2005 for review). They invade their hosts forming communities that can be observed and described from several hierarchical levels (Bush et al., 1997). The lowest community level is the infracommunity, composed of all parasite individuals of different species within one single host. As they are limited to only one individual, their maximum lifespan is equal to their host' lifespan, during which they are in constant turnover. All parasites species inhabiting a host population at a certain moment make component community, representing a local source of parasites from the infracommunity. Each component community is comprised in the highest hierarchical level – parasite fauna, having rather artificial then biological notation (Poulin, 2004). Based on the characteristics of infra- and component community, parasite assemblages can be

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defined as species poor, with rare interactions; highly rich and interactive communities or, more usual, somewhere between the two extremes (Holmes and Price, 1986). The shaping forces of parasite community structure still are the main subject in the ecological parasitology (Poulin, 1998; Poulin and Morand, 2004), whilst community predictability and repeatability showed that hardly a generally applicable role is ever going to be assessed (Rohde et al., 1998; Poulin and Valtonen, 2001, 2002; Timi and Poulin, 2003).

Defining and describing parasite communities also can be very useful from the epizootiological point, in order to help in the assessment of the medical and economical impact of certain parasitosis (Anderson, 1998; Bouloux et al., 1998; Rousset et al., 1996), moreover when hosts are economically valuable reared species in aquaculture system, as it is the case with the European sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*). Parasitic infections in these two species cultured in the Mediterranean have been the topic of many researches, showing high number and abundance of parasitic species (Christophilogiannis, 1992; Rodgers and Furones, 1998; Le Breton, 1999; Scholz, 1999; Mladineo, 2003; Mladineo et al., 2008). In Adriatic cage-reared systems however, previous study showed parasite communities to be stable and impoverished stochastic assemblages, poor in species richness at infra- and component community level (Mladineo, 2005, 2006). Observed moderate to high abundances proved that the rearing system provides ideal conditions for the exploitation and easy spread among hosts, indicating monogenean trematodes as predominant parasitic group affected by seasonal oscillations. These monogeneans belonged to specialist (*Dipleactanum aequans*, Monophystocotylea and *Sparicotyle chrysophrii*, Polyophisthocotylea) or generalist (*Lamellodiscus elegans*, Monophystocotylea) species (Mladineo, 2004) with the affinity for transmission among phylogenetically related host (Mladineo and Maršić-Lučić, 2007). Since their life cycle is simple and direct, it enables easy transfer from host to host, mediated by higher fish density in the captive conditions. From the pathological point of view, *D. aequans* and *S. chrysophriii* are considered as threatening pathogens able to induce hemorrhages, necrosis, depletion and secondary bacterial infections of affected gill lamellae, with subsequent decrease in growth rate or mortalities (Cecchini et al., 1998; Mladineo, 2004; Sitjà-Bobadilla and Alvarez-Pellitero, 2009). The rest of isolated parasitic groups in Adriatic cage-reared fish included Myxozoa (*Ceratomyxa sparusaurati*, *Sphaerospora dicentrarchi*, *Polysporoplasma sparis*, *Myxobolus* sp.), Ciliophora (*Cryptocaryon irritans*, *Trichodina* sp.), Nematoda (*Anisakis* sp.) and Copepoda (*Caligus minimus*). Interestingly, only the isopod *Ceratothoa oestroides* and *Amyloodinium ocellatum* (Mastigophora) were commonly shared between all sampled host species.

Since studies of parasite communities in reared marine fish have been rarely done even though their actors can play an important role in the economic feasibility of the rearing process, our aim was to evaluate their character in a typical Adriatic finfish farm rearing sea bass and sea bream. We have done this by assessing diversity indices and nestedness of parasite communities, their differences in respect to season and composition, as well as fish growth.

2. Materials and methods

2.1. Sampling

European sea bass (*D. labrax*) (in total $N = 151$) and sea bream (*S. aurata*) (in total $N = 145$) were sampled from a semi offshore netpen at the aquaculture facility in the central part of east Adriatic Sea (N 45°18′ E 16°27′), from September 2008 to 2009. The same fish population (aged 1+) was sampled once in every three months ($\sim N = 30$), always from the same cage. Temperature was measured by Seabird-25 CTD probe. Collected fish were put on ice and brought within hours in the laboratory. After recording biometrical measures, parasitological examination was done as described earlier (Mladineo, 2005). Briefly, fresh smears were taken from gills, skin and fins, from three different parts of alimentary duct (pyloric area, middle intestine and rectal part, gall bladder), spleen, liver, gonads and kidney. The number of protozoan was recorded only as presence/absence, thus only prevalence was calculated. Gill monogeneans were counted from each gill arch under the stereomicroscope, isolated and identified. Fish condition index was calculated using Fulton's index K: $K = (W/L^3) \times 100$, where W is total body weight and L is total length.

Ecological terms describing parasitological dynamic were used according Margolis et al. (1982). Prevalence, intensity and abundance were calculated according to Bush et al. (1997). Sterne's exact 95% confidence limits were calculated for prevalences, bootstrap 95% confidence limits (number of bootstrap replications = 2000) for mean abundances and exponent of the negative binomial (k) for the parasite skewness, using Quantitative Parasitology 3.0 software (Reiczigel and Rózsa, 2005). Since parasite individuals typically exhibit an aggregated (right-skewed) distribution among host individuals, the negative binomial distribution represents the observed data following the maximum-likelihood method (Bliss and Fisher, 1953).

2.2. Statistical analysis

The difference of parasite assemblages in two fish species (sea bass, sea bream) was tested between year seasons using ANOVA. Five samplings were done seasonally, starting from the summer 2008, ending with the summer 2009. The experimental design incorporated factor "time of year" (Summer2008, Autumn2008, Winter2009, Spring2009 and Summer2009) which was considered as fixed factor. Before ANOVA, heterogeneity of variance was tested with Cochran's C-test and the data were subsequently $\log(x + 1)$ transformed (Underwood, 1997). *Post hoc* Student-Newman-Kuel (SNK) test was used if significant differences were found.

Non-parametric multivariate techniques were used to compare parasite compositions of the assemblages. All multivariate analyses were preformed using the PRIMER statistical package. Triangular similarity matrices were calculated using the Bray-Curtis similarity coefficient (Clarke

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