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Parasitic inventory of *Balistes capriscus* (Teleostei: Balistidae) from the Gulf of Gabès (Southern Tunisia, Central Mediterranean Sea)

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ABSTRACT

Objective: To investigate the parasitic inventory of *Balistes capriscus* (Teleostei: Balistidae) (*B. capriscus*) from the Gulf of Gabès (Southern Tunisia, Central Mediterranean Sea).

Methods: A parasitological survey of the grey triggerfish *B. capriscus* (Gmelin, 1788) from the Gulf of Gabès (Southern Tunisia, Central Mediterranean Sea) was conducted monthly from May 2007 to April 2009. A total of 480 fishes were collected from commercial catches by pelagic trawl net at different fishing ports at Chebba (34°14' N, 11°06' E), Kerkennah (34°45' N, 11°17' E) and Zarzis (33°41' N, 11°48' E). The weight, the size, the sex, the date and the area of capture of each specimen were recorded. *B. capriscus* were then examined to search for ectoparasites and endoparasites. For each parasite species, parasitological indices were calculated.

Results: Five species of parasites were identified, among which a new species of Digenea *Hypocreadium caputvadum* was discovered and two species of parasites were reported for the first time in the Mediterranean.

Conclusions: It is the first inventory of the ecto and endoparasites of grey triggerfish collected from the Gulf of Gabès Mediterranean Sea.

1. Introduction

The balistid fishes *Balistes capriscus* (Gmelin, 1789) (*B. capriscus*) is an amphi-Atlantic fish widely found in the tropical and temperate waters[1]. This species is common in the Southern Mediterranean Sea[2] and appears to have extended its distribution area northwards due to global warming[3]. It is associated with artificial reef structures and natural hard bottom substrate[4]. *B. capriscus* has a very wide bathymetric distribution occurring near the bottom as well as near the surface of the sea (usually 15-50 m in depth in coastal waters).

Although several studies have been carried out on the parasites of *B. capriscus*, captured from the Atlantic Ocean[5], no data was reported on the parasites from the Mediterranean water. Thus, this study is an attempt to develop an inventory of the parasitic helminths of *B. capriscus* in the Gulf of Gabès (Southern Tunisia, Central Mediterranean Sea). The result of this work could be used as baseline study for future monitoring activities. The potential of using this parasite inventory as environmental indicators of heavy metals was presented in separate study[6].

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2. Materials and methods

The investigation of parasites was performed on 480 specimens of *B. capriscus* having a fork length ranging from 139 to 427 mm. Fish samples were collected monthly from May 2007 to April 2009. Specimens were captured, using pelagic trawl net from different areas of the Gulf of Gabès: Chebba (34°14' N, 11°06' E), Kerkennah (34°45' N, 11°17' E), Zarzis (33°41' N, 11°48' E) (Figure 1). Fishes were put individually in sealed plastic bags at 4 °C.

In the laboratory, fishes were identified using Fisher[7] and Whitehead[8]. The weight, size, sex, date and place of capture of each specimen were recorded and examined for ectoparasites.

Using a hand lens, areas around the fins, nostril, operculum and the buccal cavity were examined for external parasites. The operculum of each specimen was opened and the inner

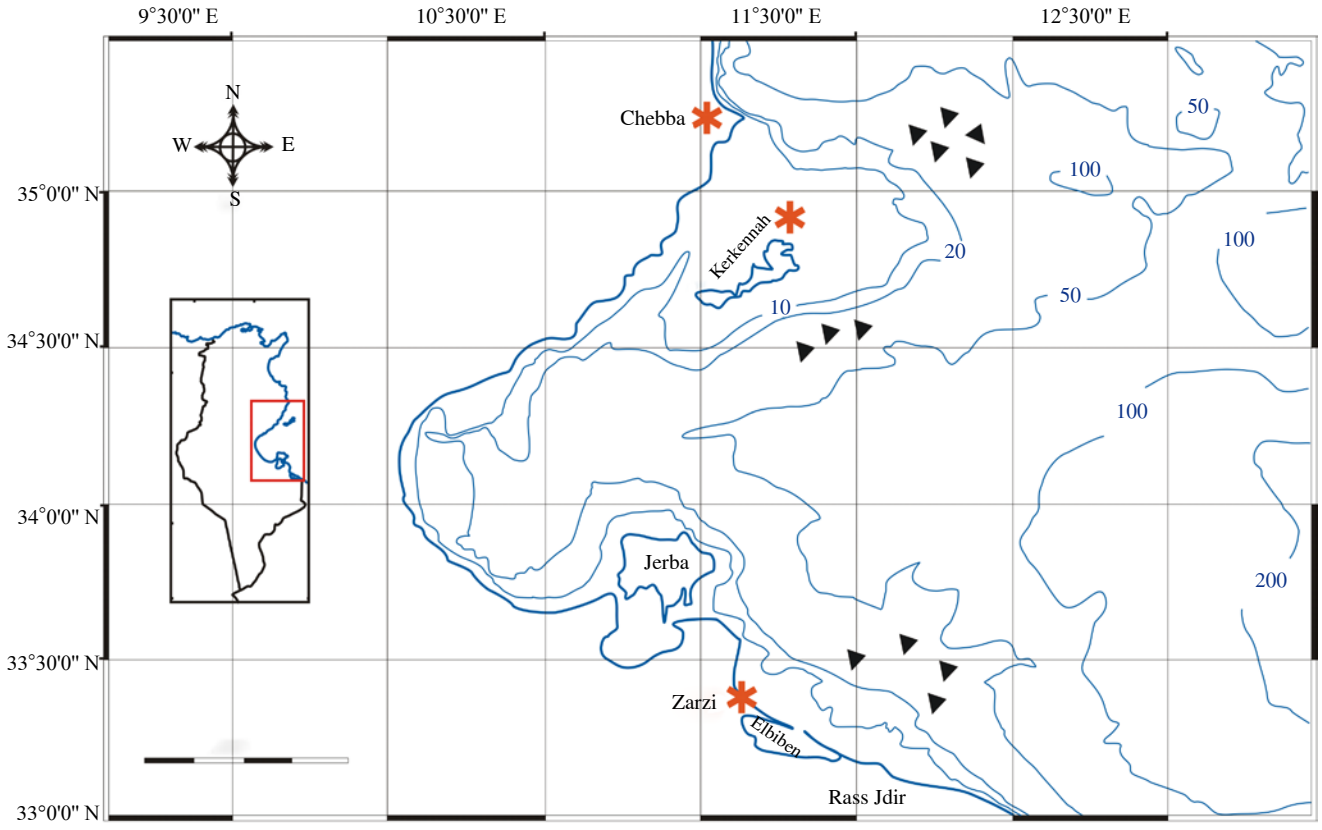

Figure 1. Map of the Gulf of Gabès.

side each gill arch were removed and placed in Petri dishes containing filtered seawater was examined under the dissecting microscope.

Monogeneans were detected using a stereomicroscope, detached from the gills and operculum and then transferred to a dish containing filtered seawater. They were studied either alive or fixed between slide and coverslip in 70% alcohol. Fixed specimens were stained with Semichon's acetic carmine. After dehydration through a graded ethanol series, specimens were cleared with clove oil and mounted in Canada balsam. Some fixed specimens were mounted in Berlese's fluid in order to study the haptoral sclerites and the genital armature.

Copepods which were attached to the gill filaments were fixed and preserved in ethanol (70%). Before being dissected, they were cleared and stained in lactophenol. Copepods were studied using stereo and light microscopy. Parasites species identification was based on morphological features according to Yamaguti, Kabata and Ho and Kim.

Digenea were washed in physiological saline water, slightly flattened between slide and cover slip and fixed in 70% alcohol or 5% formalin. Some living specimens were washed in cold saline then fixed in hot saline and preserved in 5% formalin. Whole mounts for light microscopy were stained with Semichon's acetic carmine, dehydrated using a graded ethanol series, cleared in clove oil, and mounted in Canada balsam. Parasites species identification was based on morphological features according to Gibson.

For each parasite species, prevalence, abundance and mean intensity were calculated according to Bush[9].

One-way ANOVA (with Tukey HSD *post-hoc* tests) was used to analyze the variation of parasitological indices between the three parasites class. Statistical significance level was evaluated at $P<0.05$.

3. Results

Five species of parasites were collected. Three of them were found on the gills, namely a species of *Ancyrocephalus balisticus* (Monogenea: Ancyrocephalidae) (*A. balisticus*)[10] and two species of Copepoda including *Taeniacanthus balistae* (Taeniacanthidae) (*T. balistae*)[11] and *Naobranchia variabilis* (Lernaeopodidae) (*N. variabilis*)[12].

The remaining two species of Digenea which belong to two distinct families were collected in the intestine. They were *Hypocreadium caputvadum* (Lepocreadiidae) (*H. caputvadum*)[5] and *Neoapocreadium chabaudi* (Apocreadiidae) (*N. chabaudi*)[13].

The highest abundance, mean intensity level infestation of *B. capriscus* was well linked to Monogenea *A. balisticus* ($P=0.001$, $P=0.002$ respectively) than Digenea and Copepod species (*H. caputvadum*, *N. chabaudi* and *T. balistae*, *N. variabilis*, repectively). The parasitic analysis of the gills of *B. capriscus* has demonstrated a rise in the monogenic *A. balisticus* compared to the two species of copepods (Figure 2, Table 1).

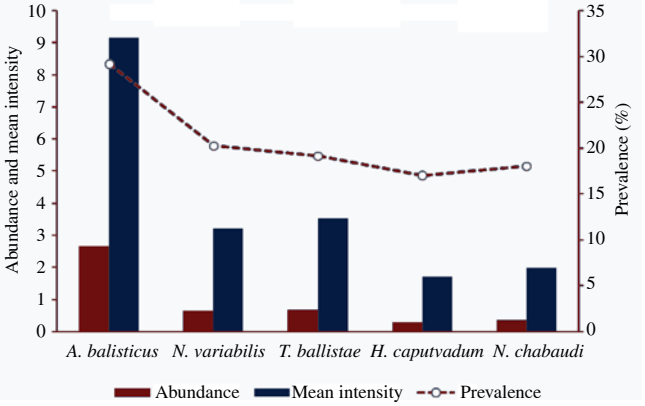

Figure 2. Variation in prevalence, mean abundance and mean intensity for each parasite of *B. capriscus*.

Table 1
Analysis of variance (ANOVA) testing for parasite class differences.

Source		*df*	MS	*F*	*P*	Tukey test
Abundance	Parasite class	2	1.955	1623.922	0.001	M>C>D
	Residual	2	0.001			
Mean intensity	Parasite class	2	18.343	449.825	0.002	M>C>D
	Residual	2	0.041			
Prevalence	Parasite class	2	46.740	82.291	0.012	M>C=D
	Residual	2	0.568			

M: Monogenea; C: Copepoda; D: Digenea.

4. Discussion

The present parasitological study of *B. capriscus* is a pioneering work representing an inventory of the parasites of grey triggerfish in the Gulf of Gabès, Southern Tunisia, Central Mediterranean Sea. In fact, the obtained results have confirmed the presence of five species of parasites.

A. balisticus was reported on the gills of *B. capriscus* fished from the Gulf of Mexico[13]. It is for the first time that this parasite is reported on *B. capriscus* caught from the gulf of Gabès, Mediterranean Sea.

The *N. variabilis* Brian[12] is commonly found in the Atlantic Ocean for many fish species belonging to several families such as (*Lagocephalus laevigatus*), Serranidae (*Centropristes striatus*, *Diplectrum formosum*), Pomadasyidae (*Haemulon plumieri*), Monacanthidae (*Ceratacanthus schoepfi*), Diodontidae (*Chilomycterus spinosus*, *Chilomycterus atinga*, *Chilomycterus schepfi*), Ogcocephalidae (*Ogcocephalus* sp., *Ogcocephalus radiatus*) and Clupeidae (*Brevoortia paronus*)[14]. Furthermore, recently we report *N. variabilis* in the Mediterranean area but it was collected in other areas at the Atlantic[14] and in India[15].

T. balistae was found for the first time on the gill filaments *Balistes* sp. by Claus[11]. This copepod was also reported in *Alutera monoceros*, *Stephanolepis setifer*, *Stephanolepis hispidus*, *Diodon hystrix*, *Canthidermis rotundatus*, *Cantherhines pullus*, *Balistes vetula* and *Aluterus heudelotii*[16] in different regions of the world such as Florida, Lebanon, Haiti , Philippine Islands, Alabama, the Gulf of Tunis and Belize.

The examination of the digestive tract of the harvested fish has allowed us to identify two species of trematodes belonging to two distinct families: Lepocreadiidae (*Hypocreadium caputvadum*) and Apocreadiidae (*Neoapocreadium chabaudi*). The latter has been reported in *Stephanolepis hispidus* on the coast of Brazil[13]. However, this investigation has confirmed its presence on *B. capriscus* for the first time in the Mediterranean area and particularly in the Gulf of Gabès.

The highest abundance, mean intensity level infestation of *B. capriscus* was well linked to Monogenea *A. balisticus* (P=0.001, P=0.002 respectively) than Digenea and Copepod species. This could be related to the gregarious behavior of the fish[17]. In fact, the bench behavior facilitates the transmission of parasites especially those having a direct cycle.

Conflict of interest statement

We declare that we have no conflict of interest.

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