INSTM Bulletin
Marine and Freshwater Sciences

Vol. 48, 2023, 69–78

Research Article

Preliminary inventory of metazoan parasites of the Lessepsian bluespotted cornetfish *Fistularia commersonii* in the Gulf of Gabès, Tunisia

Wiem BOUSSELLAA *[1, 2], **Hela DERBEL** [1] **& Lassad NEIFAR** [1]

[1] Sfax University. Faculty of Science of Sfax. Department of Life Sciences, Sfax, Tunisia
[2] Marine Turtle Research Group, Department of Marine Animal Conservation and Public Engagement, Stazione Zoologica Anton Dohrn, Via Nuova Macello 16, 80055 Portici, Italy

*Correspondence: wiem.bousellaa@szn.it

Received: 02/05/2023; **Accepted**: 29/10/2023; **Published**: 23/11/2023

Abstract: Biological invasions in the word are widely acknowledged as a serious threat to biodiversity, but the role of parasites in marine ecosystem processes is still poorly understood. Among these invasions we are interested in the present work in the parasitofauna of bluespotted cornetfish *Fistularia commersonii* introduced species through the Suez Canal from the Red Sea to the Mediterranean Sea and so-called Lessepsian migration. 43 specimens of *F. commersonii* were sampled from the Gulf of Gabès. Parasite prevalence and intensity were investigated. Moreover, we reviewed the literature to identify native and invasive parasite species recorded. Eleven parasite species infecting *Fistularia commersonii* from the Gulf of Gabès were found. Our results suggest the co-introduction of five parasite species one Acanthocephala *Sclerocollum* sp., four Digenea *Allolepidapedon petimba*, *Neoallolepidapedon hawaiiense*, *Ectenurus* virgulus; Stephanostomum sp. that are assumed to be originate from the Red Sea. In addition, six parasites have been acquired from the Mediterranean Sea two Cestoda Phyllobothriidae and *Nybelinia Africana, one Digenea Lecithochirium* sp., one Hirudinea *Trachelobdella lubrica, one* Isopoda *Gnathia* sp. and one Nematoda *Hysterothylacium* sp. These results show the importance of using parasite community studies, such as the one described here, to understand the role of parasites in Lessepsian migration.

Keywords: Metazoan parasites; Lessepsian migration; *Fistularia commersonii*; Gulf of Gabès; Tunisia; Mediterranean.

1. Introduction

The influx of Red Sea species into the Mediterranean Sea via the Suez Canal has been well documented (Golani, 1998). Among all taxa, fish have been the most studied, due to their commerciaimportance and their relatively clear taxonomy.

The bluespotted cornetfish, *F. commersonii* is an Indo-Pacific and Red Sea species (Fritzsche, 1976). This species has spread rapidly throughout the Mediterranean to be one of the most successful invaders in the Mediterranean Sea (Streftaris & Zenetos, 2006). Firstly, it was recorded in the Eastern Mediterranean coasts (Golani,

2000) and in a short time, it spread until reaching the Western Basin of the Mediterranean Sea in the Gulf of Sicily (Pipitone et al., 2004), Tunisian coast (Ben Souissi *et al.,* 2004), Sardinia (Pais et al., 2007), and in 2007, it reached the sea of Alboran (Sanchez-Tocino *et al.,* 2007), which is the furthest point than a migrant lessepsien has never been recorded since its introduction (CIESM, 2009). Genetic studies have shown that this successful invasion was the result of a single introduction episode that resulted in a serious bottleneck of the Mediterranean population (Golani *et al.,* 2007).

Many researchers were interested in documenting the presence of this Lessepsian sprinter fish along the Mediterranean coasts. Other investigations focused on the population structure of the species (Bariche, & Kajajian, 2012), biological data (Edelist, 2014; Castriota et al., 2014; Mouine-Oueslatia et al., 2017), diet (Bariche, 2007; Bariche et al., 2009; Kalogirou et al., 2007), reproduction (Bariche et al., 2013), length-weight relationships (Taskavak & Bilecenoglu, 2001; Erguden et al., 2009) and maximum length (Torcu Koc et al., 2019). At present, few data have been published on the parasites of *F. commersonii*. In the Mediterranean Sea, two parasitological study was published by Pais *et al.* (2007) and Merella *et al.* (2016), adding new information on the parasite fauna of this migrant fish. However, no studies have been done in the Tunisian coasts. Here we investigated metazoan parasite infections in the Lessepsian fish *F. commersonii* Rüppel, 1838, along the Tunisian coast. By sampling this invasive fish along the Gulf of Gabès, and by conducting an additional parasitological literature survey, we aimed to provide baseline information on the parasite fauna of *F. commersonii* from Tunisian coast.

2. Material and Methods

Between 2014 and 2016, 43 specimens (28 females and 15 males) of *Fistularia commersonii* were collected from different fishing area in the Gulf of Gabès; Tunisia (Figure1).

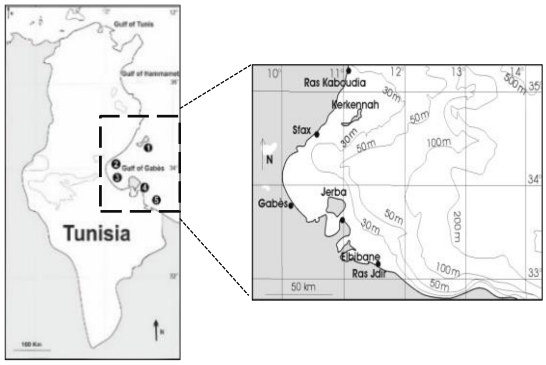

Figure 1. Sampling Location of *F. commersonii* in the Gulf of Gabès, Tunisia (Central Mediterranean Sea).

Location names, coordinates, sampling dates and sampling effort per species are mentioned in the Table1.

Fish skin, fins, nasal pits, eyes and buccal cavities were thoroughly examined under a stereomicroscope with incident light for the presence of ectoparasites. Gill arches were separated by incision, removed, rinsed and examined individually. Internal organs (stomach, pyloric caeca, intestines, rectum, heart, liver, spleen, gall bladder and gonads) were separated and individually examined for the presence of endoparasites. Parasites were identified to the lowest taxonomic level possible Parasites were identified to the lowest taxonomic level possible using Gibson et al. (2002) for Digenea, the keys of Kabata (2003) for Copepoda, Berland (1961) and Petter & Maillard (1988) for Nematoda and Euzet (1994) for Cestoda. We searched literature databases for published records of additional parasite species from the Mediterranean Sea and the Red Sea. Parameters of infection such as prevalence (P) and mean intensity (MI) were determined following Bush et al. (1997).

3. Results and discussions

Based on samples from the Tunisian coasts, eleven parasite species infecting *Fistularia commersonii* were found. (Table2). Our results suggest that the Lessepsian migrant has co-introduced five parasite species to the Tunisian coasts one Acanthocephala *Sclerocollum* sp., four Digenea *Allolepidapedon petimba*, *Neoallolepidapedon hawaiiense*, *Ectenurus* virgulus; *Stephanostomum* sp. and four elsewhere in the Mediterranean Sea (Merella et al., 2016), that are assumed to be originate from the Red Sea. In fact, the two exotic Digenea *A. petimba* and *N. hawaiiense* are the two most prevalent parasites in the Gulf of Gabès (100% and 70%, successively) and the non-native Digenea *A. petimba* has the highest intensity (IM = 62) in the Gulf of Gabès In spite of their heteroxenous life cycle, these parasites seem to be co-introduced in the Mediterranean Sea. This successful introduction can be explained that parasites had found suitable hosts and environmental conditions to complete the life cycle in the new habitat or their intermediate hosts are already co-introduced in the Mediterranean Sea and their life cycle has been achieved (Boussellaa *et al.,* 2017). However, the fact that all the specimens of these parasites were retrieved at the adult stage could also suggest a residual infection that took place before of the host migration. In addition, we found that the invasive fish has acquired six parasites in the Tunisian coasts two Cestoda Phyllobothriidae and *Nybelinia Africana, one Digenea Lecithochirium* sp., one Hirudinea *Trachelobdella lubrica, one* Isopoda *Gnathia* sp., one Nematoda *Hysterothylacium* sp. that are assumed native in the Mediterranean Sea. Introduced fish are naive hosts to native parasites (Colautti et al. 2004). Therefore, native parasites could represent an important source of selection against migrants (MacColl & Chapman, 2010). The high infection parameters of *F. commersonii* parasites found in the Mediterranean Sea, suggesting a potential competitive advantage and confirm that this species is today one of the most successful invaders of the Mediterranean Sea.

4. Conclusion

According to our research, the Lessepsian migrant may have an impact on native fish hosts by changing the population dynamics of local parasite species through parasite co-introduction, and parasite acquisition, leading to higher infection levels in invaded areas. The success of *F. commersonii* which is the only Lessepsian fish that shows a severe bottleneck in the Mediterranean Sea which offer in the new habitat a rich parasite assemblage that which could potentially infect it even more than in its native area.

Table 1. Information on the sampling design of *Fistularia commersonii* collected for this study from the Gulf of Gabès. Given are the location name, geographic coordinates, sampling dates and sample sizes (per sex).

Location number	Location name	Geographic coordinates	Sampling dates	*Fistularia commersonii*	
				Females (Size min-max) (cm)	**Males (Size min-max) (cm)**
1	Kerkennah	34° 39′ 29″ N 11° 04′ 07″ E	17/09/2014 16/10/2014 15/02/2016	6 (79.5-87)	2 (74.5-78.3)
2	Skhira	34° 17′ 57″ N 10° 04′ 11″ E	13/10/2014	3 (78.5-85.6)	1 (86.8)
3	Zarat	33° 39' 59" N 10° 20' 59" E	05/02/2014 01/12/2014 25/07/2015	8 (82-93.5)	4 (67.5-99)
4	Zarzis	33° 30′ 14″ N 11° 06′ 43″ E	25/07/2015	6 (71.7-89.2)	2 (72.4-79.8)
5	El-Keteef	35° 40' 7" N 10° 53' 32" E	17/06/2014 08/11/2014	5 (78.6-90.5)	6 (73.5-85)
		Total		**28**	**15**

Table 2. Parasite species found in this study and recorded in the literature, with information on the life cycle and the invasive/native status in the Mediterranean Sea and occurrence in *Fistularia commersonii* from the Mediterranean Sea. If quantitative data were available, prevalence and mean intensity (± SE) are given.

Parasite taxa	Parasite species	Infection site	Status Med. Sea	*Fistularia commersonii* P (%)	*Fistularia commersonii* MI	Référence
Acanthocephala	*Sclerocollum* sp.	Intestine	invasive	9.3	1.25(±0.06)	This study
	Breizacanthus ligur	Intestine	native	17.6	1.5	Merella et al. (2016)
Cestoda	Phyllobothriidae	Intestine	native	41.86	69.11(±14.85)	This study
	Nybelinia africana	Stomach	native	30.23	25.38 (±3.58)	This study
	Pseudogrillotia sp.	Intestine	native	23.5	1.9	Merella et al. (2016)
	Dasyrhynchus basipunctatus	Intestine	invasive	-	-	Beveridge et al. (2014)
Copepoda	*Caligus fistulariae*	Mouth cavity	invasive	-	-	Merella et al. (2016
	Caligus elongatus	Mouth/gills	native	5.9	1	Merella et al. (2016)
	Caligus minimus	Mouth	native	2.9	1	Merella et al. (2016)
	Caligus flexispina	Mouth	invasive	-	-	Rigby et al. (1999)
Digenea	*Allolepidapedon petimba*	Stomach/Intestine	invasive	100%	61.72(±9.81)	This study
	Neoallolepidapedon hawaiiense	Stomach	invasive	69.76	3.46 (± 0.48)	This study
	Ectenurus virgulus	Stomach	invasive	18.60	1(± 0.06)	This study
	Lecithochirium sp.	Stomach	Native	23.25	1.4 (± 0.1)	This study
	Stephanostomum sp.	Intestine	invasive	16.28	1.14(± 0.07)	This study
	Allolepidapedon fistulariae	Stomach/Intestine	invasive	66.7	7.5	Merella et al. (2016)
	Bucephalidae	Intestine	native	2.9	3	Merella et al. (2016)
	Hemiuridae	Stomach	native	2.9	1	Merella et al. (2016)
	Trematoda (juvenile)	Stomach	native	2.9	1	Merella et al. (2016)
	Trematoda (metacercaria)	Stomach	native	8.8	1.3	Merella et al. (2016)
	Lecithochirium microstomum	Stomach	native	-	-	Rigby et al. (1999)
Hirudinea	*Trachelobdella lubrica*	Mouth/gills	native	20.93	1 (± 0.06)	This study
Isopoda	*Gnathia* sp.	Mouth/gills	native	13.95	3.16(± 0.23	This study
Nematoda	*Hysterothylacium* sp.	Body cavity/digestive tract	native	69.76	8.73(± 2)	This study
	Hysterothylacium aduncum	Body cavity/digestive tract	native	8.8	2.3	Merella et al. (2016)
	Hysterothylacium fabri	Body cavity/digestive tract	native	41.2	5.1	Merella et al. (2016)
	Spinitectus sp.	Intestine	native	8.8	1.3	Merella et al. (2016)
	Cystidicolidae	Stomach	native	2.9	1	Merella et al. (2016)
	Philometridae	Stomach	native	2.9	1	Merella et al. (2016)

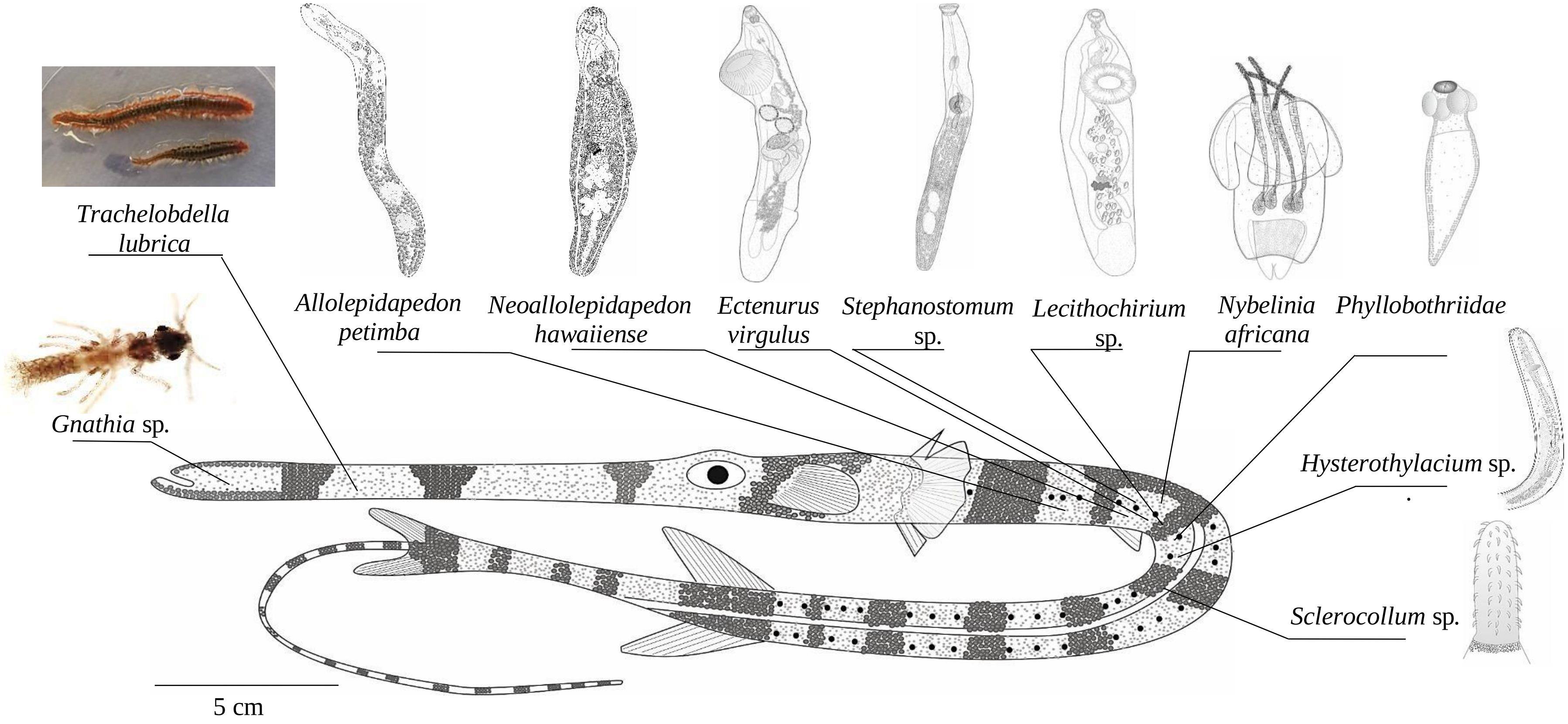

Figure 2. Parasites collected from *Fistularia commersonii* from the Gulf of Gabès

Acknowledgments

We thank Dr. Maroof Khalaf and Dr. Tariq Al-Najjar from the Faculty of Marine Sciences, Department of Aqaba Marine Biology and all fishermen of Gulf of Gabès for their help during literature investigation and the fish sampling mission. We thank Pr. Lassad Neifar and Dr. Hela Derbel for their useful comments on parasite identification.

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