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PARASITES AND THEIR HOST FISH IN THE GULF OF BEJAIA, ALGERIAN COAST

Souhila Ramdani, Zouhir Ramdane

Laboratoire de la Zoologie Appliquée et Ecophysiologie Animale, Faculté Sciences de la Nature et de la Vie, Université Abderrahmane Mira-Bejaia, Algérie
Corresponding author. Email: souhilaramdani.dz@gmail.com, souhila.ramdani@univ-bejaia.dz
Souhila Ramdani: https://orcid.org/0000-0003-4436-2620

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Abstract. A total of 1643 specimens of 15 fish species belonging to 8 families, from three different study sites off the Algerian coast (the Gulf of Bejaia, the Soummam River and the aquaculture farm of Beni Ksila) were examined for their parasites. The examined fish species play host to several taxa of parasites, especially metazoans such as six digeneans (25.39%), three monogeneans, one acanthocephalan (20 %), five nematodes (13.48 %), three cestodes (11.58%) and nine crustaceans (9.77%). Only one protozoan parasite, *Glugea* sp. was collected and identified (45.52%). Three species (*Opechona ollsoni*, *Dichelyne* (*Cucullanellus*) *pleuronectidis*, *Hysterothylacium reliquens*) are new to the Algerian coastal parasite fauna. The highest parasite infestation rates with a prevalence of 100%, were recorded in *Trachinus draco* and *Xiphias gladius* followed by *Mullus barbatus* and *Sardinella aurita* with a prevalence of 91.67% and 87.62%, respectively. No infection with parasites was found in the fish species from brackish waters (Soummam River) and from the aquaculture farm (Beni Ksila).

INTRODUCTION

Food and Agriculture Organization (2018) recognizes the importance of fish and numerous fishery products not only for food security and nutrition, but also, through fish production and trade, for economic growth, poverty alleviation and job creation in rural areas. Due to its ability to address food needs, the fishing sector in Algeria is considered to be an economic activity in its own right (Benghali 2015). A total of 67 species belonging to 22 families and 46 genera are known from Algerian continental waters (Lounaci-Daoudi et al. 2016).

Parasitism has various detrimental consequences on the health of fish (Price 1980). It can even affect their nutritional quality. Fish parasites are important determinants of the general health of their hosts, they are good indicators of host biology, environmental pollutants and structure of food chains (Sindermann 1989).

In this context, parasite biodiversity can be very important, because parasitism plays key roles in ecosystems, regulating the abundance or density of host populations, stabilizing food webs and structuring animal communities (Poulin and Morand 2004). Thus, comprehensive knowledge of parasite diversity is crucial for environmental management and conservation (Poulin 2004).

Parasitological studies on Algerian fishes in the Mediterranean region, date back to long ago; ichthyoparasitological research in this region was exclusively taxonomic, this was the result of studies conducted in particular areas (Brahim Tazi et al. 2009; Merzoug et al. 2012; Ider et al. 2014; Ramdani et al. 2020, 2021a, b, 2022a, b, 2023; Ramdani 2023; Bensaada et al. 2023).

In the last years, a remarkable effort has been made to catalogue Algerian fish parasites through numerous regional check-lists, including almost all known main groups of parasites and the scope of these contributions has increased significantly (Ichalal et al. 2017; Hadjou et al. 2017; Ider et al. 2018; Saadi et al. 2020; Ramdani et al. 2023; Ramdani 2023). At the same time, the number of papers dealing with ichthyopathological and histopathological aspects of fish parasites in Algerian waters has increased (Saadi et al. 2019; Ramdani et al. 2021a, b, 2022a, b; Bensaada et al. 2023).

Here, we present and describe the parasite diversity of fishes off the Algerian coast. Our objectives were to analyze the richness of parasitic species and to evaluate host epidemiological characters by calculating infection indices, because these data are fundamental for future marine aquaculture. These characters will be compared with those reported in other studies. These analyses allow revealing the possible influence of local factors on the known parasite diversity and on parasitological research.

MATERIALS AND METHODS

A total of 1643 specimens of fish belonging to fifteen species, which are most commonly consumed by the local population, are economically important for the region and are available on the market, were sampled from commercial landings in the Gulf of Bejaia, off the eastern coast of Algeria (the Gulf of Bejaia 36°45'21.13" N, 5°05'3.59" E, Soummam River 36°43'36" N, 5°04'41" E and the aquaculture farm of Beni Ksila 36°52'57" N, 4°39'43" E), from 2017 to 2019. The length (TL), total mass (Wt) and sex of each fish specimen were recorded. In the laboratory (University of Bejaia), the specimens were examined for parasites both externally and internally. The external examination for ectoparasites was done by visual inspection of the body surface, fins, buccal and branchial cavities, and gills. Endoparasites were examined through dissection of the abdominal cavity, intestine, stomach, caecum, esophagus, liver, and gonads. The collected parasites were cleaned in water and preserved in pure ethanol for subsequent identification, and were photographed under a light microscope (LEICA DM300). The parasites were identified under the stereomicroscope and the light microscope, using identification keys based on their morpho-anatomic characteristics (Williams and Bunkley-Williams 1996). Host-fish species were identified using FishBase (https://www.fishbase.se/search.php) as a reference. Parasitological indexes (P (%): Prevalence; Im: Mean intensity; Am: Mean abundance), were calculated according to Bush et al. (1997) (Table 1).

RESULTS

A total of 28 parasite species including 27 metazoan taxa and one protozoan taxon were found in 1643 specimens of 15 teleost fish species, 3 species of which were uninfected (Table 1). The parasites recovered from the infected fishes included 9 crustaceans, 6 digeneans, 5 nematodes, 3 monogeneans, 3 cestodes (3), 1 acanthocephalan (1), and 1 protozoan (microsporidian) (Table 2).

Among the collected parasites, 12 were ectoparasites, recovered from gills, pectoral and pelvic fins, represented by 3 species of monogeneans: *Tristoma coccineum* (Cuvier, 1817), *Tristoma integrum* (Diesing, 1850), *Gotocotyla acanthophallus* (MacCallum and MacCallum, 1913). The highest infection rates were recorded for *Tristoma coccineum* and *Tristoma integrum* with a prevalence of 20%, respectively, infecting *Xyphias gladius* (Linnaeus, 1758) (Xiphiidae Swainson, 1839). All 9 species of crustaceans were ectoparasites: *Clavellisa emarginata* (Krøyer, 1873), *Naobranchia cygniformis* Hesse, 1863, *Peroderma Cylindricum* (Heller, 1865), *Peniculus minuticaudae* (Shiino, 1956), *Peniculus fistula fistula* (Nordmann, 1832), *Pennella instructa* (Wilson, 1917), *Argulus vittatus* (Rafinesque-Schmaltz, 1814), *Hatschekia mulli* (Van Beneden, 1851), *Ceratothoa oestroides* (Risso, 1816). The crustacean *Pennella instructa* infecting *Xyphias gladius* (Linnaeus, 1758) (Xiphiidae Swainson, 1839) exhibited the highest infection rates with the prevalence of 60%. *Clavellisa emarginata*, which was found infecting the fish *Sardinella aurita* (Valencienne, 1847) (Clupeidae Cuvier, 1817), showed the lowest infection rates (P = 3.81%).

Endoparasites were represented by 6 species of digeneans: *Aphanurus stossichii* (Monticelli, 1891), *Aphanurus virgula* (Looss, 1907), *Hemiurus communis* (Odhner, 1905), *Parahemiurus merus* (Linton, 1910), *Opecoeloides furcatus* (Bremser in Rudolphi, 1819), *Opechona ollsoni* (Yamaguti, 1934). The highest infection rates with a prevalence of 42% were recorded for *Aphanurus*

Table 1. Parasitological indexes, infestation rates of the examined host-fish species.

Host species	NEF	NIF	NP	P (%)	Im	Am
Sardinella aurita (Valencienne, 1847)	525	460	1972	87.62	4.29	3.76
Sardina pilchardus (Walbaum, 1792)	415	92	198	22.17	2.15	0.48
Alosa alosa (Linnaeus, 1758)	50	42	180	84	4.29	3.60
Engraulis encrasicolaus (Linnaeus, 1758)	200	04	07	02	1.75	0.04
Trachurus trachurus (Linnaeus, 1758)	50	30	142	60	4.73	2.84
Boops boops (Linnaeus, 1758)	105	47	60	44.76	1.28	0.57
Pagellus acarne (Risso, 1827)	60	32	82	53.33	2.56	1.37
Trachinus draco (Linnaeus, 1758)	30	30	259	100	8.63	8.63
Thunnus thynnus (Linnaeus, 1758)	05	01	01	20	01	0.20
Xiphias gladius (Linnaeus, 1758)	05	05	15	100	03	3.00
Mullus barbatus (Linnaeus, 1758)	120	110	440	91.67	04	3.67
Mullus surmuletus (Linnaeus, 1758)	20	14	43	70	3.07	2.15
Mugil cephalus (Linnaeus, 1758)	40	00	00	00	00	00
Cyprinus carpio (Linnaeus, 1758)	08	00	00	00	00	00
Sparus aurata (Linnaeus, 1758)	10	00	00	00	00	00
Total: 15	1643	867	3399	53.09	3.92	2.08

NEF: Number of the examined fishes; **NIF:** Number of the infested fishes; **NP:** Number of parasites; **P (%):** Prevalence; **Im:** Mean intensity; **Am:** Mean abundance.

Table 2. Parasitological indexes, infections rates of parasite species records per host fish.

Parasites Species	Host species	NEF	NIF	NP	P (%)	Im	Am
Monogeneans							
Tristoma coccineum Cuvier, 1817	*Xiphias gladius* (Linnaeus, 1758)	05	01	04	20	04	0.80
Tristoma integrum Diesing, 1850	*Xiphias gladius* (Linnaeus, 1758)	05	01	03	20	03	0.60
Gotocotyla acanthophallus (MacCallum and MacCallum, 1913)	*Boops boops* (Linnaeus, 1758)	105	12	05	11.43	0.42	0.05
	Trachurus trachuus (Linnaeus, 1758)	50	06	10	12	1.67	0.20
Digeneans							
Aphanurus stossichii (Monticelli, 1891)	*Sardinella aurita* (Valencienne, 1847)	525	189	225	36	1.19	0.43
	Alosa alosa (Linnaeus, 1758)	50	21	45	42	2.14	0.90
	Engraulis encrasicolus (Linnaeus, 1758)	200	01	01	0.50	01	0.01
	Boops boops (Linnaeus, 1758)	105	18	17	17.14	0.94	0.16
Aphanurus virgula Looss, 1907	*Sardinella aurita* (Valencienne, 1847)	525	189	206	36	1.09	0.39
	Alosa alosa (Linnaeus, 1758)	50	21	21	42	01	0.42
Hemiurus communis Odhner, 1905	*Sardinella aurita* (Valencienne, 1847)	525	189	143	36	0.76	0.27
	Alosa alosa (Linnaeus, 1758)	50	21	17	42	0.81	0.34
Parahemiurus merus (Linton, 1910)	*Sardinella aurita* (Valencienne, 1847)	525	189	215	36	1.14	0.41
	Alosa alosa (Linnaeus, 1758)	50	21	23	42	1.10	0.46
Opecoeloides furcatus (Bremser in Rudolphi, 1819)	*Mullus barbatus* (Linnaeus, 1758)	120	27	96	22.50	3.56	0.80
	Mullus surmuletus (Linnaeus, 1758)	20	03	06	15	02	0.30
Opechona ollsoni (Yamaguti, 1934)	*Mullus barbatus* (Linnaeus, 1758)	120	27	109	22.50	4.04	0.91
	Mullus surmuletus (Linnaeus, 1758)	20	03	08	15	2.67	0.40
Cestoda							
Scolex pleuronectis Müller, 1788	*Sardina pilchardus* (Walbaum, 1792)	415	58	113	13.98	1.95	0.27
	Boops boops (Linnaeus, 1758)	105	05	07	4.76	1.40	0.07
	Trachurus trachurus (Linnaeus, 1758)	50	03	11	06	3.67	0.22
Acanthobothrium sp.	*Sardina pilchardus* (Walbaum, 1792)	415	58	31	13.98	0.53	0.07
Diphyllobothrium sp.	*Boops boops* (Linnaeus, 1758)	105	05	08	4.76	1.60	0.08
Crustaceans							
Clavellisa emarginata (Krøyer, 1873)	*Sardinella aurita* (Valencienne, 1847)	525	20	203	3.81	10.15	0.39
	Alosa alosa (Linnaeus, 1758)	50	15	28	30	1.87	0.56
Naobranchia cygniformis Hesse, 1863	*Boops boops* (Linnaeus, 1758)	105	08	02	7.62	0.25	0.02
	Trachurus trachurus (Linnaeus, 1758)	50	08	18	16	2.25	0.36
Peroderma Cylindricum (Heller, 1865)	*Sardina pilchardus* (Walbaum, 1792)	415	34	64	8.19	1.88	0.15
Peniculus minuticaudae Shiino, 1956	*Mullus barbatus* (Linnaeus, 1758)	120	32	42	26.67	1.31	0.35
Peniculus fistula fistula Nordmann, 1832	*Mullus barbatus* (Linnaeus, 1758)	120	32	27	26.67	0.84	0.23
	Mullus surmuletus (Linnaeus, 1758)	20	06	11	30	1.83	0.55
Pennella instructa (Wilson, 1917)	*Xiphias gladius* (Linnaeus, 1758)	05	03	05	60	1.67	01
Argulus vittatus (Rafinesque-Schmaltz, 1814)	*Boops boops* (Linnaeus, 1758)	105	08	03	7.62	0.38	0.03
	Trachurus trachurus (Linnaeus, 1758)	50	08	33	16	4.13	0.66
Hatschekia mulli (Van Beneden, 1851)	*Mullus barbatus* (Linnaeus, 1758)	120	32	11	26.67	0.34	0.09
Ceratothoa oestroides (Risso, 1816)	*Boops boops* (Linnaeus, 1758)	105	08	02	7.62	0.25	0.02
	Alosa alosa (Linnaeus, 1758)	50	15	19	30	1.27	0.38
	Mullus barbatus (Linnaeus, 1758)	120	32	12	26.67	0.38	0.10
Nematoda							
Anisakis simplex (Rudolphi, 1809)	*Alosa alosa* (Linnaeus, 1758)	50	06	27	12	4.50	0.54
	Engraulis encrasicolus (Linnaeus, 1758)	200	03	06	1.50	02	0.03
	Trachurus trahurus (Linnaeus, 1758)	50	13	39	26	03	0.78
	Boops boops (Linnaeus, 1758)	105	04	09	3.81	2.25	0.09
	Pagellus acarne (Risso, 1827)	60	32	27	53.33	0.84	0.45
Hysterothylacium aduncum (Rudolphi, 1802)	*Sardinella aurita* (Valencienne, 1847)	525	12	23	2.29	1.92	0.04
	Pagellus acarne (Risso, 1827)	60	32	13	53.33	0.41	0.22
	Mullus barbatus (Linnaeus, 1758)	120	51	40	42.50	0.78	0.33
	Mullus surmuletus (Linnaeus, 1758)	20	05	18	25	3.60	0.90
	Trachinos draco (Linnaeus, 1758)	30	30	122	100	4.07	4.07
	Xiphias gladius (Linnaeus, 1758)	05	01	02	20	02	0.40
Hysterothylacium reliquens (Norris and Overstreet, 1975)	*Mullus barabatus* (Linnaeus, 1758)	120	51	44	42.50	0.86	0.37
Hyterothylacium fabri (Rudolphi, 1819)	*Pagellus acarne* (Risso, 1827)	30	32	31	106.67	0.97	1.03
	Mullus barbatus (Linnaeus, 1758)	120	51	59	42.50	1.16	0.49
	Trachinos draco (Linnaeus, 1758)	30	30	111	100	3.70	3.70
	Boops boops (Linnaeus, 1758)	105	04	05	3.81	1.25	0.05
	Trachurus trachurus (Linnaeus, 1758)	50	13	41	26	3.15	0.82
Dichelyne (Cucullanellus) pleuronectidis (Yamaguti, 1935)	*Pagellus acarne* (Risso, 1827)	60	32	29	53.33	0.91	0.48
	Trachinos draco (Linnaeus, 1758)	30	30	26	100	0.87	0.87
Acanthocephala	*Thunnus thynnus* (Linnaeus, 1758)	05	01	01	20	01	0.20
Protozoan (Microspodian, *Glugea* sp.)	*Sardinella aurita* (Valencienne, 1847)	525	239	957	45.52	04	1.82

NEF: Number of the examined fishes; **NIF:** Number of the infested fishes; **NP:** Number of parasites; **P (%)**: Prevalence; **Im:** Mean intensity; **Am:** Mean abundance.

stossichii, *Aphanurus virgula*, *Hemiurus communis* and *Parahemiurus merus* infecting *Alosa alosa* (Linnaeus, 1758) (Clupeidae Cuvier, 1817). The rates (P = 0.5%) of the host species *Engraulis encrasicolus* (Linnaeus, 1758) (Engraulidae Gill, 18611) infection with *Aphanurus stossichii* were the lowest. The highest rates (P = 13.98%) of infection with 3 species of the identified cestodes (Scolex *pleuronectis* Müller, 1788, *Acanthobothrium* sp., and *Diphyllobothrium* sp. *Scolex pleuronectis* and *Acanthobothrium* sp.) were determined in *Sardina pilchardus* (Walbaum, 1792) (Alosidae Svetovidov, 1952). The identified five species of nematodes were: *Anisakis simplex* (Rudolphi, 1809), *Hysterothylacium aduncum* (Rudolphi, 1802), *Hysterothylacium reliquens* (Norris and Overstreet, 1975), *Hyterothylacium fabri* (Rudolphi, 1819) and *Dichelyne* (*Cucullanellus*) *pleuronectidis* (Yamaguti, 1935). The highest rates of infection with the parasite *Hysterothylacium aduncum* were recorded in the host species *Trachinos draco* (Linnaeus, 1758) (Trachinidae Rafinesque, 1815) (P = 100%), and the lowest rates of infection with Anisakis simplex (P = 1.50%) were found in the host species *Engraulis encrasicolus* (Linnaeus, 1758) (Engraulidae Gill, 18611). One acantocephalan (unidentified species) with a prevalence of 20% and one microsporidian protozoan (*Glugea* sp.) (P = 45.52%) were recovered from various organs and regions: abdominal cavity, intestine, stomach, cecum, esophagus, liver, and gonads.

Infection rates of the recorded parasites are shown in Table 2 and their sites of infection are presented in Table 4. The highest number of parasites was found in the host *Sardinella aurita* (Valencienne, 1847) (Clupeidae Cuvier, 1817), which had 1972 records (Table 1). Parasitological records clearly show that most host fish species have between 1 and 9 parasite records (Table 2). The host species *Sardinella aurita* (Valencienne, 1847) (Clupeidae Cuvier, 1817), *Trachurus trachurus* (Linnaeus, 1758) (Carangidae Rafinesque, 1815) and *Boops boops* (Linnaeus, 1758) (Sparidae Rafinesque, 1818) show a diverse parasitic community (Table 3). *Mugil cephalus* (Linnaeus, 1758) (Mugilidae Jarocki, 1822), *Cyprinus carpio* (Linnaeus, 1758) (Cyprinidae Rafinesque, 1815) and *Sparus aurata* (Linnaeus, 1758) (Sparidae Rafinesque, 1818) from freshwater and the aquaculture farm had no parasites.

Infestation rates differed among the examined fish species. However, the highest rates with a prevalence of 100% were recorded in *T. draco* and *X. gladius* followed by *Mullus barbatus* (Linnaeus, 1758) (Mugilidae Jarocki, 1822) and *S. aurita* with a prevalence of 91.67% and 87.62% respectively.

Fish were found to be highly infested with the following parasite species: digeneans with a prevalence of 25.39%, followed by monogeneans and acanthocephala with a prevalence of 20%, nematodes with the prevalence of 13.48%, cestodes with that of 11.58%, and crustaceans with the prevalence of 9.77%.

DISCUSSION

The identified parasites are mainly represented by metazoans with only one identified protozoan. Among the parasites identified, three species are new to the Algerian coastal parasite fauna: the digenean *Opechona ollsoni*, and the nematodes *Dichelyne* (*Cucullanellus*) *pleuronectidis* and *Hysterothylacium reliquens*.

Table 3. Distribution of parasite groups with the number of parasite specimens recorded in host-fish species off the Algerian coast.

Host species	Mono	Dig	Cest	Crus	Nema	Acan	Pro	Total
Sardinella aurita (Valencienne, 1847)	0	789	0	203	23	0	957	1972
Sardina pilchardus (Walbaum, 1792)	0	0	134	64	0	0	0	198
Alosa alosa (Linnaeus, 1758)	0	106	0	47	27	0	0	180
Engraulis encrasicolaus (Linnaeus, 1758)	0	1	0	0	6	0	0	07
Trachurus trachurus (Linnaeus, 1758)	10	0	11	51	70	0	0	142
Boops boops (Linnaeus, 1758)	5	17	15	7	16	0	0	60
Pagellus acarne (Risso, 1827)	0	0	0	0	82	0	0	82
Trachinus draco (Linnaeus, 1758)	0	0	0	0	259	0	0	259
Thunnus thynnus (Linnaeus, 1758)	0	0	0	0	0	1	0	01
Xiphias gladius (Linnaeus, 1758)	7	0	0	5	3	0	0	15
Mullus barbatus (Linnaeus, 1758)	0	205	0	92	143	0	0	440
Mullus surmuletus (Linnaeus, 1758)	0	14	0	11	18	0	0	43
Mugil cephalus (Linnaeus, 1758)	0	0	0	0	0	0	0	00
Cyprinus carpio (Linnaeus, 1758)	0	0	0	0	0	0	0	00
Sparus aurata (Linnaeus, 1758)	0	0	0	0	0	0	0	00
Total: 15	22	1132	160	480	647	1	957	3399

Mono: Monogeneans, **Dig:** Digeneans, **Cest:** Cestoda, **Crus:** Crustaceans, **Nema:** Nematoda, **Acan:** Acanthocephala, **Pro:** protozoan.

Table 4. List of parasite species according to the site of infection.

Parasites	Groups	Species/ family	Site of infection
Ectoparasites	Monogeneans	*Tristoma coccineum* Cuvier, 1817 *Tristoma integrum* Diesing, 1850 *Gotocotyla acanthophallus* (MacCallum and MacCallum, 1913)	Gills Branchial cavities
	Crustaceans	*Clavellisa emarginata* (Krøyer, 1873) *Naobranchia cygniformis* Hesse, 1863	
		Peniculus minuticaudae Shiino, 1956 *Peniculus fistula fistula* Nordmann, 1832 *Argulus vittatus* (Rafinesque-Schmaltz, 1814) *Hatschekia mulli* (Van Beneden, 1851)	Pectoral fins Pelvic fins
		Ceratothoa oestroides (Risso, 1816)	Buccal cavity
Mesoparasites		*Peroderma Cylindricum* (Heller, 1865) *Pennella instructa* (Wilson, 1917)	Inserted and embedded into the muscle
Endoparasites	Digeneans	*Aphanurus stossichii* (Monticelli, 1891) *Aphanurus virgula* Looss, 1907 *Hemiurus communis* Odhner, 1905 *Parahemiurus merus* (Linton, 1910) *Opecoeloides furcatus* (Bremser in Rudolphi, 1819) *Opechona ollsoni* (Yamaguti, 1934)	Abdominal cavity Intestine Stomach Caecum Esophagus Liver Gonads
	Cestoda	*Scolex pleuronectis* Müller, 1788 *Acanthobothrium* sp. *Diphyllobothrium* sp.	
	Nematoda	*Anisakis simplex* (Rudolphi, 1809) *Hysterothylacium aduncum* (Rudolphi, 1802) *Hysterothylacium reliquens* (Norris and Overstreet, 1975) *Hyterothylacium fabri* (Rudolphi, 1819) *Dichelyne (Cucullanellus) pleuronectidis* (Yamaguti, 1935)	
	Acantocephala	Rhadinorhynchidae Lühe, 1912	
	Protozoan	*Glugea* sp. Glugeidae Thélohan, 1892	

In our samples, the most abundantly represented parasites were crustaceans (9 species). Several species of parasites (particularly Isopods and Copepods) have already been reported off the eastern coast of Algeria by several other authors. Hafir-Mansouri et al. (2017) reported *Naobranchia cygniformis* on the host species *Sparus aurata* and *Peroderma cylindricum* infecting *Sardina pilchardus*. The parasite *Clavellisa emarginata* has been reported by Ramdani et al. (2020) on the fish host *Sardinella aurita*.

The copepod *P. instructa* has already been reported in *X. gladius* from off the Algerian coast by Ramdani et al. (2021a, b). It was recorded in the Mediterranean Sea off the coast of Italy by Mattiucci et al. (2005) and Massi et al. (2014); and off the coast of Turkey by Öktener et al. (2007, 2010). This parasite has also been recovered from other host species such as *Seriola dumerili* (Risso, 1810) in Turkey (Öktener 2009). The two recovered parasite species, *A. vittatus* and *C. oestroides*, have been previously collected from *Boops boops*, *Pagrus pagrus*, *Pagellus erythrinus*, *Sparus aurata* and *Mullus barbatus* (Ramdane et al. 2009; Ichalal et al. 2017 and Ider et al. 2014, 2018) from Algerian waters.

Among the parasitic digeneans already collected from Algeria, *A. stossichii*; *A. virgula*; *H. communis*; *P. merus* were collected from *Sardinella aurita* from western Algeria (Merzoug et al. 2012), *Trachurus trachurus* and *Boops boops* from eastern Algeria (Ichalal et al. 2017; Ider et al. 2018). Digenean *O. furcatus* was previously reported from *Mullus surmuletus* by Brahim-Tazi et al. (2009). The discovery of *O. ollsoni* in *M. barbatus* and *M. surmuletus* in our study represents a new host record of the parasite fauna off the Algerian coast.

The monogeneans *T. coccineum*, *T. integrum* were recovered from the gills of *X. gladius* while *G. acanthophallus* from the gills of *Trachurus trachurus* and *Boops boops*. These associations were recorded by Euzet and Quignard (1961) in France and by Ramdani et al. 2021b in Algeria.

The nematodes *A. simplex*; *H. aduncum*; *H. fabri* have already been reported by Ichalal et al. 2015 in *Trachurus trahurus* and *Boops boops*, by Hadjou et al. 2017 in *Pagellus acarne*, by Ider et al. 2018 in *Boops boops*, by Saadi et al. 2020 and Ramdani et al. 2022b in various fish species in Algeria. *Dichelyne (Cucullanellus) pleuronectidis* that was recovered from *Pagellus acarne* and *Trachinus draco* in Algeria is a new geographical record of the parasite as previously it was recovered from *Pleuronichthys cornutus* in the East China Sea.

We identified one protozoan microsporidian species (*Glugea* sp.), which has been already reported by Ramdani et al. (2022a). Only one acanthocephalan taxon was

identified, but the species remained unidentified.

It should be noted that in the fish species sampled from the Soummam River and in the fishes from the Beni Ksila aquaculture farm (*Mugil cephalus*, *Cyprinus carpio* and *Sparus aurata*), there was no infection observed. Several scientific studies have shown that parasites are more numerous and diverse in marine fishes (Falaise 2017). The increase in directly transmitted parasites appeared to be a compensatory increase in the abundance of their host (Wood et al. 2014). On the other hand, fish species from fresh or brackish waters harbor fewer parasites (Tahri et al. 2017; Bakaria et al. 2018; Attir 2018).

The prevalence of crustaceans in *X. gladius* was 60%, and in *A. alosa* and *M. surmuletus* 30%. Digeneans with a prevalence of 15.86% showed the second highest infection rate. In *A. alosa* and *S. aurita*, the prevalence of digeneans was 42% and 36%, respectively. Our results corroborate those reported by Derbel et al. (2012) and Feki et al. (2015) from Tunisia, who reported the same parasite species in *S. aurita*.

Infection rates of cestode larvae were low (below 5%). Ichalal et al. (2017) and Ider et al. (2018) reported these larvae with low prevalence in *T. trahurus* and *B. boops* off the Algerian east coast.

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