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Parasitologie

THE PARASITE FAUNA OF *TRACHURUS TRACHURUS* (LINNAEUS, 1758) (TELEOSTEI: CARANGIDAE) FROM THE EASTERN COAST OF ALGERIA

par

Keltoum ICHALAL [*1,2], Amirouche CHIKHOUNE [3],

Zouhir RAMDANE [2], Mokrane IGUER-OUADA [1]

& Mohammed KACHER [4]

963 specimens of horse mackerel, *Trachurus trachurus* (L.), were sampled between February 2013 and April 2014, and examined for parasites. Out of these, 25.12% were found to be parasitized. Nineteen parasite species were identified: 7 Digenea, 4 Isopoda, 3 Nematoda, 2 Monogenea, 2 Cestoda and 1 Copepoda. Five species were collected for the first time in the eastern coast of Algeria: *Scolex pleuronectis* (Muller, 1788), *Gastrocotyle trachuri* (Van Beneden & Hesse, 1863), *Pseudaxine trachuri* (Parona & Perugia, 1889), *Nybelinia* sp. and *Lecithochirium fusiforme* (Luche, 1901). Parasite specificity was variable in terms of both host and attachment site. *Anisakis simplex* (Rudolphi, 1809) and *Monascus filiformis* (Rudolphi, 1819) were the most abundant parasite species (P=9.96% and P=6.02%, respectively). The highest infection rates were observed in May 2013 (P=60%) and February 2014 (P=53.85%). Male and female hosts had a similar rate of infection (P=44.52% and P=43.50%, respectively). Our

1. Laboratoire Associé en Écosystèmes Marins et Aquacoles (LAEMA), Faculté des Sciences de la Nature et de la Vie, Université de Bejaia (06000), Algérie [ichalalk@gmail.com, imokrane@gmail.com].

2. Laboratoire de Zoologie Appliquée et d'Écophysiologie Animale, Faculté des Sciences de la Nature et de la Vie, Université de Bejaia (06000), Algérie [zohir22000@yahoo.fr].

3. Laboratoire d'Écologie Microbienne (LEM), Faculté des Sciences de la Nature et de la Vie, Université de Bejaia (06000), Algérie [chikhouneamirouche@gmail.com].

4. Centre National de Recherche et du Développement de la Pêche et de l'Aquaculture, Bousmaïl, Algérie [mohamed.kacher@gmail.com].

* Corresponding author: ichalalk@gmail.com

results show that parasitic infection increases proportionally with host size. A checklist of all metazoan parasites collected to date from *T. trachurus* is given.
Keywords: *Trachurus trachurus*, parasite fauna, parasitological indices, checklist, Algeria.

La parasitofaune de *Trachurus trachurus* (Linnaeus, 1758) (Téléostéen: Carangidae) de la côte est algérienne

Un nombre total de 963 spécimens du chinchard *Trachurus trachurus* (L.) ont été échantillonnés entre février 2013 et avril 2014 et examiné pour leur parasitofaune. 25,12 % des poissons examinés ont été infestés. Dix-neuf espèces de parasites ont été identifiées : 7 Digènes, 4 Isopodes, 3 Nématodes, 2 Monogènes, 2 Cestodes et 1 Copépode. Cinq espèces ont été signalées pour la première fois dans la côte Est de l'Algérie : *Scolex pleuronectis* (Muller, 1788), *Gastrocotyle trachuri* (Van Beneden et Hesse, 1863), *Pseudaxine trachuri* (Parona et Perugia, 1889), *Nybelinia* sp. et *Lecithochirium fusiforme* (Luche, 1901). La spécificité des parasites est variable vis-à-vis de l'hôte et du site de fixation. *Anisakis simplex* (Rudolphi, 1809) et *Monascus filiformis* (Rudolphi, 1819) sont les parasites les plus abondants (P = 9,96 % et P = 6,02 %, respectivement). Les taux d'infestation les plus élevés ont été observés en mai 2013 (P = 60 %) et en février 2014 (P = 53,85 %). Les mâles et les femelles ont des taux d'infection similaires (P = 44,52 % et P = 43,50 %, respectivement). Nos résultats ont montré que l'infestation parasitaire augmente proportionnellement à la taille de l'hôte. Une liste de tous les parasites métazoaires collectés jusqu'à présent chez *T. trachurus* a été établie.

Mots-clés : *Trachurus trachurus,* parasitofaune, indices parasitologiques, liste, Algérie.

Introduction

The Horse mackerel, *Trachurus trachurus* (L.), is a semi-pelagic species that is distributed widely in all oceanic waters of moderate tropical and subtropical seas. It is also present in the northeastern Atlantic, from the Bay of Biscay to Mauritania, in the Black Sea and, especially, in the Mediterranean (BEKTAS *et al*., 2009). Despite its economic importance (ABAUNZA *et al*., 2008), studies concerning the biology and parasitology of this species are scarce. According to a study conducted by MACKENZIE *et al*. (2004) in Atlantic waters, horse mackerel hosts many species of parasites. The list established by these authors reports that horse mackerel has a fairly varied parasitic fauna. Otherwise, studies in the Atlantic and the Black Sea (GESTAL & AZEVEDO, 2005; OĞUZ & ÖKTENER, 2007; PEKMEZCI *et al*., 2012; MANSOUR *et al*., 2013) suggest a geographic specificity in *T. trachurus* parasites. This specificity of their distributions can serve the objective of identifying stocks of horse mackerel through its various habitats. The works of KABATA, 1979; ADROHER *et al*., 1996; BENMANSOUR & BEN HASSINE, 1997; CHARFI-CHEIKHROUHA *et al*., 2000; ABAUNZA *et al*., 2004; ABAUNZA *et al*., 2008; MACKENZIE *et al*., 2008; ICHALAL *et al*., 2015; ICHALAL *et al*., 2016, conducted in the Atlantic, the northern and southern of the Mediterranean, have well attested it.

Five topics were particularly studied: the parasites' biodiversity, their infestation rates, their impact on the condition of the host, the risks posed by some patho-

genic parasites (like Nematoda) on the health of consumers, and stock discrimination (fisheries management).

In Algeria, the parasite fauna of horse mackerel was largely unknown previously. Only some Crustacean parasites had been reported (NUNES-RUIVO, 1954; RAMDANE *et al.,* 2007; RAMDANE & TRILLES, 2007).

The aims of the present study are to complete the list of metazoan parasites species infecting Algerian horse mackerel and provide a checklist of all metazoan parasites collected to date from *T. trachurus*.

Material and methods

963 specimens of *Trachurus trachurus* (L.) were randomly sampled from the eastern coast of Algeria with a scientific ship, during the ALDEM 2013 survey (Figure 1), from February 2013 to April 2014. The total length was measured for each specimen. Subsequently, its sex was recorded and inspections of the internal organs and muscles were carried out under a stereoscope to detect parasites. The parasites obtained were photographed under a light microscope, measured using a graduated eyepiece, drawn with a camera Lucida and preserved in 70% alcohol for detail examination and identification on the basis of their morphology and anatomy using the following identification keys: HURST (1984), LARIZZA & VOVLAS (1995), SHIH & JENG (2002) and MORSY *et al*. (2013) for Nematoda; LLEWELLYN

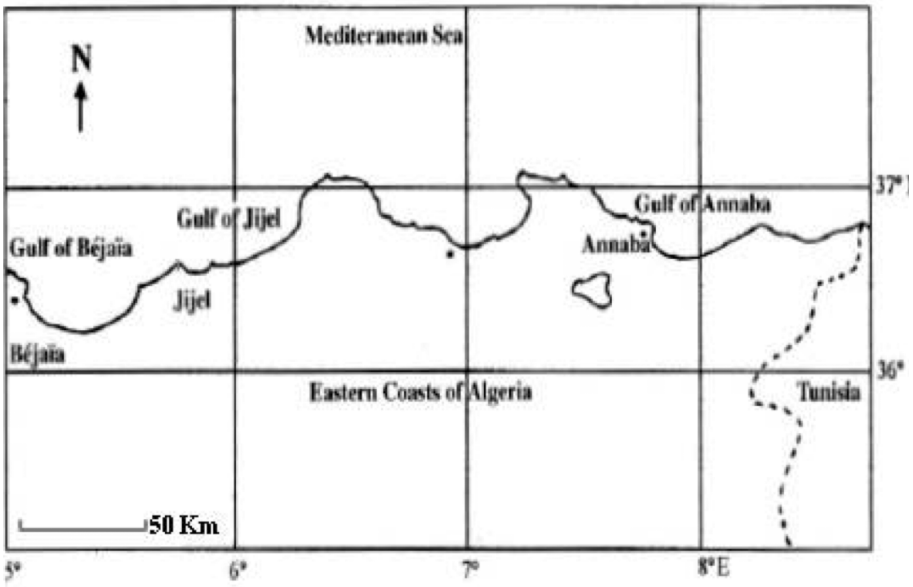


Figure 1

Map of the study area, eastern coast of Algeria (from RAMDANE *et al.,* 2008).
Le site d'étude: côte Est de l'Algérie (d'après RAMDANE et al., *2008).*

(1959, 1962) for Monogenea; BRAY & GIBSON (1980, 1990), GIBSON & BRAY (1979, 1986), GIBSON (1996), BRAY & CRIBB (1998), GIBSON *et al*. (2002) and BARTOLI & BRAY (2004) for Digenea; YAMAGUTI (1963), KABATA (1979), VIDJAK *et al*. (2008) and RAMDANE (2009) for Crustacea; and PALM (1997, 1999) for Cestoda.

Parasitological indexes were calculated according to MARGOLIS *et al*. (1982) and BUSH *et al*. (1997). The prevalence (%) and mean intensity according to month, sex and size classes were assessed with the Chi-square test (χ^2) and Student test, respectively, using Microsoft Office Excel 2007 software.

Results

Metazoan parasite species collected on *Trachurus trachurus* (L.)

A total of 446 parasites was obtained, representing 19 identified species. These belong to 6 parasitic groups (Table 1). Ectoparasites are represented by 7 species (1 Copepoda, 4 Isopoda and 2 Monogenea), whereas endoparasites were more diverse, with 12 species (2 Cestoda, 7 Digenea and 3 Nematoda). One specimen of Acanthocephala remains unidentified. The measurements performed on the collected specimens of Digenea and Monogenea are given in Table 2.

In the present study, some parasite species are reported (Table 1) for the first time from either the eastern coast of Algeria [*Scolex pleuronectis* (Muller, 1788), *Nybelinia* sp., *Pseudaxine trachuri* (Parona & Perugia, 1889) and *Gastrocotyle trachuri* (Van Beneden & Hesse, 1863)), or the Bejaia Gulf (*Ectenurus lepidus* (Looss, 1907), *Hemiurus communis* (Odhner, 1905), *Monascus filiformis* (Rudolphi, 1819), *Opechona* sp. (Looss, 1907), *Prodistomum polonii* (Molin, 1859), *Lecithochirium fusiforme* (Luche, 1901) and *Pseudopecoeloides chloroscombri* (Fischthal & Thomas, 1970)].

Our results (Table 1) show that *T. trachurus* hosts many and diverse parasite species in Algerian waters. The Digenea were the most abundant group in terms of numbers of species, but we found that larval nematodes were the most abundant parasites in terms of numbers of individuals.

We found that *T. trachurus* is most often infested by *Anisakis simplex* (Nematoda) (P=9.97%), followed by the digenean *Monascus filiformis* (P=6.02%) (Table 1). Infection rates of these two parasite species were statistically different (DDL=19; α=5%; χ^2=808.66, P=0.02). The other parasite species have relatively low prevalence ranging from 0.10% to 1.35%. It should be noted that the parasitic load of *A. Simplex* and *Pseudodaxine trachuri* is quite higher compared to other parasite species (mean intensity ranging from 1.86 to 2.45 parasites per infected fish) (Table 1). Abundance values do not exceed 0.24 parasites per examined fish; this is likely for all collected parasites species.

The sites of attachment are variable and the most frequent were the digestive tract where Nematoda, Digenea, Cestoda and Acanthocephala were collected, followed by the gills which constituted the favorable environment for Monogenea and

The parasite fauna of *Trachurus trachurus* from eastern Algeria

Table 1

Parasitological indices and specificity of the parasite species collected from 963 specimens of *T. trachurus*. *Indices parasitologiques et spécificité des espèces de parasites collectées*.

Parasite species	NIF	NP	P(%)	Im	A	FS	SP
Digenea							
Ectenurus lepidus (Looss, 1907)*	8	9	0.831	1.125	0.009	DT	Euryxenic
Hemiurus communis (Odhner, 1905)*	2	3	0.208	1.500	0.003	DT	Euryxenic
Lecithochirium fusiforme (Luche, 1901)*	3	3	0.312	1.000	0.003	DT	Euryxenic
Monascus filiformis (Rudolphi, 1819)*	58	88	6.023	1.517	0.091	DT	Euryxenic
Opechona sp. (Looss, 1907)*	2	3	0.208	1.500	0.003	DT	Euryxenic
Prodistomum polonii (Molin, 1859)*	13	15	1.350	1.154	0.016	DT	Euryxenic
Pseudopecoeloides chloroscombri (Fischthal & Thomas, 1970)*	9	10	0.935	1.111	0.010	DT	Euryxenic
Unidentified Digenea	10	10	1.038	1.000	0.010	DT	-
Monogenean							
Gastrocotyle trachuri (Van Beneden & Hesse, 1863)**	12	16	1.246	1.333	0.017	G	Oixenic
Pseudaxine trachuri (Parona & Perugia, 1889)**	7	13	0.727	1.857	0.013	G	Euryxenic
Unidentified Monogenea	6	6	0.623	1.000	0.006	G	-
Nematoda							
Anisakis simplex (Rudolphi, 1809)	96	236	9.969	2.458	0.245	DT /Go	Euryxenic
Hysterothylacium aduncum (Rudolphi, 1802)	11	16	1.142	1.455	0.017	DT	Euryxenic
Hysterothylacium sp (Ward & Magath, 1917)	6	6	0.623	1.000	0.006	DT	Euryxenic
Cestoda							
Nybelinia sp.**	1	1	0.104	1.000	0.001	DT	Euryxenic
Scolex pleuronectis (Muller, 1788)**	3	3	0.312	1.000	0.003	DT	Euryxenic
Isopoda							
Anilocra phesodes (Milne Edwards, 1840)	1	1	0.104	1.000	0.001	S	Euryxenic
Ceratothoa paralella (Otto, 1828)	1	1	0.104	1.000	0.001	BC	Euryxenic
Ceratothoa oestroides (Risso, 1826)	2	2	0.208	1.000	0.002	BC	Euryxenic
Gnathia sp.	1	1	0.104	1.000	0.001	G	Euryxenic
Copepoda							
Peniculus fistula (Von Nordman, 1832)	2	2	0.208	1.000	0.002	F	Euryxenic
Acanthocephala							
Unidentified Acanthocephala	1	1	0.104	1.000	0.001	DT	-

NIF: Number of infected fish; **NP**: Number of parasites; **P**: Prevalence; **Im**: Mean intensity; **A**: Abundance; **FS**: Fixing site; **SP**: Specificity; **DT**: Digestive tract; **G**: Gills; **F**: Fins; **BC**: Buccal cavity; **S**: Surface; **Go**: Gonads.*: Newly collected in the Gulf of Bejaia; **: newly collected in the eastern coast of Algeria.

***NIF**: Nombre de poissons infestés; **NP**: Nombre de parasites; **P**: Prévalence; **Im**: Intensité Moyenne; **A**: Abondance; **FS**: Site de fixation; **SP**: Spécificité; **DT**: Tractus digestif; **G**: Branchies; **F**: Nageoires; **BC**: Cavité buccale; **S**: Surface; **Go**: Gonades.*: Nouvellement collectée dans le Golfe de Bejaia; **: Nouvellement collectée au niveau de la côte-est algérienne*.

Table 2

Measurements (mm) of digenean and monogenean specimens.
Les mensurations (mm) effectuées pour les spécimens de Digènes et de Monogènes.

Parasites species	Lt (M ±SD)	W (M ±SD)	Oral sucker (M ±SD)	Ventral sucker (M±SD)	Pharynx (M ±SD)	Wh (M ±SD)
Digenea						
Monascus filiformis	(1.73±1.31)	(0.17±0.13)	(0.10±0.01)	(0.08±0.01)	(0.09±0.013)	_
Pseudopecoeloides chloroscombri	(6.15±0.59)	(0.38±0.09)	(0.19±0.02)	(0.39±0.10)	(0.12±0.01)	_
Prodistomum polonii	1.3-3	_	_	_	_	_
Opechona sp.	0.5-0.75	0,2-0,25	_	_	_	_
Ectenurus lepidus	(0.9±0.08)	(0.20±0.04)	(0.06±0.005)	(0.126±0.001)	(0.032± 0.002)	_
Hemiurus communis	1.1- 1.25	_	0.05-0.1	0.15-0.17	_	_
Lecithochirium fusiforme	(1.14±0.1)	(0.25±0.05)	(0.06±0.01)	(0.17±0.02)	(0.01±0.01)	_
Monogenea						
Gastrocotyle trachuri	(1.2 ±0.21)	_	_	_	_	_
Pseudaxine trachuri	(0.9 ±0.09)	(0.09 ±0.037)	_	_	_	(0.3 ±0.05)

Lt: Total length; **W**: Width; **Wh**: Width of hapteur of Monogenea; **M**: Mean; **SD**: Standard Deviation.
***Lt** : Longueur totale ; **W** : Largeur ; **Wh** : Largeur de l'hapteur des Monogènes ; **M**: Moyenne ; **SD** : Erreur Standard.*

some Isopoda like *Gnathia* sp. The buccal cavity is the preferred attachment site for two species of Isopoda (*Ceratothoa estroides* and *Ceratothoa parallela*). Finally, the fish body-surface hosts only one species of Copepoda (*Peniculus fistula*) and one species of Isopoda (*Anilocra physodes*).

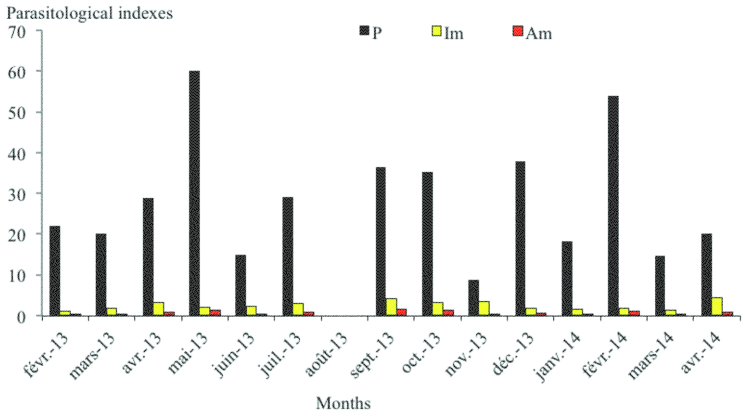
Most of the collected parasites show a euryxenic specificity to their host. The only oixenic parasite species is *Gastrocotyle trachuri* (Table 1).

Variations in parasitological indices according to month, sex and host size

The highest prevalence was observed in May (2013) and February (2014) with 60% and 53.85%, respectively (Figure 2A). Differences in infestation rates were also observed between months (DDL=13, α=5%, χ^2=39.40, p< 0.001). During these months, *Monascus filiformis* (P=40%) and *Anisakis simplex* (P=36.53%) were the most prevalent. The highest values of mean intensity (3.25-4.55 parasites/infected fish) were observed in April (2013 and 2014) and September (2013). The remaining months generally showed a low parasitic load (1.03–3.07 parasites/infested fish).

Figure 2 (ci-contre)

Variation of parasitological indices according to month (A), sex (B) and size classe (C).
Variations des indices parasitologiques en fonction des mois (A), sexes (B) et classes de taille (C).


Parasitological indexes
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Im
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mars-13
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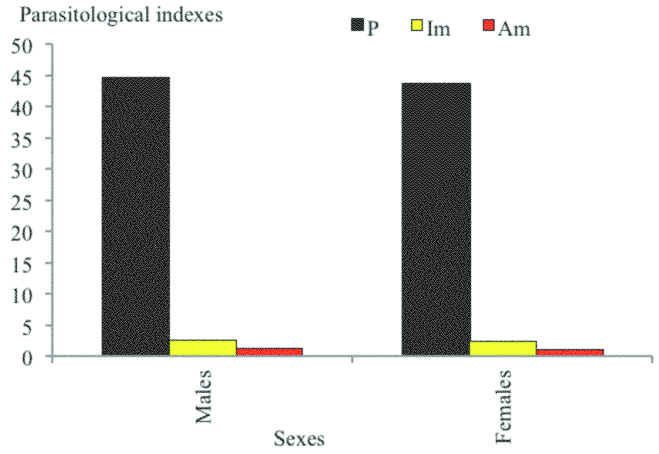
juin-13
juil.-13
août-13
sept.-13
oct.-13
nov.-13
déc.-13
janv.-14
févr.-14
mars-14
avr.-14
Months

A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P
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Males
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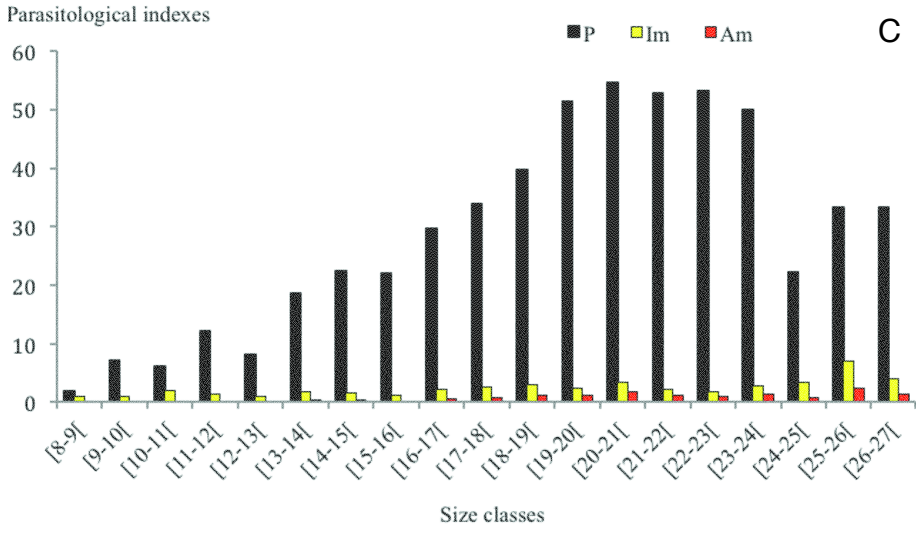
Parasitological indexes
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Size classes

C

Table 3

Checklist of the metazoan parasites reported from horse mackerel, *Trachurus trachurus* (L.)
Inventaire des métazoaires parasites signalés chez le chinchard, Trachurus trachurus *(L.).*

Parasite groups	Parasite species	References
Digenea	*Ancylocoelium typicum* (Nicoll, 1912)	NICOLL, 1915; BARTOLI & BRAY, 2004.
	Aphanurus stossichi (Monticelli, 1891)	NICOLL, 1915; AKMIRZA, 1998; KOSTADINOVA, 2004; MACKENZIE *et al.,* 2004.
	Bathycreadium elongatum (Maillard, 1970)	MACKENZIE *et al.,* 2004.
	Derogenes varicus (Muller, 1784)	NICOLL, 1914; NICOLL, 1915; MACKENZIE *et al.,* 2004; BARTOLI *et al.,* 2005; MACKENZIE *et al.,* 2008.
	Ectenurus lepidus (Looss, 1907)	NICOLL, 1915; GIBSON & BRAY, 1986; MACKENZIE *et al.,* 2004; MACKENZIE K. *et al.,* 2008; ÖZTÜRK & ÖZER, 2016; Present study.
	Ectenurus virgulus (Looss, 1910)	MACKENZIE *et al.,* 2004.
	Helicometra pulchella (Rudolphi, 1819)	MACKENZIE *et al.,* 2004.
	Hemiurus communis (Odhner, 1905)	NICOLL, 1915; MACKENZIE, 1963; MACKENZIE *et al.,* 2004; MACKENZIE *et al.,* 2008; Present study.
	Hemiurus luehei (Odhner, 1905)	MACKENZIE *et al.,* 2004.
	Hemiurus ocreatus (Odhner, 1905)	NICOLL, 1914.
	Lasiotocus tropicus (Manter, 1940)	MACKENZIE *et al.,* 2008.
	Lasiotocus typicus (Nicoll, 1912)	MACKENZIE *et al.,* 2004; MACKENZIE *et al.,* 2008; ÖZTÜRK & ÖZER, 2016.
	Lecithaster confusus (Odhner, 1905)	MACKENZIE *et al.,* 2004.
	Lecithochirium fusiforme (Luche, 1901)	ABID-KACHOUR, 2004, Present study.
	Lecithochirium musculus (Looss, 1907)	MACKENZIE *et al.,* 2004.
	Lecithocladium excisum (Rudolphi, 1819)	NICOLL, 1915; LOZANO *et al.,* 2001; MACKENZIE *et al.,* 2004; MACKENZIE *et al.,* 2008.
	Lecithaster gibbosus (Looss, 1907)	NICOLL, 1914; NICOLL, 1915.
	Monascus filiformis (Rudolphi, 1819)	BRAY & GIBSON, 1980; LOZANO *et al.,* 2001; MACKENZIE *et al.,* 2004; MACKENZIE *et al.,* 2008; ÖZTÜRK & ÖZER, 2016; ICHALAL *et al.,* 2016; Present study.
	Opechona sp (Looss, 1907)	Present study.

Digenea (following)	*Opechona bacillaris* (Molin, 1859)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008.
	Opechona pyriforme (Linton, 1900)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008.
	Pseudopecoeloides chloroscombri (Fischthal & Thomas, 1970)	BARTOLI *et al*., 2003; MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008; Present study.
	Pseudopecoeloides carangis (Yamaguti, 1938)	MACKENZIE *et al*., 2004.
	Prodistomum polonii (Molin, 1859)	MACKENZIE *et al*., 2004; MACKENZIE K. *et al*., 2008; ÖZTÜRK & ÖZER, 2016; Present study.
	Prodistomum orientalis (Layman, 1930)	MACKENZIE *et al*., 2004.
	Tergestia laticollis (Rudolphi, 1819)	NICOLL, 1914; NICOLL, 1915; MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008; AKMIRZA, 1998.
	Pharyngora polonii (Molin, 1859)	NICOLL, 1915.
	Haplocladus typicus (Odhner, 1905)	NICOLL, 1915.
	Pristisomum pumex (Looss, 1907)	NICOLL, 1915.
	Zoogonus rubellus (Olsson, 1868)	MACKENZIE *et al*., 2004.
Cestoda	*Anthobothrium cornucopia* (van Beneden, 1850)	MACKENZIE *et al*., 2004.
	Callitetrarhynchus gracilis (Rudolphi, 1819)	MACKENZIE *et al*., 2004.
	Christianella minuta (van Beneden, 1849)	MACKENZIE *et al*., 2004.
	Grillotia bothridiopunctata (Dollfus, 1969)	MACKENZIE *et al*., 2004.
	Grillotia erinaceus (van Beneden, 1858)	MACKENZIE *et al*., 2004.
	Lacistorhynchus tenuis (van Beneden, 1858)	MACKENZIE *et al*., 2004.
	Nybelinia sp (poche, 1926)	MACKENZIE *et al*., 2004; Present study.
	Nybelinia lingualis (Cuvier, 1817)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008.
	Scolex pleuronectis (Muller, 1788)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008; Present study.
	Grillotia sp.	MACKENZIE *et al*., 2008.
	Pseudophyllidean plerocercoids	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008.

Table 3 (following)

Parasite groups	Parasite species	References
Acanthocephala	*Corynosoma strumosum* (Rudolphi, 1802)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008.
	Corynosoma wegeneri (Heinze, 1934)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008.
	Rhadinorhynchus cadenati (Golvan & Houin, 1964)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008; GARGOURI *et al*., 2016.
	Solearhynchus Kostylewi (MEYER, 1932)	KVACH Y & OGUZ, 2010
	Longicollum pagrosomi	OGUZ & KVACH, 2006; GARGOURI *et al*., 2016.
Nematoda	*Anisakis simplex* (Rudolphi, 1809)	ABAUNZA *et al*., 1995; ADROHER *et al*., 1996; MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008; MATTIUCCI *et al*., 2008; SORIC *et al*., 2012; SMRZLIC *et al*., 2012; ICHALAL *et al*., 2015; ICHALAL *et al*., 2016; Present study.
	Anisakis pegreffii (Campana-Rouget & Biocca, 1955)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008; MATTIUCCI *et al*., 2008; VARDIC SMRZLIC *et al*., 2012; ABATTOUY *et al*., 2014.
	Anisakis physeteris (Baylis, 1923)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008.
	Anisakis typica (Diesing, 1860)	MACKENZIE *et al*., 2008.
	Hysterothylacium aduncum (Rudolphi, 1802) larve	ADROHER *et al*., 1996; MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008; MATTIUCCI *et al*., 2008; GUTIERREZ-GALINDO *et al*., 2010; PEKMEZCI *et al*., 2012; VARDIC SMRZLIC *et al*., 2012; ICHALAL *et al*., 2015; ICHALAL *et al*., 2016; Present study.
	Hysterothylacium sp (Ward & Magath, 1917)	Present study.
	Hysterothylacium aduncum (Rudolphi, 1802) adulte	ADROHER *et al*., 1996; MACKENZIE *et al*., 2008; MATTIUCCI *et al*., 2008.
	Pseudoterranova decipiens (Krabbe, 1878)	MACKENZIE *et al*., 2004; MACKENZIE *et al*., 2008.
	Contracaecum sp	MACKENZIE *et al*., 2004; GALINDO *et al*., 2010.
	Cosmocephalus obvelatus (Creplin, 1825) larvae	MACKENZIE *et al*., 2004.
	Paracuaria tridentata (Linstow, 1877) larvae	MACKENZIE *et al*., 2004.
	Pseudanisakis sp. larvae	MACKENZIE *et al*., 2004.
	Raphidascaris sp. larvae (Rego (1987)	MACKENZIE *et al*., 2004.

Crustacea	*Caligus diaphanus* (Nordmann, 1832)	KABATA, 1979; MACKENZIE *et al.*, 2004.
	Argulus Vittatus (Risso, 1826)	CAMPBELL, 2008.
	Argulus purpureus (Risso, 1826)	MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008.
	Caligus elongatus (Nordmann, 1832)	KABATA (1979); MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008.
	Caligus pelamydis (Krøyer, 1863)	KABATA, 1979; MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008.
	Peniculus fistula (Nordmann, 1832)	MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008; Present study.
	Lernanthropus trachuri (Brian, 1903)	MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008; ROSE & VAISSIERE, 1952 ; NUNES-RUIVO, 1954 ; RAMDANE & TRILLES, 2007.
	Ceratothoa oestroides (Risso, 1826)	MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008; CHARFI-CHEIKHROUHA *et al.*, 2000; MACKENZIE *et al.*, 2004; OGUZ & ÖKTENER, 2007; RAMDANE *et al.*, 2007; MACKENZIE *et al.*, 2008; Present study.
	Ceratothoa parallela (Otto, 1828)	RAMDANE *et al.*, 2007; Present study.
	Anilocra physodes (L., 1758)	OGUZ & ÖKTENER, 2007; Present study.
	Praniza gnathiid isopod larva	MACKENZIE *et al.*, 2004; Present study.
Monogenea	*Cemocotyle trachuri* (Dillon & Hargis, 1965)	MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008.
	Gastrocotyle trachuri (van Beneden & Hesse, 1863)	LLEWELLYN, 1959, 1962; SHAW, 1979; MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008; CAMPBELL, 2005; Present study.
	Heteraxinoides atlanticus (Gaevskaya & Kovaleva, 1979)	MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008.
	Pseudaxine trachuri (Parona & Perugia, 1889)	LLEWELLYN, 1959, 1962; SHAW, 1979; MACKENZIE *et al.*, 2004; MACKENZIE *et al.*, 2008; Present study.
	Paradiplectanotrema trachuri (Kovaleva, 1970)	MACKENZIE *et al.*, 2008.
	Grubea cochlear (Diesing, 1858)	EREMINA, 1970.

During this study (Figure 2B) the same infection rates were observed for males and females (43.51-44.52%). No difference in prevalence was noted between the two sexes of this fish (DDL= 1, α=5%, χ^2=0.012, p=1.96). The mean intensity was very similar between males and females (Im=2.60 and 2.30 parasites/infested fish, respectively).

Figure 2C shows clearly the increase of parasitic infection with the growing of host. The lowest rate (5.06%) was found in small specimens (length less than 11 cm). The highest rate (54.55%) was noted in specimens between 20 and 24 cm in length. The largest specimens were moderately infected (33.33%). A significant difference was observed between fish size classes (DDL=21, α=5 %, χ^2=81.04, P<0.001).

Mean intensity values varied between 1 and 4 parasites/infected fish with the exception of the 25-26 cm size class, in which 7 parasites were collected from one infected fish.

A checklist of metazoan parasites of *Trachurus trachurus*

Table 3 shows that *T. trachurus* has a varied parasite fauna, comprising 75 species, many of which are specific to the genus *Trachurus*. Digenea is the most abundant group in term of numbers of species (30), followed by Nematoda (13), Cestoda (11), Crustacea (10), Monogenea (6) and Acanthocephala (5).

The species found during the present study represent 25% of the total number of parasite species recorded. 28% of the species were recorded in the eastern, western and central part of the Mediterranean Sea.

Discussion

The present study reports important new parasitological data on *Trachurus trachurus* from the eastern coast of Algeria.

T. trachurus from Algerian coasts hosts many and diverse metazoan parasites. The same parasite species were reported by AKMIRZA (1998) and ADROHER *et al*. (1996) in Turkey and Spain, respectively.

In our study, the digeneans are well represented in the parasite fauna of *T. trachurus*. These species had already been recorded by BARTOLI *et al*. (2005) in many teleost fishes from the western coasts of the Mediterranean Sea. They were also reported by MACKENZIE *et al*. (2008), ÖZTÜRK & ÖZER (2016) from the northern shore of the Mediterranean Sea, along the Atlantic coasts of the North Sea and in the Black Sea.

To our knowledge, *Lecithochirium fusiforme* (Luche, 1901), collected in our study, had been reported previously from *T. trachurus* for the first time by ABID-KACHOUR (2014). According to this author, a number of searchers have reported this species on other teleost fish, such as the common conger (*Conger congre*) and

the anglerfish (*Lophius piscatorius*) (JONES, 1934; MATHIAS, 1934; GIBSON & BRAY, 1979). The parasitic species *Pseudopecoeloides chloroscombri* has often been used as a bio-indicator of *T. trachurus* stocks in different regions (from the Moroccan coast to southwest Norway and throughout the Mediterranean Sea) (ABAUNZA *et al*., 2008; MACKENZIE *et al*., 2008).

The two species of Monogenea recorded here, *Gastrocotyle trachuri* (van Beneden & Hesse, 1863) and *Pseudaxine trachuri* (Parona & Perugia, 1889), were reported from the same host by LLEWELLYN (1959, 1962), SHAW (1979) and MACKENZIE *et al*. (2008) from Atlantic coasts and the northern shore of the Mediterranean Sea.

Among the identified Isopod species, Ceratothoa oestroides, *C. parallela* and *Anilocra physodes* were already reported by CHARFI-CHEIKHROUHA *et al*. (2000), OĞUZ & ÖKTENER (2007) and RAMDANE & TRILLES (2007) in *T. trachurus* from the Tunisian, Turkish and Algerian coasts, respectively.

Generally, four species of copepod infest *T. trachurus* along the Mediterranean coasts (MACKENZIE *et al*., 2008): *Lernanthropus trachuri* (Brian, 1903), the most commonly collected, *Caligus elongatus* (Nordmann, 1832), *Caligus pelamydis* (Krøyer, 1863) and *Peniculus fistula* (Nordmann, 1832). The latter has been recorded from our specimens of horse mackerel.

The evaluation of the parasitological indices shows that, for all parasite species recorded in horse mackerel, the infestation rates are relatively low, the highest being those of *Anisakis simplex* and *Monascus filiformis*. Our results are consistent with those of ADROHER *et al*. (1996), CAMPBELL (2005), MACKENZIE *et al*. (2008) and TANTANASI *et al*. (2012), who report the predominance of *A. simplex* on *T. trachurus* in the Atlantic and the Mediterranean. The prevalence and parasitic loads observed for *M. filiformis* are similar to those reported by BARTOLI *et al*. (2005) in the Mediterranean and by ÖZTÜRK & ÖZER (2016) in the Black Sea.

In this study, variations in parasite infra-communities in relation to the month were observed. We have found that the overall prevalence was high in May 2013 and February 2014.

The month of May is characterized by a high infestation by Digenea. According to DE KINKELIN (1971), an increase in temperature favours the multiplication of certain digenean parasites. Thus, infestation by these Digenea begins during the onset of summer period (DESCLAUX, 2003). In this study, the high infestation rate by the digenean *M. filiformis* in May 2013 may have been due to the accumulation of metacercariae. Therefore, the observed changes in infestation rates are likely to be related to environmental factors and host behavior.

Our results concerning infestation rates according to host size and sex are similar to those reported by TANTANASI *et al*. (2012) in *T. trachurus* and confirm that the number of parasites is directly related to host size and not to sex.

The highest infestation rates were observed in large individuals and the dominant parasite group was Nematoda. This may be related to the diet of horse mackerel,

which varies according to fish size (GARRIDO *et al.,* 2008). In addition, Euphausiaceae (zooplankton) are a major food source for *T. trachurus*. According to SMITH (1983), Euphausiids are the main intermediate hosts of *A. simplex*. The distribution of the latter is therefore strongly influenced by the existence of this zooplankton.

RÉFÉRENCES

ABATTOUY, N., VALERO LOPEZ, A., LOZANO MALDONADO, J., BENAJIBA, M.H. & MARTIN-SANCHEZ, J. (2014).- Epidemiology and molecular identification of *Anisakis pegreffii* (Nematoda: Anisakidae) in the horse mackerel *Trachurus trachurus* from northern Morocco. *J. Helminthol.,* **88**, 257-263.

ABAUNZA, P., MURTA, A., MATTIUCCI, S. *et al*. [22 authors] (2004).- Stock discrimination of horse mackerel (*Trachurus trachurus*) in the Northeast Atlantic and Mediterranean Sea: integrating the results from different stock identification approaches. *ICES CM /EE*: **19**. (http://www.ices.dk/sites/pub/CM%20Doccuments/2004/EE/EE1904.pdf).

ABAUNZA, P., MURTA, A.G., CAMPBELL, N. *et al*. [21 authors] (2008).- Stock identity of horse mackerel (*Trachurus trachurus*) in the Northeast Atlantic and Mediterranean Sea: Integrating the results from different stock identification approaches. *Fish. Res.,* **89**, 196-209.

ABID-KACHOUR, S. (2014).- *Contribution à l'étude des parasites digènes de trois poissons téléostéens merlu (*Merluccius merluccius*), pageot (*Pagellus erythrinus*) et chinchard (*Trachurus trachurus*) de la côte oranaise*. Thèse de Doctorat, Université d'Oran.

ADROHER, J., VALERO, A., RUIZ-VALERO, J. & IGLESIAS, L. (1996).- Larval Anisakids (Nematoda: Ascaridoidea) in horse mackerel (*Trachurus trachurus*) from the fish market in Granada, Spain. *Parasitol. Res.,* **82**, 319-322.

AKMIRZA, A. (1998).- The parasite fauna of horse mackerel. *III. National symposium of aquatic products* (10-12 June 1998, Erzurum), pp. 333-344.

AZBAID, L., LAMTAI, A., TALBAOUI, E.M. & CHIDI, F. (2012).- Occurrence of *Anisakis* spp. in horse mackerel (*Trachurus trachurus* L.) from the North Atlantic Moroccan coasts. *Moroccan J. Biol.,* **8-9**, 51-57.

BARTOLI, P., BRAY, R.A. & GIBSON, D.I. (2003).- Opecoelidae (Digenea) from western Mediterranean fishes: three rare species. *Syst. Parasitol.,* **55**, 81-95.

BARTOLI, P. & BRAY, R.A. (2004). - *Ancylocoelium typicum* Nicoll, 1912 (Digenea: Monorchiidae), a poorly known parasite of *Trachurus* spp. (Teleostei: Carangidae) from the western Mediterranean and north-eastern Atlantic, and observations its taxonomic position. *Syst. Parasitol.,* **58**, 23-39.

BARTOLI, P., GIBSON, D.I. & BRAY, R.A. (2005).- Digenean species diversity in teleost fish from a nature reserve off Corsica, France (Western Mediterranean), and a comparison with other Mediterranean regions. *J. Nat. Hist.,* **39** (1), 47-70.

BEKTAS, Y. & OSMAN, A. (2009).- Morphological variation among Atlantic horse mackerel *Trachurus trachurus* population from Turkish Coastal waters. *J. Anim. Vet. Adv. Medwell journals,* **8** (3), 511-517.

BENMANSOUR, B. & BEN HASSINE, O.K. (1997).- Preliminary analysis of parasitic copepod species richness among coastal fishes of Tunisia. *Ital. J. Zool.,* **65** (Suppl.), 341-344.

BRAY, R.A. & CRIBB, T.H. (1998).- Lepocreadiidae (Digenea) of Australian coastal fishes: new species of *Opechona* Looss, 1907, *Lepotrema* Ozaki, 1932 and *Bianium* Stunkard, 1930 and comments on other species reported for the first time or poorly known in Australian waters. *Syst. Parasitol.,* **41**, 123-148.

BRAY, R.A. & GIBSON, D.I. (1980).- The Fellodistomidae (Digenea) of fishes from the north-east Atlantic. *Bull. Br. Mus. Nat. Hist.,* (Zool.) **37** (4), 199-293.

BRAY, R.A. & GIBSON, D.I. (1990).- The Lepocreadiidae (Digenea) of fishes of the north-east Atlantic: review of the genera *Opechona* Looss, 1907 and *Prodistomum* Linton, 1910. *Syst. Parasitol.,* **15**, 159-202.

BUSH, A.O., LAFFERTY, K.D., LOTZ, J.M. & SHOSTAK, A.W. (1997).- Parasitology meets ecology on its own terms: Margolis *et al*. Revisited. *J. Parasitol.,* **83** (4), 575-583.

CAMPBELL, N. (2005).- The myxosporean parasitofauna of the Atlantic horse mackerel, *Trachurus trachurus* (L.) in the North-East Atlantic Ocean and Mediterranean Sea. *Acta Parasitol.,* **50** (2), 97-101.

CAMPBELL, N. (2008).- *Population studies of horse mackerel (*Trachurus trachurus *(L.)) and herring (*Clupea harengus *L.) using parasites as biological tags*. PhD thesis. University of Aberdeen.

CHARFI-CHEIKHROUHA, F., ZGHIDI, W., OULD YARBA, L. & TRILLES J.-P. (2000).- Les Cymothoidae (Isopodes parasites de poissons) des côtes tunisiennes: écologie et indices parasitologiques. *Syst. Parasitol.,* **46**, 146-150.

DE KINKELIN, P. (1971).- *Précis de pathologie des poissons*. Institut National de la Recherche Agronomique, Paris, Masson, 487 p.

DESCLAUX, C. (2003).- *Interactions hôtes-parasites : Diversité, mécanismes d'infestation et impact des Trématodes Digènes sur les coques* Cerastoderma edule *(mollusque bivalve) en milieu lagunaire macrotidal*. Thèse de Doctorat en océanographie. Université Bordeaux-I. École Doctorale des Sciences du Vivant, Géosciences, Sciences de l'Environnement, 253 p.

EREMINA, B.A. (1970).- The infection of certain commercial fish on the south-western coast of Africa]. *In*: A.M. Parukhin (Editor), *Problems of marine parasitology: data of the 1st All-Union Symposium on parasites and diseases of marine animals, Sebastopol*. Kiev: Izdatelstvo 'Naukova Dumka', 26-29 (In Russian).

GARGOURI, L., ANTAR, R., ZARROUK, F. & MAAMOURI, F. (2016).- The occurrence of acanthocephalans in teleost fish from the Bizerte lagoon, Tunisia. *J. Helminthol.,* **90** (1), 96-101.

GARRIDO, S., MURTA, A.G., MOREIRA, A., FERREIRA, M.J. & ANGÉLICO, M.M. (2008).- Horse mackerel (*Trachurus trachurus*) stomach fullness off Portugal: index calibration and spatio-temporal variations in feeding intensity. *ICES J. Mar. Sci.,* **65**, 1662-1669.

GESTAL, C. & AZEVED, O.C. (2005).- Ultrastructure of *Goussia cruciata* (Apicomplexa: Coccidia) infecting the liver of horse mackerel, *Trachurus trachurus* (L.), from Ibero-Atlantic waters. *J. Fish. Dis. Mar.,* **28** (3), 125-132.

GIBSON, D.I. & BRAY, R.A. (1979).- The heminroidea: terminology, systématics and evolution. *Bull. Br. Mus. Nat. Hist. (Zool.),* **36** (2), 35-146.

GIBSON, D.I. & BRAY, R.A. (1986).- The hemiuridea (Digenea) of fishes from the north-east Atlantic. *Bull. Br. Mus. Nat. Hist. (Zool.),* **51** (1), 1-125.

GIBSON, D.I. (1996).- Trematoda. *In*: Margolis, L. & Kabata, Z. [Editors] *Guide to the parasites of fishes of Canada*. Part IV. Canadian Special Publication of Fisheries and Aquatic Sciences No. 124. Ottawa: NRC Press, 373 p.

GIBSON, D.I., JONES A. & BRAY, R.A. (2002).- *Keys to the Trematoda*. Vol. 1, CABI Publishing, New York, 544 p.

GUTIÉRREZ-GALINDO, J.F., OSANZ-MUR, A.C. & MORA-VENTURA, M.T. (2010).- Occurrence and infection dynamics of anisakid larvae in *Scomber scombrus, Trachurus trachurus, Sardina pilchardus* and *Engraulis encrasicolus* from Tarragona (NE Spain). *Food Control,* **21**, 1550-1555.

HURST, R.J. (1984).- Identification and description of larval *Anisakis simplex* and *Pseudoterranova decipiens* (Anisakidae: Nematoda) from New Zealand waters. *N. Zeal. J. Mar. Fresh. Res.,* **18** (2), 177-186.

ICHALAL, K., RAMDANE, Z., IGUER-OUADA, M. & KACHER, M. (2016).- First observation of intersex in *Trachurus trachurus* (Carangidae) from the Eastern Coast of Algeria: are nematodes the causative factor? *Cybium,* **40** (3), 225-233.

ICHALAL, K., RAMDANE, Z., IDER, D., KACHER, M., IGUEROUADA, M., TRILLES, J.-P., COURCOT, L. & AMARA, R. (2015).- Nematodes parasitizing *Trachurus trachurus* (L.) and *Boops boops* (L.) from Algeria. *Parasitol. Res.,* **114** (11), 4059-4068.

JONES, D.O. (1934).- The anatomy of three digenetic trematodes, *Skrjabiniella aculeatus* (Odhner), *Lecithochirium rufoviride* (Rud.) and *Sterrhurus fusiformis* (Luhe) from Conger conger (Linn.). *Parasitol.,* **35**, 40-57.

KABATA, Z. (1979).- *Parasitic Copepoda of British Fishes*. Ray Society, London. 468 p.

KOSTADINOVA, A., GIBSON, D.I., BALBUENA, J.A., POWER, A.M., MONTERO, F.E., AYDOĞDU, A. & RAGA, J.A. (2004).- Redescriptions of *Aphanurus stossichii* (Montecelli, 1891) and *A. vigula* Looss, 1907 (Digenea: Hemiuridae). *Syst. Parasitol.,* **58**, 175-184.

LARIZZA, A. & VOVLAS, N. (1995).- Morphological observations on third-stage larvae of *Anisakis simplex* (Anisakidae: Nematoda) from Adriatic and Ionian waters. *J. Helminthol. Soc. W.,* **62** (2), 260-264.

LLEWELLYN, J. (1959).- The larval development of two species of Gastrocotylid trematode parasites from the gills of *Trachurus trachurus*. *J. Mar. Biol. Ass. U.K.,* **38**, 461-467.

LLEWELLYN, J. (1962).- The life histories and population dynamics of monogenean gill parasites of *Trachurus trachurus* (L). *J. Mar. Biol. Ass. U.K.,* **42**, 587-600.

LOZANO, C., UBEDA, J.M., DE ROJAS, M., ARIZA, C. & GUEVARA, D.C. (2001).- Estudio de digenidos de peces marinos del sur de la Península Ibérica. *Res. Rev. Parasitol.,* **61**, 103-116.

MACKENZIE, K., CAMPBELL, N., MATTIUCCI, S., RAMOS, P., PEREIRA, A. & ABAUNZA, P. (2004).- A checklist of the protozoan and metazoan parasites reported from the Atlantic horse mackerel, *Trachurus trachurus* (L.). *Bull. Eur. Ass. Fish Pathol.,* **24** (4), 180.

MACKENZIE, K., CAMPBELL, N., MATTIUCCI, S., RAMOS, P., PINTO, A.L. & ABAUNZA, P. (2008).- Parasites as biological tags for stock identification of Atlantic horse mackerel *Trachurus trachurus* L. *Fish. Res.,* **89**, 136-145.

MANSOUR, L., THABET, A., CHOURABI, K., HARRATH, A. H., GTARI, M., AL OMAR, S.Y. & BEN HASSINE, O.K. (2013).- *Kudoa azevedoi* n. sp. (Myxozoa, Multivalvulida) from the oocytes of the Atlantic horse mackerel *Trachurus trachurus* (Perciformes, Carangidae) in Tunisian coasts. *Parasitol. Res.,* **112**, 1737-1747.

MATHIAS, P. (1934). - Sur quelques trématodes de poissons marins de la région de Banyuls. *Arch. Zool. exp. gén.,* **75**, 567-581.

MATTIUCCI, S., FARINA, V., CAMPBELL, N., MACKENZIE, K., RAMOS, P., PINTO, A.L., ABAUNZA, P. & NASCETTI, G. (2008).- *Anisakis* spp. larvae (Nematoda: Anisakidae) from Atlantic horse mackerel: Their genetic identification and use as biological tags for host stock characterization. *Fish. Res.,* **89**, 146-151.

MARGOLIS, I., ESCHE, W., HOLMES, J. C., KURIS, A.M. & SCHAD, G.A. (1982).- The use ecological terms in parasitology (report of an adhoc committee of the American society of parasitologists. *J. Parasitol.* **1**, 137-133.

MORSY, K., BASHTAR, A-R., GHAFFAR, F-A. & MOSTAFA, N. (2013).- New host and locality records of two nematode parasites *Dujardinnascaris mujibii* (Heterocheilidae) and *Hysterothylacium aduncum* (Anisakidae) from the common seabream *Pagrus pagrus*: a light and scanning electron microscopic study. *Parasitol. Res.,* **112**, 807-815.

NICOLL, W. (1914).- The trematode parasites of fishes from the English Channel. *J. Mar. Biol. Assoc. U.K.,* **10**, 466-505.

NICOLL, W. (1915).- A list of the trematode parasites of British marine fishes. *Parasitol.,* **7**, 339-378.

NUNES-RUIVO, L. (1954).- Copépodes parasites de poissons. Résultats Campagne du Pr Lacaze-Duthiers. I. Algérie 1952. *Vie Milieu,* **suppl. 3**, 115-138.

OĞUZ, M.C. & KVACH, Y. (2006).- Occurrence of acanthocephalans in Teleost fishes of Gemlik Bay, Sea of Marmara, Turkey. *Helminthol.,* **43** (2), 103-108.

OĞUZ , M.C. & ÖKTENER, A. (2007).- Four parasitic crustacean species from marine fishes of Turkey. *Türk. Parazitol. Der.,* **31** (1), 79-83.

ÖZTÜRK, T. & ÖZER, A. (2016).- Digenean parasites of Atlantic horse mackerel (*Trachurus trachurus*) in the Turkish Black Sea coast. *Ege J.F.A.S.,* **33** (1), 35-40.

PALM, H.W. (1999).- *Nybelinia* Poche, 1926, *Heteronybelinia* gen. nov. and *Myxonibelinia* gen. nov. (Cestoda, Trypanorhyncha) in the collections of the Natural History Museum, London. *Bull. Nat. Hist. Mus. Zool. Series*, **65**, 133-153.

PALM, H.W., WALTER, T., SCHWERDTFEGER, G. & REIMERT, L.W. (1997).- *Nybelinia poche*, 1926 (cestoda: trypanorhyncha) from the moçambique coast, with description of *N. beveridgei* sp. nov. and systematic consideration of the genus. *S. Afr. J. mar. Sci.,* **18**, 273-285.

PEKMEZCI, G.Z., BOLUKBAS, C.S., GURLER, A.T. & ONUK, E.E. (2012).- Occurrence and molecular characterization of *Hysterothylacium aduncum* (Nematoda: Anisakidae) from *Merlangius merlangus euxinus* and *Trachurus trachurus* off the Turkish coast of Black Sea. *Parasitol. Res. Mar,* **112** (3), 1031-1037.

RAMDANE, Z., BENSOUILAH, M.A. & TRILLES, J.-P. (2007).- The Cymothoidae (Crustacea, Isopoda), parasites on marine fishes, from the Algerian fauna. *Belg. J. Zool.,* **137** (1), 67-74.

RAMDANE, Z. & TRILLES, J.-P. (2007).- Parasitic copepods (Crustacea: Copepoda) from Algerian marine fishes. *Zootaxa,* **1574**, 49-68.

RAMDANE, Z. (2009).- *Identification et écologie des ectoparasites Crustacés des poissons Téléostéens de la côte Est algérienne*. Thèse Doctorat en biologie marine. Université Badjimokhtar, Annaba, Algérie, 235 p.

ROSE, M. & VAISSIÈRE, R. (1952).- Catalogue préliminaire des Copépodes de l'Afrique du Nord. *Bull. Soc. Hist. Nat. Afr. Nord,* **43**, 164-176.

SHAW, M.K. (1979).- The development of the clamp attachment organs of the monogenean *Gastrocotyle trachuri*. *Z. Paras.,* **59**, 277-294.

SHIH, H.H. & JENG, M.S. (2002).- *Hysterothylacium aduncum* (Nematoda: Anisakidae) Infecting a Herbivorous Fish, *Siganus fuscescens*, off the Taiwanese Coast of the Northwest Pacific. *Zool. Stud.,* **41** (2), 208-215.

SMITH, J.W. (1983).- *Anisakis simplex* (Rudolphi, 1809, det. Krabbe, 1878) (Nematoda: Ascaridodea): morphology and morphometry of larvae from euphausiids and fish, and a review of the life-history and ecology. *J. Helminthol.,* **57**, 205-224.

SMRZLIĆ, V.I., VALIĆ, D., KAPETANOVIĆ, D., KURTOVIĆ, B. & TESKEREDŽIĆ, E. (2012).- Molecular characterisation of Anisakidae larvae from fish in Adriatic Sea. *Parasitol. Res.* **111**, 2385-2391.

SORIC, R.E., SEQUEIROS, L. C.M., MIRON, L. & SOLER, A.P. (2012).- Morphometrics for Anisakiasis diagnosis in the North Atlantic horse mackerel (*Trachurus trachurus*). *Sci. Parasitol.,* **13** (2), 77-81.

TANTANASI, J., DIAKOU, A., TAMVAKIS, A. & BATJAKAS, I.E. (2012).- Anisakis spp. burden in *Trachurus trachurus*. *Helminthol.,* **49** (1), 16-20.

VIDJAK, O., ZORICA, B. & SINOVČIĆ, G. (2008).- First record of parasitic copepod *Peniculus fistula* von Nordmann, 1832 (Siphonostomatoida: Pennellidae) from garfish *Belone belone* (Linnaeus, 1761) in the Adriatic Sea. *Cah. Biol. Mar.,* **49**, 209-213.

YAMAGUTI, S. (1963).- *Parasitic Copepoda and Brachioura of fishes*. Interscience publ., New York, London, Sydney: 1104 p.

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