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Effect of parasitism on the length/weight relationship and the condition index in two groups of *Pagellus acarne* (Risso, 1826) (Perciformes Sparidae), parasitized and unparasitized specimens, from the Eastern Coast of Algeria

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ABSTRACT In the present study, the relationship between parasitism and some host biological parameters is studied for the first time in *Pagellus acarne* (Risso, 1826) (Perciformes Sparidae) from the eastern coast of Algeria. This study is carried out on 111 specimens, examined between April 2013 and March 2014. Parasitofauna of *P. acarne* is rich and various; 373 parasites belonging to different parasite groups are reported. Eleven parasite species are identified: 3 Digenea, 1 Isopoda, 3 Monogenea and 4 Nematoda, with the predominance of Nematoda (more than 50%). Our results reveal that mean intensity increases with the length of the host and varies from 4 to 8 parasites by infested host. The comparison of some biological parameters (length/weight relationship and the Fulton condition index K) does not show significant differences between parasitized and unparasitized specimens. These results allow us to deduct that *P. acarne* from the eastern cost of Algeria is not affected by parasitism despite the important parasite infestation.

KEY WORDS Parasites; *Pagellus acarne*; biological parameters; Eastern Algeria.

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INTRODUCTION

In contrast to free-living organisms, parasites are characterized by the fact that they are lodged in the host biotope; therefore, this relationship requires some conditions in which the host fish represents both; the biotope and the food source of the parasite, thus maintaining the equilibrium of the marine ecosystem (Euzet & Combes, 1980).

In the Mediterranean, several authors have reported numerous economic losses due to teleost fishes caused by the pathogenic effect of ectoparasites (Ben Hassine et al., 1990; Ben Cheikh, 1993; Ben Cheikh et al., 1994; Faliex & Morand, 1994; Sasal et al., 1996; Ramdane, 2009); for example, Isopod Gnathidae are haematophagous ectoparasites causing perforations in the host tissues and therefore lesions that would represent pathways to viruses and bacteria (Cohen & Poore, 1994; Bunkley et al., 2006; Tanaka & Nishi, 2008), so parasitism can have a series of stress and disturbances over the life cycle of fish (Bobadilla, 2009; Ferrer-Maza et al., 2014); recently, Ichalal et al. (2016) reported that nematodes induced intersexuality in females of *Trachurus trachurus* (Linnaeus, 1758).

Pagellus acarne (Risso, 1826) (Perciformes

Sparidae) is widespread in the Mediterranean Sea, Europe, Africa and the Black Sea; on the Algerian coast at depths up to 520 meters (Refes, 2011), despite the economic importance of this species, the studies devoted to its parasitofauna in Algeria have not exceeded the group of ectoparasites which was carried out by (Ramdane et al., 2009; Kaouachi et al., 2010; Boualeg et al., 2012). The objective of this article is to clarify the hypothesis concerning the effect of parasitism on the biological performances of *P. acarne* from the eastern cost of Algeria.

MATERIAL AND METHODS

Our study was carried out on one hundred and eleven axillary Seabream which were sampled (randomly, depending on the availability of the species), between April 2013 and March 2014 from the commercial fishing vessels; from the Gulf of Bejaia, in the eastern coast of Algeria, the fish are examined in the spawning state; the total length (Lt) and the total weight (Wt) of each fish were measured using an ichthyometer (0.5 cm accuracy) and an electronic balance (0.1mg accuracy) so the parasitological study was made for each fish in order to collect all the existing parasites. To do that, we examined the surface of the fish thoroughly first with the naked eye and after under a magnifying glass with stereomicroscope for a rapid identification of the ectoparasites and to dissect immediate of the fish; once the meso-parasites were collected, they were cleaned and fixed in 70% Ethanol (for subsequent identification). In order to assess parasitism on *P. acarne,* we calculated the population descriptors namely: prevalence, mean intensity and abundance as proposed by Bush et al. (1997) and Margolis et al. (1982), and also the condition index K: $K = (W)/Lt^b$ (W: weight, L: length b: allometric coefficient considered as equal to 3) (Sutton et al., 2000), in order to compare the muscle reserves of the two groups of *P. acarne* (parasitized and unparasitized) and concerning the comparison in length/weight relationship between parasitized and unparasitized specimens the values of the constants a = intercept, b = slope (of the length-weight relationship) “a” and “b”of the linear regression of the length/weight relationship ($\log W = b \log L + \log a$) were calculated. The slopes of the equations were compared using a covariance analysis (ANCOVA) (variable used: length (cm) and weight (g)) made with the “XLSTAT” (2016) software.

RESULTS AND DISCUSSION

Parasitic diversity

We have collected 373 parasites, the prevalence of the different groups of parasites reveals the predominance of the Nematoda group (P= 50.45%). We report in this article some species of parasites, identified on the *P. acarne* from the gulf of Bejaia: *Hysterothylacium fabri* (Rudolphi, 1819), *Hystrothylacium* sp., *Cucullanus* sp., and *Ascarophis* sp.; the predominance of the Nematoda has already been reported from Suez Canal area with (P=60%), but the species identified differ from those reported in Suez Canal area (Egypt) (Eissa et al., 2012), followed by Monogenea (P= 29.72%) (*Lamellodiscus drummondi* Euzet et Oliver, 1967 *Atrispinum acarne* (Maillard et Noisy, 1979), *Choricothyle chrysophrii* (Monticelli, 1888)) which is also reported in the Mediterranean Sea (Maillard & Noisy, 1979) and in Algeria by Kaouachi et al. (2010) then the Tetraphyllidae larvae and Isopoda: (*Gnathia* sp.) with a prevalence of 17.11%, the Isopoda group has been reported too in the eastern cost of Algeria by Ramdane et al. (2009) and Boualeg et al. (2012), then Digenea group (P= 8.10%) (*Derogenes latus* Janiszewska, 1953, *Lepocreadium album* Stossich, 1904 and *Pycnadenoides senegalensis* Fischthal et Thomas, 1972; the different species of the Nematoda and Digenea fauna are reported for the first time in *P. acarne* from the eastern coast of Algeria. and finally Acanthocephala (P= 6.3%) (Fig.1). It emerges from this study that *P. acarne* from the Gulf of Bejaia hosts a very diverse parasitic fauna, this groups have already been reported in the North East Atlantic by Petter & Cabaret (1995), in the North Atlantic Moroccan’s Waters (Azbaid et al., 2016) and in the Mediterranean sea by several authors (Bray & Cribb, 1997; Sasal et al., 1997).

Parasitological indexes

Our results on parasitological indexes (Figs. 2, 3) show that the specimens with a high length of this fish are the most infested, the abundance and the prevalence increases with the growth in length

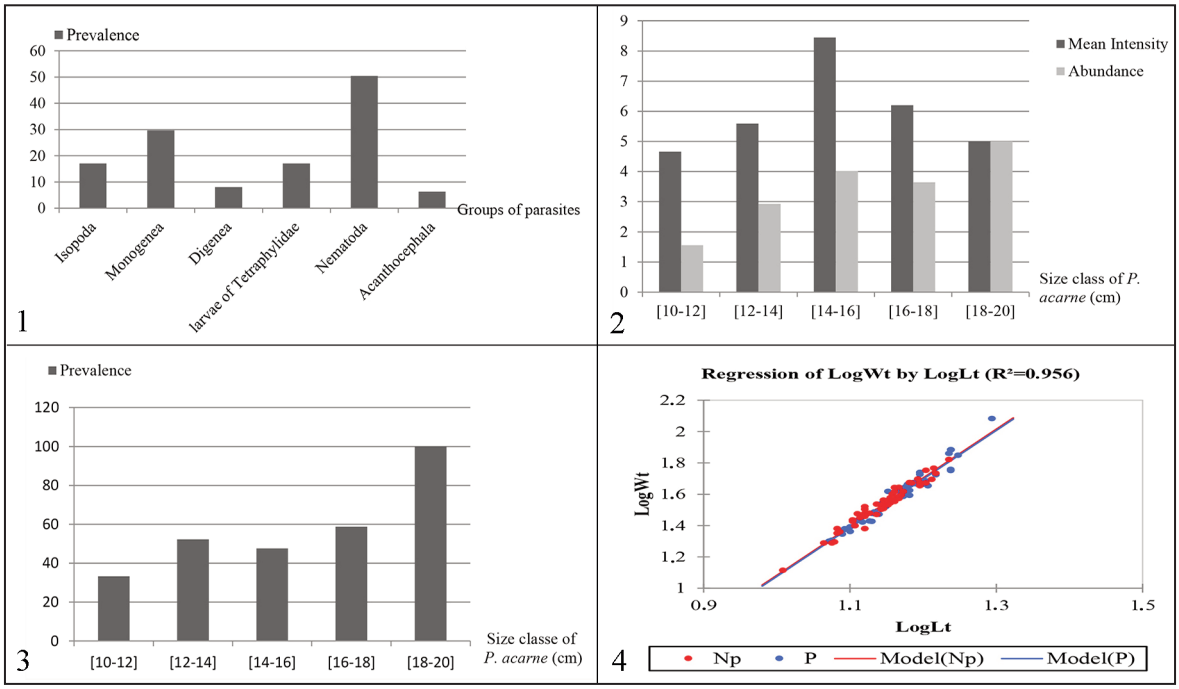

Figure 1. Prevalence (%) of *Pagellus acarne* parasites from the Gulf of Bejaia. Figure 2. Variation of parasitological indexes (mean intensity and abundance) according to size class of *Pagellus acarne*. Figure 3. Variation of prevalence (%) according to size class of *Pagellus acarne*. Figure 4. Regression of Log weight by Log length of the (P) parasitized and (Np) unparasitized specimens of *Pagellus acarne*, R^2: correlation coefficient.

of the fish; abundance varies from 1 to 5 parasites by fish, whereas mean Intensity varies from 4 to 8 parasites by infested fish. Parasitic loads seem to increase with specimen's length. Our findings corroborate with those of Azbaid et al. (2016), Lo et al. (1998) and Machado et al. (1994) who showed clearly that the level of parasitism increases over the host size development.

The condition index of Fulton K

This index characterizes nutritional status and energy reserves of the fish (Table 1). K does not show any significant difference between parasitized and unparasitized *P. acarne* (ANOVA, P= 0.388 >0.05). This was confirmed in *Mullus barbatus barbatus* (Linnaeus, 1758) by Ramdane et al. (2010), whose condition index was not affected despite the large infestation by various parasites species. It seems that parasitized fish increase their energy gain by feeding more than unparasitized specimens to compensate for their losses; accord-ing to Östlund-Nilsson et al. (2005), host develops strategies to overcome the corresponding energy losses (form of adaptation developed by the host).

The relationship length/weight

The results obtained from the study of the length/weight relationship (Fig. 4) show a good correlation between the length and weight of the two groups of *P. acarne* (parasitized and unparasitized) r^2=0.955: so both groups keep the same normal general form with a good correlation without any difference, whether parasitized or not. Statistical analysis did not show any significant difference (ANCOVA, p= 0.481> 0.0001) and, in the Mediterranean Sea, different research for the exponential relationship between the length and weight of the axillary Seabream indicates that «b» change from one locality to another and varies from 2.086 to 3.281 (Table 2). This difference is related to the ecological niche of the species (geographical position and ecological conditions of the biotope like upwelling, salinity, temperature…). It also has relationship with fish biology: age, sex, length, fish diet, etc. (Ricker, 1975; Bagenal & Tesch, 1978; So-

marakis & Machias, 2002). Our results are included in this range but unparasitized groups have an isometric growth (b= 3.0) while the parasitized groups have an upper bound allometry (b= 3.19>3). The difference between the two groups of *P. acarne* cannot be linked to the presence of parasites; according to Rameshkumar et al. (2014), the presence of a parasite in the marine environment does not always mean the occurrence disorders in the fish especially in the case of a wild fish and we noticed predominance of: size class (11–15), indeterminate sex and male sex in the group of non-infested *P. acarne*, which explains the difference, Özaydın & Taskavak (2006), Özaydın et al. (2007) and Sangun et al. (2007) have found a lower result than ours. Dorel (1986) explains that a fish of undetermined sex generally exhibit isometric growth as long as these specimens have not yet reached their sexual maturity so the presence of parasite did not induce any effect on the length/weight relationship of the *P. acarne,* especially that isometric growth that has already been reported in this fish species in several Mediterranean research and also in the western Algerian coastline (Bensahla Talet et al., 2009). In addition to, research conducted in the northeast Mediterranean Sea by Genc (2007) suggests that Gnathiid parasites have no effect on the growth and general health condition of infested *Epinephelus marginatus* (Lowe, 1834), despite the high parasitic infestation; in Hajji et al. (1994), the authors also reported the lack of difference between the length/weight relationships in the two groups of sardine.

Specimens examined	N	K±SD	p
Parasitized specimens	56	1.24±0.09	P=0.38> 0.05
Unparasitized specimens	55	1.25±0.08	

Table 1. Variation of the condition index (K) (g.cm-3) between parasitized and unparasitized specimens. N: number of *Pagellus acarne*, SD: standard deviation, P: ANOVA test

Site		Type of fish	n	a	b	r^2	Authors
Spain The *Canary Islands*		M	556	0.0065	3.242	0.98	(Pajuelo & Lorenzo, 2000)
		F	968	0.0062	3.281	0.99	
Turkey	Mediterranean Sea	C	83	0.0186	2.841	0.91	(Sangun et al., 2007)
		C	901	0.0075	3.15	0.95	(Cicek et al., 2006)
	Aegean Sea	C	335	0.0942	2.086	0.95	(Özaydın & Taskavak, 2006)
		C	303	0.0302	2.782	0.963	(Özaydın et al., 2007)
		C	334	0.0104	3.06	0.93	(Ilkyaz et al., 2008)
		C	46	0.0088	3.112	0.952	(Ceyhan et al., 2009)
France Bay of Biscay		Ind	257	0.086	3.131	0.994	(Dorel, 1986)
Algeria	Bay of Oran	C	850	0.0089	3.10	0.959	(Bensahla Talet et al., 2009)
		M	271	0.0093	3.08	0.969	
		F	306	0.0111	3.03	0.969	
	Gulf of Bejaia	P	56	0.007	3.19	0.956	Present
		UNP	55	0.012	3	0.953	Work

Table. 2. Parameters of the length-weight relationship [weight (in g) and length (in cm)] of *Pagellus acarne* in different regions of the Mediterranean Sea; n; number of *P. acarne*, a: allometric coefficient, b: slope of the regression line, r^2: coefficient of correlation M: male, F: female, C: combined, Ind: indeterminate sex, P: parasitized fish, NP: unparasitized fish.

CONCLUSIONS

It emerges from this study that *P. acarne* of the eastern cost of Algeria harbors a very diverse parasitic fauna, with a dominance of the group of Nematoda. Size class 18–20 cm is more infested by various systematic groups. The parasitism has no effect on the biological performance of *P. acarne* despite the important parasite infestation. This may probably be due to the adaptation of the host to the presence of the parasite.

REFERENCES

Azbaid L., Belcaid S. & Talbaoui M., 2016. Anisakid Nematodes of *Pagellus acarne* and *Trachurus trachurus*, from North Atlantic Moroccan's Waters Journal of Life Sciences 279–288.

Bagenal T.P. & Tesch F.W., 1978. Age and Growth. In: T.B. Bagenal (Ed.), Methods for Assessment of Fish production in Freshwater. 3rd ed. IBP Handbook, Blackwell, Oxford, pp. 93–130.

Bartoli P., Gibson I.D., Bray A.R., Maillard C. & Lambert M., 1989. The Opecoelidae (Digenea) of sparid fishes of the western Mediterranean. II. *Pycnadenoides* Yamaguti, 1938 and *Pseudopycnadena* Saad Fares & Maillard, 1986. Systematic Parasitology, 13: 35– 51.

Ben Cheikh S., 1993. Contribution à l'étude de *Peroderma cylindricum* Heller, 7865, parasite de la sardine, *Sardina pilchardus* (Walbaum, 1792) des côtes tunisiennes. DEA, 91 p. Faculté des Sciences de Tunis.

Ben Cheikh S., Raibaut A., Euzet S. & Ben Hassine O.K., 1994. Etude biosystémique de deux populations de téléostéens (*Sardina pilchardus*) et de leurs copépodes parasites (*Peroderma cylindricurn*) sur les côtes tunisiennes. Parasite, 1: 279– 282.

Ben Hassine O.K., Raibaut A., Ben Souissi J. & Rousset V., 1990. Morphologie de *Peroderma cylindricum* Heller, 1865, copépode parasite de la sardine, *Sardina pilchardus* (Walbaum, 1792) et quelques aspects de son écologie dans les eaux côtières tunisiennes. Annales des sciences naturelles, 11: 9– 16.

Bensahla Talet L., Abi Ayad S.M.A., Kerfouf S.A., Boutiba Z. & Bensahla Talet A., 2009. Paramètres de la croissance relative et absolue de (*Pagellus acarne* Risso, 1826) des eaux oranaises Bulletin de l'Institut National des Sciences et Technologies de la Mer (I.N.S.T.M. Salammbô). Actes des Onzièmes Journées Tunisiennes des Sciences de la Mer (Nabeul TUNISIE 19–22 décembre 2009), Numéro Spécial 14: 66–69.

Bobadilla A.S., 2009. Can myxosporean parasites compromise fish and amphibian reproduction? Proceedings of the Royal Society of London B, 276: 2861–2870.

Boualeg C., Kaouachi N. & Bensouilah M., 2012. L'infestation de douze espèces de Sparidae par le parasite *Gnathia* sp. (Isopoda: Gnathiidae) dans le littoral est-algérien. Bulletin de l'Institut Scientifique, Rabat, section Sciences de la vie, 34: 65–70.

Bray R.A. & Cribb T.H., 1997. The subfamily Aephnidiogeninae Yamaguti, 1934 (Digenea: Lepocreadiidae), its status and that of the genera *Aephnidiogenes* Nicoll, 1915, *Holorchis* Stossich, 1901, *Austroholorchis* n. g., *Pseudaephnidiogenes* Yamaguti, 1971, *Pseudoholorchis* Yamaguti, 1958 and *Neolepocreadium* Thomas, 1960. Systematic Parasitology, 36: 47–68.

Bush A.O., Lafferty K.D., Lotz J.M. & Shostak A.W., 1997. Parasitology meets ecology on its own terms: Margolis et al. Revisited. Journal of Parasitology, 83: 575–583.

Bunkley W.L., Williams E.H. & Bashirullah A.K.M., 2006. Isopods (Isopoda: Aegidae, Cymothoidae, Gnathiidae) associated with Venezuelan marine fishes (Elasmobranchii, Actinopterygii). Revista De Biologia Tropical, 54: 175–188.

Ceyhan T., Akyol O 1. & Eerdem M., 2009. Length-Weight Relationships of Fishes from Gökova Bay, Turkey (Aegean Sea) Turkish Journal of Zoology, 33: 69–72.

Cicek E., Avsar D., Yeldan H. & Ozutok M., 2006. Length–weight relationships for 31 teleost fishes caught by bottom trawl net in the Babadillimani Bight (northeastern Mediterranean). Journal of Applied Ichthyology, 22: 290–292. DOI: 10.1111/j.1439-0426.2006.00755.x.

Cohen B.F. & Poore G.C.B., 1994. Phylogeny and biogeography of the Gnathiidae (Crustacea: Isopoda) with descriptions of new genera and species, most from south-eastern Australia. Memoirs of Museum Victoria, 54, 271–397.

Dorel D., 1986. Poissons de l'Atlantique nord-est relations taille-poids. Institut Français de Recherche pour l'Exploitation de la Mer. Nantes, France, 165 pp.

Eissa I.A.M., Mona A.E., El-Genidy H.M. & El-Fatah W.A.A., 2012. Studies on prevailing nematodiasis in marine fish *Pagellus acarne* in Suez, Egypt. Global Journal of Fisheries and Aquaculture Researches, 5: 58–70.

Euzet L. & Combes C., 1980. Les problèmes de l'espèce chez les animaux parasites. Mémoires de la Société Zoologique de France, 40: 239–285.

Faliex E. & Morand S., 1994. Population dynamics of the metacercarialstage of the bucephalid trematode, *Labatrema minimus* (Stossich, 1887) from Salses-Leucate lagoon (France) during the cercarial shedding period. Journal of Helminthology, 168: 35–40.

Ferrer-Maza D., Lloret J., Munoz M., Faliex E., Vila S. & Sasal P., 2014. Parasitism, condition and reproduction of the European hake (*Merluccius merluccius*) in the northwestern Mediterranean Sea. ICES Journal of Marine Science, 71: 1088–1099.

Genc E., 2007. Infestation status of gnathiid isopod juveniles parasitic on Dusky grouper (*Epinephelus marginatus*) from the northeast Mediterranean Sea. Parasitology Research, 101: 761–766.

Hajji T., Ben Hassine O.K. & Farrugio H., 1994. Impact du copépode parasite *Peroderma cylindricum* Heller, 1868 sur la croissance et la fécondité des stocks exploités de la sardine *Sardina pilchardus* (Walbaum, 1792). CIHEAM Options Méditerranéennes, 79–86.

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: 225–233.

Ilkyaz A., Metin G., Soykan O. & Kinacigil H., 2008. Length weight relationship of 62 fish species from the Central Aegean Sea, Turkey. Journal of Applied Ichthyoloy, 23: 699–702.

Kaouachi N., Boualleg C., Bensouilah M. & Marchand B., 2010. Monogenean parasites in Sparid fish (*Pagellus* genus) in eastern Algeria coastline, African Journal of Microbiology Research, 4: 989–993.

Lo C.M., Morand S. & Galzin R., 1998. Parasite diversity/host age and size relationship in three coral-reef fishes from French Polynesia. International Journal for Parasitology, 28: 1695–1708.

Machado M.H., Pavanelli G.C. & Takemoto R.M., 1994. Influence of host's sex and size on endoparasitic infrapopulations of *Pseudoplatystoma corruscans* and *Schizodon borelli* (Osteichthyes) of the high Paraná river, Brazil. Revista Brasileira de Parasitologia Veterinária, 3: 143–148.

Maillard D. & Noisy D., 1979. *Atrispinum acarne* n. g. n.sp. (Monogenea Microcotylidae), parasite de *Pagellus acarne* (Telostei) du Golfe du Lion. Vie et Milieu, 28/29: 579–588.

Margolis L., Esch G.W., Holmes J.C., Kuris A.M. & Schad G.A., 1982. The use of ecological terms in parasitology (report of an ad hoc committee of the American Society of parasitologists). Journal of Parasitology, 68: 131–133.

Östlund-Nilsson S., Curtis L., Goran E.N. & Grutter A.S., 2005. Parasitic isopod *Anilocra apogonae*, a drag for the cardinal fish *Cheilodipterus quinquelineatus*. Marine Ecology Progress Series, 287: 209–216.

Özaydın O. & Taskavak E., 2006. Length-weight relationships for 47 fish species from Izmir Bau eastern Aegean Sea, Turkey. Acta Adriatica, 47: 211.

Özaydın O., Uçkun D., Akalın S., Leblebici S. & Tosunoğlu Z., 2007. Length-weight relationships of fishes captured from Izmir Bay, Central Aegean Sea. Journal of Applied Ichthyology, 23: 695–696.

Pajuelo J G. & Lorenzo J.M., 2000. Reproduction, age, growth and mortality of axillary seabream, *Pagellus acarne* (Sparidae), from the Canarian archipelago. Journal of Applied Ichthyology, 16: 41–47.

Petter A.J. & Cabaret J., 1995. Ascaridoid Nematodes of Teleostean fishes from the eastern North Atlantic and sea of the North of Europe. Parasite, 2: 217–230.

Ramdane Z., 2009. Identification et écologie des ectoparasites Crustacés des poissons Téléostéens de la côte Est algérienne. Thèse de Doctorat, University Badji Moktar, Annaba, 235 pp.

Ramdane Z., Bensouilah M.A. & Trilles JP., 2009. Étude comparative des crustacés isopodes et copépodes ectoparasites de poissons marins algériens et marocains. Cybium, 33: 123–131.

Ramdane Z., Amara R. & Trilles JP., 2010. Impact des parasites sur les performances biologiques de *Mullus barbatus barbatus* L. INOC-Tischreen University, International conference on Biodiversity of the Aquatic Environment, 369–384.

Rameshkumar G., Ravichandran S. & Venmathi Maran B.A., 2014. Occurrence of parasitic copepods in Carangid fishes from Parangipettai, Southeast coast of India. Journal of Parasitic Diseases, 38: 317–323.

Refes W., 2011. Contribution à la connaissance de la biodiversité des fonds chalutables de la côte algérienne: les peuplements ichtyologiques des fonds chalutables du secteur oriental de la côte algérienne. Thèse de Doctorat, Univ. Badji Moktar, Annaba, 280 pp.

Ricker W.E., 1975. Computation and interpretation of biological statistics of fish populations. Bulettin of the Fisheries Research Board of Canada, 191: 1–382.

Sangun L., Akamca E. & Akar M., 2007. Weight-Length Relationships for 39 Fish Species from the North-Eastern Mediterranean Coast of Turkey. Turkish Journal of Fisheries and Aquatic Sciences, 7: 37–40.

Sasal P., Falliex E. & Morand S., 1996. Parasitism of *Gobius bucchichii* Steindachner, 1870 (Teleostei, Gobiidae) in protected and unprotected marine environment. Journal of Wildlife Diseases, 32: 607–613.

Sasal P., Morand S. & Guegan J-F., 1997. Determinants of parasite species richness in Mediterranean marine fishes. Marine Ecology Progress, 149, 61–71.

Sutton S.G., Bult T.P. & Haedrich R., 2000. Relationships among fat weight, body weight, water weight and condition factors in wild Atlantic Salmon Parr. Transactions of the American Fisheries Society, 129: 527–538.

Somarakis S. & Machias A., 2002. Age, Growth and bathymetric distribution of red Pandora (*Pagellus erythrinus*) on the Cretan shelf (eastern Mediterranean). Journal of the Marine Biological Association of the United Kingdom, 82: 149–160.

Tanaka K. & Nishi E., 2008. Habitat use by the gnathiid isopod *Elaphognathia discolor* living in terebellid polychaete tubes. Journal of the Marine Biological Association UK, 88: 57–63.

XLSTAT, 2016. Data Analysis and Statistical Solution for Microsoft Excel. Paris, France.