Iranian Journal of Veterinary Science and Technology

Received: 2025-Jan-22
Accepted after revision: 2025-Oct-11
Published online: 2025- Oct-11

RESEARCH ARTICLE

DOI: 10.22067/ijvst.2025.91719.1463

The parasitic *isopod Anilocra physodes* (Cymothoidae; Crustacea) on its fish host from the Atlantic coast of Morocco

Mourad Bendada[a], Abderrahmane Hadini[a], Youssef Moallaqat[b], Khalid El Bekkaye[a], Khalid Chaabane[a]

[a] Laboratory of Agricultural Production Improvement, Biotechnology and Environment, Faculty of Sciences, Mohammed First University, Box 717, Oujda 60000, Morocco.
[b] The National Office of Fisheries, Laboratory Wholesale fish market of Oujda, Oujda 60000, Morocco.

ABSTRACT

This study investigated the parasitism of three species of fish species, Pagellus bogaraveo, (family Sparidae), Sardina pilchardus (family Clupeidae) and Umbrina canariensis (family Sciaenidae), collected from the Atlantic coast of Morocco. A total of 5419 fish specimens were examined. Among them, 3600 fish individuals of Sardina pilchardus, 920 of Umbrina canariensis and 899 of Pagellus bogaraveo, were found to carry 328 isopod parasites of the species Anilocra physodes (family Cymothoidae). Most of these ectoparasitic isopods were primarily located on the body surface or within the gill chambers of their hosts. Parasitism was quantified using various parasitological indices (prevalence, intensity which is the mean number of parasites per infected host and abundance) calculated for each fish species. The results showed that infestation rates by A. physodes were relatively low and did not exceed prevalence of 11.11%. The mean infestation intensity is ranged between 1 and 2 parasites per infected fish, while, abundance values remain below 0.14 parasites per examined fish across all host species. These findings indicate that infestation levels are strongly associated with the host species. Overall, this study provides valuable insights into the effects of this ectoparasite crustacea on fish health, emphasizing the need for fisheries management strategies and marine conservation in the region.

Keywords

Cymothoid isopods; ectoparasites; Anilocra physodes; parasitic indices; parasitism;

Number of Figures: 3
Number of Tables: 2
Number of References:: 42
Number of Pages: 9

Abbreviations

A. physodes: Anilocra physodes

Corresponding author: *Mourad Bendada*
Email: mourad.bendada@ump.ac.ma
Tel: +21(26)4809-1841

Introduction

Morocco benefits from having two maritime coastlines of approximately 3500km, including more than 500km along the Mediterranean and nearly 3,000km along the Atlantic Ocean. Cymothoid isopods belong to a group of highly host-specific parasites known to infect wide range of fish species worldwide, mainly in marine waters but also in freshwater [1,2]. There are 43 established [2]. Members are hematophagous protandrous hermaphrodites [3], their life cycle involves only one host (holoxenic cycle) [4]. These parasites can attach externally to the body surface, envelop in a pouch, or burrow inside the flesh, buccal cavity, or gill chamber [5,6]. They parasitize numerous species across various fish families, leading to substantial economic losses to fisheries and aquaculture industry [7]. These isopods cause various levels of damage to their hosts, ranging from minor tissue damage at the binding site to differential mortality [8]. Like most isopods, cymothoids are considered to feed principally on host blood, but they may also consume subcutaneous tissues, mucus, and epithelial tissues [4]. Infested fish often display symptoms such as slow growth rates, tissue damage, anemia and ultimately death [7]. Secondary bacterial or fungal inflammation and contamination have often been found around wounds, inspired by these ectoparasites, and may further facilitate the infection of other pathogenic microorganisms [9,10]. In some field studies, isopod-infested fish have been found to suffer from decreased condition index and growth [11,12], altered reproductive capacity and shortened lifespan [12]. However, cymothoid infestation cannot be generalized and standardized treatments cannot be performed for all fish, due to the biological variability of the host and parasites including differences in size, age, life stage, sex and behavior [1,13]. Generally, studies carried out in the field of parasitology are always based on parasitological indices. These indices give us a clear idea about the state of infestation in the studied populations and even provide information on the degree of parasite-host affinity (high infestation rates would explain the affinity of a parasite to its host).

Little information is known about the fish infestation status by Anilocra physodes, their distribution, host specificity, and ecological impacts along the Atlantic coast of Morocco. This region supports diverse fisheries critical to local economies, yet no comprehensive studies have assessed how A. physodes infestations affect commercially important fish species.

In this study, the main objectives were, to study the infestation rate, and characterize the prevalence and parasitism intensity of Anilocra physodes (Cymothoidae; Isopoda) on fish species hosted on the coasts of Morocco. This research will provide valuable insights into the prevalence and intensity A. physodes in Moroccan waters and contribute to the development of sustainable management strategies to mitigate parasite impacts on fish populations.

Although Anilocra physodes is a common and widely distributed species, many aspects of its ecology and biology, such as its impact on specific host traits, environmental conditions on the parasite dynamics and diversity of this ectoparasite have rarely been studied.

Result

Examination of the gills and external surfaces of the collected fish revealed a total of 328 parasites belonging to the family Cymothoidae, identified as Anilocra physodes (Figure 1). Among these, 38 individuals were found on Umbrina canariensis, 44 individuals on Pagellus bogaraveo and a high number, 246 individuals, on Sardina pilchardus. The evaluation of parasitological indices revealed that infestation rates by Anilocra physodes were generally low, with a maximum prevalence of 11.11% (Figure 2). The mean intensity of infestation was also very low, ranged between 1 and 2 parasites per infested fish, while the abundance values remained below 0.14 parasites per examined fish across all the host species.

1. Enumeration of collected parasites

The results revealed that the highest number of parasites was recorded in Sardina pilchardus during November on the South Atlantic coast, with 21 parasites collected. Conversely, the lowest number (3 individuals) was recorded during March on the North Atlantic coast. For Umbrina canariensis infestations were observed in January, June and July on the North Atlantic coast, with three ectoparasites collected during each of these months. In the case of Pagellus bogaraveo, infestations occurred in October on the South Atlantic coast, with six ectoparasites collected. Overall, the number of parasites collected from Sardina pilchardus was higher on the North Atlantic coast compared to the South Atlantic coast. The opposite trend was observed for Pagellus bogaraveo, which exhibited higher infestation levels on the South Atlantic coast compared to the North Atlantic coast. For Umbrina canariensis, infestation levels were similar between the two study areas.

2. Distribution of parasitological indices

2.1. By host species

The host-parasite relationship constitutes a biological entity that is expressed by parasite specificity

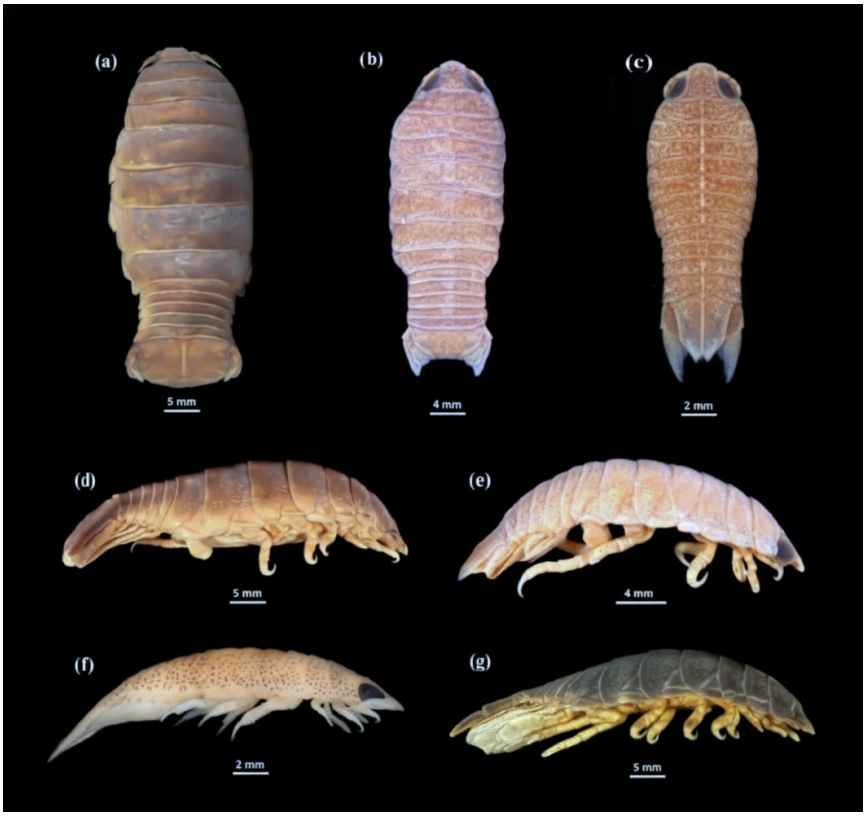

Figure 1.
Anilocra physodes (Linnaeus, 1758) were collected in this study. (a) Female. (b) Male. (c) Immature stage 3. (d) Gravid female, lateral view. (e) Male, lateral view. (f) Immature stage 3, lateral view. (g) Non-gravid female, lateral view

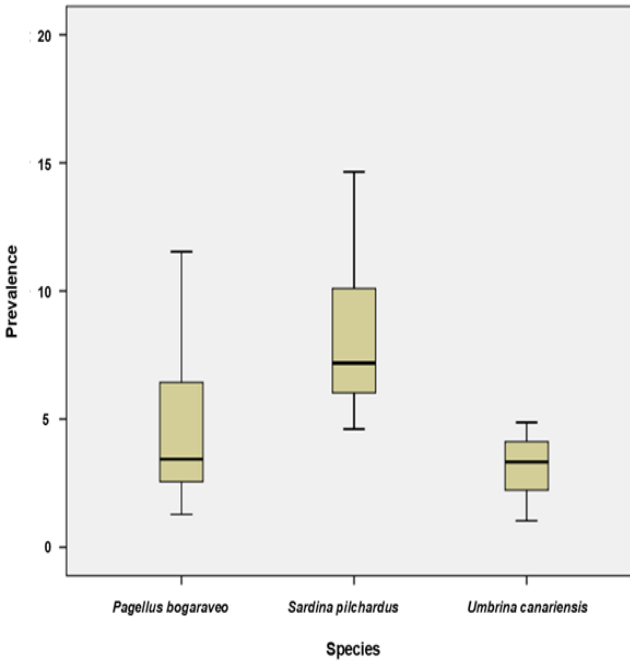

Figure 2.
Prevalence of parasite effects on fish species. The samples were carried out for 12 months: the data were recorded for a total of 3 samples per species per location, repeated 3 times. The boxplot represents averages and error lines of one standard deviation *** indicates the significant differences at $p < 0.01$ based on the SNK test.

[14]. According to Lumbery [15], specificity refers to the number of host species a parasite can infect and serves as a measure of the strength of the relationship between a parasite and its host. Data analysis revealed that infestation rates were globally low, with prevalence values not exceeding 11.11%. The highest prevalence was observed in Sardina pilchardus and Pagellus bogaraveo (p = 11.11%) followed by Umbrina canariensis (p = 8.33%) (Figure 2). In terms of parasitic load, Sardina pilchardus exhibited the highest mean infestation intensity. On the other hand, the abundance values do not exceed 0.14 parasites/fish examined in Sardina pilchardus and remain below 0.13 parasites/fish examined in the other species.

2.2. According to geographical distribution

On the southern Atlantic coast, Sardina pilchardus and Pagellus bogaraveo exhibited the highest infestation rates by Anilocra Physodes (p = 11.11%) during November, January and August, respectively. In contrast, Umbrina canariensis, showed its highest prevalence values on the Southern Atlantic coast as well (p = 9.09%) during July. Regarding mean intensity, results indicated that parasite load values (ranging from 1 to 2 parasites per infested fish), and abundance were very low and slightly higher the northern Atlantic coast compare to the southern Atlantic coast during the study period.

Discussion

The present study aimed to identify the parasitism intensity of Anilocra Physodes affecting three species of fish species, Pagellus bogaraveo, (family Sparidae), Sardina pilchardus (family Clupeidae) and Umbrina canariensis (family Sciaenidae) through the infestation rate, the prevalence and the mean infestation intensity.

This study highlights significant variations in the infestation rates across different host fish species, with Sardina pilchardus supporting the highest infestation, followed by Pagellus bogaraveo and Umbrina canariensis.

In general, isopods parasitize a wide range of fish species worldwide, causing significant economic losses [16]. The species Anilocra physodes has been reported in the Atlantic Ocean, Mediterranean Sea, Black Sea and Adriatic Sea [17–22]. This euryxene parasite has a wide host range. In Tunisia, infestations are predominantly recorded in the Sparidae family (D. annularis, S. cantharus, Dentex vulgaris, Pagrus auriga, B. boops) and in the Pomatomidae (Pomatomus saltator) [23,24]. In France, it has also been observed mainly on Sparidae and the Maenidae [19].

Infestations by cymothoid isopods such as Anilocra physodes can have significant biological and ecological consequences for host fish, affecting growth, reproduction, and overall health. As an ectoparasite, A. physodes attaches to the body surface of fish, often on the head or flank, and feeds on blood and tissue fluids, leading to chronic stress and energy depletion in the host [4]. Sasal et al., [25], reported that Acanthocephaloides propinquus, a parasite of Marine fish, have negatively effects on females reproduction level by reducing the gonadosomatic index and egg production. Similarly, Fogelman [26] suggest that Anilocra apogonae negatively affects host growth and reproduction. Ecologically, such impacts on individual fish can translate into population-level consequences, especially in heavily infested populations, potentially altering community structure and predator-prey dynamics. Therefore, A. physodes infestations represent not only a parasitic burden to individual fish but also a potential threat to the health and sustainability of fish populations in natural ecosystems.

Our study suggest a relatively high degree of host specificity for A. physodes along the Moroccan Atlantic coast. The parasite was recorded on three fish species belonging to different families: Pagellus bogaraveo (Sparidae), Sardina pilchardus (Clupeidae), and Umbrina canariensis (Sciaenidae). Brusca [27] noted that some species of Cymothoidae prefer a host based on their ecological characteristics than on taxonomic identity.

In the present study, Sardina pilchardus hosted the largest number of parasite (N = 246), while Pagellus bogaraveo harbored only 44 parasite and Umbrina canariensis harbored only 38. According to Zender and Kesting [28], the eutrophic state of an environment can increases the parasite infestation level. However, the prevalence of infested fish can vary over time and space [1]. In our study, we found high parasitization of Anilocra physodes on Sardina pilchardus, followed by Pagellus bogaraveo, and Umbrina canariensis respectively (Figure 2). The statistically analy-

Table 1.
Impact of ectoparasite Anilocra physodes on host species shown by one-way ANOVA test. Significant values are highlighted in bold: P < 0.05; **$p < 0.01$; ***$p < 0.001$.

		Sum of squares	Average of squares	F	Signification
Prevalence	Inter- groups	228,043	45,609	4,432	·001***
	Intra-groups	2160,979	10,290		
	Total	2389,022			
Intensity	Inter- groups	·037	,007	5,456	,000***
	Intra-groups	,286	,001		
	Total	,323			

sis revealed that the prevalence of parasite species was significantly greater within the intergroups (F = 4.432 and p = 0.001), and the intensity also differed significantly (F = 5.456 and p = 0.0001, Table 1). In Morocco, Dollfus and Trilles [29], provided some figures on the intensity of Cymothoidae and reported values that varied between 1 and 2 parasites per fish, without specifying the number of fish specimens examined. The results obtained from our parasite load assessment are in accordance with those of Dollfus and Trilles [35], which who reported that the intensity of infestation is very low, ranged between 1 and 2 parasites per infested fish. According to Ternengo et al. [30], emphasized that each fish species harbors a characteristic parasitic fauna and unique infestation dynamics. Isopod dispersion and abundance are influenced by many environmental factors such as salinity, predators, water temperature, light intensity, and food availability [31]. In our study, the three host species sampled presented abundance values of less than 0.14 parasites per fish examined. The study of parasitism according to the geographical distribution of the fishes examined confirmed that: in Sardina pilchardus the highest rate of infestation was recorded on the North coast. In contrast it is more important in the South Atlantic in the host species Pagellus bogaraveo. In the host Umbrina canariensis there was an equality between the two study areas. This may be related to and due to anthropogenic pressure, which can affect the immune system of fish hosts and host-parasite interactions. Zharikova [32], reported that environmental pollution, the infestation of fish by parasites decreases and that the emergence of dominant species may reflect adaptive response of the parasite. Results from the multivariate linear model test (Table 2), confirmed that infestation levels of ectoparasite Anilocra physodes were strongly influenced by host species (p < 0.0001). Comparatively, there was no significant association between time and locality (p = 0.121 and I = 0.230) and (p = 0.828 and I = 0.833) respectively. Interaction between time-species locality were also not significant (Table 2). The causes of these variations may be due, to the influence of multiple factors related to biogeography, the environment, ethology, the immune system, the presence of other parasites, genetics, and the age of the host [33]. The results of the distribution of parasite indices of Anilocra physodes across host species show an inequality in the face of parasitism toward the latter; they vary from one host to another and from one marine area to another along the Moroccan coasts.

Table 2.
Results of the multivariate approach linear model test comparing the prevalence and intensity of Anilocra physodes in the three fish species according to factor month, species and locality. Significant values are highlighted in bold, p < 0.05; **p < 0.01; ***p < 0.001.

Source of variation	Dependent variable	F value	P value
Month	Prevalence	1,546	,121
	Intensity	1,301	,230
Species	Prevalence	11,598	,000***
	Intensity	14,254	,000***
Locality	Prevalence	,047	,828
	Intensity	,045	,833
Month * Species	Prevalence	,917	,574
	Intensity	1,153	,300
Month * Locality	Prevalence	1,101	,365
	Intensity	1,348	,204
Species * Locality	Prevalence	,047	,954
	Intensity	,551	,577
Month * Species * Locality	Prevalence	1,267	,204
	Intensity	1,354	,147

Materials and Methods

Study site

The present study was conducted in 2022 along the Atlantic coast of Morocco. The study area is subdivided into two zones, as follows: zone 1, the Moroccan North Atlantic coast from Tanger to North West to Essaouira, and zone 2: from Agadir to South West to Dakhla corresponds to the Moroccan South Atlantic coast (Figure 3).

Fish collection

A total of 5419 marine fish specimens belonging to three fish species infested by Anilocra physodes (Linnaeus, 1758) (Figure 1) were examined. The species composition included Sardina pilchardus (3600 individuals), Umbrina canariensis (920 individu-

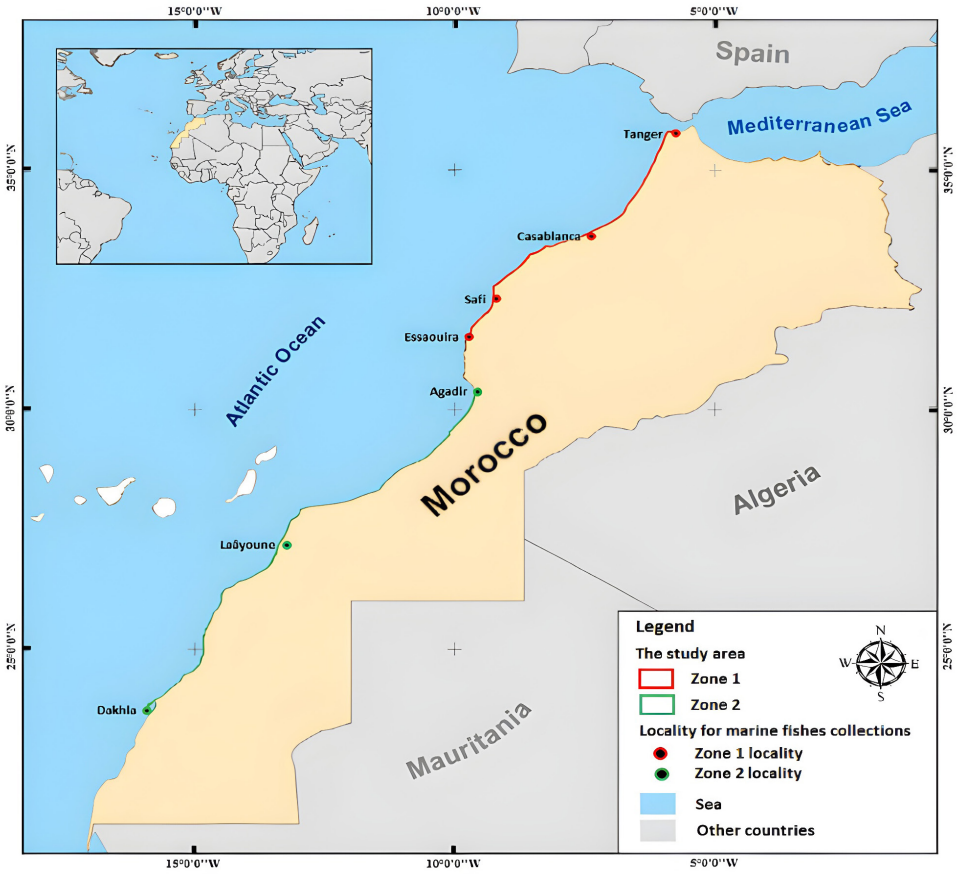

Figure 3.
Map showing the sampling areas. The study area is subdivided into too zones, which are, zone 1: the Moroccan North Atlantic coast from Tangier to Essaouira (indicated by red circles), and zone 2: the Moroccan South Atlantic coast from Agadir to Dakhla.

als) and Pagellus bogaraveo (899 individuals). Fish samples were obtained with the aid of fishers from commercial catches and individual fishermen from January 2022 to December 2022. This one-year sampling period allowed for the evaluation of any seasonal variations in infestation prevalence. Sampling sites were selected based on the previous frequent records indicating isopod infestations reported in these areas. Samplings were performed twice a month with three replicate samples per site, in order to enhance temporal resolution and statistical reliability. The prevalence (number of infested hosts/total number of examined hosts ×100), mean intensity (total number of parasites collected/total number of infested hosts), and abundance (total number of parasites collected/ total number of examined hosts) of the ectoparasite during the entire study period (12 months), were calculated according to Margolis et al. [34] and Bush et al. [35]. These parameters define the level of parasitic infestation.

Treatment and identification of parasites

After collection, isopod parasites were detached from the their host fish and immediately fixed in 70% ethanol. The sampling locality, date and host fish were noted. In the laboratory, specimens were identified, using stereoscopic microscopes in collaboration with specialists and reference materials. Species identification followed standard taxonomic keys and descriptions from previous works [19,36–38]. Host nomenclature and fish taxonomy are performed according to the guide of identification of the marine resources of Morocco [39], and the FishBase database [40–42]. All laboratory analyses were conducted at the Laboratory of Agricultural Production Improvement, Biotechnology and Environment, Faculty of Sciences, Mohammed First University.

Statistical analyses

All raw data obtained from field and laboratory examinations were entered into Microsoft Excel. The analyses were performed in triplicate with the corresponding standard deviations of our results for each month (for each parameter: 3 determinations × 3 samples = 9). One-way ANOVA and Tukey's test revealed significant differences between the sources of variation. Significant differences between the 12-month infestation results were determined via the t-student test. The threshold for a significant difference was set at 5% threshold ($p < 0.05$). All statistical analyses were analyzed using IBM SPSS Statistics (version 21 software program).

Conclusions

This study highlights the significant impact of the parasitic isopod Anilocra physodes on fish host from the Atlantic coast, Morocco. The results demonstrate that the prevalence and intensity of infestation vary notably among host species and geographic localities. Infestation levels were found to be associated with host fish species studied, suggesting that probably intrinsic characteristics of each host species play a major role in determining susceptibility to parasitism.

Among the examined species, Sardina pilchardus exhibited the highest infestation rate by A. physodes followed by Pagellus bogaraveo and Umbrina canariensis. However, overall infestation rates were relatively low, with prevalence not exceeding 11.11%. The mean intensity of infestation, show a very low average infestation intensity, ranging between 1 and 2 parasites per infested fish, while, abundance values remain below 0.14 parasites per examined fish across all host species. The data obtained in this study contribute valuable insight into the parasitic infections dynamics of Anilocra physodes on the Moroccan coast in particular and worldwide in general.

These findings stress the need for further studies on defense mechanisms in host species, environmental influences on parasitism and better understand the ecology and biology of this ectoparasite to improve fisheries management strategies and marine conservation.

Authors' Contributions

M.B., A.H., Y.M., K.E.B., K.C conceived and planned the experiments. M.B, A.H., Y.M., K.E.B. and K.C carried out the experiments. M.B. contributed to sample preparation. M.B., and A.H. contributed to the interpretation of the results. M.B. took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Acknowledgements

We would like to thank the fishermen who helped us. This study would not be possible without their effective participation. Finally, we would also like to thank The National Office of Fisheries, Laboratory Wholesale fish market of Oujda for providing us with the required laboratory facility during the study period. The current study was conducted without the support of funding sources.

Competing Interests

The authors declare that there is no conflict of interest.

Reference

1. Brusca RC. A monograph on the Isopoda Cymothoidae (Crustacea) of the eastern Pacific. Zoological Journal of the Linnean Society.1981;73(2):117-99. Doi:10.1111/j.1096-3642.1981.tb01592.x.

2. Smit NJ, Bruce NL, Hadfield KA. Global diversity of fish parasitic isopod crustaceans of the family Cymothoidae. International Journal for Parasitology: Parasites and Wildlife. 2014;3(2):188-97. Doi: 10.1016/j.ijppaw.2014.03.004.

3. Bullar JF. The generative organs of the parasitic Isopoda. Journal of Anatomy and Physiology. 1876.19(1):118-123.

4. Bunkley-Williams L, Williams EH. Isopods Associated with Fishes: A Synopsis and Corrections. The Journal of Parasitology. 1998;84(5):893-896. PMID: 9794626.

5. Horton T, Okamura B. The distribution of Ceratothoa steindachneri (Crustacea: Isopoda: Cymothoidae) parasitic in Echiichthys vipera in the north-east Atlantic. J Mar Biol Ass. 2002;82(3):415-7. Doi: 10.1017/S0025315402005660.

6. Bruce NL , Wong HP.-S. An overview of the marine Isopoda (Crustacea) of Singapore. Raffles Bulletin of Zoology. 2015; Suppl31:152-68.

7. Bunkley-Williams L, Williams EH Jr, Bashirullah AKM. Isopods (Isopoda: Aegidae, Cymothoidae, Gnathiidae) associated with Venezuelan marine fishes (Elasmobranchii, Actinopterygii). Rev Biol Trop. 2006;54(Suppl 1):175-88.

8. Adlard RD. The effects of the parasitic isopod Anilocra pomacentri on the population dynamics of the reef fish Chromis nitida [PhD thesis]. Brisbane: The University of Queensland; 1989 [cited 2025 Jan 17]. Available from: https://espace.library.uq.edu.au/view/UQ:366166

9. Brusca RC, Gilligan MR. Tongue replacement in a marine fish by a parasitic isopod. Copeia. 1983;1983(4):813-6. doi:10.2307/1444352

10. Horton T, Okamura B. Post-haemorrhagic anaemia in sea bass caused by Ceratothoa oestroides. J Fish Dis. 2003;26(7):401-6. doi:10.1046/j.1365-2761.2003.00476.x.

11. Romestand B, Trilles JP. Influence of the cymothoid isopods on growth of hosts. Z Parasitenkd. 1979;59(2):195-202. doi:10.1007/BF00927401.

12. Adlard RD, Lester RJG. Dynamics of interaction between Anilocra pomacentri and Chromis nitida. Parasitology. 1994;109(3):311-24. doi:10.1017/S0031182000078343.

13. Horton T, Okamura B. Cymothoid isopod parasites in aquaculture. Dis Aquat Org. 2001;46:181-8. Doi: 10.1017/s003118200007834.

14. Euzet L, Combes C. Les problèmes de l'espèce chez les animaux parasites. Mem Soc Zool Fr. 1980;40:239-85

15. Lymbery AJ. Host specificity, host range and host preference. Parasitol Today. 1989;5:1-298. doi:10.1016/0169-4758(89)90021-5

16. Ravichandran S, Rameshkumar G, Trilles JP. New records of two parasitic cymothoids from Indian fishes. J Parasit Dis. 2011;35(2):232-4. Doi: 10.1007/s12639-011-0046-3.

17. Trilles JP. Les Cymothoidae… II. Zool Meded. 1979;54:245-75.

18. Trilles JP. Les Cymothoidae d'Afrique. Bull Mus Natl Hist Nat. 1986;4:617-36. Doi: 10.5962/p.326714.

19. Trilles JP. Les Cymothoidae du monde. Studia Marina. 1994;1:1-288.

20. Junoy J, Castelló J. Catálogo de las especies ibéricas y baleares de isópodos marinos. Graellsia. 2003;59(2-3):293-325.

21. Öktener A, Alaş A, Türker D. First record of Anilocra physodes on Phycis blennoides. Jordan J Biol Sci. 2018;11(2):1-8

22. Boyko CB, Bruce NL, Hadfield KA, Merrin KL, Ota Y, Poore GCB, et al. World Marine… Isopod Crustaceans database: Anilocra Leach, 1818 [Internet]. WoRMS; 2008 [cited 2022 May 9]. Available from: http://www.marinespecies.org/aphia.php?p=taxdetails&id=146493.

23. Trilles JP, Raibaut A. Aegidae et Cymothoidae parasites de poissons tunisiens. Bull Inst Natl Sci Tech Mer Salammbô. 1971;2:71-86.

24. Trilles JP, Raibaut A. Sur les Cymothoidae parasites de poissons marins de Tunisie (2e note). Bull Mus Hist Natl. 1973;3:273-81. Doi: 10.5962/p.272639.

25. Salal P, Faliex E, De Buron I, Morand S. Sex discriminatory effect of Acanthocephaloides propinquus. Parasite. 2001;8(3):231-6.Doi: 10.1051/ parasite/2001083231.

26. Fogelman RM. Effect of Anilocra apogonae on cardinal fish [MPhil thesis]. Brisbane: The University of Queensland; 2005 [cited 2025 Apr 7]. Available from: https://espace.library.uq.edu.au/view/UQ:4d7e5a8.

27. Brusca RC. Studies on Cymothoid fish symbionts I. Crustaceana. 1978;34:141-54. Doi: 10 .1163/156854078X00718.

28. Zander CD, Kesting V. Colonization and seasonality of goby parasites. Parasitol Res. 1998;84(6):459-66. Doi:10.1007/s004360050430.

29. Dollfus RP, Trilles JP. Cymothoidae of Morocco and Algeria. Bull Mus Hist Natl. 1976;3:821-30.

30. Ternengo S, Levron C, Marchand B. Metazoan parasites in sparid fish in Corsica. Bull Eur Assoc Fish Pathol. 2005;25(6):262-9

31. Dufour CM, Engels NM, Burns CW. Distribution and habitat of Austridotea lacustris. N Z J Mar Freshw Res. 2007;41(3):299-307. Doi:10 .1080/00288330709509917.

32. Zharikova TI. Adaptive reaction of gill ectoparasites of bream. Parasitologia. 2000;34:50-5.

33. Combes C. Interactions durables: écologie et évolution du parasitisme. Paris: Masson; 1995. 524 p.

34. Margolis L, Esch GW, Holmes JC, Kuris AM, Schad GA. The use of ecological terms in parasitology. J Parasitol. 1982;68(1):131-3. Doi:10 .2307/3281335.

35. Bush AO, Lafferty KD, Lotz JM, Shostak AW. Parasitology meets ecology. J Parasitol. 1997;83(4):575-83. Doi:10 .2307/3284227.

36. Trilles JP. Sur deux espèces d'Anilocres mal connues. Ann Parasitol Hum Comp. 1965;40(5):575-94.

37. Trilles JP. Les Cymothoidae du Rijksmuseum… Méditerranée et Atlantique. Zool Meded. 1977;51:7-17.

38. Trilles JP. Les Cymothoidae des Antilles. Bull Mus Natl Hist Nat. 1981;3(2):583-602.Doi:10 .5962/p.285837.

39. Lloris D, Rucabado J. Guide d'identification des ressources marines du Maroc [Internet]. Rome: FAO; 1998. 263 p. Available from: https://openknowledge.fao.org/handle/20.500.14283/w9160f.

40. Froese R, Pauly D. Sardina pilchardus [Internet]. WoRMS; 2022 [cited 2022 Jan 3]. Available from: https://www.marinespecies.org/aphia.php?p=taxdetails&id=126421

41. Froese R, Pauly D. Umbrina canariensis [Internet]. WoRMS; 2022 [cited 2022 Jan 3]. Available from: https://www.marinespecies.org/aphia.php?p=taxdetails&id=127011

42. Froese R, Pauly D. Pagellus bogaraveo [Internet]. WoRMS; 2022 [cited 2022 Jan 3]. Available from: https://www.marinespecies.org/aphia.php?p=taxdetails&id=127059

How to cite this article
Bendada M, HadiniA, MoallaqatY, El BekkayeKh, ChaabaneKh. The parasitic isopod Anilocra physodes (Cymothoidae; Crustacea) on its fish host from the Atlantic coast of Morocco. Iran J Vet Sci Technol. 2025; 17(4): 58-66.
DOI: https://doi.org/10.22067/ijvst.2025.91719.1463
URLhttps://ijvst.um.ac.ir/article_47392.html