ISSN Versión impresa 2218-6425 ISSN Versión Electrónica 1995-1043

RESEARCH NOTE/ NOTA CIENTÍFICA

NEW RECORDS OF PARASITIC COPEPODS (COPEPODA: PANDARIDAE, EUDACTYLINIDAE, CALIGIDAE) ON FIVE SHARK SPECIES (PISCES: ELASMOBRANCHIA) IN THE GULF OF MEXICO

NUEVOS REGISTROS DE COPÉPODOS PARÁSITOS (COPEPODA: PANDARIDAE, EUDACTYLINIDAE, CALIGIDAE) EN CINCO ESPECIES DE TIBURONES (PISCES: ELASMOBRANCHIA) EN EL GOLFO DE MÉXICO

M. Amparo Rodríguez-Santiago[1], Samuel Gómez[2] & Mayra I. Grano-Maldonado[3,4]

[1]Catedras CONACYT, Universidad Autónoma del Carmen (UNACAR) Facultad de Ciencias Naturales Centro de Investigación de Ciencias Ambientales (CICA) Av. Laguna de Términos s/n Col. Renovación 2da Sección, C.P. 24155 Ciudad del Carmen, Campeche, México. Tel. 938 11018 EXT. 1806. marodriguezsa@conacyt.mx, amparoshalom@hotmail.com
[2]Instituto de Ciencias del Mar y Limnología, Unidad Académica Mazatlán, Universidad Nacional Autónoma de México; Joel Montes Camarena s/n, Mazatlán, 82040, Sinaloa, México. samuelgomez@ola.icmyl.unam.mx
[3]Departamento de Ecofisiología, Facultad de Ciencias del Mar, Universidad Autónoma de Sinaloa. Paseo Claussen s / n. A. P. 610. Mazatlan, Sinaloa, Mexico Tel/Fax: + 52 669 982 86 56 grano_mayra@hotmail.com; [4]CCMAR-CIMAR L.A., Centro de Ciencias do Mar, Universidade do Algarve, Faro, Portugal. mgmaldonado@ualg.pt.

Neotropical Helminthology, 2015, 9(1), jan-jun: 177-182.

ABSTRACT

The present study is part of an ongoing survey of the parasitic copepods on fishes from coastal waters in Campeche State (Southern Gulf of Mexico). The aim of this work is to describe the parasitic copepod species found on five shark species: *Carcharhinus leucas* (Müller & Henle, 1839), *Carcharhinus limbatus* (Müller & Henle, 1839), *Carcharhinus plumbeus* (Nardo, 1827), *Rhizoprionodon terraenovae* (Richardson, 1836), and *Sphyrna tiburo* (Linnaeus, 1758). Except for *R. terraenovae*, all shark species were at least infected with one copepod species. A total of eight copepod species were found: *Nesippus orientalis* Heller, 1865, *Nemesis* sp. and *Paralebion elongatus* Wilson C.B., 1911 on *C. leucas* (n = 6); *Tuxophorus caligodes* Wilson C.B., 1908, *Lepeophtheirus longispinosus* Wilson C.B., 1908 and *Pandarus sinuatus* Say, 1818 on *C. limbatus* (n = 9); *Pandarus sp. on C. plumbeus* (n = 4); and *Eudactylina longispina* Bere, 1936 on *S. tiburo* (n = 24). The occurrence of these copepod species on these sharks from the Gulf of Mexico constitutes new host records and extends their known geographical distribution, and contributes to the knowledge of the biodiversity of parasitic copepods in Mexico.

Keywords: Atlantic Ocean - Elasmobranchs - fish parasites - Mexico - Parasitic copepods - sharks - Siphonostomatoida.

RESUMEN

El presente estudio es parte de una investigación en curso de los copépodos parásitos de peces de las aguas costeras en el Estado de Campeche (sur del Golfo de México). El objetivo de este trabajo fue describir las especies de copépodos parásitos que se encontraron en cinco especies de tiburones: *Carcharhinus leucas* (Müller & Henle, 1839), *Carcharhinus limbatus* (Müller & Henle, 1839), *Carcharhinus plumbeus* (Nardo, 1827), *Rhizoprionodon terraenovae* (Richardson, 1836), y *Sphyrna tiburo* (Linnaeus, 1758). A excepción de *R. terraenovae*, todas las especies de tiburones estuvieron infectados al menos con una especie de copépodo. Un total de ocho especies de copépodos fueron encontrados: *Nesippus orientalis* Heller, 1865, *Nemesi*s sp. y *Paralebion elongatus* Wilson C.B., 1911 en *C. leucas* (n = 6); *Tuxophorus caligodes* Wilson C.B., 1908, *Lepeophtheirus longispinosus* Wilson C.B., 1908 y *Pandarus sinuatus* Say, 1818 en *C. limbatus* (n = 9); *Pandarus s*p. en *C. plumbeus* (n = 4); y *Eudactylina longispina* Bere, 1936 en *S. tiburo* (n = 24). La ocurrencia de estas especies de copépodos en estos tiburones del Golfo de México constituye nuevos registros de hospedero y extienden su distribución geográfica conocida, y contribuye al conocimiento de la biodiversidad de los copépodos parásitos en México.

Palabras clave: copépodos - Elasmobranquios - parásitos - Siphonostomatoida - Mexico - Océano Atlántico - tiburones.

INTRODUCTION

Elasmobranchs have a widespread distribution in all tropical and subtropical seas. They can be found in coastal areas, estuaries, shallow freshwater creeks and coastal lagoon systems, usually near the bottom (Compagno, 1984). Since sharks are located on the top of the food chain (Randhawa & Poulin, 2010), they provide and exceptional habitat for a variety of parasitic fauna (Caria, 1990; Caira & Healy, 2004; Caira *et al.*, 2005; Randhawa & Poulin, 2010; Palm, 2011), and have been used as biological indicators (Vankara *et al.*, 2007; Haseli *et al.*, 2010; Palm, 2011). In Mexico, consumption of shark meat is widespread and has traditionally been used as food particularly appreciated because of its quality. There are at least 34 species of sharks in the Gulf of Mexico. These species belong to the genera *Carcharhinus* de Blainville, 1816 and *Sphyrna* Rafinesque, 1810 (Bonfil, 1997). Species like the bullshark *Carcharhinus leucas* (Müller and Henle, 1839), the blacktip shark *C. limbatus* (Müller and Henle, 1839), the sandbar shark *C. plumbeus* (Nardo, 1827), the atlantic sharpnose shark *Rhizoprionodon terraenovae* (Richardson, 1836), and the bonnethead *Sphyrna tiburo* (Linnaeus, 1758) are also some of the most economically important species (Bonfil, 1997). Small shark species are usually sold fresh and whole are generally sold in local markets as dried and salted fillets (Bonfil, 1997). The general pattern these parasitic copepods exhibit with regard to their host includes the following aspects according with (Alvarez & Winfield, 2001): the site of attachment is variable among hosts, the usual sites are the gills, nasal cavity, mouth, tail, fin and body surface in general; and most species of sharks appear to have from one to a few species of copepods, and to harbour from one to several hundred individuals of each those species. The life cycle of these small aquatic crustacean parasites is described in De Mees *et al.* (1990). They have a direct cycle with a fairly long free swimming phase (at least three days). Once attached to the host the parasite becomes mucophagous. Mating occurs on the body surface of the host and, once fertilized, females colonise the gill cavity where they lay eggs that develop and give birth to free swimming larvae. Most parasitic copepods

parasitize more than one host (Alvarez & Winfield, 2001), showing in general very little specificity. Regarding their distribution, it seems to be world-wide as they, like their hosts, occur in all warm and temperate seas. However, knowledge of parasitic copepods on elasmobranches in the Gulf of Mexico is limited. Therefore, the aim of this study was to describe and report the parasitic copepod fauna that infect five shark species in the southern Gulf of Mexico, these records represent the first from Campeche State. This study contributes to the knowledge of ectoparasites of sharks in this region, where there is a clear need for studies to provide information concerning both, parasitic copepods and their hosts.

MATERIAL AND METHODS

During year 2013, samples of five different species of shark *C. leucas* (n = 6 specimens), *C. limbatus* (n = 9), *C. plumbeus* (n = 4), *R. terraenovae* (n = 2) and *S. tiburo* (n = 24) were obtained from commercial catches of the local fisherman in three regions in Campeche State; San Pedro (18°.64'09?N, 92°46'88?S), Champotón (19°21'N 90°43'W) and Ciudad del Carmen (18° 39' 38? N, 91° 48' 51? W) southeast Gulf of Mexico. Fish specimens were sacrificed by decapitation to ensure a fast dead, which is according to Mexican laws (NOM-033-ZOO-1995) and were transported in individual plastic bags in a cool box to the Institute of Marine Sciences and Limnology, National Autonomous University of Mexico El Carmen Research Unit (ICMYL-UNAM). All fishes were examined for the presence of parasitic copepods on skin, fins, gills and gill rakers. The examination of copepods on the body surface of the hosts was performed under good illumination, and gill arches were removed from each fish and carefully inspected in a Petri dish using a stereomicroscope (LEICA MZ9.5). The plastic bag contents were also examined for the presence of detached copepods. Parasites found on each fish were preserved in labeled vials with 70% ethanol. Copepods identification was performed following Cressey & Boyle (1980, 1985), Kabata (1979, 1988, 1992a, 1992b), Boxshall (2004) and Hayes *et al.* (2012).

RESULTS

Except for *R. terraenovae*, all shark species were at least infected with one copepod species. A total of eight copepod species were identified on the skin: *Nesippus orientalis* Heller, 1865 (Siphonostomatoida: Pandaridae), *Nemesis* sp. (Siphonostomatoida: Eudactylinidae) and *Paralebion elongatus* Wilson C.B., 1911 (Siphonostomatoida: Caligidae) were identified from *C. leucas* (prevalence = 100% in the three copepod species). *Tuxophorus caligodes* Wilson C. B., 1908 (Siphonostomatoida: Caligidae), *Lepeophtheirus longispinosus* Wilson C.B., 1908 (Siphonostomatoida: Caligidae) and *Pandarus sinuatus* Say, 1818 (Siphonostomatoida: Pandaridae) on *C. limbatus* (prevalence = 22.2%, 44.4% and 77.7%, respectively). *Pandarus* sp. (Siphonostomatoida: Pandaridae) on *C. plumbeus* (prevalence = 50%) and *Eudactylina longispina* (Siphonostomatoida: Eudactylinidae) on *S. tiburo* (prevalence = 29.1%).

DISCUSION

Worldwide, there are several reports from copepods parasites in sharks; *Carcharodon carcharias* (Linnaeus, 1758) collected in Canada and California (Hogans & Dadswell, 1985; Benz *et al.*, 2003); in the tiger shark *Galeocerdo cuvier* (Perón & Lesueur, 1822) from off the northwestern coast of Australia (Tang & Newbound, 2007). Despite the economic importance sharks in the coasts of

Gulf of Mexico (Bonfil, 1994) little is known about the ecology of its parasitic fauna, particularly of the parasitic copepods found in this study. Except for *R. terraenovae*, all shark species were infected by at least one copepod species. This study increases our knowledge of the biodiversity of parasitic copepods in Mexico and provides a baseline of new information on the distribution of species of parasitic copepods from five species of sharks from the Gulf of Mexico, including new host records and new locality records. The only published reports of parasitic copepods *Dinemoura latifolia* (Steenstrup & Lütken, 1861) and *Pandarus smithii* Rathbun, 1886 found in sharks in the Gulf of Mexico were reported from Veracruz State by Alvarez & Winfield (2001) and secondly, a recent review by Morales-Serna *et al.* (2012) where the presence of the following species were reported: *Kroyeria sphyrnae* Rangnekar, 1957 in *Sphyrna lewini* (Griffith & Smith, 1834) and *Sphyrna zygaena* (Linnaeus, 1758) (Deets, 1994); *Kroyerina benzorum* Deets, 1987 in *Alopias vulpinus* (Bonnaterre, 1788) and *Isurus oxyrinchus* Rafinesque, 1810 (Deets, 1987); *Kroyerina cortezensis* Deets, 1987 in *Carcharhinus falciformis* (Müller and Henle, 1839) (Deets, 1987), *Kroyerina elongata* Wilson C. B., 1932 in *Prionace glauca* (Linnaeus, 1758) (Deets, 1987); *Kroyerina mobulae* Deets, 1987 in *Mobula japonica* (Müller & Henle, 1841) and *Mobula thurstoni* (Lloyd, 1908) (Deets, 1987), and *Kroyerina scottorum* Cressey, 1972 in *Sphyrna* zygaena (Deets, 1987). In the Neotropical zone, the importance of copepods, according to Luque & Poulin (2007), is that these organisms constitute the second and third largest parasitic group on marine and freshwater fishes, respectively. In this study, the five shark species studied are economically important in the region, and further work will continue based on parasite biodiversity in order to understand their ecological importance, their biogeography and evolution, and to support and improve management and conservation strategies. For this reason, parasitic copepods are without a doubt an important component of global biodiversity and may reflect the ecological status of fish species locally and in the Gulf of Mexico. There is no doubt that further surveys in the region will increase the number of records of species of this group of parasites providing ecological information.

BIBLIOGRAPHIC REFERENCES

Alvarez, F & Winfield, I. 2001. *New records of* Dinemoura latifolia *and* Pandarus smithii *(Copepoda, Siphonostomatoida, Pandaridae) parasitizing the shark* Isurus oxyrinchus *in the Gulf of Mexico.* Crustaceana, vol. 74, pp. 501-503.

Benz, G, Mollet, H, Ebert, D & Davis. C. 2003. *Five species of parasitic copepods (Siphonostomatoida: Pandaridae) from the body surface of a white shark captured in Morro Bay, California.* Pacific Science, vol.57, pp. 39-43.

Bonfil, R. 1997. *Status of shark resources in the southern Gulf of México and Caribbean: implications for management*. Fisheries Research, vol. 29, pp. 101–117.

Boxshall, G. 2004. *An introduction to copepod diversity.* The Ray Society, London.

Caira, JN. 1990. *Metazoan parasites as indicators of elasmobranch biology.* NOAA Tech Rep, National Marine Fisheries Service, vol. 90, pp. 71–96.

Caira, JN, Mega, J & Ruhnke. TR. 2005. *An unusual blood sequestering tapeworm (*Sanguilevator yearsleyi *n. gen., n. sp.) from Borneo with description of* Cathetocephalus resendezi *n. sp. from Mexico and molecular support for the recognition of the order Cathetocephalidea (Platyhelminthes: Eucestoda).* International Journal for Parasitology, vol. 35, pp. 1135–1152.

Caira, JN & Healy, CJ. 2004. *Elasmobranchs as hosts of metazoan parasites*. pp.

523–551. In. *The biology of sharks and their relatives.* Carrier, J, Musack, J & Heithaus, E. (eds). CRC Press. Boca Raton.

Compagno, LJV. 1999. *An overview of chondrichtyan systematic and biodiversity in southern Africa*. Transactions of the royal society South Africa, vol. 54, pp. 75-120.

Cressey R & Boyle, H. 1980. *Parasitic copepods of Mackerel and tuna-like fishes (Scombridae) of the world*. Smithsonian Contributions to Zoology, vol. 311, pp. 54-61.

Cressey, R & Boyle. H. 1985. Holobomolochus (Copepoda: Bomolochidae) redefined, with descriptions of three new species from the eastern pacific. Journal of Crustacean Biology, vol. 5, pp. 717–727.

De Mees, T, Renaud, F & Gabrion. C. 1990. *A model for studying isolation mechanisms in parasitepopulations: the genus* Lepeophtheirus *(Copepoda, Caligidae).* Journal of Experimental Zoology, vol. 254, pp. 207–214.

Haseli, M, Malek, M & Palm. HW. 2010. *Trypanorhynch cestodes from the Persian Gulf.* Zootaxa, vol. 2492, pp. 28–48.

Hayes, P, Justine JL & Boxshall. GA. 2012. *The genus* Caligus *Müller, 1785 (Copepoda: Siphonostomatoida): two new species from reef associated fishes in New Caledonia, and some nomenclatural problems resolved.* Zootaxa, vol. 3534, pp. 21–39.

Hogans, WE & Dadswell. MJ. 1985. *Parasitic copepods of the white shark (*Carcharodon carcharius *L.) from the Bay of Fundy.* Canadian Journal of Zoology, vol. 63, pp. 740–741.

Kabata, Z. 1979. *Parasitic copepoda of British Fishes.* The Ray Society, The British Museum, London, vol. 152 (1-12): pp. 1–4.

Kabata, Z. 1988. *Some evolutionary trends in caligid copepods.* Hidrobiologia, vol. 167/168, pp. 617–622.

Kabata, Z. 1992 a. *Copepods parasitic on fishes: keys and notes for identification of the species.* Synopses of the British Fauna (New Series) No. 47. Universal Book Services/W. Backhuys: Oegstgeest. VII

Kabata, Z. 1992b. *Copepoda parasitic on Australian fishes, XV. Family Ergasilidae (Poecilostomatoida).* Journal of Natural History, vol. 26, pp. 47-66.

Luque, JL & Poulin. R. 2007. *Metazoan parasite species richness in Neotropical fishes: hotspots and the geography of biodiversity.* Parasitology, vol. 134, pp. 865–878.

Morales-Serna, FN, Gómez, S & Pérez-Ponce de León. G. 2012. *Parasitic copepods reported from Mexico.* Zootaxa, vol. 3234, pp. 43–68.

Palm, H.W. 2011. *Fish parasites as biological indicators in a changing world: Can we monitor environmental impact and climate change*? pp. 223 –250. *In*: Mehlhorn, H. (Eds.), Progress in Parasitology, Research Monographs 2, Springer-Verlag Berlin Heidelberg. DOI 10.1007/978-3-642-21396-0_12

Randhawa, HS & Poulin, R. 2010. *Determinants of tapeworm species richness in elasmobranch fishes: untangling and phylogenetic influences.* Ecography, vol. 33, pp. 866–877.

Tang, D. & Newbound, DR. 2004. *A new species of copepod (Siphonostomatoida: Caligidae) parasitic on the tiger shark* Galeocerdo cuvier *(Péron and Lesueur) from Western Australian waters.* Systematic Parasitology, vol. 58, pp. 69–80.

Vankara, AP, Vijayalkshmi, C & Gangadharam. T. 2007. *On a new species,* Cathetocephalus leucas *(Tetraphyllidea: Cathetocephalidae) from the bull shark,* Carcharhinus leucas

(Valenciennes, 1839) from Bay of Bengal, Visakhaptnam coast, Pradesh, India. Journal of Parasitic Diseases, vol. 31, pp. 114-119.

Received November 4, 2014.
Accepted February 2, 2015.