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ARTICULO ORIGINAL

Checklist of free-living marine nematodes from Jardines de la Reina coral reef system, Cuba

Lista taxonómica de nemátodos marinos de vida libre del sistema de arrecife coralino Jardines de la Reina, Cuba

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Abstract

The coral reef system Jardines de la Reina (JR) includes one of the most remarkable Marine Protected Areas in the Caribbean due to its extension and high level of conservation. However, the diversity of small invertebrates (organisms with body size less than 0.5 mm) in JR is unknown. For this reason, we propose to make the first taxonomic checklist of free-living marine nematodes associated with coralline bottoms in JR. During the Alucia expedition in 2017, we studied six sites in the reef terrace (5m–10 m depth), distributed in the west, center and east of the JR archipelago. We identified 1 546 nematodes belonging to 70 species, 20 families, and six orders. The best represented orders were Chromadorida (20 genera), Desmodorida (18 genera) and Enoplida (13 genera). The most abundant species were *Croconema cinctum*, *Euchromadora vulgaris*, *Desmodora communis*, *Chromadora brevipapillata*, and *Dichromadora amphidiscoides*. Ten species were new records for Cuba *Chromadorina epidemos*, *Desmoscolex campbelli*, *Draconema ophicephalum*, *Metadesmodora amphidiscata*, *Oncholaimus* sp., *Paracyatholaimus intermedius*, *Perepsilonema ritae*, *Praeacanthonchus* sp, *Prochromadorella mediterranea* and *Zalonema vicentei*.

Keywords: reef system, inventory, species richness, hard bottom, meiofauna.

Resumen

El sistema de arrecifes coralinos Jardines de la Reina (JR) incluye una de las Áreas Marinas Protegidas más notables del Caribe por su extensión y nivel de conservación. Sin embargo, la diversidad de invertebrados pequeños (organismos con tamaños corporales menores a 0.5 mm) en JR es desconocida. Por ello se propone confeccionar la primera lista taxonómica de nemátodos marinos de vida libre asociados a fondos coralinos en JR. Durante la expedición del buque Alucia en 2017 se estudiaron seis sitios en la zona de la terraza del arrecife (5m–10 m de profundidad), distribuidos en el oeste, centro y este del archipiélago JR. Se identificaron 1 546 nemátodos pertenecientes a 70 especies, 20 fami-

lias y seis órdenes. Los órdenes mejor representados fueron Chromadorida (20 géneros), Desmodorida (18 géneros) y Enoplida (13 géneros). Las especies más abundantes fueron *Croconema cinctum*, *Euchromadora vulgaris*, *Desmodora communis*, *Chromadora brevipapillata* y *Dichromadora amphidiscoides*. Diez especies fueron nuevos registros para Cuba: *Chromadorina epidemos, Desmoscolex campbelli, Draconema ophicephalum, Metadesmodora amphidiscata, Oncholaimus* sp., *Paracyatholaimus intermedius, Perepsilonema ritae, Praeacanthonchus* sp., *Prochromadorella mediterranea* y *Zalonema vicentei*.

Palabras clave: sistema arrecifal, inventario, riqueza de especie, fondo duro, meiofauna.

Introduction

The Jardines de la Reina (JR) archipelago is one of the most notable Marine Protected Areas (MPAs) in the Caribbean. This MPA is characterized by the high diversity and abundance of commercially important fishes and invertebrates (Hernández-Fernández *et al.* 2019). Within the JR archipelago, the coral reefs are the most studied ecosystem (Pina-Amargós *et al.* 2021); but the knowledge about the diversity of small invertebrates is still scarce. Until now, no any species inventory has been done on meiobenthic taxa (i.e., those < 0.5 mm of body size) in the JR archipelago. This constitutes a knowledge gap about the biodiversity of the reef system that should be addressed.

Free-living nematodes are the most abundant metazoans in marine environments and exhibit a high diversity (Heip *et al.* 1985). The composition of nematode communities strongly depends on sediment characteristics such as grain size, sediment sorting, dissolved oxygen, depth of redox discontinuity layer, and content of organic matter (Moens *et al.* 2014). The number of valid described species for free-living marine nematode species is approximately 6900, which constitutes only 12% of the potential diversity (Appeltans *et al.* 2012). The knowledge of the number of species (species inventory) is key to understanding the structure and functioning of communities and ecosystems. Species inventories are important as well for decision-making in conservation and management programs (Gotelli, 2004; Thomson *et al.* 2018; Pérez-García *et al.* 2020).

Two checklists of nematode species have been published so far for Cuban waters. López-Cánovas and Pastor De Ward (2006) reported 48 species in seagrass meadows of Sabana-Camagüey archipelago. After, Pérez-García *et al.* (2020) reported 469 species in nine habitat types covering a large extension of the Cuban archipelago. However, JR archipelago was not included in these two studies. Therefore, the objective of this study is to compile a species checklist of free-living nematodes of the Jardines de la Reina reef system.

Material and methods

We carried out a scientific expedition onboard the M/V Alucia throughout the entire JR archipelago from November 1st to 23th, 2017. We located six sampling sites in the reef terrace area (5–10 m depth), distributed in the west, center and east of the coral reef system (Fig. 1, Table 1). The map was designed with the SIG Qgis 2.8, the coordinate system used was WGS 84 and the units of the geographic coordinates used were degrees and minute. We deployed randomly 10 sampling units (a PVC frame 25 cm × 25 cm) at each sampling site on the hard substrate within a radius of ca. 25 m from a central point. If the PVC frame was mostly on top of a coral colony, it was retrieved and launched

Table 1. Geographical coordinates and depth of the study sites.

Site	Latitude (N)	Longitude (W)	Depth (m)
GQ-2A	21°18.351'	79°35.556'	10
GQ-3A	21°11.029'	79°32.738'	10
GQ-5A	20°58.030'	79°11.847'	12
GQ-18A	20°51.286'	79°02.910'	8
GQ-12A	20°37.612'	78°35.676'	9
GQ-14A	20°30.788'	78°23.179'	10

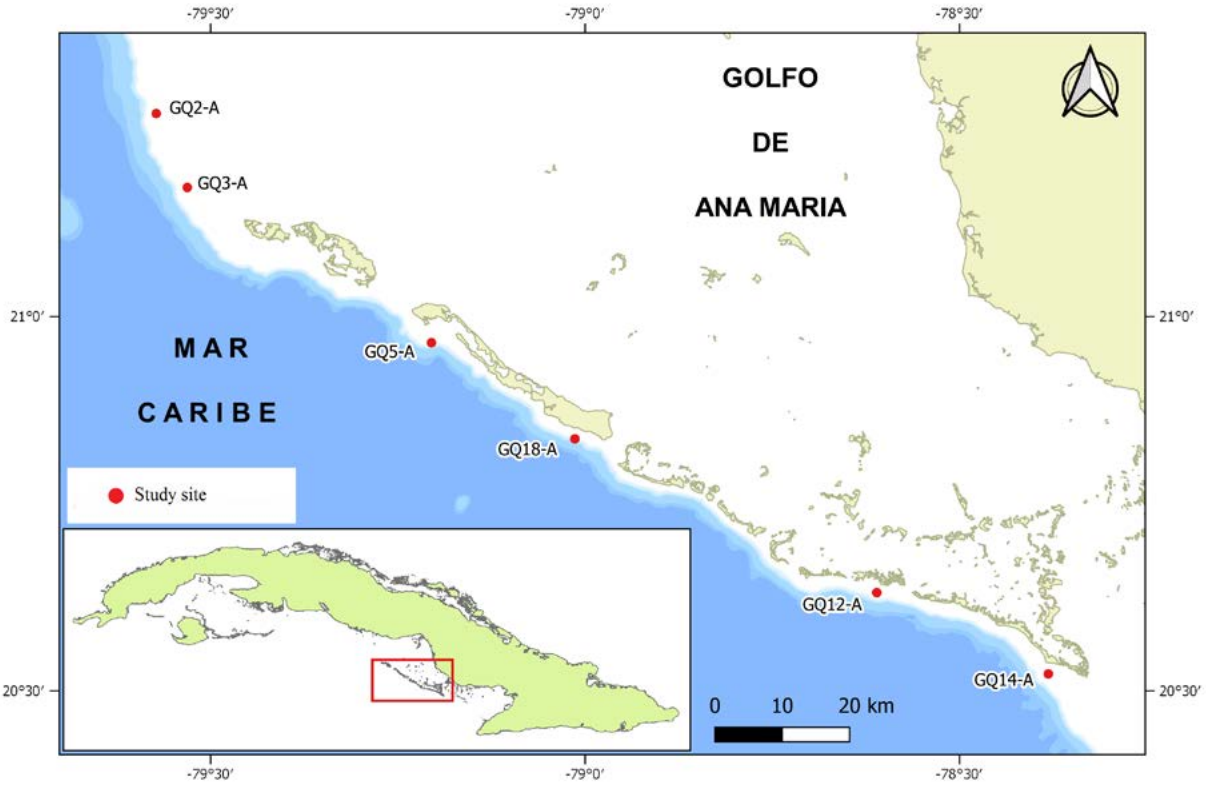

Fig. 1. Study sites in the coral reef system Jardines de la Reina.

again. We collected carefully by hand all the material (macroalgae and associated sediment) within a frame and deposited it inside a Ziploc bag. The bags were kept frozen at -10 °C until analysis in the laboratory.

In the laboratory, the samples we washed with filtered water over two test sieves of 500 and 63 μm of mesh aperture. We observed all the collected material under a stereomicroscope Olympus SZX7 (maximum magnification 115x), counted all the organisms, and identified them to higher taxa (e.g., nematodes, copepods). We picked up all nematodes with a handle needle and stored in vials with 70% ethanol. The nematodes were mounted in permanent preparations following the procedure described by Vincx (1996) that includes dehydration with ethanol and inclusion in pure glycerol. All this preserved material is preserved in the CIM-UH laboratory of meiofauna. We identified the nematodes using the pictorial keys of Warwick *et al.* (1998), Platt and Warwick (1988), the book by Schmidt-Rhaesa (2014) and taxonomic papers that included revision of taxa and/or description of species. Scientific names, authorships and classification were based on **Nemys: World Database of Nematodes (Nemys eds. 2022).** We used the term "sp." to identify specimens, mostly in female or juvenile stages, clearly identified as different from other congeneric species. The symbol (*) in the list of species indicates that the species or genus is a new report for Cuba.

Results and Discussion

About 1 546 nematodes belonging to 70 species, 20 families and six orders were identified. The best represented orders were Chromadorida (20 genera), Desmodorida (18 genera), and Enoplida (13 genera).

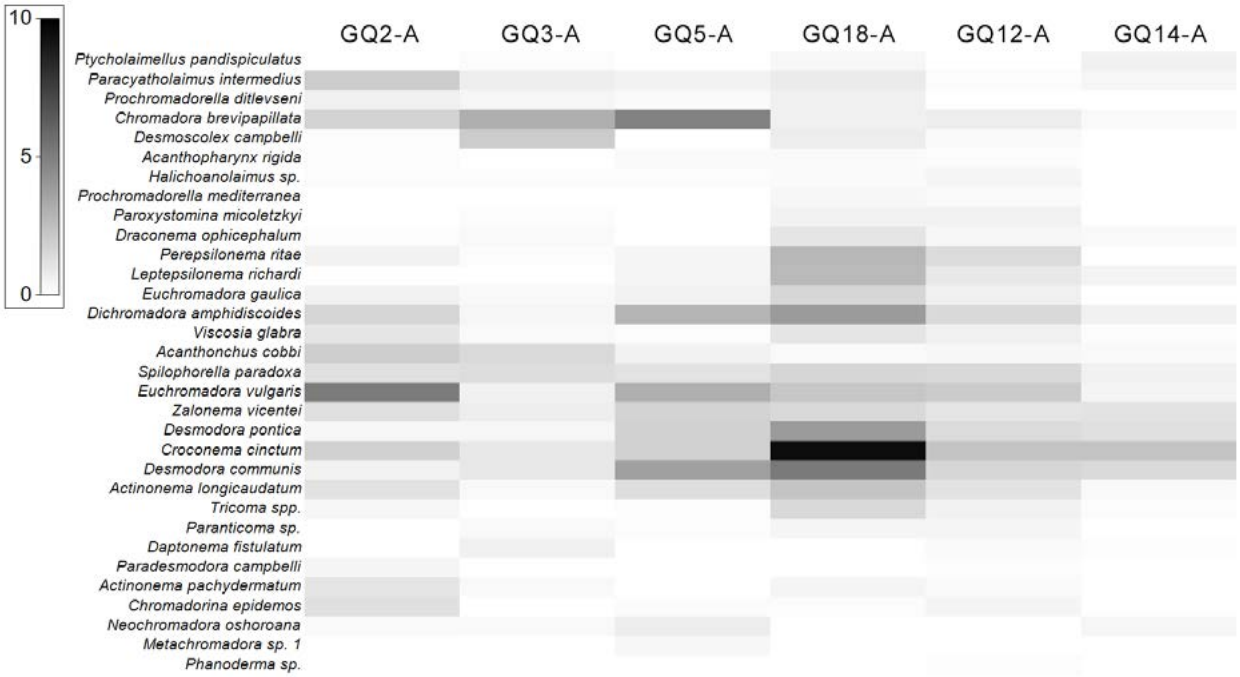

Fig. 2. "Color map" indicating changes in the average relative abundance of the most important nematode species (those that contribute at least 10% of the total abundance at any site) across sites in the Jardines de La Reina reef system. Darker colors in the cells indicate greater abundance of the species.

Of these 70 species, 10 were new records for Cuba, which did not appear in the list of species published by Pérez-García *et al.* (2020). Most of these new records were not rare species since they presented high abundance in the samples, except for two species with two and one occurrences (Table 2). Organisms of genus *Oncholaimus* and *Praeacanthonchus*, were found for the first time in Cuba.

The best represented families of nematodes were Chromadoridae (40%), Desmodoridae (32%), Epsilonematidae (7%), Cyatholaimidae (7%), and Desmoscolecidae (5%), which comprise 91% of the total abundance. These results broadly agree with other studies in tropical coral reefs (e.g., Raes *et al.* 2007; Pérez-García *et al.* 2019). Gobin (2007) reported that families Chromadoridae, Cyatholaimidae, Draconematidae, Oncholaimidae, and Oxystominidae were the most abundant in hard bottoms of Trinidad and Tobago (Caribbean Sea). Only the first two families coincide with dominant families reported in our study likely because differences in local environment with the reefs such as physical disturbance and substrate heterogeneity.

The most abundant species in our study (in parentheses the relative abundance) was *Croconema cinctum* Cobb, 1920 (12%). *C. cinctum* was found in the six sampled sites and with highest abundance at site 18A (Fig. 2). Other species with high abundance

Table 2. New records of nematode genera and species for Cuba derived of this study.

Species	Abundance
Zalonema vicentei	75
Perepsilonema ritae	52
Paracyatholaimus intermedius	43
Desmoscolex campbelli	28
Chromadorina epidemos	18
Draconema ophicephalum	18
Oncholaimus sp.	6
Prochromadorella mediterranea	5
Praeacanthonchus sp.	2
Metadesmodora amphidiscata	1

were *Euchromadora vulgaris* (Bastian, 1865) de Man, 1886 (9%), *Desmodora communis* (Bütschli, 1874) (8%), *Chromadora brevipapillata* Micoletzky, 1924 (7%), and *Dichromadora amphidiscoides* Kito, 1981 (7%). These results agree with reports of dominance in dead coral substrates by Ruiz-Abierno and Armenteros (2017) and Pérez-García *et al*. (2019). *Euchromadora vulgaris* tends to be very abundant in these two habitat types because its tolerance to physical disturbances given by thick cuticle that protects of abrasion, setae scattered throughout the body for reception of mechanical stimulus, and conical tail with developed spinneret that secrete adhesive substances (Platt & Warwick 1988).

Checklist of nematode species of the Jardines de la Reina coral reef system

PHYLUM NEMATODA Cobb, 1932

CLASS CHROMADOREA Inglis, 1983

ORDER ARAEOLAIMIDA De Coninck & Schuurmans Stekhoven, 1933

Family Comesomatidae Filipjev, 1918

Setosabatieria hilarula (de Man, 1922)

Family Diplopeltidae Filipjev 1918

Diplopeltis cirrhatus (Eberth, 1863) Cobb, 1891

ORDER CHROMADORIDA Chitwood, 1933

Family Chromadoridae Filipjev, 1917

Actinonema chitwoodi Wieser, 1954

Actinonema pachydermatum Cobb, 1920

Chromadora brevipapillata Micoletzky, 1924

Chromadorella filiformis (Bastian, 1865) Filipjev, 1918

Chromadorina epidemos Hopper & Meyers, 1967*

Chromadorita sp.

Dichromadora amphidiscoides Kito, 1981

Endeolophos fossiferus (Wieser, 1954)

Euchromadora gaulica Inglis, 1962

Euchromadora vulgaris (Bastian, 1865) de Man, 1886

Innocuonema sp.

Neochromadora oshoroana Kito, 1981

Prochromadorella ditlevseni (de Man, 1922) Wieser, 1954

Prochromadorella mediterranea (Micoletzky, 1922) Micoletzky, 1924*

Prochromadorella paramucrodonta (Allgén, 1929) Wieser, 1951

Ptycholaimellus pandispiculatus (Hopper, 1961) Wieser & Hopper, 1967

Spilophorella candida Gerlach, 1951

Spilophorella paradoxa (de Man, 1888) Filipjev, 1917

Family Cyatholaimidae Filipjev, 1918

Acanthonchus cobbi Chitwood, 1951

Longicyatholaimus egregius Hopper, 1972

Marylynnia oculissoma (Hopper, 1972) Hopper, 1977

Paracanthonchus perspicuus Kito, 1981
Paracyatholaimus intermedius (de Man, 1880) Micoletzky, 1922*
Praeacanthonchus sp.*
Family Selachinematidae De Coninck, 1965
Halichoanolaimus sp.
ORDER DESMODORIDA De Coninck, 1965
Family Aponchiidae Gerlach, 1963
Synonema sp.
Family Desmodoridae Filipjev, 1922
Acanthopharynx rigida Schuurmans Stekhoven, 1950
Croconema cinctum Cobb, 1920
Desmodora communis (Bütschli, 1874)
Desmodora pontica (Filipjev, 1922)
Desmodora scaldensis de Man, 1889
Desmodorella sp.
Eubostrichus sp. Certes, 1899
Laxus parvum Armenteros, Ruiz-Abierno & Decraemer, 2014
Metachromadora sp. 1
Metachromadora sp. 2
Metadesmodora amphidiscata Schuurmans Stekhoven, 1942*
Molgolaimus sp.
Paradesmodora campbelli (Allgén, 1932)
Paradesmodora immersa Wieser, 1954
Zalonema vicentei Larrazábal-Filho, Da Silva & Esteves, 2015*
Family Draconematidae Steiner, 1930
Apenodraconema sp.
Draconema ophicephalum (Claparède, 1863) Filipjev, 1918*
Family Epsilonematidae Steiner, 1927
Leptepsilonema richardi Verschelde & Vincx, 1992
Metepsilonema sp.
Perepsilonema ritae Verschelde & Vincx, 1994*
Perepsilonema sp.
Family Microlaimidae De Coninck & Schuurmans Stekhoven, 1933
Microlaimus sp.
ORDER DESMOSCOLECIDA Filipjev, 1929
Family Desmoscolecidae Shipley, 1896
Desmoscolex campbelli Allgén, 1946*
Desmoscolex sp.
Tricoma sp.
ORDER MONHYSTERIDA Filipjev, 1929

Family Linhomoeidae Filipjev, 1922
Linhomoeus sp.
Terschellingia sp.
Family Xyalidae Chitwood, 1951
Daptonema fistulatum (Wieser & Hopper, 1967)
CLASS ENOPLEA Inglis, 1983
ORDER ENOPLIDA Filipjev, 1929
Family Anticomidae Filipjev, 1918
Paranticoma sp.
Family Enchelidiidae Filipjev, 1918
Eurystomina minutisculae Chitwood, 1951
Symplocostoma sp.
Family Leptosomatidae Filipjev, 1916
Leptosomatum sp.
Family Oncholaimidae Filipjev, 1916
Oncholaimus sp.*
Pontonema sp.
Viscosia glabra (Bastian, 1865) de Man, 1890
Family Oxystominidae Filipjev, 1918
Halalaimus filicollis Timm, 1961
Halalaimus sp.
Paroxystomina micoletzkyi Wieser, 1953
Family Phanodermatidae Schuurmans Stekhoven, 1935
Micoletzkyia elegans Ditlevsen, 1926
Phanoderma sp.
Phanodermopsis sp.
Family Rhabdolaimidae Chitwood, 1951
Syringolaimus striatocaudatus de Man, 1888

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Statements

Author contributions

Methodology: DMP, JAPG and MA. Formal analysis: DMP, JAPG and MA. Investigation: DMP, JAPG and MA. Data curation: JAPG and MA. Writing of original draft: DMP. Writing-review and editing: DMP, JAPG and MA.

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Conflict of interest

The author has no financial or non-financial conflicts of interest to declare that are relevant to the content of the manuscript.

Ethical behaviour

The author has followed all applicable international, national, and institutional recommendations related to the use and handling of animals for research.

Permits for sampling and other permits:

No permits were required for the conduct of this research.

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