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New records of the genus *Lysmata* (Risso, 1816) for the Mexican Caribbean and Gulf of México

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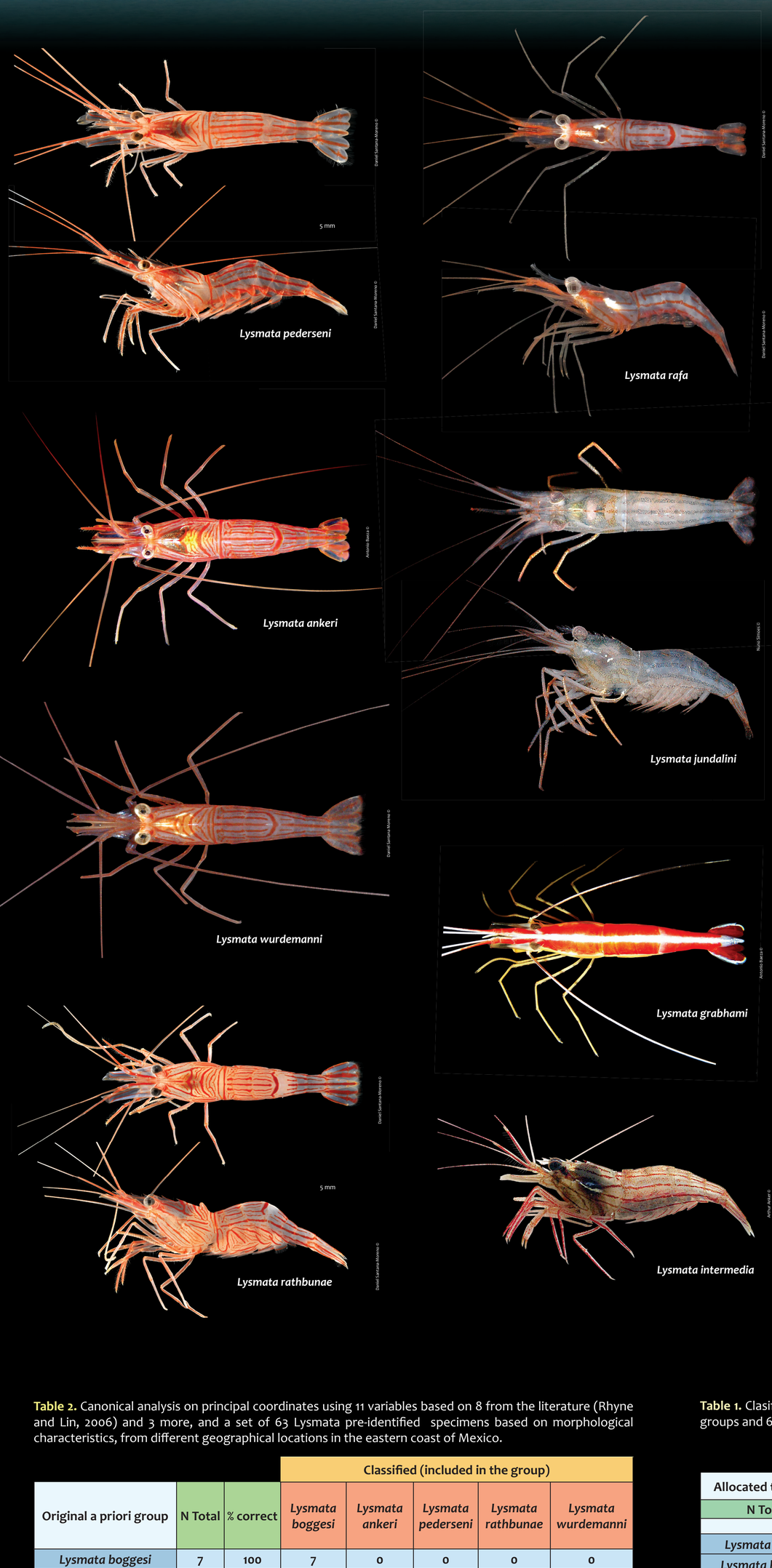

Introduction

The genus Lysmata includes 43 species, 13 of which occur in the Atlantic Ocean and from these, thirteen are now known from the western Atlantic (species organized by date of description):

1. *Lysmata wurdemanni* (Gibbes, 1850)
2. *Lysmata intermedia* (Kingsley, 1878)
3. *Lysmata moorei* (Rathbun, 1902)
4. *Lysmata grabhami* (Gordon, 1935)
5. *Lysmata rathbunae* Chace, 1970
6. *Lysmata anchisteus* Chace, 1972
7. *Lysmata ankeri* Rhyne and Lin, 2006
8. *Lysmata boggesi* Rhyne and Lin, 2006
9. *Lysmata pederseni* Rhyne and Lin, 2006
10. *Lysmata bahia* Rhyne and Lin, 2006
11. *Lysmata rafa* Rhyne & Anker, 2007
12. *Lysmata rauli* Laubenheimer & Rhyne, 2010
13. *Lysmata jundalini* Rhyne et al, 2012

What used to be two species of peppermint shrimp, *Lysmata wurdemanni* (Gibbes, 1850) and the similar *L. rathbunae* Chace, 1970, in the western Atlantic, were separated into 6 cryptic species from the wurdemanni complex (*L. wurdemanni, L. rathbunae, L. ankeri, L. boggessi, L. pederseni* and *L. bahia*) by Rhyne and Lin in 2006. Since then, three more species have been described within this cryptic species complex (*L. rafa, L. jundalini* and *L. rauli*). Collected specimens in those studies come from the US coast, the Caribbean Sea and Brazil with no records from Mexico where only *Lysmata wurdemanni* and *L. rathbunae* had been recorded, together with *L. grabhami, L. intermedia* and *L. moorei.*

Results and Discusion

Present results add 4 new species to the genus in Mexico (Atlantic Ocean): *L. ankeri, L. jundalini, L. pederseni* and *L. rafa*. All are recently described species that were previously identified as *L. wurdemanni.*

Lysmata ankeri – wide distribution from the south of Florida to Brasil. It was previously reported for the north sector of the Gulf of México. First report for México.

Lysmata pederseni – wide distribution, from Florida to Venezuela. First record for Mexico.

Lysmata rafa – only know in the Florida Keys. Now also reported for Alacranes Reef. New record for Mexico

*Lysmata jundalini** – new record for the Gulf of Mexico at Alacranes, Yucatan.

Regarding meristics, *Lysmata wurdemanni* is very similar to *L. ankeri*, being difficult to separate the two species based on either a discriminant function or using a canonical analysis on principal coordinates. *L. boggesi* is also similar to these two groups.

Carolinian atlantic had the less *Lysmata* species, with only *L. wurdemanni* (the most common and abundant species), whilst the north Gulf of Mexico had four species and the Caribbean 5. The south Gulf of Mexico is the large marine eco-region with more species (8).

Materials and Methods

Present study uses recent field collections and observations in the Mexican Caribbean and Gulf of Mexico (Fig. 1), plus revision of specimens hold at the "Colección Nacional de Crustáceos, Instituto de Biologia, Universidad Nacional Autonoma de México (UNAM)", and "Colección de parasitocarcinologia, Instituto de Ciencias del Mar y Limnologia, UNAM", to update the information on the Genus *Lysmata* in the Eastern coast of México. Geographic distribution data of all species was complemented with a bibliographic review and validated public biodiversity information databases (OBIS, GBIF).

Based on the meristic variables used by Rhyne & Lin (2006), we ran a discriminant analysis on newly collected and preserved specimens from the wurdemanni complex, in order to distinguish and confirm the new *L. wurdemanni* complex species (table 1). This analysis was complemented with a canonical analysis on principal coordinates using 11 newly selected variables based on their independence and maximization of the difference between centroids (table 2, figure 2). Simple, presence/absence distribution in each of the large marine eco-regions proposed by Wilkinson *et al* 2010 is shown in Figure 3 and Table 3.

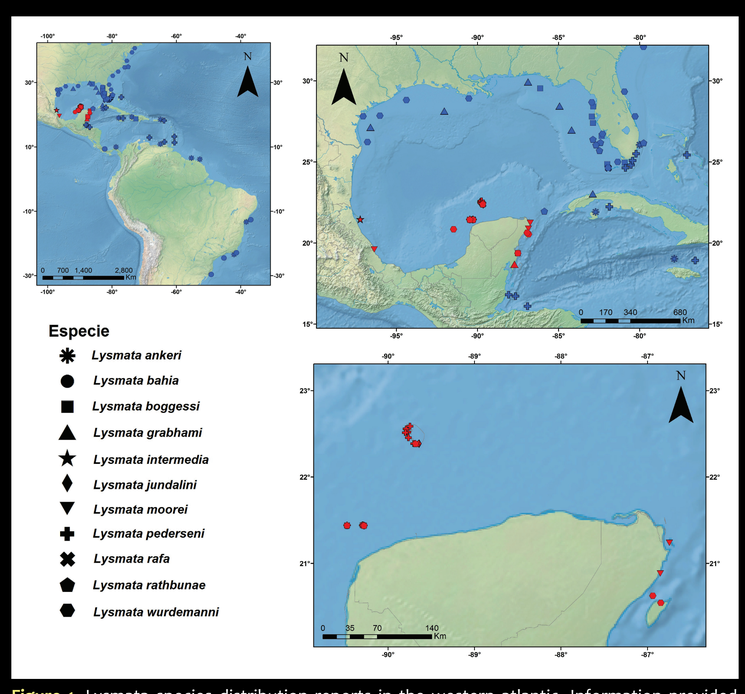

Figure 1. Lysmata species distribution reports in the western atlantic. Information provided by present work (BDMY), crustacean literature, and zoological collections published by online databases: Global Biodiversity Information Facility (GBIF) and Ocean Biogeographic Information System (OBIS).

Legend:

Previous international bibliography

Present study (field collections, revision of existing mexican zoological colections and Mexican bibliography.

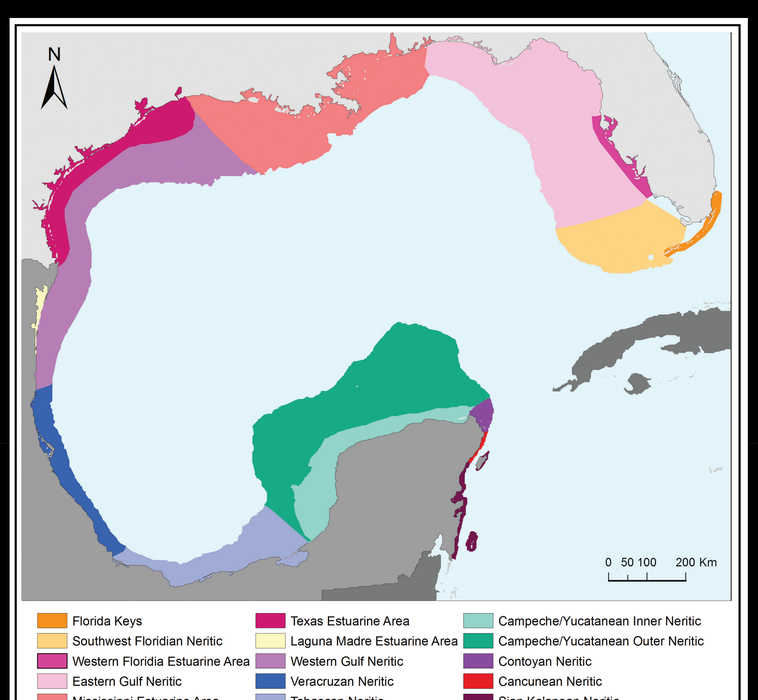

Figure 3. Large Marine eco-regions defined Wilkinson et al (2010)

Table 2. Canonical analysis on principal coordinates using 11 variables based on 8 from the literature (Rhyne and Lin, 2006) and 3 more, and a set of 63 Lysmata pre-identified specimens based on morphological characteristics, from different geographical locations in the eastern coast of Mexico.

			Classified (included in the group)				
Original a priori group	N Total	% correct	*Lysmata boggesi*	*Lysmata ankeri*	*Lysmata pederseni*	*Lysmata rathbunae*	*Lysmata wurdemanni*
Lysmata boggesi	7	100	7	0	0	0	0
Lysmata ankeri	12	83.4	1	10	0	0	1
Lysmata pederseni	16	93.8	0	0	15	1	0
Lysmata rathbunae	6	100	0	0	0	6	0
Lysmata wurdemanni	21	76.2	0	5	0	0	16
Total correct:	54/62 (87.1%)						
Mis-classification error:	12.9%						

Variables:
1) AVG_3P4P5P-DactylusSpine-N
2) RostrumDorsalTeeth-N
3) 2per-Carpus-Length
4) 2per-Dactylus-Length
5) Carapace-Length
6) Rostrum-Length
7) R_2P-CarpusL/2P-PropodusL
8) R_CarapaceL/2P-DactylusL
9) R_5P-CarpusL/5P-PropodusL
10) R_5P-DactylusL/CarapaceL
11) R_CarapaceL/5P-DactylusL

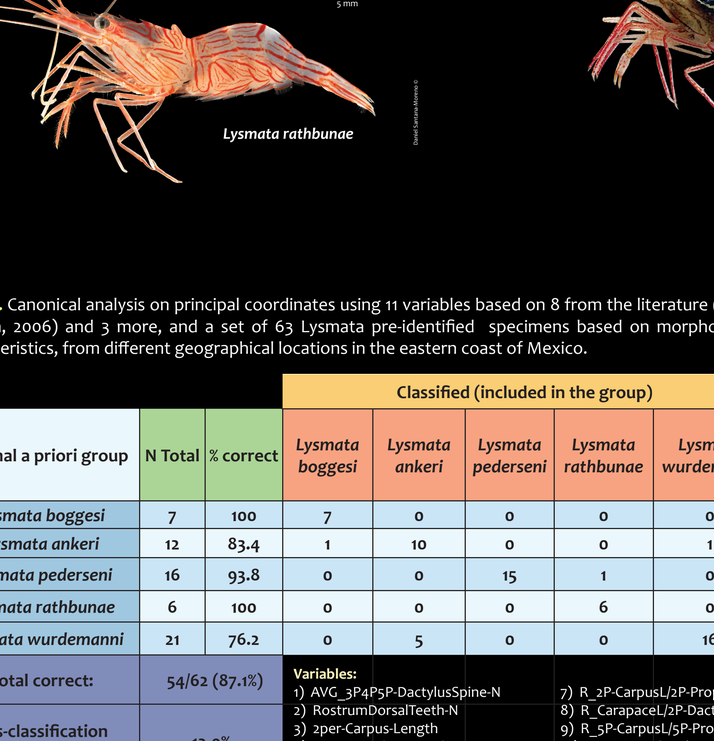

Figure 2. Canonical Analysis of Principal Coordinates with 8 variables and 5 a priori defined groups (species), with 63 observations.

Table 1. Clasification results, using fisher discriminant function with 62 individuals, 5 groups and 6 of the meristic variables used by Rhyne and Lin (2006).

	True/original group				
Allocated to group	*Lysmata ankeri*	*Lysmata boggesi*	*Lysmata pederseni*	*Lysmata rathbunae*	*Lysmata wurdemanni*
N Total	12	7	16	6	21
Lysmata ankeri	11	0	0	0	3
Lysmata boggesi	0	7	0	0	0
Lysmata pederseni	0	0	16	0	0
Lysmata rathbunae	0	0	0	6	0
Lysmata wurdemanni	1	0	0	0	18
N correct	11	7	16	6	18
Proportion	0.92	1	1	1	0.86

N = 62 N Correct = 58 Proportion Correct = 0.935

Variables used :
1) RostrumDorsalTeeth-N
2) R_2P-CarpusL/2P-PropodusL
3) R_CarapaceL/2P-DactylusL
4) R_5P-CarpusL/5P-PropodusL
5) R_5P-DactylusL/CarapaceL
6) R_CarapaceL/5P-DactylusL

Table 3. Biogeography of the genus Lysmata within the Gulf of Mexico and Caribbean Sea: distribution of known species within the marine eco. regions proposed by Wilkinson et al 2010.

		Atlantico Carolino			South Florida and Bahamas							North Gulf of Mexico							South Gulf of Mexico							Caribbean Sea					
		Sur de la cuenca del Atlantico		Extensión Carolina	SOUTH FLORIDA						BAHAMAS	Plataforma del norte del golfo de México					Talud Gulf of Mexico	Cuenca Gulf of Mexico	Plataforma del sur del Golfo de México			Abanico del Misisipi	Talud golfo de México	Cuenca	Plataforma del Caribe mesoamericano		Talud del Caribe mesoamericano	Cuenca de Yucatán	Cordillera		
Species	Quantity	Zona estuarina de Piedmont	Zona neritica carolina		Southeast Floridian Neritic	Florida Keys	Florida Bay	Shark River Estuarine Area	Tramo arrecifal de Dry Tortugas y cayos de Florida	Southwest Floridian Neritic		Western Florida Estuarine Area	Eastern Gulf Neritic	Mississippi Estuarine Area	Texas Estuarine Area	Laguna Madre Estuarine Area	Western Gulf Neritic			Veracruzan Neritic	Tabascan Neritic	Campeche/Yucatanean Inner Neritic	Campeche/Yucatanean Outer Neritic				Contoyan Neritic	Cancunean Neritic	Sian Ka'anean Neritic			
L. wurdemanni	10																													
L. rathbunae	6																													
L. boggessi	5																													
L. grabhami	4																													
L. pederseni	4																													
L. moorei	3																													
L. ankeri	2																													
L. rafa	2																													
L. intermedia	1																													
L. jundalini	1																													
L. bahia	0																													

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(Chace, 1970)
(D' Udekem D'Akoz, 2000)

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