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Crustáceos (Decapoda & Stomatopoda) del Golfo Dulce (Pacífico, Costa Rica) en la colección del Museo de Zoología, Universidad de Costa Rica

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ABSTRACT:

Introduction: The availability of recently updated lists of species from a particular area is an important first step to evaluate changes in species composition and abundance. Golfo Dulce is a fjord-like embayment with relatively pristine shores and relatively deep waters (200m) that have been sampled occasionally for crustaceans. **Methods:** In this study the all species from Golfo Dulce deposited in the collection of the University of Costa Rica Museum of Zoology were listed and scientific names were updated. The MZUCR catalog number, station, substrate type, and year of collection were included for each species. **Results:** A total of 106 species were listed. *Neogonodactylus zaca* was present in four of the 19 stations represented in the collections for Golfo Dulce. Nine species were present in three stations, 19 in two stations and the remaining 77 in one station each. The families with most species were Ocypodidae y Palaemonidae (7) and Porcellanidae (14). **Conclusions:** Is necessary to improve our knowledge of the decapods and stomatopods fauna from Golfo Dulce through further samplings. Intertidal sites such as Golfito and Rincón bays have been poorly sampled as well as intertidal and subtidal environment from the western and eastern shores. However, the fauna is relatively rich when it is related to the area of Golfo Dulce (750km²) and is indicative of a relatively undisturbed environment. Updated management policies are urgently needed and this list of species is a step towards this goal.

KEYWORDS: Biodiversity, eastern Tropical Pacific, Stomatopoda, Dendrobranchiata, Caridea, Anomura, Brachyura.

RESUMEN:

“Crustáceos (Decapoda & Stomatopoda) del Golfo Dulce (Pacífico, Costa Rica) en la colección del Museo de Zoología, Universidad de Costa Rica”. **Introducción:** Las listas actualizadas de especies son un primer paso para evaluar cambios temporales en composición y abundancia. Golfo Dulce es un cuerpo de agua marino semejante a un fiordo, con costas poco alteradas y aguas relativamente profundas (200m). **Métodos:** Elaboramos una lista taxonómicamente actualizada de las especies de macrocrustáceos recolectados en Golfo Dulce y depositadas en la colección del Museo de Zoología de la Universidad de Costa Rica (MZUCR). El número de catálogo del MZUCR, estación, tipo de sustrato, y año de colecta fueron anotados para cada especie. **Resultados:** Hay 106 especies en la lista. *Neogonodactylus zaca* estuvo en cuatro de las 19 estaciones representadas en las colecciones para Golfo Dulce. Nueve especies en tres estaciones, 19 en dos estaciones y las restantes 77 en una estación cada una. Las familias con más especies fueron Ocypodidae y Palaemonidae (7) y Porcellanidae (14). **Conclusiones:** Se requieren más muestreos, particularmente en sitios entre mareas como las bahías de Golfito y Rincón; y fondos de entre mareas y submareales de las costas oeste y este. La fauna es relativamente rica considerando el área de Golfo Dulce (750 km²) y es indicadora de un ambiente relativamente inalterado. Se requiere urgentemente de políticas de manejo actualizadas y esta lista en un paso hacia ese objetivo.

PALABRAS CLAVE: Biodiversidad, Pacífico Tropical Este, Stomatopoda, Dendrobranchiata, Caridea, Anomura, Brachyura.

Golfo Dulce is a deep embayment on the Pacific coast (08°30'N & 83°20'W) of Costa Rica. The water dynamics of the system were described by Svendsen, Rosland, Myking, Vargas, Lizano and Alfaro (2006). The gulf is characterized by an inner basin (200m) and a sill (70m) at the entrance (Fig. 1). The bathymetry of the gulf was described by Hebbeln, Beese and Cortés (1996). The presence of a deep basin, steep shores and a sill results in Golfo Dulce being considered essentially a tropical fjord-like embayment (Wolff, Hartmann, & Koch, 1996). Narrow shores with fringing mangrove forests, rocky outcrops, decaying coral reefs, and sandy beaches surround most of Golfo Dulce (Cortés, 1990; Samper-Villarreal & Silva-Benavides, 2015). Hypoxic and anoxic conditions are found in waters deeper than 100m (Córdoba & Vargas, 1996; Dalsgaard, Canfield, Peterson, Thamdrup, & Acuña-González, 2003), and no macrofaunal organisms have been found living in the anoxic basin sediments (León-Morales & Vargas, 1998).

Information about the macro-crustacean fauna of Golfo Dulce is scarce. The most important survey was conducted by the R.V. Victor Hensen (1993-1994) which collected crustaceans over a depth range of 15 to 200m using Otter and beam trawls. A preliminary list of 50 macro-crustaceans from Golfo Dulce collected during the R.V. Victor Hensen survey was published by Vargas, Jesse and Castro (1996). In addition, Castro and Vargas (1996) listed 68 species of macro-crustaceans reported in the literature for Golfo Dulce and included additional data for those collected during the survey. The spatial distributions of the species collected by the research vessel were analysed by Jesse (1996). Voucher specimens from most of the survey were deposited in the collection of the Museum of Zoology, University of Costa Rica (MZUCR). Other specimens deposited in the MZUCR were obtained over the years during occasional visits to different sites around the estuary, but a planned inventory of the crustacean fauna of the estuary is yet to be conducted.

Golfo Dulce is under the increasing pressure of local, regional and global stressors, such as pollution, coastal development, extraction of resources, and climate change (Morales-Ramírez, 2011, Morales-Ramírez, Acuña-González, Lizano, Alfaro, & Gómez, 2015). A trophic model in Golfo Dulce considering the key roles of the crustaceans and other groups was developed by Woff et al. (1996), but it needs to be updated. In this context, information on the biodiversity of Golfo Dulce is urgently needed as input in order to improve the trophic model and to develop of new management policies at the ecosystem level. Data on the previously recorded species from the gulf is important to evaluate changes in biodiversity over time and to identify sites of relevance for future surveys. Thus, the objective of this report is to provide an updated list of species of macro-crustaceans (Decapoda and Stomatopoda) from Golfo Dulce deposited in the collection of the UCR-Museum of Zoology, identify gaps of information, and make suggestions for a future survey of the fauna.

MATERIALS AND METHODS

The crustacean collection of the Museum of Zoology of the University of Costa Rica (MZUCR) is composed with three components. First, the collection of specimens preserved in 70% ethanol in labeled glass jars. Second, a dossier of handwritten catalog cards, with data for each collecting site. Third, a digital file filled with data obtained from the catalog cards. All catalog entries of marine macro-crustacean species belonging to Golfo Dulce were selected from the digital file. The handwritten cards and the specimen collection were reviewed when sampling data was not clear and/or the species identification was necessary to double-check records. A list of species was assembled, arranged in alphabetical order, and a code number assigned to each one. The list includes the presently accepted species name, authority, catalog number, station and year of collection. Other information such as depth (intertidal, subtidal) and substrate description (rocks, coral, sediment, other) was also included, when available. Two Golfo Dulce species are listed in the cards with no other station data. Most of the specimens in the collection were collected by hand and occasionally by

SCUBA while those from the R.V. Victor Hensen expedition were captured with otter and beam trawl nets. All species names were verified for their currently accepted name based in the web page World Register of Marine Species (WORMS).

Ethical, conflict of interest and financial statements: The authors have fully complied with all pertinent and legal requirements both during the study and in the production of the manuscript. We state that there are no conflicts of interest of any kind. The financial sources are fully and clearly stated in the acknowledgements section and we fully.

RESULTS

In total, there were 19 stations for which information was available (Fig. 1). Intertidal and SCUBA diving stations were assigned a code number, while those from trawl nets were identified with capital letters. A total of 106 species of macrocrustaceans with 173 entries was available for Golfo Dulce and catalogued in the collection of the Museum of Zoology (Appendix 1). Of this total, 102 are decapods and four are stomatopods. The earliest collection records are from 1969, followed by a time gap, until 1990 and 1993-1995 when 83 (48%) new entries were listed, many as the result of the R.V. Victor Hensen survey. The next intensive sampling effort took place during 2012-2013. Thirty-nine of the collecting sites were coral rocks, while 32 stations were from sediments. Most of the collecting sites were intertidal. The maximum depth sampled was 200m (Appendix 1).

The 102 species of decapods were distributed into 32 families, while the four species of stomatopods were represented by two (Table 1). The most specious family was the Porcellanidae, with 14 species. Other families, represented by five or more species, are: Ocypodidae (7), Palaemonidae (7), Alpheidae (6), Diogenidae (6), Xanthidae (6), Mithracidae (5), and Portunidae (5). Eleven families were represented by only one species (Table 1). There were ten most frequently species collected in the 19 stations (Table 2). Only one species, the stomatopod *Neogonodactylus zaca*, was collected at four stations. Nine species were found in three stations, 19 in two stations and the remaining 77 in only one station each. Station 12 had the most species (21), followed by stations 7 (17), 10 (16), 9 (15), and 3 (14). The other stations had less than 10 species each. Stations 1, 13, had one species each (Table 2). The R.V. Victor Hensen stations located near the sill and at the mouth of Golfo Dulce (F, H, and G, I) included 10, 5, 6, and 6 species, respectively. Those stations in deeper waters inside the gulf had 1 (L) and 3 (M) species.

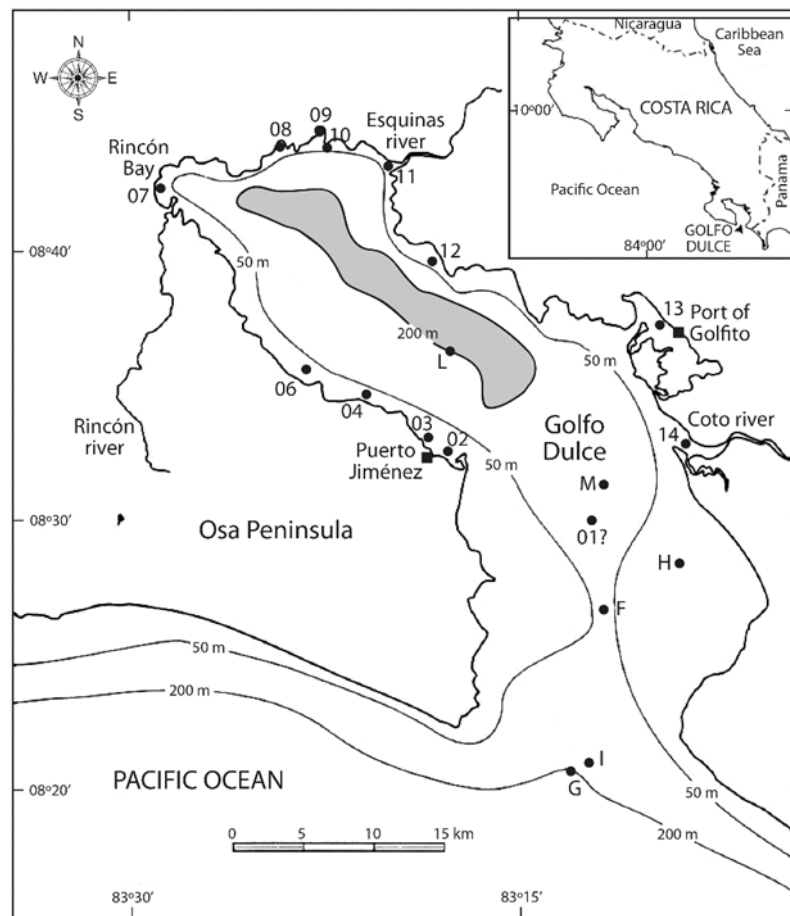


Fig. 1. Location of the stations reported in this study in Golfo Dulce. 2-14, intertidal and shallow water; F, G, H, I, M, deep-water stations from the R.V. Victor Hensen survey (1993 / 1994). The gray shaded area encloses basin depths of 200 to 215m. Station F is located at the sill (70m).

TABLE 1

DECAPODA	No. species
Alpheidae	6
Calappidae	1
Callinidae	1
Cancridae	1
Chasmocarcinidae	1
Diogenidae	6
Dynomenidae	1
Gecarcinidae	1
Grapsidae	2
Hippidae	1
Hippolytidae	2
Leucosiidae	3
Mithracidae	5
Munididae	2
Ocypodidae	7
Ozidae	3
Paguridae	3
Palaemonidae	7
Pandalidae	2
Panopeidae	4
Penaeidae	3
Pilumnidae	2
Pinnotheridae	1
Porcellanidae	14
Portunidae	5
Processidae	1
Pseudorhombilidae	1
Sesamidae	3
Sicyonidae	2
Solenoceridae	2
Upogebiidae	3
Xanthidae	6
STOMATOPODA	
Gonodactylidae	1
Squillidae	3
TOTAL	106

Families of crustaceans and number of species for each family catalogued in the collection of the Museum of Zoology. Golfo Dulce, Pacific coast of Costa Rica

TABLE 2
Species of crustaceans most frequently listed for the 19 stations, and stations where these were found; B. Total number of species reported at each station.

A. Species	Total	Station codes
<i>Neogonodactylus zaca</i>	4	6 - 8 - 10 - 12
<i>Alpheus rostratus</i>	3	6 - 8 - 12
<i>Clibanarius lineatus</i>	3	3 - 7 - 9
<i>Goniopsis pulchra</i>	3	3 - 7 - 9
<i>Hemus finnegan</i>	3	6 - 10 - 12
<i>Munida gracilipes</i>	3	1 - G - I
<i>Palaemonella holmesi</i>	3	6 - 8 - 10
<i>Playpodiella rotundata</i>	3	6 - 8 - 12
<i>Pomatogebia rugosa</i>	3	6 - 8 - 12
<i>Processa peruviana</i>	3	8 - 12 - I
B. Station	1 (1 sp), 2 (2), 3 (14), 4 (3), 6 (9), 7 (17), 8 (9), 9 (15), 10 (16), 11 (2), 12 (21), 13 (1), 14 (2), F (10), G (6), H (5), I (6), L (1) M (3)	

DISCUSSION

Because almost all the specimens of macrocrustaceans from Golfo Dulce were collected during occasional visits, there is yet to be an intensive sampling effort covering most of the diverse habitats around its shores and in deep waters. The specimens came from a wide variety of habitats. The northern shore is characterized by decaying coral reefs and steep walls while the southern shore has mostly sandy beaches and mangrove swamps. The eastern shore has sandy beaches and a more extense shallow sandy platform. The only survey of deep waters was performed by the R.V. Victor Hensen expedition and it was restricted to a few stations.

Although sampling effort in Golfo Dulce has been relatively important, there is still much additional sampling needed to reach a reliable picture of the invertebrate biodiversity of the embayment. Of relevance are future collections in the area of Gofito Bay where only one entry is reported in the UCR Museum catalogue despite the relatively easy access to many of the environments around this shallow bay. Other relatively unexplored regions are intertidal and subtidal areas near Rincon Bay, the tip of the Osa peninsula, and the sandy beaches and shallow bottoms on the eastern shore. The fact that 77 species were found at only

one station each supports the idea that each type of substrate appears to host a characteristic assemblage of species and emphasize the need to explore other sites characterized by different types of substrates.

According to Morales-Ramírez (2011), Golfo Dulce contains 21,5% of the marine biodiversity of the Pacific coast of Costa Rica in an area of about 750km². He also reported a total of 1022 species of different animal groups (invertebrates and vertebrates) for Golfo Dulce. This total represents nearly 1,36 species per km², a figure considered by Morales-Ramírez (2011) to be nearly double than that of the larger (1 990km²) and shallower Gulf of Nicoya estuary, where a more intensive sampling effort has been conducted (Vargas, 2016; Vargas-Zamora, Vargas-Castillo, & Sibaja-Cordero, 2019)

Despite of some local pollution problems (Spongberg & Davis, 1998; Spongberg, 2004; García, Acuña-González, Vargas-Zamora, & García-Céspedes, 2006; Spongberg et al., 2011), the biodiversity of Golfo Dulce appears to indicate a relatively healthy ecosystem (Morales-Ramírez et al., 2015). In this context updated information on the biodiversity of the estuary may contribute to a better management of its resources and attract interested visitors. In addition, updated lists are a first step to evaluate structural community changes due to local, regional or global stressors such as coastal development, pollution, and climate change. This list of selected groups of macrocrustaceans presented herein is a step towards these goals.

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REFERENCIAS

- Castro, M., & Vargas, R. (1996) Annotated list of species of marine crustaceans (Decapoda and Stomatopoda) from Golfo Dulce, Costa Rica. *Revista de Biología Tropical*, 44 (Supplement 3), S87 - S95.
- Cortés, J. (1990). The coral reefs of Golfo Dulce, Costa Rica: distribution and community structure. *Atoll Research Bulletin*, 344, 1 - 37. DOI: 10.5479/si.00775630.344.1
- Córdoba, R., & Vargas, J. A. (1996). Nutrient profiles at a 200 m deep station in Golfo Dulce, Costa Rica. *Revista de Biología Tropical*, 44 (Supplement 3), S233 - S236.
- Dalsgaard, T., Canfield, D. E., Peterson, J., Thamdrup, B., & Acuña-González, J. (2003). N₂ production by the anammox reaction in the anoxic water column of Golfo Dulce, Costa Rica. *Nature*, 422, 606 - 608. DOI: 10.1038/nature01526
- García, V., Acuña González, J., Vargas Zamora, J. A., & García Céspedes, J. (2006). Calidad bacteriológica y desechos sólidos en cinco ambientes costeros de Costa Rica. *Revista de Biología Tropical*, 54 (Supplement 1), S35 - S48.
- Hebbeln, D., Beese, D., & Cortés, J. (1996). Morphology and sediment structures in Golfo Dulce, Costa Rica. *Revista de Biología Tropical*, 44 (Supplement 3), S1 - S10
- Jesse, S. (1996). Demersal crustacean assemblages along the Pacific coast of Costa Rica: a quantitative and multivariate assessment based on the Victor Hensen Costa Rica Expedition (1993 / 1994). *Revista de Biología Tropical*, 44 (Supplement 3), S115 - S134.
- León-Morales, R., & Vargas, J. A. (1998). Macroinfauna of a tropical fjord-like embayment, Golfo Dulce, Costa Rica. *Revista de Biología Tropical*, 46 (Supplement 6), S81 - S90.
- Morales-Ramírez, A. (2011). La diversidad marina del Golfo Dulce, Pacífico sur de Costa Rica: amenazas a su conservación. *Biocenosis*, 24, 9 - 20.
- Morales-Ramírez, Á., Acuña-González, J., Lizano, O., Alfaro, E., & Gómez, E. (2015). Rasgos oceanográficos en el Golfo Dulce, Pacífico de Costa Rica: una revisión para la toma de decisiones en conservación marina. *Revista de Biología Tropical*, 63 (Supplement 1), S131 - S160.

- Samper-Villarreal, J., & Silva-Benavides, A. M. (2015). Complejidad estructural de los manglares de Playa Blanca, Escondido y Rincón de Osa, Golfo Dulce, Costa Rica. *Revista de Biología Tropical*, 63 (Supplement 1), S199 - S208.
- Svendsen, H., Rosland, R., Myking, S., Vargas, J. A., Lizano, O. G., & Alfaro, E. J. (2006). A physical-oceanographic study of Golfo Dulce, Costa Rica. *Revista de Biología Tropical*, 54 (Supplement 1), S147 - S170.
- Spongberg, A. I., & Davis, P. (1998). Organochlorinated pesticide contaminants in Golfo Dulce, Costa Rica. *Revista de Biología Tropical*, 46 (Supplement 6), S111 - S124.
- Spongberg, A. I. (2004). PCB contamination in marine sediments from Golfo Dulce, Pacific Costa Rica. *Revista de Biología Tropical*, 52 (Supplement 2), S23 - S32.
- Spongberg, A. L., Witter, J. D., Acuña, J., Vargas, J. A., Murillo, M., Umaña, G., Gómez, E., & Pérez, G. (2011). Reconnaissance of selected Pharmaceutical and Personal Care Product compounds in Costa Rican surface waters. *Water Research*, 45, 6709 - 6717. DOI: 10.1016/j.watres.2011.10.004
- Vargas, R., Jesse, S., & Castro, M. (1996). Checklist of crustaceans (Decapoda and Stomatopoda), collected during the Victor Hensen Costa Rica Expedition (1993 / 1994). *Revista de Biología Tropical*, 44 (Supplement 3), S97 - S102.
- Vargas, J. A. (2016). The Gulf of Nicoya estuarine ecosystem. In: M. Kaapelle (Ed.). *Costa Rican Ecosystems* (pp. 106-124). Chicago, USA: University of Chicago Press.
- Vargas-Zamora J. A., Vargas-Castillo, R., & Sibaja Cordero, J. A. (2019). Crustáceos (Decapoda y Stomatopoda) del R.V. Skimmer y R.V. Victor Hensen en el Golfo de Nicoya, Pacífico. Costa Rica. *Revista de Biología Tropical*, 67, 286 - 305. DOI: 10.15517/rbt.v67i1.34729
- Wolff, M., Hartmann, H. J., & Koch, V. (1996). A pilot trophic model for Golfo Dulce: a fjord-like embayment, Costa Rica. *Revista de Biología Tropical*, 44 (Supplement 3), S215 - S231.

