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The cleaning mutualism between the shrimp, *Lysmata grabhami* (Malacostraca: Hippolytidae) and fish, with description of a new interaction with *Mycteroperca fusca* (Actinopterygii: Serranidae) from the Eastern Atlantic Ocean

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ABSTRACT

The activity of *Lysmata grabhami* as cleaner shrimp is well known, and its cleaning mutualism with many client fish species in different biogeographic areas have been documented. The literature reviewed resulted in 49 fish species belonging to 15 families to be cleaned at both sides of the Atlantic Ocean. Overall, Muraenidae, Serranidae, Pomacentridae, Holocentridae and Acanthuridae were the families that accounted more species of client fish; both families and the pool of species were different at Western and Eastern Atlantic. This work reports and describes a new cleaning interaction between the cleaner shrimp, *L. grabhami* (Gordon, 1935), and the island grouper, *Mycteroperca fusca* (Lowe, 1838) from the Canary Islands, North-eastern Atlantic ocean.

Keywords: cleaner shrimp, island grouper, symbiosis, Atlantic Ocean, Canary Islands.

RESUMEN

La actividad de la gamba limpiadora *Lysmata grabhami* es bien conocida, y las relaciones mutualísticas con diferentes especies de peces han sido documentadas con anterioridad. Un total de 49 especies de peces pertenecientes a 15 familias han sido registradas como clientes de esta gamba limpiadora a ambos lados del Océano Atlántico. Las familias Muraenidae, Serranidae, Pomacentridae, Holocentridae y Acanthuridae fueron las familias que totalizaron un mayor número de especies de peces, y las familias y las especies fue-

ron diferentes entre el Atlántico Oeste y el Atlántico Este. En este estudio se registra por primera vez una interacción entre la gamba limpiadora *L. grabhami* (Gordon, 1935) y el abade, *Mycteroperca fusca* (Lowe, 1838) en las islas Canarias (Atlántico Nororiental).

Palabras clave: gamba limpiadora, abade, simbiosis, Océano Atlántico, islas Canarias.

1. INTRODUCTION

Cleaning mutualisms are widespread among marine animals (CÔTÉ, 2000; GRUTTER, 2002). During cleaning interactions in the sea, the 'cleaner' removes parasites, skin, scales and mucus from the body surface of their 'clients', which include many types of marine organisms (e.g. invertebrates, fishes, turtles, and whales); this behaviour often is considered to be mutualistic, i.e. the cleaner receives a meal, and the client is freed from irritants or parasites, and is allowed by the client to do so without being attacked or harmed (CÔTÉ, 2000; GRUTTER, 2002; FLOETER *et al*., 2007; WICKSTEN, 2009). The factors affecting the cleaning interactions, such as client body size, abundance, schooling or solitary, active or sedentary, type of feeding and habitat, obligate or facultative cleaners, have been widely studied (see reviews in CÔTÉ, 2000 and FLOETER *et al*., 2007 and references therein).

Around the world, at least 132 marine organisms have been documented to have cleaning behaviour, 112 fish species and 20 invertebrates, mainly crustaceans of the families Hippolytidae, Palaemonidae, Stenopodidae and Majidae (VAN TASSELL *et al*., 1994). The first family includes species of *Lysmata*, commonly called cleaner shrimps (DEBELIUS, 2001). They inhabit rocks, coral reefs, or shipwrecks from the intertidal zone to the continental shelf in tropical and warm temperate seas. Phylogenetic analysis revealed *ca.* 26 species within the genera *Lysmata* and *Exhippolysmata*; these species are rare among marine invertebrates, because they are protandric simultaneous hermaphrodites, i.e. shrimps initially mature and reproduce solely as males, and later in life become functional simultaneous hermaphrodites (BAEZA, 2010). At least 11 species have been reported to be cleaners (WICKSTEN, 2009), within this group, *Lysmata grabhami* (Gordon, 1835), is considered to be 'highly evolved' or 'specialized' shrimp cleaner. It has conspicuous white antennae contrasting with the body color, which has a mid-dorsal white stripe flanked by red and yellow. This species lives in pairs and occupy cleaning stations-areas, where client fishes visit them (WICKSTEN, 2009).

In the past, *L. grabhami* was misidentified with *Lysmata amboinensis* (De Man, 1888), a species distributed in the Indo-Pacific (see RANDALL, 1958; BRUCE, 1974; HAYASHI, 1975). The genetic distance found in the molecular analysis together with minor but constant differences in colour pattern support that they are different valid species (see BAEZA, 2010). *L. grabhami* has an amphi-Atlantic distribution in tropical and subtropical areas. In the Western Atlantic, it has been recorded from the Florida Keys, Bahamas, and North-eastern Gulf of Mexico (LIMBAUGH, 1961), Netherlands Antilles, Lesser Antilles, Antigua Island, Colombian Caribbean coast, Bermuda (CHACE, 1972; CRIALES & CORREDOR, 1977; CRIALES, 1979; MANNING & CHACE, 1990; WICKSTEN, 1995), Brazil (KASSUGA *et al*., 2015), and Saint Paul's Rocks (HOLTHUIS *et al*., 1980). In the Eastern Atlantic from Madeira (GORDON, 1935, type locality), Canary Islands (MORENO

et al., 1978, as *Hippolysmata grabhami*), and Cape Verde Archipelago (TÜRKAY, 1982, as *Lysmata amboinensis*), Ascension Island (MANNING & CHACE, 1990), coast of Senegal (WIRTZ, 2011), and the Gulf of Guinea islands from Annobon (CROSNIER, 1971, as *H. grabhami*), and Sâo Tomé and Príncipe (WIRTZ, 2004).

Overall, specific works on the cleaning behaviour of *L. grabhami* are scarce. The cleaning activity of *L. grabhami* was first reported by LIMBAUGH *et al.* (1961) in Lyford Cay (Bahamas). Posteriorly, the habitat, type of associations and cleaning activity were studied by CRIALES & CORREDOR (1977) and CRIALES (1979) in Santa Marta Bay (Colombia), this work reported the larger number of client fish. In the Eastern Atlantic, there are not specific studies on the cleaning behaviour of *L. grabhami.* Van TASSELL *et al*. (1994) reported the cleaning activity of *L. grabhami* in the Canary Islands, and its interactions with five fish species. WIRTZ (1997) studied the crustacean symbionts associated with the sea anemone *Telmatactis cricoides* (Duchassaing, 1850), and pointed out that *L. grabhami* is generally found in association with this anemone at Madeira and the Canary Islands.

2. MATERIAL AND METHODS

A literature review was made to check for previously clean interactions between *L. grabhami* and client fish species. The systematic arrangement of the present account of fish species followed NELSON (2006), and their taxonomic status was assigned according to ESCHMEYER (2015) and FROESE & PAULY (2015). Recreational or professional scuba diving focused on biodiversity observations and underwater photography proved useful instrumental in providing information about the presence and distribution of invertebrates and fish fauna, including the most easily overlooked species (RIOLO & BETTI, 2015). The fish and shrimps were observed during a scientific diving at 'El Cabrón', Eastern of Gran Canaria, 27º58'N 15º36'W, June 2015, in a complex rocky reef with numerous crevices, holes and cavities, 8-10 m depth. Sea surface temperature during the observation was 21.5ºC.

3. RESULTS

The literature review reported 49 fish species belonging to 15 families as clients of *Lysmata grabhami* (Table 1). The families with more number of client species were Muraenidae, Serranidae, Pomacentridae and Acanthuridae. Both sides of the Atlantic showed similar number of species (23 Eastern *vs* 28 Western Atlantic) (Figure 1). Nevertheless, the pool of species at both sides was different, species of Torpedinidae, Dasyatidae and Tetraodontidae were exclusive of the Eastern Atlantic; while Apogonidae, Lutjanidae, Chaetodontidae, Pomacanthidae and Ostraciidae were exclusive of the Western Atlantic; only two species were shared *Myripristis jacobus* and *Chromis multilineata* (see Table 1 and Figure 1). Muraenidae showed the large difference in number of species between both sides of the ocean (8 Eastern *vs* 2 Western).

Two specimens of *L. grabhami*, *ca*. 5-7 cm, and one of *M. fusca*, *ca*. 30 cm TL, were observed on a rocky bottom inside a small cave (Figure 2). Initially, the island grouper

was resting on one side over the bottom of the cave, and both specimens of *L. grabhami* were cleaning on the side of the body. When they detected the diver light, the island grouper woke up.

4. DISCUSSION

Interactions between *Lysmata grabhami* as cleaner shrimp and many fish species as clients have been documented in different biogeographic areas (see Tables 1 and 2). Nevertheless, data of this work suggests that these type of interactions are rare related to fish diversity, only a few fish species in each geographic area use the cleaning service of the shrimp; e.g. in the Caribbean Sea, only 28 species (3.4%) of *ca*. 814 reef fish (FLOETER *et al*., 2008); while in the Canary Islands, only 14 species (7%) of *ca*. 200 shore fish species (BRITO *et al*., 2002) have been reported as clients.

The interaction with specimens of Muraenidae showed the high number of species, this could be explained because individuals of this family are frequent in coral and rocky reefs at both sides of the Atlantic Ocean, and they share the habitat with the cleaner shrimp, i.e. small caves, holes and crevices. These factors facilitate the occurrence of the cleaning interaction, as reported in the Caribbean Sea by CRIALES & CORREDOR (1977), and CRIALES (1979). In the Eastern Atlantic, the association of Muraenidae with *L. grabhami* was reported by VAN TASSELL *et al*. (1994), who found three species (*Enchelycore anatina*, *Gymnothorax unicolor* and *Muraena helena*) being cleaned in the Canary Islands. Posteriorly, WIRTZ (1977) found that in Madeira and the Canary Islands, when *L. grabhami* is not in association with the sea anemone *Telmatactis cricoides*, usually is found in association with a moray eel in the same crevice.

The island grouper is a characteristic species of the Eastern Atlantic islands. It has been recorded from Azores, Madeira, Selvagens, Canary and Cape Verde archipelagos. Although, there is a record in the Mediterranean Sea, where it is probably introduced (HEEMSTRA *et al*., 2010).

The study species, *Lysmata grabhami,* has been shown cleaning *Acanthurus coeruleus* Bloch & Schneider, 1801, *Lutjanus mahogoni* Cuvier, 1828, *Ocyurus chrysurus* (Bloch, 1791), *Bodianus rufus* (Linnaeus, 1758), and *Epinephelus adscensionis* (Osbeck, 1765) in Bonaire (Dutch Antilles) (WICKSTEN, 1995). The cleaning behaviour of *L. grabhami* has been documented on *A. coerulerus* in the Bahamas (LIMBAUGH *et al*., 1961). This species has also been reported cleaning *Acanthurus monroviae* Steindachner, 1876*, Paranthias furcifer* (Valenciennes*,* 1828), *Chromis multilineata* (Guichenot, 1853)*, Enchelycore nigricans* (Bonnaterre, 1788)*, Echidna peli* (Kaup, 1856)*, Muraena melanotis* (Kaup, 1859)*, Holocentrus adscensionis* (Osbeck, 1765)*, Myripristis jacobus* Cuvier, 1829*,* and *Sargocentron hastatum* (Cuvier, 1829) in Sâo Tomé and Príncipe Islands (WIRTZ, 2003, 2004; QUIMBAYO *et al*., 2012). *Lysmata grabhami* has also been observed cleaning other moray species such as, *Channomuraena vittata*, *Gymnothorax moringa*, *G. unicolor* and *Enchelycore nigricans* in Ascension Island (MORAIS *et al*., 2016).

In spite of *L. grabhami* is a widely distributed species in the Atlantic Ocean, it coexists with *M. fusca* in sympatric distribution only in Madeira, Canary and Cape Verde archipelagos, and probably in the Selvagens Islands. The marine littoral areas of these is-

lands are relatively well explored, and many scientific studies have been carried out, especially on marine fauna. Nevertheless, the cleaning mutualism described herein has not been previously reported. In the Canary Islands, previously works pointed out that *L. grabhami* was observed frequently cleaning many species of fishes such as, *Dasyatis pastinaca* (Linnaeus, 1758), *Taeniura grabata* (Geoffroy Saint-Hilaire, 1817), *Torpedo marmorata* Risso, 1810, *Muraena augusti* (Kaup, 1856), *M. helena* Linnaeus, 1758, *Gymnothorax unicolor* (Delaroche, 1809), *Enchelycore anatina* (Lowe, 1838), *Mullus surmuletus* Linnaeus, 1758, *Epinephelus marginatus* (Lowe, 1834) and *Similiparma lurida* (Cuiver, 1830) (Van Tassell *et al*., 1994; González, 1995; Espino *et al*., 2007). However, the most common fish clients are the damselfish, *Chromis limbata* (Valenciennes, 1833), and the pufferfish, *Canthigaster capistrata* (Lowe, 1839) at Madeira and the Canary Islands (WIRTZ, 1997; WIRTZ & DEBELIUS, 2003).

M. fusca is a demersal species over rocky and rock-sand bottoms (BRITO *et al*., 2002), usually found in waters around rocky-outcrops and vertical cliffs (ESPINO *et al*., 2007), rarely inside caves or holes. This could explain the low level interaction with the cleaner shrimp. However, the high number of fish species cleaned by *L. grabhami* in the Macaronesian region (Canary Islands and Madeira) is partially explained by the lack of facultative fish species that perform cleaning activities, as occurs in other regions (MORAIS *et al*., 2016). In Ascension Island the cleaning interactions were mainly dominated by juveniles of the facultative fish cleaners *Bodianus insularis* Gomon & Lubbock, 1980 and *Pomacanthus paru* (Bloch, 1787), followed by *Chaetodon sanctaehelenae* Günther, 1868 and *Thalassoma ascensionis* (Quoy & Gaimard, 1834) (MORAIS *et al*., 2016). Isolated places such as, Ascension Island, are poorer in species than coastal reefs because of geographic isolation, however, it provides the opportunity of plastic species to occupy this ecological role and perform a cleaning niche.

In contrast, if considered the whole diversity of fishes from the Canary Islands and Madeira (>200 coastal species) only a small fraction of fish are cleaned by *L. grabhami*. Several reasons may explain this pattern, (i) the presence of fewer parasite species in these archipelagos relative to other geographical regions. Former studies have shown that isolated reefs sustain less parasite species compared to non-isolated reefs (QUÉRO *et al*., 1990); (ii) the low complexity of reef food webs in the Canary Islands and Madeira. Complex food webs contain higher parasite species compared to simplified food webs (LAFFERTY *et al*., 2006, 2008).

Cleaning interactions between species have been so far scarcely studied, especially in temperate rocky reefs. Records of opportunistic or symbiotic relationships between fish and cleaners are of utmost importance to understand the interactions among species in reefs. In oceanic archipelagos which have never had a land connection with a continent such as, the Canary Islands and Madeira, it would be an asset for the study of symbiotic behaviour to report interactions between cleaners and hosts.

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6. REFERENCES

BAEZA, J.A. 2010. Molecular systematics of peppermint and cleaner shrimps: phylogeny and taxonomy of the genera *Lysmata* and *Exhippolysmata* (Crustacea: Caridea: Hyppolytidae). *Zoological Journal of the Linnean Society*, 160(2): 254-265.

BRITO, A. P. J. PASCUAL, J. M. FALCÓN, A. SANCHO & G. GONZÁLEZ. 2002. Peces de las Islas Canarias. Catálogo comentado e ilustrado, Francisco Lemus Editor, La Laguna, 419.

BRUCE, A. J. 1974. On *Lysmata grabhami* (Gordon), a widely distributed tropical hippolytid shrimp (Decapoda, Caridae). *Crustaceana* 27, 107-109.

CHACE, F.A. 1972. The Shrimps of the Smithsonian-Bredin Caribbean Expeditions with a Summary of the West Indian Shallow-water Species (Crustacea: Decapoda: Natantia). *Smithsonian Contributions to Zoology*, 98: 1-179.

CÔTÉ, I. M. 2000. Evolution and ecology of cleaning symbioses in the sea. *Oceanography and Marine Biology: an Annual Review*, 38: 311-355.

CRIALES, M. M & L. CORREDOR. 1977. Aspectos etológicos y ecológicos de camarones limpiadores de peces. *Anuario del Instituto de Investigaciones Marinas, Punta Betín*, 9: 141-156.

CRIALES, M. M. 1979. Ecología y etología de los camarones limpiadores de peces *Periclimenes perdersoni* Chace y *Lysmata grabhami* (Gordon) en la Bahía de Santa Marta (Colombia). *Acta Científica Venezolana*, 30: 570-576.

CROSNIER, A. 1971. Sur quelques Crustacés Décapodes ouest-africains nouveaux ou rarement signalés. *Bulletin du Muséum National D'Histoire Naturelle*, 3: 569-595.

DEBELIUS, H. 2001. Crustacea Guide of the World. IKAN-Unterwasserarchiv, Frankfurt, Germany, 321.

ESCHMEYER, W. N. 2015. Catalog of Fishes: Genera, Species, References. (http://research.calacademy.org/research(ichthyology/catalog/SpeciesbyFamily.asp). Electronic version accessed, 23th October 2016.

ESPINO, F., A. BOYRA, F. TUYA & R. HAROUN. 2007. Guía Visual de Especies Marinas de Canarias. Segunda Edición. Oceanográfica Ediciones, Las Palmas de Gran Canaria, España, 484.

FLOETER, S. R., D. P. VÁZQUEZ & A. S. GRUTTER. 2007. The macroecology of marine cleaning mutualisms. *Journal of Animal Ecology*, 76: 105-111.

FLOETER, S. R., L. A. ROCHA, D. R. ROBERTSON, J. C. JOYEUX, W. F. SMITH-VANIZ, P. WIRTZ, A. J. EDWARDS, J. P. BARREIROS, C. E. L. FERREIRA, J. L. GASPARINI, A. BRITO, J. M. FALCÓN, B. W. BOWEN & G. BERNARDI. 2008. Atlantic reef fish biogeography and evolution. *Journal of Biogeography*, 35: 22-47.

FROESE, R & D. PAULY (eds.) 2015. FishBase. World Wide electronic publication. www.fishbase.org, version (08/2015).

GONZÁLEZ, J. A. 1995. Catálogo de los Crustáceos Decápodos de las Islas Canarias. Gambas, Langostas, Cangrejos. Publicaciones Turquesa. Santa Cruz de Tenerife, España, 273.

GORDON, I. 1935. On new or imperfectly known species of Crustacea Macrura. *Linnean Journal of Zoology*, 39: 307-351.

GRUTTER, A. S. 2002. Cleaning symbioses from the parasites' perspective. *Parasitology*, 124: S65-S81.

HAYASHI, K-I. 1975. *Hippolysmata grabhami* Gordon, a synonym of *Lysmata amboinensis* (De Man) (Decapoda, Caridea, Hippolytidae). *Publication of the Seto Marine Biological Laboratory*, 22: 285-296.

HEEMSTRA, P., A. ARONOV & M. GOREN. 2010. First record of the Atlantic island grouper *Mycteroperca fusca* in the Mediterranean Sea. *Marine Biodiversity Records*, 3 (e92): 1-3.

HOLTHUIS, L. B., A. J. EDWARDS & H. R. LUBBOCK. 1980. The Decapod and Stomatopod Crustacea of St Paul's Rocks. *Zoologische Mededelingen*, 56: 27-51.

KASSUGA, A. K., K. DIELE & M. HOSTIM-SILVA. 2015. New records of the cleaner shrimp *Lysmata grabhami* (Gordon, 1935) from Brazil, Southwestern Atlantic. *Brazilian Journal of Biology*, 75(4): 936-939.

LAFFERTY, K. D., A. P. DOBSON & A. M. KURIS. 2006. Parasites dominate food web links. *Proceedings of the National Academy of Sciences USA*, 103: 11211-11216.

LAFFERTY, K. D., J. C. SHAW & A. M. KURIS. 2008. Reef fishes have higher parasite richness at unfished Palmyra atoll compared to fished Kiritimati Island. *EcoHealth*, 5: 338-345.

LIMBAUGH, C. 1961. Cleaning symbiosis. *Scientific American*, 205: 42-49.

LIMBAUGH, C., H. PEDERSON & JR. F. A. CHACE. 1961. Shrimps that clean fishes. *Bulletin of Marine Science*, 11: 237-257.

MANNING, R.B., & JR. F. A. CHACE. 1990. Decapod and stomatopod crustacea from Ascension Island, South Atlantic Ocean. *Smithsonian Contribution to Zoology*, 503: 1-91.

MORAIS, R. A., J. BROWN, S. BEDARD, C. E. L. FERREIRA, S. R. FLOETER, J. P. QUIMBAYO, L. A. ROCHA & I. SAZIMA. 2016. Mob rulers and part-time cleaners: two reef fish associations at the isolated Ascension Island. *Journal of the Marine Biological Association of the United Kingdom*, doi:10.1017/S0025315416001041.

MORENO, E., A. BARRERA & J. CARRILLO. 1978. Primera cita para las aguas de Canarias de *Hippolysmata grabhami* Gordon 1935. *Resultados expediciones científicas del buque oceanográfico "Cornide de Saavedra"*, 7: 257.

NELSON, J. S. 2006. Fishes of the World. 4th ed. John Wiley & Sons Inc. Hoboken, New Jersey, USA, 601.

QUÉRO, J. C., J. C. HUREAU, C. KARRER, A. POST & L. SALDANHA (eds) 1990. Check-list of the fishes of the eastern tropical Atlantic (CLOFETA). JNICT, Lisbon; SEI, Paris; UNESCO, Paris.

QUIMBAYO, J. P., S. R. FLOETER, R. NOGUCHI, C. A. RANGEL, J. L. GASPARINI, C. L. S. SAMPAIO, C. E. L. FERREIRA & L. A. ROCHA. 2012. Cleaning mutualism in Santa Luzia (Cape Verde Archipelago) and Sâo Tomé Islands, Tropical Eastern Atlantic. *Marine Biodiversity Records*, 5 (e118): 1-7.

RANDALL, J. E. 1958. A review of the labrid fish genus *Labroides*, with descriptions of two new species and notes on ecology. *Pacific Science*, 12: 327-347.

RIOLO, F. & F. BETTI. 2015. First record of Europe's smallest marine fish *Lebetus guilleti* (Gobiidae) in the Italian seas. *Marine Biodiversity Records*, 8: e12.

TÜRKAY, M. 1982. Marine Crustacea Decapoda von den Kapverdischen Inseln mit Bemerkungen zur Zoogeographie des Gebietes. *Courier Forschungsinstitut Senckenberg*, 52: 91-129.

VAN TASSELL, J. L., A. BRITO & S. A. BORTONE. 1994. Cleaning behavior among marine fishes and invertebrates in the Canary Islands. *Cybium*, 18: 117-127.

WICKSTEN, M. K. 1995. Associations of fishes and their cleaners on coral reefs of Bonaire, Netherlands Antilles. *Copeia*, 1995: 477-481.

WICKSTEN, M. K. 2009. Interactions with fishes of five species of *Lysmata* (Decapoda, Caridea, Lysmatidae). *Crustaceana,* 82: 1213-1223.

WIRTZ, P. 1997. Crustaceans symbionts of the sea anemone *Telmatactis cricoides* at Madeira and the Canary Islands. *Journal of Zoology*, 242: 799-811.

WIRTZ, P. 2003. New records of marine invertebrates from Sâo Tomé Island. *Journal of the Marine Biological Association of the United Kingdom*, 83: 735-736.

WIRTZ, P. & H. DEBELIUS. 2003. Mediterranean and Atlantic invertebrate guide. Conchbooks, Hackenheim. 305.

WIRTZ, P. 2004. Four amphi-Atlantic shrimps new for Sâo Tomé and Príncipe (eastern central Atlantic). *Arquipelago: Life and Marine Science*, 21: 83-85.

WIRTZ, P. 2011. New records of marine invertebrates from the coast of Senegal. *Arquipelago Life and Marine Sciences*, 28: 7-9.

Table 1.- List of records of client fish species of *Lysmata grabhami*.

Family	Client fish species	Location	Author
Torpedinidae	*Torpedo marmorata* Risso, 1810	Canary Islands	Van Tassell *et al*. (1994); González (1995)
Dasyatidae	*Dasyatis pastinaca* (Linnaeus, 1758)	Canary Islands	González (1995)
	Taeniura grabata (Geoffroy Saint-Hilaire, 1817)	Canary Islands	González (1995)
Muraenidae	*Channomuraena vittata* (Richardson, 1845)	Ascension Island	Morais *et al*. (2016)
	Echidna peli (Kaup, 1856)	Sâo Tomé & Príncipe Islands	Quimbayo *et al*. (2012)
	Enchelycore anatina (Lowe, 1838)	Canary Islands	Van Tassell *et al*. (1994); González (1995)
	Enchelycore nigricans (Bonnaterre, 1788)	Sâo Tomé & Príncipe Islands; Ascension Island	Quimbayo *et al*. (2012); Morais *et al*. (2016)
	Gymnothorax miliaris (Kaup, 1856)	Santa Marta (Colombia);	Criales & Corredor (1977)
	Gymnothorax moringa (Cuvier, 1829)	Santa Marta (Colombia); Ascension Island	Criales & Corredor (1977); Morais *et al*. (2016)
	Gymnothorax unicolor (Delaroche, 1809)	Canary Islands; Ascension Island	Van Tassell *et al*. (1994); González (1995); Morais *et al*. (2016)
	Muraena augusti (Kaup, 1856)	Canary Islands	Espino *et al*. (2007)
	Muraena helena Linnaeus, 1758	Canary Islands	Van Tassell *et al*. (1994); González (1995)
	Muraena melanotis (Kaup, 1859)	Sâo Tomé & Príncipe Islands	Quimbayo *et al*. (2012)
Holocentridae	*Holocentrus adscensionis* (Osbeck, 1765)	Sâo Tomé & Príncipe Islands	Quimbayo *et al*. (2012)
	Holocentrus rufus (Walbaum, 1792)	Santa Marta (Colombia)	Criales & Corredor (1977)
	Myripristis jacobus Cuvier, 1829	Santa Marta (Colombia); Sâo Tomé & Príncipe Islands	Criales & Corredor (1977);Quimbayo *et al*. (2012)
	Sargocentron hastatum (Cuvier, 1829)	Sâo Tomé & Príncipe Islands	Quimbayo *et al*. (2012)
Serranidae	*Cephalopholis fulva* (Linnaeus, 1758)	Bonaire (Netherlands Antilles)	Wicksten (1995)
	Epinephelus adscensionis (Osbeck, 1765)	Bonaire (Netherlands Antilles)	Wicksten (1995)
	Epinephelus marginatus (Lowe, 1834)	Canary Islands	González (1995)
	Mycteroperca fusca (Lowe, 1838)	Canary Islands	This work
	Mycteroperca tigris (Valenciennes, 1833)	Bonaire (Netherlands Antilles)	Wicksten (1995)
	Paranthias furcifer (Valenciennes, 1828)	Sâo Tomé & Príncipe Islands	Quimbayo *et al*. (2012)
	Rypticus saponaceus (Bloch & Schneider, 1801)	Bonaire (Netherlands Antilles)	Wicksten (1995)

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Family	Client fish species	Location	Author
Apogonidae	*Apogon binotatus* (Poey, 1867)	Santa Marta (Colombia)	Criales & Corredor (1977)
	Paroncheilus affinis (Poey, 1875)	Santa Marta (Colombia)	Criales & Corredor (1977)
Lutjanidae	*Lutjanus mahogoni* (Cuvier, 1828)	Bonaire (Netherlands Antilles)	Wicksten (1995)
	Ocyurus chrysurus (Bloch, 1791)	Bonaire (Netherlands Antilles)	Wicksten (1995)
Mullidae	*Mullus surmuletus* Linnaeus, 1758	Canary Islands	Van Tassell *et al*. (1994); González (1995)
	Pseudupeneus maculatus (Bloch, 1793)	Santa Marta (Colombia)	Criales & Corredor (1977)
Chaetodontidae	*Chaetodon capistratus* Linnaeus, 1758	Santa Marta (Colombia)	Criales & Corredor (1977)
	Chaetodon sedentarius Poey, 1860	Santa Marta (Colombia)	Criales & Corredor (1977)
	Prognathodes aculeatus (Poey, 1860)	Santa Marta (Colombia)	Criales & Corredor (1977)
Pomacanthidae	*Holacanthus ciliaris* (Linnaeus, 1758)	Santa Marta (Colombia)	Criales & Corredor (1977)
	Holacanthus tricolor (Bloch, 1795)	Santa Marta (Colombia)	Criales & Corredor (1977)
	Pomacanthus paru (Bloch, 1787)	Santa Marta (Colombia)	Criales & Corredor (1977)
Pomacentridae	*Chromis cyanea* (Poey, 1860)	Santa Marta (Colombia)	Criales & Corredor (1977)
	Chromis limbata (Valenciennes, 1833)	Madeira; Canary Islands	Wirtz (1997); Wirtz & Debelius (2003)
	Chromis multilineata (Guichenot, 1853)	Santa Marta (Colombia); Sâo Tomé; & Príncipe Islands; Ascension Island	Criales & Corredor (1977); Quimbayo *et al*. (2012); Morais *et al*. (2016)
	Stegastes variabilis (Castelnau, 1855)	Santa Marta (Colombia)	Criales & Corredor (1977)
	Similiparma lurida (Cuiver, 1830)	Canary Islands	González (1995)
Labridae	*Bodianus rufus* (Linnaeus, 1758)	Bonaire (Netherlands Antilles)	Wicksten (1995)
	Clepticus parrae (Bloch & Schneider, 1801)	Santa Marta (Colombia)	Criales & Corredor (1977)
Acanthuridae	*Acanthurus bahianus* Castelnau, 1855	Santa Marta (Colombia)	Criales & Corredor (1977)
	Acanthurus chirurgus (Bloch, 1787)	Santa Marta (Colombia)	Criales & Corredor (1977)
	Acanthurus coeruleus Bloch & Schneider, 1801	Bahamas; Bonaire (Netherlands Antilles)	Limbaugh *et al*. (1961); Wicksten (1995)
	Acanthurus monroviae Steindachner, 1876	Sâo Tomé & Príncipe Islands	Quimbayo *et al*. (2012)
Ostraciidae	*Lactophrys triqueter* (Linnaeus, 1758)	Santa Marta (Colombia)	Criales & Corredor (1977)
	Lactophrys sp.	Bonaire (Netherlands Antilles)	Wicksten (1995)
Tetraodontidae	*Canthigaster capistrata* (Lowe, 1839)	Madeira; Canary Islands	Wirtz (1997); Wirtz & Debelius (2003)

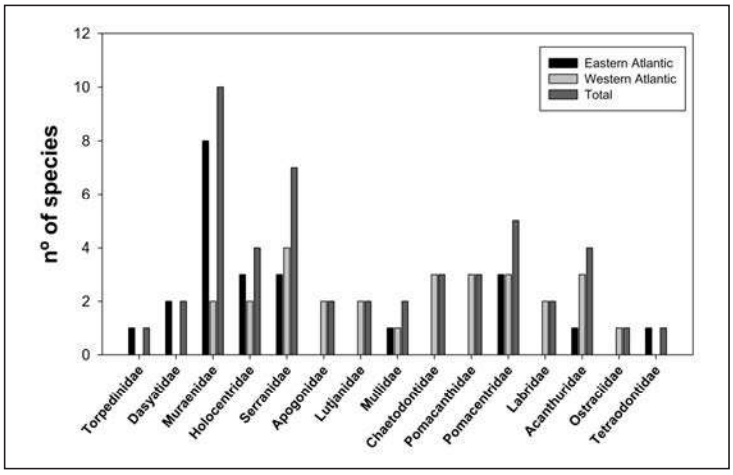

Figure 1.- Number of fish species, grouped by family, cleaned by *Lysmata grabhami* in both sides of the Atlantic Ocean.

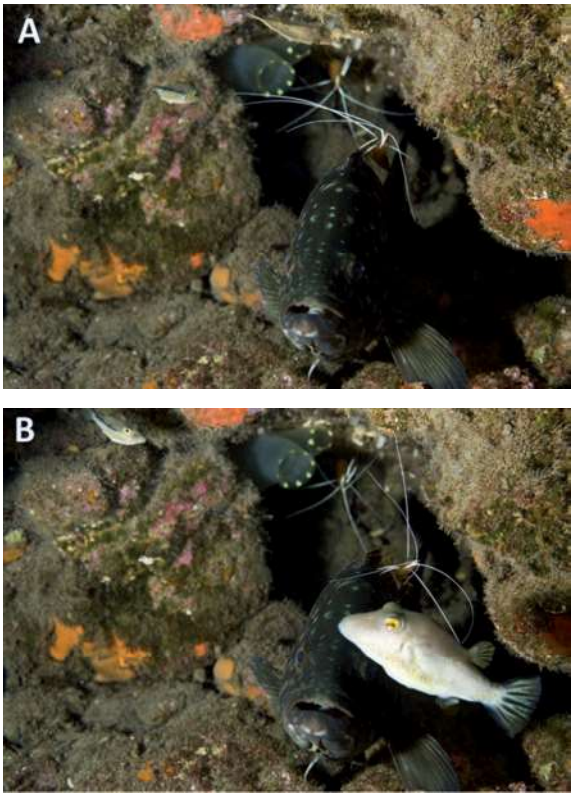

Figure 2.- The unpreviously reported interaction between *Lysmata grabhami* and *Mycteroperca fusca*, recorded in the Canary Islands.

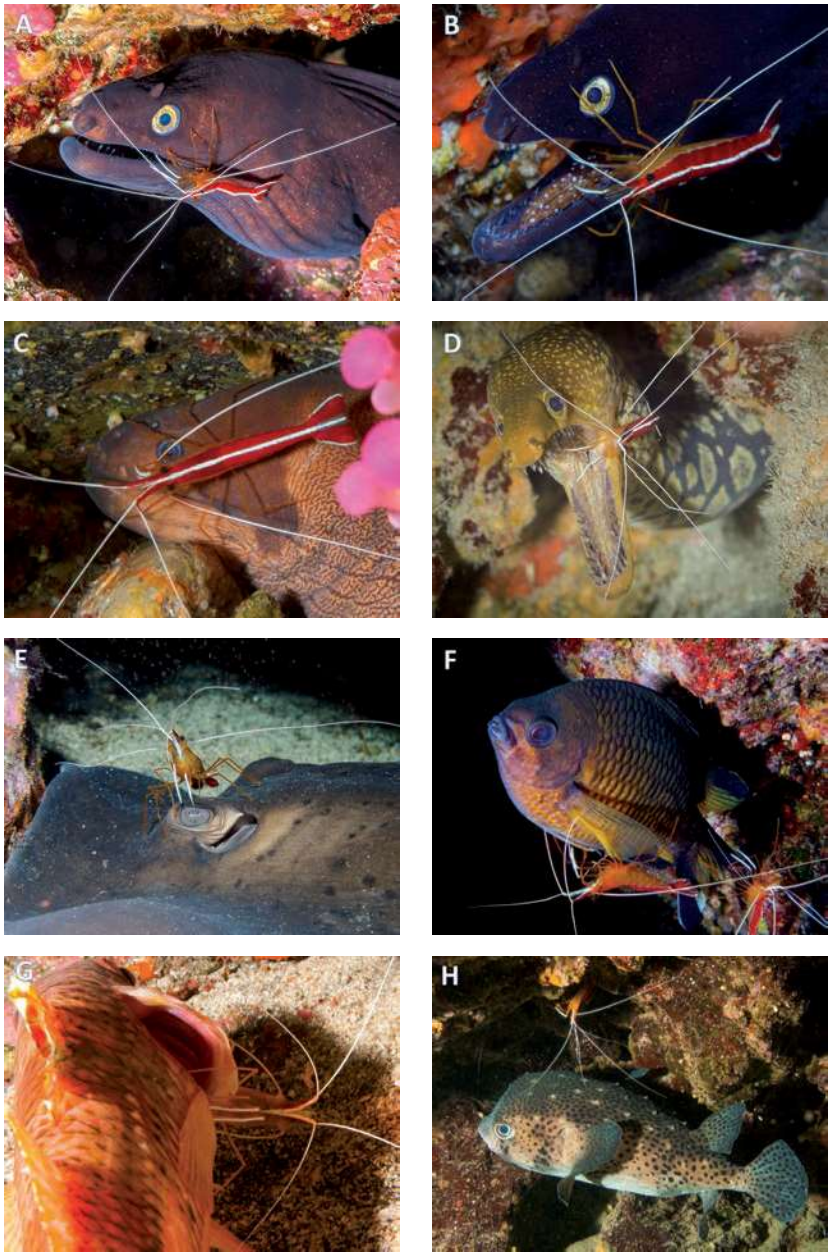

Figure 3.- Interactions between *Lysmata grabhami* and clients in the Canarian Archipelago. *L. grabhami* cleans the jaw of the moray eel *Muraena augusti* (A and B), the brown moray *Gymnothorax unicolor* (C); and the fangtooth moray *Enchelycore anatina* (D); *L. grabhami* inspects the body of the round stingray (*Taeniura grabata*) (E); the damselfish *Chromis limbata*; the gills of the striped red mullet *Mullus surmuletus* (F); and a putative but not confirmed interaction between *L. grabhami* and the spotfin burrfish *Chilomycterus atringa*.

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