

Updated checklist of fishes at Cabo Pulmo reef, Gulf of California, Mexico

Listado actualizado de peces del arrecife de Cabo Pulmo, Golfo de California, México

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ABSTRACT

Cabo Pulmo National Park is among the most successful protected areas in the Eastern Pacific Ocean and harbors the most northern coral reef in that region. The objective of this paper was to update the latest published checklist of fishes at the park. Over 500 censuses were conducted between 2004 and 2017. In addition, an extensive bibliographic review was conducted of records published on the local ichthyofauna from 2001 to 2017. As a result, 69 new records of reef fish species were added to the Cabo Pulmo reef checklist, corresponding to 24 orders, 35 families and 51 genera. With these additions, the current updated checklist consists of 302 species, corresponding to 194 genera, 74 families, and 24 orders.

Keywords: Taxonomic arrangement, Richness, Biomass, Distribution, Range.

RESUMEN

El Parque Nacional Cabo Pulmo está entre las áreas protegidas más exitosas del Océano Pacífico Oriental, y alberga el arrecife coralino más septentrional de la región. El objetivo de este trabajo fue actualizar el último listado publicado de peces presentes en el parque. Se realizaron observaciones de especímenes en más de 500 inmersiones, los censos fueron llevados a cabo entre 2004 y 2017, adicionalmente, se obtuvieron registros de una extensa revisión bibliográfica acerca de la ictiofauna local publicados entre 2001 y 2017. Aquí se agregan 69 nuevos registros de especies de peces arrecifales presentes en el arrecife de Cabo Pulmo, estos corresponden a 24 órdenes, 35 familias y 51 géneros. Con estas adiciones, el listado actual consiste en 302 especies, correspondientes a 194 géneros, 74 familias y 24 órdenes.

Palabras clave: Arreglo taxonómico, riqueza, biomasa, distribución, rango.

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INTRODUCTION

Cabo Pulmo National Park (23° 30' N, 109° 30' W), located in the southeastern coast of the Baja California Peninsula (Fig. 1), is the most northern reef with presence of coral patches in the eastern Pacific Ocean (Brusca & Thomson, 1975). Because of the involvement of local communities and the support of the local and federal government, academic institutions and nongovernmental organizations, the status of the park is excellent, to the point that Cabo Pulmo has been recognized as one of the healthiest marine areas in the world, and among the most relevant sites for conservation in the western coast of Mexico (Aburto-Oropeza *et al.* 2011; Reyes-Bonilla *et al.* 2014; Enochs & Glynn, 2017). For those reasons, in 1995 the Mexican reef was declared a national park: Parque Nacional Cabo Pulmo (www.conanp.gob.mx), and research in the area has improved noticeably in quality and quantity.

Species inventories in the area are adequate, as listings for algae (Mateo-Cid *et al.* 2000), reef corals, gorgonians (Reyes-Bonilla *et al.* 1997), polychaetes, (Bastida-Zavala, 1995), arthropods (García-Madriral & Bastida-Zavala, 1999), echinoderms (Cintra-Buenrostro *et al.* 1998) and fishes are available. In the latter case, Villarreal-Cavazos *et al.* (2000) published a

thorough checklist prepared from visual observations and literature available to that date. Later, Alvarez-Filip *et al.* (2006), Reyes-Bonilla and Alvarez-Filip (2008), Saldívar-Lucio and Reyes-Bonilla (2011), Aburto-Oropeza *et al.* (2011), as well as the park administration (Anonymous, 2006) presented data and mentioned the occurrence of diverse fish species in the reef; however, all of them were already included in the 2000 compilation. Notwithstanding, thanks to continuous visits to the reef to monitor the reef fish community condition, a number of sightings of other species have been accumulating to the point that a new revision was needed. For that reason, the objective of this paper is to update the known checklist of fishes present at Cabo Pulmo National Park, based on confirmed observations of specimens in the area.

MATERIALS AND METHODS

The authors have visited the locality yearly since 2004 as part of a continuous monitoring program of the marine assemblages. Records of fishes were made by divers using three techniques: roving searches, belt transects of 20 x 5 m in size (100 m² each), and stationary point counts in observation cylinders with a radius of 5 m (78.5 m² total area). Over 500 censuses were conducted between 2004 and 2017

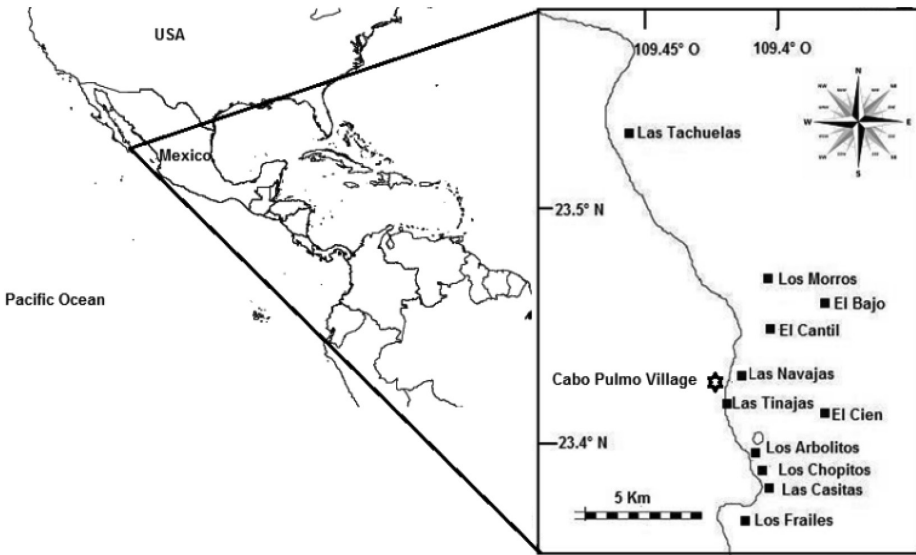


Fig. 1. Cabo Pulmo National Park and dive sites location where visual census were conducted

Fig. 1. Localización del Parque Nacional Cabo Pulmo y de los sitios principales donde se realizaron censos visuales de peces

using transects and cylinders and approximately 200 used roving searches. In addition to the field information, references on the local fish fauna published from 2001 to 2017 were reviewed (21 papers in total); citations were searched using the following databases: Web of Science, Aquatic and Science Fisheries Abstracts, Scopus, and Google Scholar, and Robertson and Allen (2015).

All records not included in the previous checklist by Villarre-

al-Cavazos *et al.* (2000) were tabulated; their nomenclature, taxonomic validity and current classification into higher taxa were confirmed by consulting the Catalog of Fishes of the California Academy of Sciences (Eschmeyer *et al.* 2017) and the Shorefishes of the Tropical Eastern Pacific Online Information System (Robertson & Allen, 2015). A final listing was generated representing additions to the previous knowledge.

RESULTS

As indicated in Table 1, there are 69 new confirmed records of fish species present at Cabo Pulmo reef obtained from 2001 to 2017, corresponding to 24 orders, 35 families and 51 genera. These taxa do not share similar characteristics: they belong to many dissimilar taxonomic groups, are very different sizes, and reside in different locations, either in the reef, the surrounding sandy areas or in the water column. Another important result is the

taxonomic change of 34 species previously reported by Villarreal-Cavazos *et al.* (2000) (Table 2). Table 2 also includes amendments as taxonomists have placed a number of species of the listing by Villarreal-Cavazos *et al.* (2000) in different families or orders after the year 2000. Finally, there was a major taxonomic change: the classes used by Villarreal-Cavazos *et al.* (2000), such as Chondrichthyes and Osteichthyes, are now respectively named Elasmobranchii and Actinopterygii (Eschmeyer *et al.* 2017).

Table 1. Systematic list of fish species reported or observed at Cabo Pulmo reef, Gulf of California, Mexico. Reference number 1 corresponds to 69 new records obtained between 2001 and 2017 from museums/collections, databases, bibliographic references and field observations, and number 2 corresponds to species previously listed by Villarreal-Cavazos *et al.* (2000)

Cuadro 1. Lista sistemática de especies de peces reportadas u observadas en el arrecife Cabo Pulmo, Golfo de California, México. El número de referencia 1 corresponde a 69 nuevos registros obtenidos entre 2001 y 2017 de museos / colecciones, bases de datos, referencias bibliográficas y observaciones de campo, y el número 2 a especies listadas anteriormente por Villarreal-Cavazos *et al.* (2000)

Phylum Chordata	Reference	
Class Elasmobranchii		
Order Orectolobiformes		
	Family Rhincodontidae	
	<i>Rhincodon typus</i> Smith, 1828	2
	Family Ginglymostomatidae	
	<i>Ginglymostoma cirratum</i> (Bonnaterre, 1788)	1
Order Lamniformes		
	Family Alopiidae	
	<i>Alopias vulpinus</i> Bonnaterre, 1788	2
	Family Lamnidae	

	<i>Isurus oxyrinchus</i> Rafinesque, 1810	1
Order Carcharhiniformes		
	Family Carcharhinidae	
	<i>Carcharhinus albimarginatus</i> (Rüppell, 1837)	1
	<i>Carcharhinus falciformis</i> (Müller and Henle, 1839)	1
	<i>Carcharhinus galapagensis</i> (Snodgrass and Heller, 1905)	1
	<i>Carcharhinus limbatus</i> (Valenciennes, 1839)	2
	<i>Carcharhinus leucas</i> (Valenciennes, 1839)	1
	<i>Carcharhinus longimanus</i> (Poey, 1861)	1
	<i>Galeocerdo cuvier</i> (Péron and Lesueur, 1822)	1
	<i>Negaprion brevirostris</i> (Poey, 1868)	2
	<i>Triaenodon obesus</i> (Rüppell, 1837)	1
	Family Sphyrnidae	
	<i>Sphyrna lewini</i> (Griffith and Smith, 1834)	1
	<i>Sphyrna zygaena</i> (Linnaeus, 1758)	1
	Family Triakidae	
	<i>Mustelus lunulatus</i> Jordan and Gilbert, 1882	1
Order Torpediniformes		
	Family Narcinidae	
	<i>Diplobatis ommata</i> (Jordan and Gilbert, 1890)	2
	<i>Narcine entemedor</i> Jordan and Starks, 1895	2
Order Rhinopristiformes		
	Family Rhinobatidae	
	<i>Pseudobatos productus</i> (Ayles, 1854)	1
	Family Trygonorrhinidae	
	<i>Zapteryx exasperata</i> (Jordan and Gilbert, 1880)	1
Order Myliobatiformes		
	Family Aetobatidae	
	<i>Aetobatus laticeps</i> (Gill, 1865)	2
	Family Dasyatidae	
	<i>Hypanus dipterurus</i> (Jordan and Gilbert, 1880)	2
	<i>Hypanus longus</i> (Garman, 1880)	2
	Family Gymnuridae	
	<i>Gymnura marmorata</i> (Cooper, 1864)	1
	Family Myliobatidae	
	<i>Myliobatis longirostris</i> Applegate and Fitch, 1964	2
	<i>Myliobatis californica</i> Gill, 1865	1
	Family Mobulidae	

	<i>Mobula birostris</i> (Walbaurn, 1792)	2
	<i>Mobula mobular</i> (Bonnaterre, 1788).	1
	<i>Mobula munkiana</i> Notarbartolo-di-Sciara, 1987	1
	<i>Mobula tarapacana</i> (Philippi, 1892)	1
	<i>Mobula thurstoni</i> (Lloyd, 1908)	1
	Family Rhinopteridae	
	<i>Rhinoptera steindachneri</i> Evermann and Jenkins, 1892	1
	Family Urotrygonidae	
	<i>Urobatis concentricus</i> Osburn and Nichols, 1916	2
	<i>Urobatis halleri</i> (Cooper, 1863)	1
	<i>Urobatis maculatus</i> Garman, 1913	2
Class Actinopteri		
Order Elopiformes		
	Family Elopidae	
	<i>Elops affinis</i> Regan, 1909	1
Order Anguilliformes		
	Family Muraenidae	
	<i>Anarchias galapagensis</i> (Seale, 1940)	2
	<i>Echidna nebulosa</i> (Ahl, 1789)	2
	<i>Echidna nocturna</i> (Cope, 1972)	2
	<i>Enchelycore octaviana</i> (Myers and Wade, 1941)	2
	<i>Gymnomuraena zebra</i> (Shaw, 1797)	2
	<i>Gymnothorax castaneus</i> (Jordan and Gilbert, 1882)	2
	<i>Gymnothorax dovii</i> (Günther, 1870)	1
	<i>Gymnothorax panamensis</i> (Steindachner, 1876)	2
	<i>Muraena clepsydra</i> Gilbert, 1898	1
	<i>Muraena lentiginosa</i> Jenyns, 1892	2
	<i>Uropterygius macrocephalus</i> (Bleeker, 1865)	2
	<i>Uropterygius polystictus</i> Myers and Wade, 1941	2
	Family Ophichthidae	
	<i>Callechelys eristigma</i> McCosker and Rosenblatt, 1972	2
	<i>Ichthyapus selachops</i> (Jordan and Gilbert, 1882)	2
	<i>Myrichthys maculosus</i> (Cuvier, 1817)	2
	<i>Myrichthys tigrinus</i> Girard, 1859	2
	<i>Paraetharchus pacificus</i> (Osburn and Nichols, 1916)	2
	<i>Phaenomonas pinnata</i> Myers and Wade, 1941	2
	<i>Quassiremus nothochir</i> (Gilbert, 1890)	2
	<i>Scytalichthys miurus</i> (Jordan and Gilbert, 1882)	2

	Family Congridae	
	<i>Gorgasia punctata</i> Meek and Hildebrand, 1923	2
	<i>Heteroconger digueti</i> (Pellegrin, 1923)	2
	<i>Paraconger californiensis</i> Kanazawa, 1961	1
Order Clupeiformes		
	Family Clupeidae	
	<i>Harengula thrissina</i> (Jordan and Gilbert, 1882)	2
Order Aulopiformes		
	Family Synodontidae	
	<i>Synodus lacertinus</i> Gilbert, 1890	2
Order Ophidiiformes		
	Family Ophidiidae	
	<i>Ophidion iris</i> Breder, 1926	2
	Family Bythidae	
	<i>Grammonus diagrammus</i> (Heller and Snodgras, 1903)	2
Order Lophiiformes		
	Family Antennariidae	
	<i>Antennarius sanguineus</i> Gill, 1863	2
	<i>Antennatus strigatus</i> (Gill, 1863)	2
Order Gobiesociformes		
	Family Gobiesocidae	
	<i>Arcos erythroptus</i> (Jordan and Gilbert, 1882)	2
	<i>Gobiesox adustus</i> Jordan and Gilbert, 1882	2
	<i>Gobiesox pinniger</i> Gilbert, 1890	2
	<i>Tomicodon boehlkei</i> Briggs, 1955	2
	<i>Tomicodon eos</i> (Jordan and Gilbert, 1882)	2
	<i>Tomicodon myersi</i> Briggs, 1955	2
	<i>Tomicodon zebra</i> (Jordan and Gilbert, 1882)	2
Order Gonorynchiformes		
	Family Chanidae	
	<i>Chanos chanos</i> (Forsskål, 1775)	1
Order Beloniformes		
	Family Hemiramphidae	
	<i>Hemiramphus saltator</i> Gilbert and Starks, 1904	2
	Family Belonidae	
	<i>Ablennes hians</i> (Valenciennes, 1846)	1
	<i>Platybelone argulus</i> (Lesueur, 1821)	2
	<i>Strongylura exilis</i> (Girard, 1854)	1

	<i>Tylosurus pacificus</i> (Steindachner, 1876)	2
	Family Exocoetidae	
	<i>Exocoetus volitans</i> Linnaeus, 1758	1
Order Atheriniformes		
	Family Atherinopsidae	
	<i>Atherinella eriarcha</i> (Jordan and Gilbert, 1882)	2
Order Holocentriiformes		
	Family Holocentridae	
	<i>Myripristis leiognathos</i> Valenciennes, 1846	2
	<i>Sargocentron suborbitalis</i> (Gill, 1863)	2
Order Blenniiformes		
	Family Blenniidae	
	<i>Entomacrodus chiostictus</i> (Jordan and Gilbert, 1883)	2
	<i>Hypsoblennius brevipinnis</i> (Günther, 1861)	2
	<i>Hypsoblennius gentilis</i> (Girard, 1854)	2
	<i>Ophioblennius steindaehneri</i> Jordan and Evermann, 1898	2
	<i>Plagiotremus azaleus</i> (Jordan and Bollman, 1890)	2
	Family Chaenopsidae	
	<i>Acanthemblemaria crockeri</i> Beebe and Tee-Van, 1938	2
	<i>Acanthemblemaria macrospilus</i> Brock, 1940	2
	<i>Chaenopsis alepidota</i> (Gilbert, 1890)	2
	<i>Chaenopsis coheni</i> Bohlke, 1957	2
	<i>Cirriemblemaria lucasana</i> (Stephens, 1963)	2
	<i>Coralliozetus angelicus</i> (Böhlke and Mead, 1957)	2
	<i>Coralliozetus micropes</i> (Beebe and Tee-Van, 1938)	2
	<i>Coralliozetus rosenblatti</i> Stephens, 1963	2
	<i>Ekemblemaria myersi</i> Stephens, 1963	2
	<i>Emblemaria hypacanthus</i> (Jenkins and Evermann, 1889)	2
	<i>Emblemaria walkeri</i> Stephens, 1963	2
	<i>Protemblemaria bicirris</i> (Hildebrand, 1946)	2
	<i>Stathmonotus sinuscalifornici</i> (Chabanaud, 1942)	2
	Family Labrisomidae	
	<i>Labrisomus multiporosus</i> Hubbs, 1953	2
	<i>Labrisomus striatus</i> Hubbs, 1953	2
	<i>Labrisomus xanti</i> Gill, 1860	2
	<i>Malacoctenus ebisui</i> Springer, 1959	1
	<i>Malacoctenus hubbsi</i> Springer, 1959	2

	<i>Malacoctenus margaritae</i> (Fowler, 1944)	2
	<i>Malacoctenus tetranemus</i> (Cope, 1877)	2
	<i>Malacoctenus zaca</i> e Springer, 1959	2
	<i>Malacoctenus zonifer</i> (Jordan and Gilbert, 1882)	1
	<i>Paraclinus beebei</i> Hubbs, 1952	2
	<i>Paraclinus mexicanus</i> (Gilbert, 1904)	2
	<i>Paraclinus sini</i> Hubbs, 1952	2
	<i>Paraclinus lanygnathus</i> Rosenblatt and Parr, 1969	2
	<i>Starksia spinipenis</i> (Al-Uthman, 1960)	2
	<i>Xenomedeia rhodopyga</i> Rosenblatt and Taylor, 1971	2
Order Syngathiformes		
	Family Fistulariidae	
	<i>Fistularia commersonii</i> Rüppell, 1835	2
	Family Syngnathidae	
	<i>Cosmocampus arctus</i> (Jenkins and Evermann, 1889)	2
	<i>Doryrhamphus excisus</i> Kaup, 1856	2
	<i>Hippocampus ingens</i> Girard, 1858	2
Order Gobiiformes		
	Family Gobiidae	
	<i>Aruma histrio</i> (Jordan, 1884)	2
	<i>Barbulifer mexicanus</i> Hoese and Larson, 1985	2
	<i>Barbulifer pantherinus</i> (Pellegrin, 1901)	2
	<i>Bathygobius ramosus</i> Ginsburg, 1947	2
	<i>Chriolepis zebra</i> Ginsburg, 1938	2
	<i>Coryphopterus urospilus</i> Ginsburg, 1938	2
	<i>Tigrigobius digueti</i> (Pellegrin, 1901)	2
	<i>Tigrigobius puncticulatus</i> (Ginsburg, 1938)	2
	<i>Gobiosoma chiquita</i> (Jenkins and Evermann, 1889)	2
	<i>Gobiosoma nudum</i> (Meek and Hildebrand, 1928)	2
	<i>Gobulus crescentalis</i> (Gilbert, 1892)	2
	<i>Gymneleotris seminudus</i> (Günther, 1864)	2
	<i>Lythrypnus dalli</i> (Gilbert, 1890)	2
	<i>Lythrypnus pulchellus</i> Ginsburg, 1939	2
Order Scorpaeniformes		
	Family Scorpaenidae	
	<i>Scorpaena mystes</i> Jordan and Starks, 1895	2
	<i>Scorpaena histrio</i> Jenyns, 1840	1

	<i>Scorpaenodes xyris</i> (Jordan and Gilbert, 1882)	2
	Family Triglidae	
	<i>Bellator loxias</i> Jordan and Gilbert, 1896	2
Order Perciformes		
	Family Serranidae	
	<i>Alphestes immaculatus</i> Breder, 1936	2
	<i>Alphestes multiguttatus</i> (Günther, 1867)	1
	<i>Dermatolepis dermatolepis</i> (Boulenger, 1895)	2
	<i>Cephalopholis panamensis</i> (Steindachner, 1876)	2
	<i>Epinephelus analogus</i> Gill, 1864	2
	<i>Epinephelus quinquefasciatus</i> (Bocourt, 1868)	2
	<i>Epinephelus labriformis</i> (Jenyns, 1843)	2
	<i>Hemanthias peruanus</i> (Steindachner, 1874)	2
	<i>Hyporthodus acanthistius</i> (Gilbert, 1892)	2
	<i>Mycteroperca jordani</i> (Jenkins and Evermann, 1889)	2
	<i>Mycteroperca prionura</i> Rosenblatt and Zahuranec, 1967	2
	<i>Mycteroperca rosacea</i> (Streets, 1877)	2
	<i>Mycteroperca xenarcha</i> Jordan, 1888	2
	<i>Paranthias colonus</i> Valenciennes, 1855	2
	<i>Paralabrax maculatofasciatus</i> (Steindachner, 1868)	1
	<i>Pseudogramma thaumasium</i> (Gilbert, 1900)	2
	<i>Rypticus bicolor</i> Valenciennes, 1846	2
	<i>Rypticus nigripinnis</i> Gill, 1861	2
	<i>Serranus psittacinus</i> Valenciennes, 1855	2
	Family Priacanthidae	
	<i>Cookeolus japonicus</i> (Cuvier, 1829)	1
	<i>Heteropriacanthus cruentatus</i> (Lacepede, 1801)	1
	Family Opistognathidae	
	<i>Opistognathus fossoris</i> Bussing and Lavenberg, 2003	1
	<i>Opistognathus punctatus</i> Peters, 1869	1
	<i>Opistognathus rosenblatti</i> Allen and Robertson, 1991	1
	<i>Opistognathus scops</i> (Jenkins and evermann, 1899)	2
	Family Apogonidae	
	<i>Apogon atricaudus</i> Jordan and McGregor, 1898	1
	<i>Apogon pacificus</i> (Herre, 1935)	1
	<i>Apogon retrosella</i> Gill, 1863	2
	Family Malacanthiidae	
	<i>Caulolatilus affinis</i> Gill, 1865	2

<i>Caulolatilus princeps</i> (Jenyns, 1842)	2
Family Echeneidae	
<i>Remora remora</i> (Linnaeus, 1758)	1
Family Carangidae	
<i>Alectis ciliaris</i> (Bloch, 1788)	2
<i>Caranx caballus</i> Günther, 1868	2
<i>Caranx caninus</i> Günther, 1867	1
<i>Caranx lugubris</i> Poey, 1860	2
<i>Caranx otrynter</i> (Jordan and Gilbert, 1883)	2
<i>Caranx sexfasciatus</i> Quoy and Gaimard, 1825	1
<i>Decapterus macarellus</i> (Cuvier, 1833)	1
<i>Gnathanodon speciosus</i> Forsskål, 1775	2
<i>Elagatis bipinnulata</i> (Quoy and Gaimard, 1825)	1
<i>Selar crumenophthalmus</i> (Bloch, 1793)	2
<i>Selene brevoorti</i> (Gill, 1863)	2
<i>Seriola lalandi</i> Valenciennes, 1833	1
<i>Seriola rivoliana</i> Valenciennes, 1833	1
<i>Trachinotus rhodopus</i> Gill, 1863	2
Family Coryphaenidae	
<i>Coryphaena hippurus</i> Linnaeus, 1758	2
Family Lutjanidae	
<i>Hoplopagrus guentheri</i> Gill, 1862	2
<i>Lutjanus aratus</i> (Günther, 1864)	1
<i>Lutjanus argentiventris</i> (Peters, 1869)	2
<i>Lutjanus colorado</i> Jordan and Gilbert, 1882	2
<i>Lutjanus guttatus</i> (Steindachner, 1869)	2
<i>Lutjanus novemfasciatus</i> Gill, 1862	2
<i>Lutjanus peru</i> (Nichols and Murphy, 1922)	1
<i>Lutjanus inermis</i> (Peters, 1869)	1
<i>Lutjanus viridis</i> (Valenciennes, 1845)	2
Family Haemulidae	
<i>Anisotremus davidsonii</i> (Steindachner, 1875)	2
<i>Anisotremus interruptus</i> (Gill, 1862)	2
<i>Anisotremus taeniatus</i> Gill, 1861	2
<i>Haemulon flaviguttatum</i> Gill, 1863	2
<i>Haemulon maculicauda</i> (Gill, 1862)	1
<i>Haemulon scudderi</i> Gill, 1862	1

<i>Haemulon sexfasciatum</i> Gill, 1863	2
<i>Haemulon steindachneri</i> (Jordan and Gilbert, 1882)	1
<i>Microlepidotus inornatus</i> Gill, 1862	2
Family Sparidae	
<i>Calamus brachysomus</i> (Lockington, 1880)	2
Family Scianidae	
<i>Pareques</i> sp. a	2
<i>Umbrina dorsalis</i> Gill, 1862	2
<i>Umbrina roncador</i> Jordan and Gilbert, 1881	2
<i>Umbrina xanti</i> Gill, 1862	2
Family Mullidae	
<i>Mulloidichthys dentatus</i> (Gill, 1863)	2
<i>Mulloidichthys vanicolensis</i> (Valenciennes, 1831)	1
Family Kyphosidae	
<i>Girella simplicidens</i> Osburn and Nichols, 1916	2
<i>Kyphosus azurea</i> (Jenkins and Evermann, 1889)	2
<i>Kyphosus vaigiensis</i> (Quoy and Gaimard, 1825)	2
<i>Kyphosus elegans</i> (Peters, 1869)	2
<i>Kyphosus ocyurus</i> (Jordan and Gilbert, 1882)	1
Family Ephippidae	
<i>Chaetodipterus zonatus</i> (Girard, 1858)	2
Family Chaetodontidae	
<i>Chaetodon humeralis</i> Günther, 1860	2
<i>Forcipiger flavissimus</i> Jordan and McGregor 1898	2
<i>Johnrandallia nigrirostris</i> (Gill, 1862)	2
<i>Prognathodes falcifer</i> (Hubbs and Rehnitzner, 1958)	2
Family Pomacanthidae	
<i>Holacanthus clarionensis</i> Gilbert, 1890	2
<i>Holacanthus passer</i> Valenciennes, 1846	2
<i>Pomacanthus zonipectus</i> (Gill 1862)	2
Family Pomacentridae	
<i>Abudefduf declivifrons</i> (Gill, 1862)	2
<i>Abudefduf troschelii</i> (Gill, 1862)	2
<i>Chromis alta</i> Greenfield and Woods, 1980	2
<i>Chromis atrilobata</i> Gill, 1862	2
<i>Chromis limbaughi</i> Greenfield and Woods, 1980	2
<i>Microspathodon bairdii</i> (Gill, 1862)	2
<i>Microspathodon dorsalis</i> (Gill 1862)	2

<i>Stegastes acapulcoensis</i> (Flower, 1944)	2
<i>Stegastes flavilatus</i> (Gill, 1863)	2
<i>Stegastes leucorus</i> (Gilbert, 1892)	2
<i>Stegastes rectifaenum</i> (Gill, 1863)	2
Family Cirrhitidae	
<i>Cirrhitichthys oxycephalus</i> (Bleeker, 1855)	2
<i>Cirrhitus rivulatus</i> (Valenciennes, 1855)	2
<i>Oxycirrhites typus</i> Bleeker 1857	2
Family Mugilidae	
<i>Mugil cephalus</i> Linnaeus, 1758	2
<i>Mugil curema</i> Valenciennes, 1836	2
Family Labridae	
<i>Bodianus diplotaenia</i> (Gill, 1863)	2
<i>Decodon measma</i> Gomon, 1974	2
<i>Halichoeres chierchiae</i> Caporiacco, 1974	2
<i>Halichoeres dispilus</i> (Günther, 1864)	2
<i>Halichoeres melanotis</i> (Gilbert, 1890)	2
<i>Halichoeres nicholsi</i> (Jordan and Gilbert, 1881)	2
<i>Halichoeres notospilus</i> (Günther, 1864)	2
<i>Halichoeres semicinctus</i> (Ayres, 1859)	2
<i>Iniistius pavo</i> (Valenciennes, 1840)	2
<i>Novaculichthys taeniorus</i> (Lacepede, 1801)	2
<i>Sagittalarva inornatus</i> (Gilbert, 1890)	2
<i>Thalassoma grammaticum</i> Gilbert, 1890	2
<i>Thalassoma lucasanum</i> (Gill, 1863)	2
<i>Xyrichtys mundiceps</i> (Gill, 1862)	2
Family Scaridae	
<i>Nicholsina denticulata</i> (Everman and Radcliffe, 1917)	2
<i>Scarus compressus</i> (Osburn and Nichols, 1916)	2
<i>Scarus ghobban</i> Forskål, 1775	2
<i>Scarus perrico</i> Jordan and Gilbert, 1881	2
<i>Scarus rubroviolaceus</i> Bleeker, 1814	2
Family Tripterygiidae	
<i>Axoclinus nigricaudus</i> Allen and Robertson, 1991	1
<i>Enneanectes carminalis</i> (Jordan and Gilbert, 1882)	2
<i>Enneanectes reticulatus</i> Allen and Robertson, 1991	2
<i>Crocodylichthys gracilis</i> Allen and Robertson, 1991	1
Family Dactyloscopidae	

<i>Dactylagnus mundus</i> Gill, 1863	2
<i>Dactyloscopus byersi</i> Dawson, 1969	2
<i>Dactyloscopus lunaticus</i> Gilbert, 1890	2
<i>Dactyloscopus pectoralis</i> Gill, 1861	2
<i>Gillelus arencola</i> Gilbert, 1890	2
<i>Gillelus ornatus</i> Gilbert, 1896	2
<i>Gillelus semicinctus</i> Gilbert, 1890	2
<i>Heteristius cinctus</i> (Osburn and Nichols, 1916)	2
<i>Myxodagnus opercularis</i> Gill, 1861	2
Family Zanclidae	
<i>Zanclus cornutus</i> (Linnaeus, 1758)	2
Family Acanthuridae	
<i>Acanthurus nigricans</i> (Linnaeus, 1758)	2
<i>Acanthurus triostegus</i> (Linnaeus, 1758)	2
<i>Acanthurus xanthopterus</i> Valenciennes, 1835	2
<i>Prionurus laticlavus</i> (Valenciennes, 1846)	1
<i>Prionurus punctatus</i> Gill, 1862	2
Family Scombridae	
<i>Acanthocybium solandri</i> (Cuvier, 1832)	1
<i>Euthynnus lineatus</i> Kishinouye, 1920	2
<i>Katsuwonus pelamis</i> (Linnaeus, 1758)	2
<i>Sarda chilensis</i> (Cuvier, 1832)	1
<i>Scomber japonicus</i> Houttuyn, 1782	1
<i>Scomberomorus sierra</i> Jordan and Starks, 1895	1
<i>Thunnus albacares</i> (Bonnaterre, 1788)	2
Family Istiophoridae	
<i>Istiophorus platypterus</i> (Shaw, 1792)	1
<i>Istiompax indica</i> (Cuvier, 1832)	1
<i>Makaira nigricans</i> Lacepède, 1802	1
Order Tetraodontiformes	
Family Balistidae	
<i>Balistes polylepis</i> Steindachner, 1876	2
<i>Melichthys niger</i> (Bloch, 1786)	2
<i>Pseudobalistes naufragium</i> (Jordan and Starks, 1895)	2
<i>Sufflamen verres</i> (Gilbert and Starks, 1904)	2
Family Monacanthidae	
<i>Aluterus scriptus</i> (Osbeck, 1765)	2
<i>Cantherhines dumerilii</i> (Hollard, 1854)	2

	Family Ostraciidae	
	<i>Ostracion meleagris</i> Shaw, 1796	2
	Family Tetraodontidae	
	<i>Arothron hispidus</i> (Linnaeus, 1758)	2
	<i>Arothron meleagris</i> (Bloch and Schneider, 1801)	2
	<i>Canthigaster punctatissima</i> (Günther, 1870)	2
	<i>Sphoeroides annulatus</i> (Jenyns, 1842)	2
	<i>Sphoeroides lobatus</i> (Steindachner, 1870)	2
	Family Diodontidae	
	<i>Chilomycterus reticulatus</i> (Linnaeus, 1758)	1
	<i>Diodon holocanthus</i> Linnaeus, 1758	2
	<i>Diodon hystrix</i> Linnaeus, 1758	2
Order Pleuronectiformes		
	Family Bothidae	
	<i>Bothus mancus</i> (Broussonet, 1782)	1
	Family Paralichthyidae	
	<i>Citharichthys gordae</i> Beebe and Tee-Van, 1938	2
	<i>Paralichthys woolmani</i> Jordan and Williams, 1897	2

Table 2. Taxonomic modifications from the list by Villarreal-Cavazos et al. (2000). Species presented in systematic order

Cuadro 2. Modificaciones taxonómicas de la lista Villarreal-Cavazos y colaboradores (2000). Especies presentadas en orden sistemático

Name in original report	Currently accepted name	Observations
Class Chondrichthyes	Class Elasmobranchii	
Order Rajiformes		
Family Narcinidae		
<i>Diplobatis ommata</i> (Jordan and Gilbert, 1890)		Both species currently in Order Torpediniformes
<i>Narcine entemedor</i> Jordan and Starks, 1895		
Family Dasyatidae		
<i>Dasyatis brevis</i> (Garman, 1880)	<i>Hypanus dipterurus</i> (Jordan and Gilbert, 1880)	
<i>Dasyatis longus</i> (Garman, 1880)	<i>Hypanus longa</i> (Garman, 1880)	

Family Myliobatidae	Familia Aetobatidae		
<i>Aetobatus narinari</i> (Euphrasen, 1790)	<i>Aetobatus laticeps</i> (Gill, 1865)	This species currently in Order Myliobatiformes	Three Families Urolophidae, Mobulidae and Myliobatidae currently in Order Myliobatiformes
Family Mobulidae			
<i>Manta birostris</i> (Walbaurn, 1792)	<i>Mobula birostris</i> (Walbaurn, 1792)		
Family Urolophidae			
<i>Urobatis concentricus</i> Osburn and Nichols, 1916		Both species currently placed in Family Urotrygonidae	
<i>Urobatis maculatus</i> Garman, 1913			
Class Osteichthyes	Class Actinopterygyii		
Family Muraenidae			
<i>Uropterygius tigrinus</i> Girard, 1859	<i>Myrichthys</i> <i>tigrinus</i> Girard, 1859		
Family Ophichthidae			
<i>Myrichthys</i> <i>maculosus</i> (Cuvier, 1816)	<i>Myrichthys</i> <i>tigrinus</i> Girard, 1859		
Family Bythitidae			
<i>Oligopus diagrammus</i> (Heller and Snodgrass, 1903)	<i>Grammonus diagrammus</i> (Heller and Snodgrass, 1903)		
Family Atherinidae			
<i>Eurystole eriarcha</i> (Jordan and Nichols, 1916)	<i>Atherinella eriarcha</i> (Jordan and Gilbert, 1882)	Currently placed in Family Atherinopsidae	
Family Scorpaenidae			
<i>Scorpaena plumieri mystes</i> (Jordan and Starks, 1895)	<i>Scorpaena mystes</i> Jordan and Starks, 1895		
Family Serranidae			
<i>Epinephelus acanthistius</i> (Gilbert, 1892)	<i>Hyporthodus acanthistius</i> (Gilbert, 1892)		
<i>Epinephelus panamensis</i> (Steindachner, 1876)	<i>Cephalopholis</i> <i>panamensis</i> (Steindachner, 1877)		
<i>Epinephelus itajara</i> (Lichstenstein, 1822)	<i>Epinephelus</i> <i>quiquefasciatus</i> (Bocourt, 1868)		
<i>Pseudogramma thaumasium</i> (Gilbert, 1900)		Originally placed in Family Grammistidae	

<i>Rypticus bicolor</i> Valenciennes, 1846		Originally placed in Family Grammistidae
<i>Rypticus nigripinnis</i> Gill, 1861		Originally placed in Family Grammistidae
Family Kyphosidae		
<i>Kyphosus analogus</i> Gill, 1862	<i>Kyphosus vaigiensis</i> (Quoy and Gaimard, 1825)	
<i>Sectator ocyurus</i> (Jordan and Gilbert, 1882)	<i>Kyphosus ocyurus</i> (Jordan and Gilbert, 1882)	
Family Branchiostegidae		
<i>Caulolatilus affinis</i> Gill, 1865		Currently placed in Family Malacanthidae
<i>Caulolatilus princeps</i> (Jenyns, 1840)		
Family Chaetodontidae		
<i>Chaetodon falcifer</i> Hubbs and Rechnitzer, 1958	<i>Prognathodes falcifer</i> (Hubbs and Rechnitzer, 1958)	
Family Labridae		
<i>Xyrichtys pavo</i> (Valenciennes, 1840)	<i>Iniistius pavo</i> (Valenciennes, 1840)	
<i>Pseudojulis inornatus</i> Gilbert, 1890	<i>Sagittalarva inornatus</i> (Gilbert, 1890)	
<i>Hemipteronotus mundiceps</i> (Gill, 1863)	<i>Xyrichtys mundiceps</i> (Gill, 1862)	
Family Tripterygiidae		
<i>Axoclinus carminalis</i> (Jordan and Gilbert, 1882)	<i>Enneanectes carminalis</i> (Jordan and Gilbert, 1882)	
Family Chaenopsidae		
<i>Protemblemaria lucasana</i> Stephens, 1963	<i>Cirriemblemaria lucasana</i> (Stephens, 1963)	
Family Dactyloscopidae		
<i>Dactyloscopus mundus</i> Gill, 1862	<i>Dactylagnus mundus</i> Gill, 1863	

Family Chaenopsidae

Coralliozetus angelica
 (Böhlke and Mead, 1957)

Coralliozetus angelicus
 (Böhlke and Mead, 1957)

Family Zanclidae

Zanclus canescens
 (Linnaeus, 1758)

Zanclus cornutus
 (Linnaeus, 1758)

Family Bothidae

Citharichthys gordae Beebe
 and Tee-Van, 1938

Paralichthys woolmani
 Jordan and Williams, 1897

Both species
 currently placed
 in Family
 Paralichthyidae

DISCUSSION

A total of 69 confirmed species and 4 orders (Elopiformes, Gonorhynchiformes, Myliobatiformes and Torpediniformes) was added to the previous list of 236 species seen or found at the reef, corresponding to 18 orders, 60 families and 155 genera (Villarreal-Cavazos *et al.* 2000). Consequently, the current checklist consists of 302 species, corresponding to 194 genera, 74 families and 24 orders. This amount represents approximately 30% of the 840 to 911 fishes reported at the Gulf of California (Hastings *et al.* 2011; Robertson & Allen, 2015), and is comparable with the amount found in other areas with coral reef communities in western Mexico and for which detailed checklists exist, such as Concepción Bay 26°N with 146 species (Rodríguez-Romero *et al.* 2005), La Paz 24°N: 522 species (Balart *et al.* 1995), Banderas Bay 20°N: 205 species (Moncayo-Estrada *et al.* 2006),

Navidad Bay 19°N: 245 species (Aguilar-Palomino *et al.* 2001), Acapulco 16°N: 302 species (Rojas-Herrera *et al.* 2011), and Huatulco 15°N: 112 species (López-Pérez *et al.* 2010). This observation is remarkable considering the small size of Cabo Pulmo reef (less than 1000 ha) (Anonymous, 2006) and gives more evidence of the recognized high species diversity of the site (Aburto-Oropeza *et al.* 2011).

It is interesting to note that 22 (31%) of the new records pertain to sharks and rays, of which only 10 species had previously been reported at Cabo Pulmo (Villarreal-Cavazos *et al.* 2000; Anonymous 2006; Reyes-Bonilla *et al.* 2016). This means that the number of these taxa has more than doubled at the reef. Although there is no quantitative data to document it, the authors' observations point out that, in fact, the number of elasmobranch species commonly seen at the reefs and surroundings has increased noticeably since 2005, to the point that

shark observation is now a local tourist attraction, and large schools of eagle rays and other species are frequently seen hovering below the surface. It can be assumed that the good status of the system has favored this situation as fish biomass in the area has increased over 200% between the beginning and the end of the last decade, a condition that favors the presence of large predators (Aburto-Oropeza *et al.* 2011; Reyes-Bonilla *et al.* 2016; Enochs & Glynn 2017).

In addition to the 302 species documented in Cabo Pulmo reef, the maps by Robertson and Allen (2015) indicate the possible presence of another 243 species, considering the general geographic distribution range of the species that reside in the Gulf of California. As these diagrams represent interpolations of the northernmost and southernmost reported ranges of the species, they should be taken carefully in order to avoid overestimations of the total number of fish species at any given location (in this case, Cabo Pulmo). Nevertheless, the possibility of finding new records in the locality is open.

In conclusion, this paper adds 68 species to the original checklist of 236 fish taxa that had been reported or collected at Cabo Pulmo reef, generating a new total of 302 species. Such richness is high enough to be comparable to the one reported in other reefs of the western coast of Mexico (even though

Cabo Pulmo reef is relatively small), and demonstrate the importance of this area for fish biodiversity in the Gulf of California.

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