THE NEARSHORE FISHES OF THE CEDROS ARCHIPELAGO (NORTH-EASTERN PACIFIC) AND THEIR BIOGEOGRAPHIC AFFINITIES

ARTURO RAMÍREZ-VALDEZ
OCTAVIO ABURTO-OROPEZA
Marine Biology Research Division
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92093-0202
arturorv@ucsd.edu

ARTURO RAMÍREZ-VALDEZ
JUAN CARLOS VILLASEÑOR-DERBEZ
Facultad de Ciencias Marinas
Universidad Autónoma de Baja California
Carretera Tijuana-Ensenada km 107
Ensenada, Baja California, México, 22800

ISAÍ DOMINGUEZ-GUERRERO
CONABIO, Comisión Nacional para
el Conocimiento y Uso de la Biodiversidad
Liga Periférico-Insurgentes Sur 4903
Tlalpán 14010, México, D.F.

DEIVIS S. PALACIOS-SALGADO
Escuela Nacional de Ingeniería Pesquera
Colección ictiológica (ENIP-UAN)
Apartado Postal 10, San Blas, Nayarit
México 63740

JUAN JOSÉ COTA-NIETO
GUSTAVO HINOJOSA-ARANGO
Centro para la Biodiversidad Marina
y la Conservación A.C.
La Paz, Baja California Sur, México

GUSTAVO HINOJOSA-ARANGO
Cátedra CONACYT, CIIDIR-Oaxaca
Calle de Hornos 1003
Sta. Cruz, Xoxocotlán
Oaxaca, México, 71230

FRANCISCO CORREA-SANDOVAL
Instituto de Investigaciones Oceanológicas
Universidad Autónoma de Baja California
Carretera Tijuana-Ensenada km 107
Ensenada, Baja California, México, 22800

HECTOR REYES-BONILLA
Universidad Autónoma de Baja California Sur
Departamento de Biología Marina
Apartado postal 19-B, CP 23080
La Paz, B.C.S., México

JUAN CARLOS VILLASEÑOR-DERBEZ
Bren School of Environmental
Science & Management
University of California, Santa Barbara
Santa Barbara, CA 93106

ARTURO HERNANDEZ
Comunidad y Biodiversidad, A.C.
Colonia Delicias, Guaymas, México

ABSTRACT

Located in the central region of the west coast of Baja California Peninsula, the Cedros Archipelago consists of five continental islands (Cedros Island, Natividad, San Benito Este, Medio, and Oeste), with Cedros being the largest island in the Mexican Pacific. This archipelago represents the biogeographic transition zone between the temperate and subtropical region and hence, the end of the geographic distribution of a large number of species. Based on field surveys, literature, and scientific collection records, an exhaustive species list of fishes associated with the archipelago and their biogeographic relationships is presented. The checklist includes 269 species belonging to 191 genera, 97 families, 31 orders, and 4 classes. Of the total species, 105 species were recorded in the field, 57 were the result of the literature review, and 218 species of the records were obtained from collections. A total of 14 biogeographic affinities are presented, where 51% of the species have warm-temperate or cold-temperate affinity and 37% have tropical-subtropical affinity. This work highlights the fish diversity present in a transition zone within the temperate and subtropical marine areas of the Northeastern Pacific. More importantly, it reveals a biogeographic region where a great number of species converge, and may be related with the evolutionary history of different taxa and the geological history of the region.

INTRODUCTION

The Cedros Archipelago (CEA) includes five continental islands, and is located 10 km off the coast in the east-central region of the Baja California Peninsula (fig. 1). Cedros is the largest island in the Mexican Pacific, and along with San Benito Oeste, Medio, Este, and Natividad Island, represent a land territory of 360.7 km^2. The polygon formed between all of these islands accounts for a marine region of 3,928.9 km^2.

The CEA forms a group of northwestward-trending islands that are considered an extension of the Vizcaino Desert; therefore a subregion of the Sonoran Desert (Oberbauer 1985). The area was separated from the coast of Baja California by a submersion process in the last glacial period (Busby-Spera 1988), resulting in a 200 m deep channel called the Kellet Channel. The archipelago has a complex geologic history, beginning with rock material accumulated in a deep trough in the late Jurassic period, forming the Jurassic Grand Canyon. During the Cretaceous, the formations were folded, faulted, and overlaid by marine deposits. Finally, uplift occurred as recently as the late Pleistocene (Oberbauer 1985; Busby-Spera 1988).

The Pacific islands of the Baja California Peninsula can be considered as among the least degraded ecosystems in continental islands (Littler 1980; Richards 2000; Pondella et al. 2005; Aguirre-Munoz et al. 2008), however unlike their terrestrial biodiversity (Huey 1942; Oberbauer 1985; Mellink 1993; Aguirre-Munoz et al. 2008), the marine diversity has been poorly documented. This contrasts with ecological interest on the central region of the Baja California Peninsula, which represents a transition zone between the San Diegan and the Cortez biogeographic provinces (sensu Horn et al. 2006; Ruiz-Campos et al. 2010). South of the CEA the cold waters from the California Current system converge

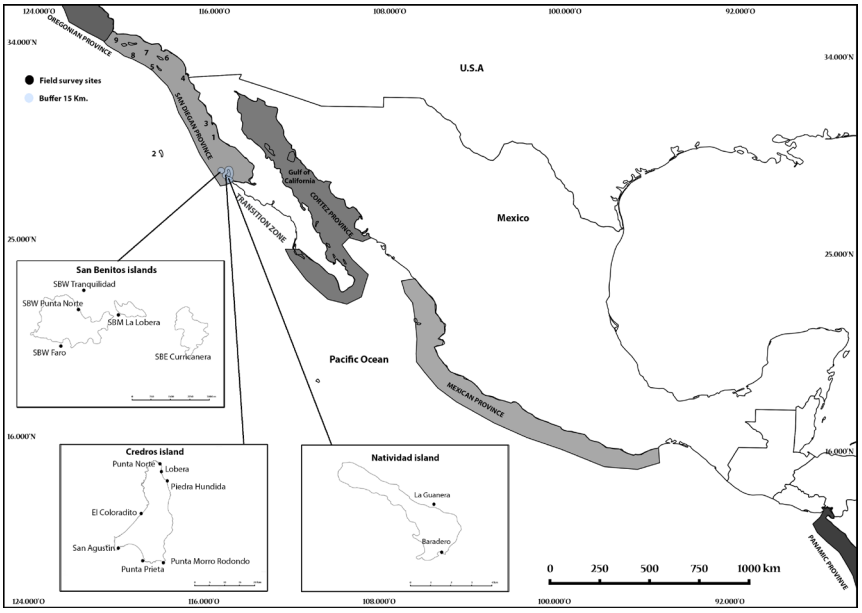

Figure 1. Locations of field surveys at the Cedros Archipelago, México

with the subtropical current system from the south, West Mexican Current (Hubbs 1960; Hickey 1979; Kessler 2006; Taylor et al. 2007), and recently documented intricate eddy motions of ocean water masses in the region contribute to the complexity of the coastal upwelling regime (Miller et al. 1999).

To the north of the CEA, temperate species associated with rocky reefs and kelp forests begin to be dominant until Point Conception, California (Horn et al. 2006). To the south of the CEA, species associated with the tropical Cortez and Mexican provinces begin to appear, mainly associated with mangrove ecosystems in estuaries and bays located in Bahía Magdalena (24°47.6'N, 112°18.2'W). While some species associated with the San Diegan faunistic province can be found as far south as Bahía Magdalena, the transition begins sharply at Punta Eugenia (27°50.7'N, 115°4.84'W), a major mainland landmark in front of the archipelago. Kelp forests do not persist farther south than Punta Eugenia and tropical marine species become more common (Taylor et al. 2007).

The CEA region has been historically relevant for extractive purposes, as archaeological investigations have documented an intensive pre-Hispanic use of marine resources (Des Lauriers 2010), and currently there are fisheries that target on spiny lobster (*Panulirus interruptus*; Randall 1840), green abalone (*Haliotis fulgens*; Philippi 1854), and pink abalone (*H. corrugata*; Gray 1828). Although the finfish fishery has less relevance, some taxa are of artisanal importance (e.g., *Paralabrax nebulifer* [Girard 1854]; *P. clathratus* [Girard 1854]; *Semicossyphus pulcher* [Ayres 1854]; and *Seriola lalandi* [Valenciennes 1833; Rodriguez-Valenica et. al 2004]).

Despite the ecological and economical importance of this region, there is scarce information about the species that inhabit it. In fact, most published species lists of marine groups contain only information from occasional visits or literature reviews (e.g., Hubbs 1960; Miller and Lea 1972; Love et al. 2005). The few studies that have specifically targeted any of the islands of the CEA are focused on particular fish families (Clinidae: Stepien and Rosenblatt 1991), species (*Sardinops* spp.: Felix-Uraga et al. 1996; Quiñonez-Velazquez et al. 2002) or habitats (reef fishes: Pondella et al. 2005; intertidal fishes: Carpizo-Ituarte et al. 2012).

Baseline studies for the CEA are a priority because the region has begun to show signs of environmental decay related to anthropogenic impacts. Among them the overexploitation of the fishing resources, overpopulation of Cedros Island, and the Mitsubishi/Mexican government-owned salt-transshipment facility, which is a source of introduction for exotic species (Mellink 1993; Des Lauriers 2009; Aguilar-Rosas et al. 2011). The lack of a detailed fish checklist hinders the efforts of decision-makers, who require comprehensive baseline data to set adequate protocols for monitoring temporal changes in community composition caused either by anthropogenic or natural forces (Reyes-Bonilla et al. 2010). Furthermore, without a thorough inventory of fish species, any biogeographic analysis of the CEA will be limited in its relevance and outcomes.

The main objective of this work is to provide the first comprehensive, systematic checklist of marine ichthyofauna of the CEA. We performed an overview of the composition of fish community and an analysis of zoo-

TABLE 1

Study sites and habitat in the Cedros Archipelago.
***I=Intertidal, S=Subtidal; **T=Tidepools, K=Kelp forest, R=Rocky reefs, S=Soft bottom.**

	Site	Coordinates	Date	Sampled zone*	Habitat**	Temp C
Cedros Island	Punta Norte	28°21'48.7 N, 115°11'50.7 W	17-May-12	I, S	T, K	14
	Lobera	28°20'12.1 N, 115°11'43.9 W	18-May-12	S	K, R	14
	San Agustin	28°4'48.9 N, 115°20'27.3 W	19-May-12	I, S	T, K	14
	El Coloradito	28°11'54.5 N, 115°15'45.7 W	I	T		
	Punta Prieta	28°2'14.6 N, 115°15'11.9 W	I	T		
	Punta Morro Redondo	28°1'56.7 N, 115°11'18.1 W	I	T		
	Piedra Garropa	28°18'17.5 N, 115°10'19.1 W	18-May-12	S	S, R	14
San Benito	SBE Curricanera	28°17'38.5 N - 115°32'28.1 W	20-May-12	I, S	T, K	15
	SBE Tranquilidad	28°19.0' N - 115°35.0' W	22-May-12	I, S	T, K	14
	SBM La Lobera	28°18'25 N - 115°34'11 W	21-May-12	S	T, K, R	16
	SBW Punta Norte	28°18'29.6 N, 115°35'9.5 W	22-May-12	I	T	
	SBW Faro	28°17'40.7 N - 115°35'31.1 W	21-May-12	S	R	15
Natividad	Baradero	27°52'31.4 N - 115°10'16.8 W		I, S	T, K	15
	La Guanera	27°51'5.8 N - 115°10'2.6 W		S	T, K	15

geographic affinity of the species using field surveys, fish collection records, and a full literature review. The results highlight that the relatively high local fish diversity is a result of physical and biological factors determining the transition between warm temperate and subtropical communities in the northeastern Pacific.

MATERIALS AND METHODS

The Cedros Archipelago (CEA) is composed of five islands. Cedros is the dominant topographic feature of a 400 km long submerged ridge, with a maximum height of 1,204 m, encompassing an area of 348.2 km^2 and laying approximately 22 km from the nearest point on the central coast of the Baja California Peninsula (fig. 1). San Benito Archipelago has three small islands situated 31.5 km west of Cedros, encompassing an area of 6 km^2 and with a highest altitude of 212 m. Finally, Natividad is located 7.5 km west of Punta Eugenia and measures 6 km in length and 2.5 km at its maximum width, accounting an area of 7.28 km^2.

In order to compile the fish checklist of the CEA, we followed three steps. First, we gathered information from electronic and in-house scientific collections from institutions in México, the United States, and Canada, encompassing records between 1934 and 2001. In the case of museum data, we reviewed records from thirty collections, either electronically or by direct visits, obtaining records of the following eleven institutions: Universidad Autónoma de Baja California (UABC; Ensenada); Centro Interdisciplinario de Ciencias Marinas (CICIMAR; La Paz); Instituto de Biología de la Universidad Nacional Autónoma de México (México, DF); Scripps Institution of Oceanography (La Jolla); Los Angeles County Natural History Museum (Los Angeles); California Academy of Sciences (San Francisco); National Museum of Natural History, Smithsonian Institution (Washington, DC); American Museum of Natural History (New York); University of Kansas Natural History Museum (Kansas City); University of Florida (Gainesville); and Canadian Museum of Nature Fish Collection (Dartmouth).

Second, we conducted an extensive literature review of the species reported in peer reviewed articles and technical reports from libraries at UABC (Ensenada, México), CICIMAR (La Paz, México), Centro de Investigaciones Biológicas del Noroeste (La Paz, México), Centro de Investigación Científica y de Educación Superior de Ensenada (Ensenada, México), and Scripps Institution of Oceanography (La Jolla, CA).

Finally, we conducted field surveys around the islands between 2010 and 2012 (table 1). Field surveys included intertidal and subtidal samplings. Intertidal fishes were sampled during eight sampling campaigns, carried out between February 2010 to April 2012 in the rocky tidepools of five sites at Cedros Island, two at San Benito, and two at Natividad (fig. 1, table 1). Tidepools were sprayed using manual aspersion pumps containing a solution of 10% eugenol (clove oil) dissolved in ethanol. After 10 minutes, the tidepools were thoroughly checked using dip and hand nets (Ruiz-Campos et al. 2010).

Subtidal fishes were sampled in May 2012 through underwater visual censuses performed by trained scuba divers. Using 30 × 2 m belt transects, we dove at three different depths (10, 15, and 20 m) and three main habitats (kelp forest, rocky reef, and soft-bottom). We carried out a total of 66 transects in four sites at Cedros, four sites at San Benito and two at Natividad. The total surveyed area with visual censuses was 3,960 m^2. Subtidal species were also recorded using the roving dive technique and underwater photography. Voucher specimens

of all recorded species in tidepools were kept in the Fish Collection at UABC, while most of the species recorded in the subtidal had in situ photographs taken.

In order to establish which records would be considered as valid for purposes of the study, in a geographical information system (QGIS 2.8) we traced a buffer area of 15 km around the archipelago. The records with coordinates inside the buffer area were considered part of the checklist, independently of the collection method or year of collection.

The taxonomic identification was performed using descriptions by Miller and Lea (1972), Fischer et al. (1995), and Robertson and Allen (2015). A specialized bibliography was also used for some groups (e.g., clingfishes [Briggs 1955]; gobies [Hoese and Reader 2001]; labrisomid blennies [Hubbs 1953]; rays [Castro-Aguirre and Espinoza-Pérez 1996]; sharks [Espinosa-Pérez et al. 2004]; tube blennies [Stephens 1963 and Stephens et al. 1996]). The final checklist follows a systematics order according to Eschmeyer (2015), with modifications by Wiley and Johnson (2010). Genera and species names are presented alphabetically. To eliminate synonyms and generate a systematic list consisting only of valid names, each taxonomic name was corroborated in the Catalog of Fishes of the California Academy of Sciences (Eschmeyer 2015) and common names in Page et al. (2013).

The biogeographic analysis followed three approaches.

1) We created a species presence/absence matrix using the species recorded in our subtidal field surveys at Cedros, San Benito and Natividad Islands, and field records from eight Northeastern Pacific islands gathered from peer review journals (Guadalupe Island, México [Reyes-Bonilla et al. 2010]; San Martin and North Coronado from México; and San Clemente, Santa Catalina, Santa Cruz, Santa Barbara, and San Nicolas from USA [Pondella et al. 2005]). Then, we performed a non-metric multidimensional scaling analysis (nMDS) (Kruskal & Wish, 1978) using the unweighted paired group method and arithmetic averages (UPGMA), based on a Bray-Curtis similarity matrix. SIMPER analysis was used to determine which species contributed with the largest dissimilarity patterns, using the statistical package PRIMER 6.1 (Primer-E Ltd: Plymouth; Clarke and Gorley 2006).
2) Species distributions were plotted using the available information for northern and southern endpoints following Love et al. (2005), and Robertson and Allen (2015). If a species had not been reported at CEA but was observed during field surveys, endpoints were updated with such information. We developed a MATLAB routine to generate latitudinal distribution for the 262 species with known distribution. We defined species with wide distribution those that have a full geographic range covering at least 60 degrees in latitude and which occurred beyond 30 degrees of latitude in both hemispheres.
3) Finally, we assessed the regionalization of the fish species recorded at CEA. The zoogeographic affinity of the ichthyofauna was achieved following Horn et al. (2006) for the North Pacific region, and Hastings (2000) for the Tropical Eastern Pacific, with modifications from Robertson and Cramer (2009). Considering their distribution range, the species were grouped into eight biogeographic provinces from the Eastern Pacific (Briggs 1974), one realm (North Pacific), and three distribution patterns (AmphiAmerican, Circumtropical, and Circumglobal).

RESULTS

The field surveys, museum records, and literature review, taken together helped to construct a list of 269 species of marine fishes of the CEA, from 191 genera, 97 families, 31 orders, and 4 classes (table 2). Perciformes was the most commonly represented order, with 33 families and 106 species in total. Almost half of the families (48) are represented by a single species. The most speciose families were Sebastidae (22 spp.), Myctophidae (16 spp.), and Embiotocidae (10 spp.). The genera with the highest number of species were *Sebastes* (22 spp.) and loosely followed by *Citharichthys* (5 spp.), and *Apogon*, *Halichoeres*, *Paralabrax*, *Icelinus*, *Lepophidium*, and *Pleuronichthys* with 4 species each.

The nMDS ordination plot based on presence/absence data clearly shows a separation of the CEA from the other eight northern islands, located in the California Current system (fig. 2). The fish assemblages from Cedros, Natividad, and San Benito are tightly grouped, indicating high similarities (>50%), while the Channel Islands, North Coronado, and Guadalupe Islands constitute a more spread group with equivalent similarity between fish assemblages (<50%), and San Martin island is separated from the rest.

According to the geographic distribution, 135 species have a temperate affinity (warm-temperate to cold-temperate) and 92 species have a tropical affinity (tropical-subtropical). A third group of 35 species are widely distributed in tropical and subtropical seas, and a geographic distribution was not assigned to seven taxa that were not identified to specific level (fig. 3).

A total of 170 species comes from a single source (field record, scientific collections and literature review) and 100 species came from multiple sources (table 2). Considering all records, 105 species were seen or collected in the field, 57 taxa were cited in the literature review and 218 species had specimens from the CEA housed in scientific collections. Based on our field records, 90 species were recorded in the subtidal (soft bottom [9 spp.]; kelp forest and rocky reefs [84 spp.],

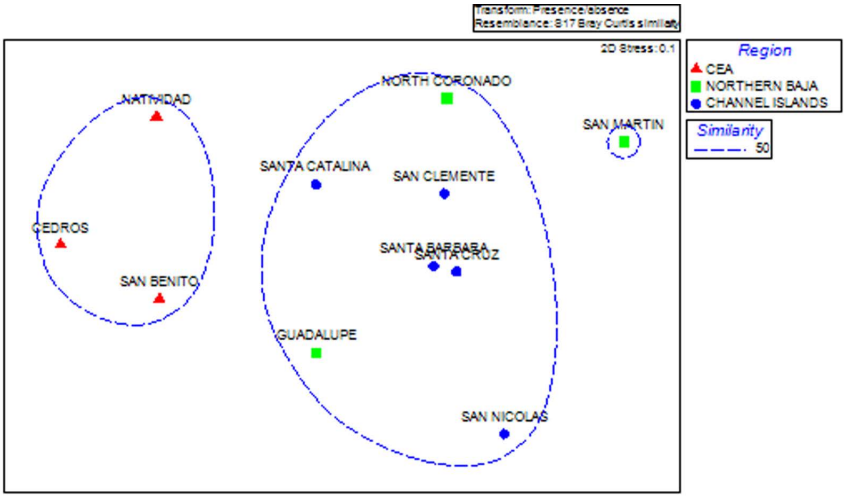

Figure 2. Non-metric Multidimensional Scaling analysis (nMDS) for fish species recorded in the subtidal field surveys at Cedros, Natividad and San Benito, and eight islands in the Pacific coast of Baja California and California [data from Pondella et al. (2005), Reyes-Bonilla et al. (2010) and present study].

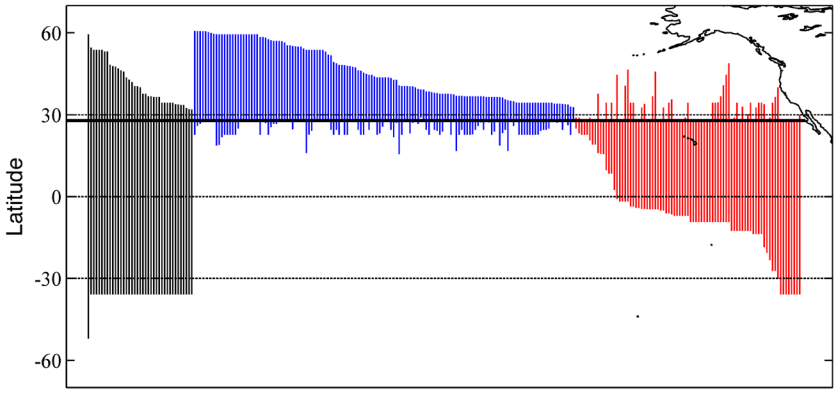

Figure 3. Distribution ranges (bars) in the eastern Pacific of 262 species included in Table 1. Black lines: species widely distributed in the EP surpassing the 30 degrees Latitude in both hemispheres. Blue lines: species with temperate affinity. Red lines: fishes with tropical-subtropical affinity. Black line: Latitude in where CEA archipelago is located.

3 species were present in both habitats). The intertidal fieldwork contributed with 24 species to the checklist.

Analyzing separately the species richness for each of the islands, Cedros had more than twice the number of taxa as San Benito (224 and 107, respectively) and four times that for Natividad Island (63 spp.). The differences are largely reduced when considering only the field surveys; in Cedros 78 species were seen or collected, 54 and 56 species at San Benito and Natividad, respectively.

The CEA represents the limit of geographical distribution for 104 species; 38% of the total species checklist. For 35 species the archipelago is the northern limit, and for 47 species it is the southernmost point of distribution (fig. 3). From the listing, we have range extensions for 19 species. For 9 species, this represents the northernmost documented record, and for 10 species the southernmost record (table 3).

According to the geographic distribution information of all the species, we found 14 distribution patterns; these included one or more biogeographic provinces (fig. 4). The distribution ranges of 95% of the species comprise two or more biogeographic provinces. The best-represented distribution in number of species was the Oregonian-San Diegan, with 46 species. The distribution pattern Aleutian-San Diegan was represented with 25 species.

The presence of 10 endemic species to the San Diegan province was recorded (fig. 4), including: the lined clingfish (*Gobiesox eugrammus*), the yellowchin sculpin (*Icelinus quadriseriatus*), the southern clingfish (*Rimicola dimorpha*), the Guadalupe blenny (*Starksia guadalupae*) the chocolate pipefish (*Syngnathus euchrous*), the tripefin poacher (*Xeneretmus ritteri*), the island kelpfish (*Alloclinus holderi*), the California moray (*Gymnothorax mordax*), the

TABLE 2

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
MYXINI											
	MYXINIFORMES										
		MYXINIDAE									
			Eptatretus deani (Evermann & Goldsborough 1907)	Black hagfish	2	2		LACM, SIO		Southern limit	AL-SD
			Eptatretus mcconnaugheyi (Wisner & McMillan 1990)	Shorthead hagfish	3	3				Southern limit	SD-CZ
			Eptatretus stoutii (Lockington 1878)	Pacific hagfish	2	2		LACM, SIO			OR-SD
CHONDRICHTHYES											
	HEXANCHIFORMES										
		HEXANCHIDAE									
			Notorynchus cepedianus (Péron 1807)	Broadnose sevengill shark			1		S		CG
	HETERODONTIFORMES										
		HETERODONTIDAE									
			Heterodontus francisci (Girard 1855)	Horn shark	1, 2	1	1	CICIMAR, LACM	S		OR-CZ
			Heterodontus mexicanus (Taylor & Castro-Aguirre 1972)	Mexican horn shark	1, 3	3	1		S		MX-PA
	LAMNIFORMES										
		LAMNIDAE									
			Isurus oxyrinchus (Rafinesque 1810)	Shortfin mako			1		S		CG
	CARCHARINIFORMES										
		SCYLIORHINIDAE									
			Cephaloscyllium ventriosum (Garman 1880)	Swell shark		2		SIO			OR-CH
		TRIAKIDAE									
			Galeorhinus galeus (Linnaeus 1758)	Tope		2		IGUNAM, SIO			CG
			Mustelus californicus (Gill 1864)	Gray smoothhound	2			CICIMAR			OR-CZ
			Mustelus lunulatus (Jordan & Gilbert 1882)	Sicklefin smoothhound		2		SIO			SD-CH
			Triakis semifasciata (Girard 1855)	Leopard shark		2		CICIMAR, SIO			OR-MX
		CARCHARHINIDAE									
			Carcharhinus brachyurus (Günther 1870)	Narrowtooth shark		2		IGUNAM, SIO			CG
		SPHYRNIDAE									
			Sphyrna zygaena (Linnaeus 1758)	Smooth hammerhead	3						CT
			Sphyrna sp.				1		S		
	SQUATINIFORMES										
		SQUATINIDAE									
			Squatina californica (Ayres 1859)	Pacific angelshark	1		1		S		EP

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
CHONDRICHTHYES (continued)											
	RAJIFORMES										
		RAJIDAE									
			Raja inornata (Jordan & Gilbert 1881)	California skate	2			CAS, LACM			AL-CZ
			Raja stellulata (Jordan & Gilbert 1880)	Starry skate	3					Southern limit	NEP
		RHINOBATIDAE									
			Rhinobatos productus (Ayres 1854)	Shovelnose guitarfish	2			LACM			OR-MX
			Zapteryx exasperata (Jordan & Gilbert 1880)	Banded guitarfish	1	1	1		S		SD-PA
	MYLIOBATIFORMES										
		MYLIOBATIDAE									
			Myliobatis californica (Gill 1865)	Bat ray	1				S		OR-MX-POI
		UROLOPHIDAE									
			Urobatis concentricus (Osburn & Nichols 1916)	Reef stingray	1, 3				S	Northern limit	CZ-MX
			Urobatis halleri (Cooper 1863)	Round stingray	1, 2		1	SIO	S		OR-PA
HOLOCEPHALI											
	CHIMAERIFORMES										
		CHIMAERIDAE									
			Hydrolagus colliei (Lay & Bennett 1839)	Spotted ratfish	2, 3			CICIMAR			AL-CZ
ACTINOPTERI											
	ANGUILLIFORMES										
		MURAENIDAE									
			Gymnothorax mordax (Ayres 1859)	California moray	1, 2	1, 2		UABC, LACM, SIO	I, S		SD
		CONGRIDAE									
			Gnathophis cinctus (Garman 1899)	Hardtail conger		2		SIO			SD-CH
		NEMICHTHYIDAE									
			Nemichthys scolopaceus (Richardson 1848)	Slender snipe eel	2			LACM			CT
		NETTASTOMATIDAE									
			Facciolella equatorialis (Gilbert 1891)	Dogface witch eel	2	2		SIO			SD-PA
	CLUPEIFORMES										
		CLUPEIDAE									
			Etrumeus teres (DeKay 1842)	Round herring	2, 3			CICIMAR, CMN, CAS			CG
			Sardinops sagax (Jenyns 1842)	Pacific sardine	1, 2, 3		1, 2		S		AL-CZ
		ENGRAULIDAE									
			Engraulis mordax (Girard 1854)	Northern anchovy	2			CICIMAR, LACM, SIO			AL-CZ

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	OSMERIFORMES										
		ARGENTINIDAE									
			Argentina sialis (Gilbert 1890)	Pacific argentine	2	2		CICIMAR, IBUNAM, LACM, SIO			OR-SD
		MICROSTOMATIDAE									
			Nansenia crassa (Lavenberg 1965)	Stout argentine	2			CICIMAR		Southern limit	OR-SD
		BATHYLAGIDAE									
			Bathylagoides wesethi (Bolin 1938)	Snubnose blacksmelt	2			CICIMAR			OR-SD
			Leuroglossus stilbius (Gilbert 1890)	California smoothtongue	2			CICIMAR			OR-PA
	STOMIIFORMES										
		GONOSTOMATIDAE									
			Cyclothone acclinidens (Garman 1899)	Benttooth bristlemouth	2			CICIMAR			CG
			Cyclothone signata (Garman 1899)	Showy bristlemouth	2			CICIMAR			EP
			Diplophos taenia (Günther 1873)	Pacific portholefish	2			CICIMAR			CG
		STERNOPTYCHIDAE									
			Argyropelecus sladeni (Regan 1908)	Sladen's hatchet fish	2			CICIMAR			CG
		PHOSICHTHYIDAE									
			Ichthyococcus irregularis (Rechnitzer & Böhlke 1958)	Bulldog lightfish	2			CICIMAR			NEP
			Vinciguerria lucetia (Garman 1899)	Panama lightfish	2			IBUNAM, CICIMAR			OR-CH
		STOMIIDAE									
			Idiacanthus antrostomus (Gilbert 1890)	Pacific blackdragon	2			CICIMAR			TEP
			Stomias atriventer (Garman 1899)	Blackbelly dragonfish	2			CICIMAR		Northern limit	SD-CH
	AULOPIFORMES										
		SCOPELARCHIDAE									
			Scopelarchus guentheri (Alcock 1896)	Staring pearleye	2			CICIMAR			CT
			Scopelarchoides nicholsi (Parr 1929)	Pearleye	3					Northern limit	SD-CH
		SYNODONTIDAE									
			Synodus lacertinus (Gilbert 1890)	Calico lizardfish	3						SD-CH-POI
			Synodus lucioceps (Ayres 1855)	California lizardfish	2	2		IBUNAM, CICIMAR, LACM, SIO		Southern limit	OR-CZ
		PARALEPIDIDAE									
			Arctozenus risso (Bonaparte 1840)	White barracudina	2			CICIMAR		Southern limit	CG
			Lestidiops ringens (Jordan & Gilbert 1880)	Slender barracudina	2			CICIMAR, LACM		Southern limit	OR-SD

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	MYCTOPHIFORMES										
		MYCTOPHIDAE									
			Ceratoscopelus townsendi (Eigenmann & Eigenmann 1889)	Dogtooth lampfish	2			CICIMAR			CG
			Diogenichthys atlanticus (Tåning 1928)	Longfin lanternfish	2			CICIMAR			CG
			Diogenichthys laternatus (Garman 1899)	Diogenes lanternfish	2			CICIMAR			SD-CH
			Electrona risso (Cocco 1829)	Electric lanternfish	2			CICIMAR			CG
			Gonichthys tenuiculus (Garman 1899)	Slendertail lanternfish	2			CICIMAR			SD-CH
			Hygophum atratum (Garman 1899)	Thickhead flashlightfish	2			CICIMAR			CZ
			Hygophum reinhardtii (Lütken 1892)	Reinhardt's lanternfish	2			CICIMAR			AA
			Lampadena urophaos (Paxton 1963)	Sunbeam lampfish	2, 3			CICIMAR			AA
			Loweina rara (Lütken 1892)	Laura's lanternfish	2			CICIMAR			CG
			Myctophum nitidulum (Garman 1899)	Pearly lanternfish	2			CICIMAR			CG
			Nannobrachium idostigma (Parr 1931)	Lanternfish	2			CICIMAR		Range extension North	TEP
			Nannobrachium ritteri (Gilbert 1915)	Broadfin lampfish	2			CICIMAR		Southern limit	NEP
			Notolychnus valdiviae (Brauer 1904)	Topside lampfish	2			CICIMAR			CT
			Protomyctophum crockeri (Bolin 1939)	California flashlightfish	2			CICIMAR			NP
			Symbolophorus californiensis (Eigenmann & Eigenmann 1889)	Bigfin lanternfish	2, 3			CICIMAR		Southern limit	NP
			Triphoturus mexicanus (Gilbert 1890)	Mexican lampfish	2			CICIMAR			AL-MX
	LAMPRIFORMES										
		TRACHIPTERIDAE									
			Zu cristatus (Bonelli 1820)	Scalloped ribbonfish	2			SIO			CG
	GADIFORMES										
		MORIDAE									
			Physiculus rastrelliger (Gilbert 1890)	Hundred-fathom codling	2			SIO			OR-PA
		MERLUCCIIDAE									
			Merluccius productus (Ayres 1855)	Pacific hake	2			CICIMAR, SIO			AL-MX

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	OPHIDIIFORMES										
		OPHIDIIDAE									
			Chilara taylori (Girard 1858)	Spotted cusk-eel	2			LACM, SIO			OR-PA
			Lepophidium negropinna (Hildebrand & Barton 1949)	Specklefin cusk-eel	2			CICIMAR, SIO		Northern limit	TEP
			Lepophidium prorates (Jordan & Bollman 1890)	Prowspine cusk-eel	2			LACM		Range extension North	TEP
			Lepophidium stigmatistium (Gilbert 1890)	Mexican cusk-eel	3					Northern limit	SD-CZ
			Lepophidium sp.		2			LACM			
			Ophidion galeoides (Gilbert 1890)	Spotfin cusk-eel	3					Northern limit	SD-PA
			Ophidion scrippsae (Hubbs 1916)	Basketweave cusk-eel	2			CICIMAR, CAS, LACM, SIO			OR-SD
	BATRACHOIDIFORMES										
		BATRACHOIDIDAE									
			Porichthys myriaster (Hubbs & Schultz 1939)	Specklefin midshipman	2			CICIMAR, SIO			OR-PA
			Porichthys notatus (Girard 1854)	Plainfin midshipman	2			CAS, IBUNAM, LACM, SIO			OR-SD
	GOBIESOCIFORMES										
		GOBIESOCIDAE									
			Gobiesox eugrammus (Briggs 1955)	Lined clingfish		2		SIO		Southern limit	SD
			Gobiesox rhessodon (Smith 1881)	California clingfish	1, 2	1, 2	1	UABC, LACM, SIO	I		OR-SD
			Rimicola dimorpha (Briggs 1955)	Southern clingfish		2		SIO		Southern limit	SD
			Rimicola eigenmanni (Gilbert 1890)	Slender clingfish	1, 2			UABC, LACM	I		SD
	ATHERINIFORMES										
		ATHERINIDAE									
			Leuresthes tenuis (Ayres 1860)	California grunion	1, 2			UABC, SIO	I, S		OR-SD
		ATHERINOPSIDAE									
			Atherinops affinis (Ayres 1860)	Topsmelt	1, 2	1, 2	1	UABC, CAS, LACM, SIO	I, S		AL-CZ
			Atherinopsis californiensis (Girard 1854)	Jacksmelt	1, 2	2		UABC, CAS, LACM, SIO	I		OR-CZ

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	BELONIFORMES										
		SCOMBERESOCIDAE									
			Cololabis saira (Brevoort 1856)	Pacific saury	2	2		CICIMAR, CAS, LACM, SIO			NP
		BELONIDAE									
			Platybelone argalus (Lesueur 1821)	Keeltail needlefish		2		SIO		Range extension North	CT
			Strongylura exilis (Girard 1854)	California needlefish	2, 3			LACM, SIO			OR-CH
			Tylosurus crocodilus (Péron & Lesueur 1821)	Hound needlefish	1, 2		1	UABCS	S	Northern limit	CG
		HEMIRAMPHIDAE									
			Euleptorhamphus viridis (van Hasselt 1823)	Ribbon halfbeak	2	2		SIO			TR
			Hemiramphus saltator (Gilbert & Starks 1904)	Longfin halfbeak	2			LACM		Range extension North	TEP
		EXOCOETIDAE									
			Cheilopogon heterurus (Rafinesque 1810)	Blotchwing flyingfish	2		2	CICIMAR, SIO			CT
			Cheilopogon pinnatibarbatus (Bennett 1831)	Smallhead flyingfish	2	2	2	CAS, LACM, SIO			OR-CZ
			Cypselurus sp.		2			LACM			
	STEPHANOBERYCIFORMES										
		MELAMPHAIDAE									
			Melamphaes lugubris (Gilbert 1890)	Highsnout melamphid	2			CICIMAR		Southern limit	NEP
	BERYCIFORMES										
		HOLOCENTRIDAE									
			Myripristis leiognathus (Valenciennes 1846)	Panamic soldierfish	1, 2			SIO	S	Northern limit	TEP
	SYNGNATHIFORMES										
		CENTRISCIDAE									
			Macroramphosus gracilis (Lowe 1839)	Slender snipefish		2		IBUNAM, CICIMAR, LACM, SIO			CG
		SYNGNATHIDAE									
			Syngnathus euchrous (Fritzsche 1980)	Chocolate pipefish	2			CAS, SIO		Southern limit	SD
			Syngnathus exilis (Osburn & Nichols 1916)	Barcheek pipefish	2, 3	2		CAS, SIO		Southern limit	OR-SD

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	SCORPAENIFORMES										
		SEBASTIDAE									
			Sebastes atrovirens (Jordan & Gilbert 1880)	Kelp rockfish	1, 2	1, 2		LACM, SIO	S	Southern limit	OR-SD
			Sebastes auriculatus (Girard 1854)	Brown rockfish	1	1			S		NEP
			Sebastes aurora (Gilbert 1890)	Aurora rockfish	3					Southern limit	NEP
			Sebastes carnatus (Jordan & Gilbert 1880)	Gopher rockfish			2	LACM			OR-SD
			Sebastes caurinus (Richardson 1844)	Copper rockfish		1, 2, 3		LACM	S	Southern limit	NEP
			Sebastes chrysomelas (Jordan & Gilbert 1881)	Black-and-yellow rockfish			2	LACM			OR-SD
			Sebastes diploproa (Gilbert 1890)	Splitnose rockfish	2, 3			SIO		Southern limit	NEP
			Sebastes elongatus (Ayres 1859)	Greenstriped rockfish	1, 3				S	Southern limit	NEP
			Sebastes flavidus (Ayres 1862)	Yellowtail rockfish	1				S	Range extension South	AL-SD
			Sebastes hopkinsi (Cramer 1895)	Squarespot rockfish	1	1			S	Range extension South	OR-SD
			Sebastes lentiginosus (Chen 1971)	Freckled rockfish	2			LACM		Southern limit	OR-SD
			Sebastes macdonaldi (Eigenmann & Beeson 1893)	Mexican rockfish	2			CICIMAR, LACM			SD-CZ
			Sebastes melanostomus (Eigenmann & Eigenmann 1890)	Blackgill rockfish	3					Southern limit	OR-SD
			Sebastes miniatus (Jordan & Gilbert 1880)	Vermilion rockfish		1, 2, 3		LACM	S	Southern limit	AL-SD
			Sebastes paucispinis (Ayres 1854)	Bocaccio rockfish	2			SIO		Range extension South	NEP
			Sebastes rosaceus (Girard 1854)	Rosy rockfish	2			SIO		Southern limit	OR-SD
			Sebastes saxicola (Gilbert 1890)	Stripetail rockfish	2			SIO			NEP
			Sebastes semicinctus (Gilbert 1897)	Halfbanded rockfish	2			SIO		Range extension South	OR-SD
			Sebastes serranoides (Eigenmann & Eigenmann 1890)	Olive rockfish		1, 2, 3		SIO	S	Southern limit	OR-SD
			Sebastes serriceps (Jordan & Gilbert 1880)	Treefish	1, 2, 3			LACM	S	Southern limit	OR-SD
			Sebastes sp.	Rockfish	1	1			S		
			Sebastes umbrosus (Jordan & Gilbert 1882)	Honeycomb rockfish		2		LACM		Southern limit	OR-SD

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	SCORPAENIFORMES (continued)										
		SCORPAENIDAE									
			Pontinus vaughani (Barnhart & Hubbs 1946)	Spotback scorpionfish	1, 2			SIO	S	Range extension North	CZ-POI
			Scorpaena guttata (Girard 1854)	California scorpionfish	1, 2			UABC, CICIMAR, LACM, SIO	I, S		SD-CZ
			Scorpaenodes xyris (Jordan & Gilbert 1882)	Rainbow scorpionfish	2	2		LACM, SIO			SD-PA-POI
		EPINEPHELIDAE									
			Mycteroperca rosacea (Streets 1877)	Leopard grouper			1		S		SD-MX
		TRIGLIDAE									
			Prionotus ruscarius (Gilbert & Starks 1904)	Rough searobin	2			CICIMAR		Range extension North	SD-CH
			Prionotus stephanophrys (Lockington 1881)	Lumptail searobin	2			CAS, LACM			OR-CH
	PERCIFORMES										
		POLYPRIONIDAE									
			Stereolepis gigas (Ayres 1859)	Giant seabass			1		S		SD-CZ
		SERRANIDAE									
			Alphestes immaculatus (Breder 1936)	Pacific mutton hamlet		1	1			Northern limit	TEP
			Epinephelus labriformis (Jenyns 1840)	Flag cabrilla	1, 3	1, 3			S		SD-PA-POI
			Paralabrax auroguttatus (Walford 1936)	Goldspotted sand bass	1, 2, 3			LACM	S	Northern limit	CZ
			Paralabrax clathratus (Girard 1854)	Kelp bass	1, 2	1, 2	1, 2	CICIMAR, LACM, SIO	S		OR-SD
			Paralabrax maculatofasciatus (Steindachner 1868)	Spotted sand bass	2			CICIMAR			OR-CZ
			Paralabrax nebulifer (Girard 1854)	Barred sand bass	1, 2	1, 2	1	CICIMAR, LACM, SIO	S		OR-MX
			Paranthias colonus (Valenciennes 1846)	Pacific creolefish		2	1	LACM	S	Northern limit	TEP
			Pronotogrammus multifasciatus (Gill 1863)	Threadfin bass	2			CICIMAR			SD-PA-POI
			Serranus psittacinus (Valenciennes 1846)	Barred serrano	1, 3				S	Northern limit	TEP

(continued)

TABLE 2 (Continued)

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CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	PERCIFORMES (continued)										
		APOGONIDAE									
			Apogon atricaudus (Jordan & McGregor 1898)	Plain cardinalfish	2, 3			CICIMAR			SD-CZ
			Apogon guadalupensis (Osburn & Nichols 1916)	Guadalupe cardinalfish		2		LACM, SIO			SD-CZ
			Apogon pacificus (Herre 1935)	Pink cardinalfish		1, 2, 3		SIO	S		SD-CH-POI
			Apogon retrosella (Gill 1862)	Barspot cardinalfish	1, 2, 3	1, 2, 3	1	LACM, SIO	S	Northern limit	TEP
		MALACANTHIDAE									
			Caulolatilus princeps (Jenyns 1840)	Ocean whitefish	1, 2	1, 2	1, 2	LACM, SIO	S		EP
		CARANGIDAE									
			Caranx caballus (Günther 1868)	Green jack			1		S		SD-CH
			Chloroscombrus orqueta (Jordan & Gilbert 1883)	Pacific bumper	2			CICIMAR			SD-CH
			Decapterus muroadsi (Temminck & Schlegel 1844)	Amberstripe scad	2	2		LACM		Northern limit	TR
			Seriola lalandi (Valenciennes 1833)	Yellowtail jack	1, 2	1	1, 2	CICIMAR, LACM, SIO	S		CT
			Trachurus symmetricus (Ayres 1855)	Pacific jack mackerel	1	1, 2		CICIMAR, LACM, SIO	S		AL-CZ
			Uraspis secunda (Poey 1860)	Whitemouth jack		2		SIO			CG
		CORYPHAENIDAE									
			Coryphaena hippurus (Linnaeus 1758)	Dolphinfish	2		1	CICIMAR, SIO	S		CT
		CARISTIIDAE									
			Caristius macropus (Bellotti 1903)	Bigmouth manefish	3					Southern limit	NEP
		GERREIDAE									
			Eucinostomus dowii (Gill 1863)	Pacific spotfin mojarra		2		SIO			SD-CH
		HAEMULIDAE									
			Anisotremus davidsonii (Steindachner 1876)	Sargo	1, 2	1, 2	1	CICIMAR, LACM, SIO	S		SD-CZ
			Anisotremus interruptus (Gill 1862)	Burrito grunt	1				S	Northern limit	TEP
			Orthopristis reddingi (Jordan & Richardson 1895)	Bronzestriped grunt	2, 3			CAS		Northern limit	SD-MX
			Xenistius californiensis (Steindachner 1876)	Salema	1	1			S		OR-PA

(continued)

TABLE 2 (Continued)

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CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	PERCIFORMES (continued)										
		SPARIDAE									
			Calamus brachysomus (Lockington 1880)	Pacific porgy		2	1	SIO	S		SD-CH
		SCIAENIDAE									
			Cheilotrema saturnum (Girard 1858)	Black croaker		2		SIO			SD-CZ
			Genyonemus lineatus (Ayres 1855)	White croaker	2			SIO			OR-SD
			Larimus acclivis (Jordan & Bristol 1898)	Steeplined drum	3					Northern limit	TEP
			Pareques sp.	Croaker	1	1, 2			S		
			Seriphus politus (Ayres 1860)	Queenfish	2			SIO			OR-CZ
			Umbrina roncador (Jordan & Gilbert 1882)	Yellowfin croaker	2			SIO			SD-CZ
		KYPHOSIDAE									
			Girella nigricans (Ayres 1860)	Opaleye	1, 2	1, 2	1, 2	UABC, LACM, SIO	I, S		SD-CZ
			Kyphosus azurea (Jenkins & Evermann 1889)	Zebraperch	1, 2		1, 2	UABC, CICIMAR	I, S		OR-CZ
			Medialuna californiensis (Steindachner 1876)	Halfmoon	1, 2	1, 2	1, 2	IBUNAM, CICIMAR, LACM, SIO	S		AL-CZ
		CHAETODONTIDAE									
			Chaetodon humeralis (Günther 1860)	Threebanded butterflyfish		2		SIO		Northern limit	SD-CH
			Johnrandallia nigrirostris (Gill 1862)	Barberfish	1, 3	3			S	Northern limit	TEP
			Prognathodes falcifer (Hubbs & Rechnitzer 1958)	Scythe butterflyfish	2	1, 2		LACM, SIO	S		SD-CZ
		MUGILIDAE									
			Mugil curema (Valenciennes 1836)	White mulet			1, 2	UABC	I		CT
		POMACANTHIDAE									
			Pomacanthus zonipectus (Gill 1862)	Cortez angelfish		2		SIO			TEP

(continued)

TABLE 2 (Continued)

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CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	PERCIFORMES (continued)										
		EMBIOTOCIDAE									
			Brachyistius frenatus (Gill 1862)	Kelp surfperch	1, 2	1, 2	1	SIO	S	Southern limit	AL-SD
			Embiotoca jacksoni (Agassiz 1853)	Black perch	1, 2	1, 2	1, 2	CICIMAR, SIO	S		OR-SD
			Embiotoca sp.		2			SIO			
			Hyperprosopon argenteum (Gibbons 1854)	Walleye surfperch	2			SIO		Southern limit	OR-SD
			Micrometrus minimus (Gibbons 1854)	Dwarf perch	2			SIO		Southern limit	OR-SD
			Phanerodon atripes (Jordan & Gilbert 1880)	Sharpnose seaperch	1	1, 2		SIO	S	Southern limit	OR-SD
			Phanerodon furcatus (Girard 1854)	White seaperch	1	1			S	Range extension South	AL-SD
			Rhacochilus toxotes (Agassiz 1854)	Rubberlip seaperch	1, 2	1, 2		LACM, SIO	S	Southern limit	OR-SD
			Rhacochilus vacca (Girard 1855)	Pile perch	2		1	LACM	S	Range extension South	NEP
			Zalembius rosaceus (Jordan & Gilbert 1880)	Pink seaperch	2			CAS, LACM, SIO		Range extension South	OR-CZ
		POMACENTRIDAE									
			Abudefduf troschelii (Gill 1862)	Panamic sergeant major	1, 2	1	1	UABC	I, S	Northern limit	SD-CH-POI
			Azurina hirundo (Jordan & McGregor 1898)	Swallow damselfish		2, 3		KU, SIO			SD-CZ
			Chromis alta (Greenfield & Woods 1980)	Silverstripe chromis	1, 2	1, 2		KU, SIO	S		SD-CH-POI
			Chromis atrilobata (Gill 1862)	Scissortail chromis	1, 2	2		SIO	S	Northern limit	TEP
			Chromis punctipinnis (Cooper 1863)	Blacksmith	1, 2	1, 2	1, 2	CICIMAR, KU, LACM, SIO	S		OR-SD
			Hypsypops rubicundus (Girard 1854)	Garibaldi	1, 2	1, 2	1, 2	UABC, CICIMAR, LACM, SIO	I, S		SD-CZ
			Stegastes flavilatus (Gill 1862)	Beaubrummel	1, 3				S	Northern limit	TEP
			Stegastes leucorus (Gilbert 1892)	Whitetail damselfish		1, 2		SIO	S		CZ-MX
			Stegastes rectifraenum (Gill 1862)	Cortez damselfish		2		LACM, SIO			SD-MX

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	PERCIFORMES (continued)										
		LABRIDAE									
			Bodianus diplotaenia (Gill 1862)	Mexican hogfish	1, 2, 3	2		LACM	S	Northern limit	SD-CH-POI
			Halichoeres dispilus (Günther 1864)	Chameleon wrasse	1	1, 2		SIO	S	Northern limit	TEP
			Halichoeres melanotis (Gilbert 1890)	Golden wrasse	3	1, 3			S	Northern limit	TEP
			Halichoeres notospilus (Günther 1864)	Banded wrasse	1, 2		1	UABC	I, S	Range extension North	TEP
			Halichoeres semicinctus (Ayres 1859)	Rock wrasse	1, 2	1, 2	1, 2	UABC, CICIMAR, CAS, LACM, SIO	I, S		SD-CZ
			Oxyjulis californica (Günther 1861)	Señorita	1	1, 2	1	SIO	S		OR-SD
			Semicossyphus pulcher (Ayres 1854)	California sheephead	1, 2	1, 2	1, 2	LACM, SIO	S		OR-CZ
			Thalassoma lucasanum (Gill 1862)	Cortez rainbow wrasse	1	1			S	Northern limit	TEP
		SCARIDAE									
			Nicholsina denticulata (Evermann & Radcliffe 1917)	Loosetooth parrotfish	1, 3	1, 3			S		SD-PA-POI
		ZOARCIDAE									
			Lyconema barbatum (Gilbert 1896)	Bearded eelpout	2	2		SIO		Southern limit	OR-SD
		CHIASMODONTIDAE									
			Chiasmodon niger (Johnson 1864)	Black swallower	2			CICIMAR		Range extension South	CG
		URANOSCOPIDAE									
			Kathetostoma averruncus (Jordan & Bollman 1890)	Smooth stargazer	2	2		UF, LACM, SIO			SD-CH
		TRIPTERYGIIDAE									
			Enneanectes carminalis (Jordan & Gilbert 1882)	Carmine triplefin		1, 2		LACM	S	Northern limit	TEP
			Enneanectes reticulatus (Allen & Robertson 1991)	Flag triplefin		2		SIO		Northern limit	CZ

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	PERCIFORMES (continued)										
		LABRISOMIDAE									
			Alloclinus holderi (Lauderbach 1907)	Island kelpfish	1, 2	1, 2	1	UABC, LACM, SIO	S		SD
			Labrisomus multiporosus (Hubbs 1953)	Porehead blenny	1, 2		1, 2	UABC	I	Northern limit	TEP
			Labrisomus sp.	Blenny		2		SIO			
			Labrisomus xanti (Gill 1860)	Largemouth blenny	1, 2		1	UABC, LACM	I	Northern limit	TEP
			Paraclinus integripinnis (Smith 1880)	Reef finspot	1, 2	1, 2	2	UABC, LACM, SIO	I		OR-SD
			Starksia guadalupae (Rosenblatt & Taylor 1971)	Guadalupe blenny		2		LACM			SD
		CLINIDAE									
			Gibbonsia elegans (Cooper 1864)	Spotted kelpfish	1, 2	1, 2	1, 2	UABC, LACM, SIO	I		OR-SD
			Gibbonsia montereyensis (Hubbs 1927)	Crevice kelpfish	1, 2	1, 2	1, 2	UABC, SIO	I	Range extension South	AL-SD
			Heterostichus rostratus (Girard 1854)	Giant kelpfish	1, 2	1, 2	1, 2	UABC, CAS, LACM, SIO	I, S		OR-SD
		CHAENOPSIDAE									
			Neoclinus blanchardi (Girard 1858)	Sarcastic fringehead	2, 3			LACM		Southern limit	OR-SD
		DACTYLOSCOPIDAE									
			Gillellus semicinctus (Gilbert 1890)	Halfbanded stargazer	2			SIO		Northern limit	TEP
		BLENNIIDAE									
			Hypsoblennius gilberti (Jordan 1882)	Rockpool blenny	1, 2		1, 2	UABC	I		SD
			Hypsoblennius jenkinsi (Jordan & Evermann 1896)	Mussel blenny	1, 2	1, 2		UABC, SIO	I		SD-CZ
			Hypsoblennius gentilis	Bay blenny	1		1		I		SD-CZ
			Ophioblennius steindachneri (Jordan & Evermann 1898)	Panamic fanged blenny	1, 2		1, 2	UABC	I, S		TEP
			Plagiotremus azaleus (Jordan & Bollman 1890)	Sabertooth blenny	1, 3				S		SD-PA-POI
		CALLIONYMIDAE									
			Synchiropus atrilabiatus (Garman 1899)	Blacklip dragonet	3						SD-CH-POI
		ELEOTRIDAE									
			Eleotris picta (Kner 1863)	Spotted sleeper	2			CICIMAR		Range extension North	TEP

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	PERCIFORMES (continued)										
		GOBIIDAE									
			Acanthogobius flavimanus (Temminck & Schlegel 1845)	Yellowfin goby	3					Range extension South	NWP
			Bathygobius ramosus (Ginsburg 1947)	Panamic frillfin	1, 2		1	UABC	I	Range extension North	TEP
			Lepidogobius lepidus (Girard 1858)	Bay goby	3					Southern limit	EP
			Lythrypnus dalli (Gilbert 1890)	Bluebanded goby	1, 2	1, 2	1	CICIMAR, LACM, SIO	S		SD-PA-POI
			Lythrypnus zebra (Gilbert 1890)	Zebra goby	2	1, 2	2	LACM, SIO	S		SD-CZ
			Rhinogobiops nicholsii (Bean 1882)	Blackeye goby	1, 2, 3	1	1	LACM	S	Southern limit	AL-SD
		LUVARIDAE									
			Luvarus imperialis (Rafinesque 1810)	Louvar	2			SIO			CG
		SPHYRAENIDAE									
			Sphyraena argentea (Girard 1854)	Pacific barracuda	2		1	CICIMAR, SIO	S		NEP
			Sphyraena lucasana (Gill 1863)	Cortez barracuda	1, 2, 3			UABCS	S	Northern limit	CZ-MX
		TRICHIURIDAE									
			Lepidopus fitchi (Rosenblatt & Wilson 1987)	Pacific scabbardfish	2			CICIMAR, LACM			OR-CH
		SCOMBRIDAE									
			Sarda chiliensis (Cuvier 1832)	Pacific bonito	2		2	SIO			AL-PA
			Scomber japonicus (Houttuyn 1782)	Pacific chub mackerel	2			CICIMAR, SIO			TR
		STROMATEIDAE									
			Peprilus simillimus (Ayres 1860)	Pacific pompano	3						OR-CZ
	COTTIFORMES										
		HEXAGRAMMIDAE									
			Ophiodon elongatus (Girard 1854)	Lingcod			1		S	Range extension South	AL-SD
			Zaniolepis frenata (Eigenmann & Eigenmann 1889)	Shortspine combfish	2	2		LACM, SIO			OR-CZ
			Zaniolepis latipinnis (Girard 1858)	Longspine combfish	2			LACM, SIO			OR-SD

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	COTTIFORMES (continued)										
		COTTIDAE									
			Chitonotus pugetensis (Steindachner 1876)	Soughback sculpin	2	2		LACM			NEP
			Clinocottus analis (Girard 1858)	Woolly sculpin	1, 2	1, 2	1, 2	UABC, LACM, SIO	I		OR-SD
			Icelinus cavifrons (Gilbert 1890)	Pit-head sculpin	2			LACM		Southern limit	OR-SD
			Icelinus fimbriatus (Gilbert 1890)	Fringed sculpin	3					Range extension South	OR-SD
			Icelinus quadriseriatus (Lockington 1880)	Yellowchin sculpin	2, 3			CAS, LACM, SIO			OR-SD
			Icelinus tenuis (Gilbert 1890)	Spotfin sculpin		2, 3		LACM		Southern limit	NEP
			Ruscarius creaseri	Roughcheek sculpin	2			SIO		Southern limit	OR-SD
			Scorpaenichthys marmoratus (Ayres 1854)	Cabezon	1, 2	2	1	UABC, LACM, SIO	I, S		AL-SD
		ANOPLOPOMATIDAE									
			Anoplopoma fimbria (Pallas 1814)	Sablefish		2, 3		LACM		Southern limit	NEP
		AGONIDAE									
			Agonopsis sterletus (Gilbert 1898)	Southern spearnose poacher	2			LACM, SIO		Southern limit	OR-CZ
			Odontopyxis trispinosa (Lockington 1880)	Pygmy poacher	2			LACM		Southern limit	NEP
			Xeneretmus ritteri (Gilbert 1915)	Stripefin poacher	3					Southern limit	SD
	PLEURONECTIFORMES										
		PARALICHTHYIDAE									
			Citharichthys fragilis (Gilbert 1890)	Gulf sanddab	2			CAS, SIO			SD-CZ
			Citharichthys sordidus (Girard 1854)	Pacific sanddab	2			CICIMAR, LACM, SIO			AL-CZ
			Citharichthys sp.		2			LACM			
			Citharichthys stigmaeus (Jordan & Gilbert 1882)	Speckled sanddab	2	2		CICIMAR, LACM, SIO			AL-CZ
			Citharichthys xanthostigma (Gilbert 1890)	Longfin sanddab	2	2		CICIMAR, SEMAR, CAS, LACM, SIO			SD-PA
			Etropus crossotus (Jordan & Gilbert 1882)	Fringed flounder	2			CICIMAR		Northern limit	AA
			Hippoglossina stomata (Eigenmann & Eigenmann 1890)	Bigmouth sole	2			CICIMAR, LACM			OR-CZ
			Paralichthys californicus (Ayres 1859)	California halibut	1, 2			IBUNAM, CICIMAR	S		OR-SD
			Xystreurys liolepis (Jordan & Gilbert 1880)	Fantail sole	2			LACM, SIO			OR-CZ

(continued)

TABLE 2 (Continued)

Systematic list of fishes of Cedros Archipelago, México, Northeastern Pacific. Classification according to Eschmeyer (2015). *Common name sensu Page et al. (2013); 1 = Fiel record, 2 = Museum recod, 3 = Literature; **Data from field surveys; ***BA = Biogeographic affinity: AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic province, PE = Peruvian province, POI = Pacific Oceanic Islands province, CG = Circumglobal, CT = Circumtropical, NWP = Northwestern Pacific, EP = Eastern Pacific, AA = AmphiAmerican. sensu Love et al. (2005) and Robertson and Allen (2015).

CLASS	ORDER	FAMILY	Scientific name	Common name*	Cedros	San Benito	Natividad	Museum data	Habitat**	Notes	BA***
ACTINOPTERI (continued)											
	PLEURONECTIFORMES (continued)										
		BOTHIDAE									
			Monolene asaedai (Clark 1936)	Dark flounder	3					Range extension North	CZ-PA
		PLEURONECTIDAE									
			Glyptocephalus zachirus (Lockington 1879)	Rex sole	3					Southern limit	NEP
			Lyopsetta exilis (Jordan & Gilbert 1880)	Slender sole	2	2		CICIMAR, SIO			AL-SD
			Parophrys vetulus (Girard 1854)	English sole	2			SIO		Southern limit	NEP
			Pleuronichthys coenosus (Girard 1854)	C-O sole			2	LACM		Southern limit	AL-SD
			Pleuronichthys decurrens (Jordan & Gilbert 1881)	Curlfin sole	2			CAS		Southern limit	AL-SD
			Pleuronichthys ritteri (Starks & Morris 1907)	Spotted turbot	2			LACM			OR-SD
			Pleuronichthys verticalis (Jordan & Gilbert 1880)	Hornyhead turbot	2		2	CICIMAR, LACM, SIO			OR-CZ
		CYNOGLOSSIDAE									
			Symphurus atricaudus (Jordan & Gilbert 1880)	California tonguefish	2			CICIMAR, CAS, LACM, SIO			OR-PA
	TETRAODONTIFORMES										
		BALISTIDAE									
			Sufflamen verres (Gilbert & Starks 1904)	Orangeside triggerfish	1, 3				S	Northern limit	TEP
		TETRAODONTIDAE									
			Sphoeroides lobatus (Steindachner 1870)	Longnose puffer			1		S		SD-CH
		DIODONTIDAE									
			Diodon holocanthus (Linnaeus 1758)	Balloonfish	2			CICIMAR			CT

TABLE 3

Fish species that present range extension in their distribution in Cedros Archipelago. Reference corresponds to the most updated geographic distribution reference for these species. *Represents field records in this study.

Scientific Name	Reference	Extension to:	Northern End	Southern End
*Bathygobius ramosus**	Robertson and Allen, 2015	North	24.55 N	06.11 S
Eleotris picta	Love et al. 2005	North	23.05 N	09.25 S
*Halichoeres notospilus**	Robertson and Allen, 2015	North	26.13 N	06.93 S
Hemiramphus saltator	Love et al. 2005	North	26.01 N	09.25 S
Lepophidium prorates	Love et al. 2005	North	27.01 N	05.10 S
Monolene asaedai	Love et al. 2005	North	24.51 N	08.50 N
Nannobrachium idostigma	Love et al. 2005	North	27.20 N	35.75 S
Platybelone argalus	Love et al. 2005	North	26.10 N	35.75 S
Prionotus ruscarius	Love et al. 2005	North	26.00 N	35.75 S
Acanthogobius flavimanus	Love et al. 2005	South	52.10 N	32.68 N
Chiasmodon niger	Love et al. 2005	South	47.33 N	32.43 N
*Gibbonsia montereyensis**	Love et al. 2005	South	53.75 N	29.05 N
Icelinus fimbriatus	Love et al. 2005	South	53.50 N	32.71 N
*Ophiodon elongatus**	Love et al. 2005	South	55.00 N	29.61 N
*Phanerodon furcatus**	Love et al. 2005	South	40.60 N	29.60 N
*Rhacochilus vacca**	Love et al. 2005	South	53.75 N	29.03 N
Sebastes flavidus	Love et al. 2005	South	59.50 N	30.49 N
*Sebastes hopkinsi**	Love et al. 2005	South	43.75 N	29.03 N
Sebastes paucispinis	Love et al. 2005	South	59.50 N	29.08 N

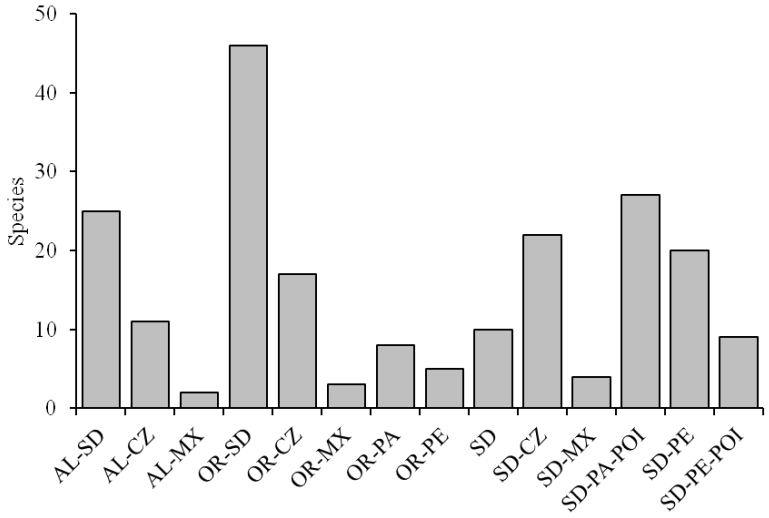

Figure 4. Distribution patterns of fish species of the Cedros Archipelago. (AL = Aleutian province, OR = Oregonian province, SD = San Diegan province, CZ = Cortez province, MX = Mexican province, PA = Panamic Province, PE = Peruvian province, POI = Pacific Oceanic Islands province)

rockpool blenny (*Hypsoblennius gilberti*), and the slender clingfish (*Rimicola eigenmanni*). Of these, the last four species were recorded in the field surveys at the CEA.

DISCUSSION

A comprehensive systematic checklist of the CEA, with a total of 269 species, is presented here. The biogeographic relationships of the fish assemblages from the CEA showed a separation from its counterparts in northern Baja California and California. Most of the fish community at the CEA (50%) has a temperate affinity (warm-temperate and cold-temperate) and the CEA represents the distribution limit for 106 species (40% of the species reported). The distribution range extension for 19 species is documented.

Based on these results, the archipelago has high species richness, 50% of the known species for the entire San Diegan province (Miller and Lea 1976; Horn et al. 2006) and 15% of those in the Cortez province (Hastings et al. 2010; Palacios-Salgado et al. 2012), are reported in this small insular territory. The CEA might be richer than coastal lagoons and bays on the Baja California Peninsula (Danemann and De la Cruz-Agüero 1993; De la Cruz-Agüero et al. 1994, 1996; Rosales-Casián

1996; Galván-Magaña et al. 2000) and even comparable with larger islands in the Gulf of California (155–190 spp.: Del Moral et al. 2013) and with those islands in the Tropical Eastern Pacific (203–363 spp.: Robertson and Cramer 2009; Erisman et al. 2011).

The species richness found in the CEA is the result of a blend of species consisting of 3 large groups with patterns of geographical distribution: 1) temperate species (warm and cold temperate) with limited intrusion into subtropical waters (51% of the species), 2) tropical species with limited intrusion into warm-temperate waters, and 3) tropical species with extended incursion into temperate waters of the Eastern Pacific (eurythermal species).

Field records showed greater species richness in Cedros (78 species), followed by Natividad and San Benito Islands, with 56 and 54 species, respectively. Although sampling effort is an important factor in species record accumulation, the sampled area for Cedros, Natividad, and San Benito is equivalent in number of transects, but not for sampling sites. The proximity between islands could assume a similarity in the fish assemblage, however the area of the islands may be an important factor. The perimeter of the island is an indicator of habitat availability and therefore increasing potential to provide shelter for more species (Planes et al. 2012). This relationship could not be obvious on islands with similar perimeters, however, the perimeter of Cedros is 6-fold higher than Natividad and 8-fold higher than San Benito.

The resulting nMDS (based on subtidal field surveys from eleven North-Eastern Pacific islands) shows the qualitative differences in fish composition along the CEA and the Southern California Bight islands. This analysis does not show the similarity pattern between San Benito and some of the Channel Islands (California) found by Pondella et al. (2005). A group of 24 species have the largest dissimilarities contribution (78%) between sites; most of them have a tropical affinity (e.g., *Abudefduf troschelii*, *Apogon retrosella*, *Caulolatilus princeps*, *Halichoeres semicinctus*, and *Zapterix exasperata*). The overall differences in the species richness between our field records and previous studies in San Benito (i.e., Pondella et al. 2005) may be related to the inclusion of diverse habitats in the field surveys (i.e., tidepools, and soft bottom), but also by the new records of a these tropical affinity species to the assemblage. Furthermore, transitional regions may be strongly influenced by seasonality, where environmental conditions can be dominant for one of the two converging regions (Horn et al. 2006), therefore inducing a shift in the presence of fish assemblages.

Comparisons to other islands and coastal rocky ecosystems highlight the importance of the CEA in terms of connectivity between warm-temperate and tropical regions. Nevertheless, conservation and management mechanisms such as Marine Protected Areas, Marine Reserves, or Marine Refuges have not yet been implemented in this region to date, excluding a small Marine Reserve at Natividad Island implemented by local fishermen 2006 (Micheli et al. 2012).

The fact that the CEA represents the distribution limit of 106 species (40% of the species reported) is evidence of the biogeographic transition zone. It has been extensively documented that the biogeographic boundaries work diffusely and that their boundaries are movable in response to climatic factors (Hubbs 1960).

This study represents the southernmost distribution extension for 10 species, and the northernmost distribution extension for 9 species. These findings may be explained by the scarcity of field studies in the region, but nevertheless, previous studies (Quast 1968; Mearns 1988; Lea and Rosenblatt 2000; Pondella et al. 2005; Palacios-Salgado and Ramirez-Valdez 2011) have noted a trend of tropical species being recorded farther north of their previously recognized distribution, especially crossing Bahía Magdalena, a geographic feature traditionally recognized as a biogeographical barrier. These extensions of distribution range may represent an indicator of the warming trend observed in this biogeographic province (Pondella et al. 2005).

In addition to the range extensions documented in this study, the record of tropical affinity species that have been reported in San Diego or even farther north are included. However, most of these records have been associated with El Niño events (Mearns 1988; Lea and Rosenblatt 2000). As some of the species were abundant and recurrent at the CEA, the record of these species in the CEA would represent their northernmost stable populations.

It is important to highlight the presence of some species in the archipelago that were absent in previous studies in the peninsula (Danemann and De la Cruz-Agüero 1993; Ruiz-Campos et al. 2010). This is the case for *Thalassoma lucasanum*, *Ophioblennius steindachneri*, *Chromis atrilobata*, and *Bodianus diplotaenia*, which were recorded farther north in Guadalupe Island (Reyes-Bonilla et al. 2010). The presence of fish species in islands and their absence on the mainland has been explained before by structural habitat differences rather than oceanographic differences (Ebeling et al. 1980), and this pattern can be important to consider when seeking to set priority among conservation areas. It also highlights the record in the Mexican coast for the Yellowfin goby (*Acanthogobius flavimanus*), a native species from the Northwestern Pacific that has been reported on the coast of California (Workman and Merz 2007).

To our knowledge, the presence of endemic species has not been recognized for the CEA. The record of *Gibbonsia norae* as an endemic species of Guadalupe Island

and San Benito (Hubbs 1960; Reyes-Bonilla et al. 2010) is now accepted as a semi-isolated population of *G. montereyensis* (Stepien and Rosenblatt 1991). Even though the proximity to the mainland may partly explain this absence of endemism, it is also known that limited endemism exists in the fish fauna of the west coast of the Baja California peninsula (Hubbs 1960).

This study demonstrates the importance of complementing recent underwater surveys with historical and museum records to prepare baseline information potentially useful for the conservation and management of fish communities. The CEA plays a key role on the connectivity in the biogeographic transition zone on the Pacific coast of the Baja California Peninsula.

SUMMARY

We documented the presence of 269 fish species in the Cedros Archipelago, and 105 species were recorded during field surveys. The observed species richness at the CEA may be the result of the confluence of three biogeographic provinces in the Pacific coast of Baja California peninsula, in addition to the proximity of the archipelago to the mainland coast and past terrestrial connection with the peninsula. Although habitat heterogeneity is an important factor in this ecosystem, our biogeographical analyses allowed us to identify the representation of 14 distribution patterns in the fish assemblage.

The biogeographic transition has a significant impact on the composition of fish communities is this region. That is evident when half of the species have temperate affinity and the rest is composed of species of tropical affinity and wide distribution. In addition, the implication as a biogeographic frontier is when the archipelago represents the distribution limit for 40% of registered species. Finally, the biogeographic analysis showed the low similarity between this island and its northern counterparts, marking the beginning of the transition to a subtropical region.

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