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The Bigeye Scad, *Selar crumenophthalmus* (Bloch, 1793) (Family Carangidae), New to the California Marine Fauna, with a List to and Keys for All California Carangids

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The anomalously warm waters of the northeast Pacific 2014–2015 brought with it a variety of subtropical and tropical fish species previously unusual or absent from California waters (Bond et al., 2015; pers. comm. M. McCrea, pers. comm.; J. Shepherd). On 1 February 2015, Mr. Keichi Yamamoto speared a fish that we have identified as *Selar crumenophthalmus* (Bloch, 1793), the bigeye scad (Fig. 1). The fish was captured in the midwaters of a kelp bed (bottom depth 8 m) off Rancho Palos Verdes (33°48′N, 118°24′W), southern California. This is the first time this species has been reported from off California. The fish he speared was one of approximately 10 conspecifics that were swimming with a school of juvenile jack mackerel, *Trachurus symmetricus* (Ayres, 1855). This specimen is housed in the fish collection at the Natural History Museum of Los Angeles County, LACM 58288-1.

We identified this fish (22.4 cm fork length) through the following diagnostic characters: Two papillae on the bone margin at the rear of the gill chamber (the lower one larger than the upper); the presence of a large eye (eye width greater than snout length) with adipose eyelid covers; and dorsal, anal, and pectoral fin counts and gill raker counts (Table 1). Meristics from our specimen fall within the range reported by other studies. Hardened scutes were present in the posterior lateral line. No finlets were present. The fish color was olive on dorsum, with a golden stripe along flanks, and a silvery belly. There was a diffuse golden ring around the eye.

Bigeye scad are normally circumtropical. In the western Pacific, they have been found as far northward as the Pacific coast of southern Japan (Nakabo, 2002) and Sea of Japan (Parin, 2003). Previous to this capture, the eastern Pacific range was from Lagunas Ojo de Liebre-Guerrero Negro, central Baja California (Galván-Magaña et al., 2000) to Cabo Blanco, Peru (Chirichigno, 1974), including the Gulf of California (Smith-Vaniz in Fischer et al., 1995), Islas Galápagos (Grove and Lavenberg, 1997), Isla de Malpelo, Isla de Coco, Isla Clipperton, and Islas Revillagigedo (Robertson and Allen, 2008). This is a pelagic species found from surface waters to depths of 170 m (558 ft) (Randall et al., 1990, Allen and Robertson, 1994). It reaches a maximum length of 70 cm (Kuiter and Tonozuka, 2001).

Of particular interest is that Mr. Yamamoto first observed a similar number of what were likely the same species in the same location in November 2014, also mixed in with juvenile jack mackerel. In addition, Mr. Yamamoto continued to observe bigeye scad at this location to as late as early March 2015, at this time swimming with a school of juvenile Pacific barracuda (*Sphyraena argentea* Girard, 1852). These sightings suggest that at least some bigeye scad may remain within a relatively circumscribed area for lengthy periods.

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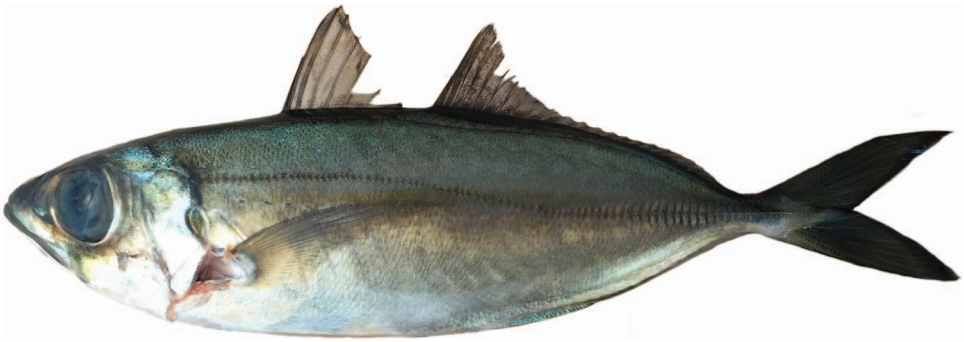

Fig. 1. A bigeye scad, *Selar crumenophthalmus* (Bloch, 1793), taken on 1 February 2015, off Rancho Palos Verdes (33°48′N, 118°24′W), southern California. Catalogued in the Los Angeles County Museum of Natural History as LACM 58288-1.

The addition of the bigeye scad to the California marine fauna brings the total number of jack species taken from these waters to 16 (Table 2). The last key to the California species (Miller and Lea, 1972) was based on 13 species and we include a new key to all known California species, using the key to eastern Pacific species created by W. F. Smith-Vaniz in Fischer et al. (1995) as a starting point. We note that this new key was tested on individuals of all carangids found in California waters. In addition to the California species, we have also included in the key the Japanese amberjack, *Seriola quinqueradiata* Timminck & Schlegel, 1845. In 2015, this species was found inside the wreckage of a Japanese vessel destroyed in the Fukishima tsunami that had floated to the Oregon coast (J. Burke, pers. comm.) raising the possibility of future captures off California. In addition, this species is often sold in California fish markets and in our experience this has led enforcement officers to confuse it with the eastern Pacific species, the yellowtail, *Seriola dorsalis* Gill (1863).

Key to the California Carangidae

1a Head profile strongly oblique; very small, embedded scales, leading to apparently naked body; very compressed body in adults 2

1b Head profile not strongly oblique; no embedded scales; moderately compressed body in adults 3

2a Oblique head profile has a slight concavity in front of eyes; small juveniles with an oval black spot above the straight portion of the lateral line: . . . . . *Selene peruviana*

2b Oblique head profile lines nearly straight in front of eyes; small juveniles with 4 or 5 interrupted dark vertical stripes on the body: . . . . . *Selene brevoortii*

3a *From 1b: Head profile not strongly oblique…*
Posterior straight part of lateral line with hardened scutes or bony shields, scutes can be poorly developed 4

3b Posterior straight part of lateral line without scutes (only pored scales, not enlarged) 12

Table 1. Meristics of bigeye scad, *Selar crumenophthalmus* (Bloch, 1793) from this study, Moser et al. (1996), Nakabo (2002), and Robertson and Allen (2015).

Source	Dorsal fin	Anal fin	Pectoral fin	Gill rakers 1st arch
This study	VIII+I,27	II+I,23	23	11+27[1]
Moser et al. (1996)	VIII+I,24–27	II+I,20–23	19–23	9–12+27–37
Nakabo (2002)	VIII+I,23–28	II+I,21–23		9–12+24–31
Robertson and Allen (2015)	VIII+24–27	II+I,21–23		9–12+27–37

[1] Counts from right arch as left gill arches were lost during capture.

Table 2. Members of the family Carangidae that are known from California waters, with notes on their maximum sizes, and geographic and depth ranges.

Caranx caballus Günther, 1868. Green Jack. To at least 70 cm TL (Allen and Robertson 1994). Monterey Bay, central California (Lea and Walker 1995) to Chile (Pequeño 1989), including Gulf of California (Robertson and Allen 2002), Islas Galápagos (Miller and Lea 1972), and Hawaii (Randall and Carlson 1999). Surf zone and to 100 m (min.: Carlisle et al. 1960; max.: De La Cruz-Agüero et al. 1997). D VIII + I,21–25; A II + I,17–24; Pect. 20; LL scutes 45–56; GR 13–16 + 25–32; Vert. 25. Recently as *Carangoides caballus* (Randall 2007).

Caranx caninus Günther, 1867. Pacific Crevalle Jack. To 100 cm TL (Smith-Vaniz in Fischer et al. 1995). Warm waters of eastern Pacific; Huntington Beach, southern California (Miller and Curtis 2008) to Iquique, northern Chile (Sielfeld et al. 2010), including Gulf of California (Robertson and Allen 2002), Islas Galápagos (Grove and Lavenberg 1997), and other offshore islands (Robertson and Allen 2002). Surface to 350 m (Smith-Vaniz in Fischer et al. 1995). D VII–VIII + I,18–23; A II+I,15–18; Pect. I,18–21; LL shields 25–42; GR 15–19 on lower limb; Vert. 24. Some previous records report this as *Caranx hippos*; however that species is now considered a separate Atlantic and Caribbean taxa.

Caranx sexfasciatus Quoy & Gaimard, 1825. Bigeye Trevally. To 120 cm TL (Sadovy and Cornish 2000). Pacific and Indian oceans; southern Japan (Nakabo 2002); San Diego Bay, southern California (Lea and Walker 1995) to northern Peru (Robertson and Allen 2015), including lower Gulf of California (Robertson and Allen 2002) and Islas Galápagos (Grove and Lavenberg 1997). Shallow, near reefs (Moser 1996), 1–96 m (min.: González-Acosta et al. 1999; max.: Myers 1999). D VII–VIII + I,19–22; A II + I,14–17; Pect. 18–21; Pelvic I,5; GR 4–8 + 15–19; Vert. 25.

Caranx vinctus Jordan & Gilbert, 1882. Cocinero. To 38 cm TL (Amezcua Linares 1996). San Diego Bay, southern California (Lea and Rosenblatt 2000) to Tumbes, Peru (Chirichigno and Vélez 1998), including central and southern Gulf of California (Robertson and Allen 2002). Surface to 50 m (De La Cruz-Agüero et al. 1997). D VII–VIII + I,22–24; A II+I,18–21; Pect. 19; GR 11–12 + 28–30; Vert. 25. Also recently as *Carangoides vinctus* (Angulo et al. 2013).

Chloroscombrus orqueta Jordan & Gilbert, 1883. Pacific Bumper. To 31 cm SL [about 38.8 cm TL) (Amezcua Linares 1996). San Pedro, southern California (Miller and Lea 1972) to Chilca, Peru (Beltrán-León and Rios Herrera 2000), including Gulf of California (Smith-Vaniz in Fischer et al. 1995) and Isla Malpelo (Robertson and Allen 2002). Shallow coastal waters and estuaries (Moser 1996) to 53 m (Zeballos 1998). D VII–VIII + I,26–30; A II + I,25–30; Pect. 19–21; Pelvic I,5; LL shields nearly obsolete, less than 20; GR 8–10 + 30–37; Vert. 24.

Decapterus muroadsi (Temminck & Schlegel, 1844). Amberstripe Scad. To about 55 cm TL (Robertson and Allen 2002). Warm waters of Pacific; Japan to East China Sea (Masuda et al. 1984); Pacific Grove, central California (Miller and Lea 1972) to Peru (Moser 1996), Easter Island (Pequeño 1989), and Islas Galápagos (Grove and Lavenberg 1997); apparently not in Gulf of California (Robertson and Allen 2002). Surface to 320 m (Mundy 2005). D VII+VIII + I,29–33 + finlet; A II + I, 25–29 + 1 finlet; Pect. 22–23; LL enlarged shields about 30; GR 13–16 + 37–42; Vert. 24. Includes *Decapterus hypodus* Gill, 1862, and *Decapterus scombrinus* (Valenciennes, 1846) as junior synonyms.

Naucrates ductor (Linnaeus, 1758). Pilotfish. To 70 cm TL (Smith-Vaniz in Fischer et al. 1995). Circumglobal; in western Pacific as far north as Japan (Nakabo 2002) and southern Kuril Islands (Savinykh 1998); Vancouver Island, British Columbia (Eschmeyer and Herald 1983) to Chile (Pequeño 1989), including Gulf of California (Smith-Vaniz in Fischer et al. 1995) and such offshore islands as Islas Galápagos (Miller and Lea 1972). Surface to 150 m (Robertson and Allen 2002). D III–VI + I,24–29; A I–II + I,15–18; Pect. 18–20; Pelvic I,5; GR 5–8 + 12–19 = 18–26; Vert. 25.

Selar crumenophthalmus (Bloch, 1793). Bigeye Scad. To 70 cm (Kuiter and Tonozuka. 2001). Circumglobal; Pacific coast of southern Japan (Nakabo 2002) and Sea of Japan (Parin 2003); Palos Verdes, southern California (this paper) to Cabo Blanco, Peru (Chirichigno 1974), including Gulf of California (Smith-Vaniz in Fischer et al. 1995) and Islas Galápagos (Grove and Lavenberg, 1997), Isla de Malpelo, Isla de Coco, Isla Clipperton, and Islas Revillagigedo (Robertson and Allen, 2008). Surface to 170 m (min.: Allen and Robertson 1994; max.: Randall et al. 1990). D VIII + I,23–28; A II + I, 20–23; Pect. 19–23; GR 9–12 + 24–37; Vert. 24.

Table 2. Continued.

Selene brevoortii (Gill, 1863). Mexican Lookdown. To 42 cm TL (Robertson and Allen 2002). Seal Beach, southern California (Jarvis et al. 2009) to northern Chile (Sielfeld et al. 2010), including Gulf of California (Smith-Vaniz in Fischer et al. 1995). Coastal waters, including bays and estuaries (Moser 1996), to 50 m (Robertson and Allen 2002). D VII–VIII + I,20–24; A II + I,17–19; Pect. 18–19; GR 5–9 + 28–34; Vert. 24.

Selene peruviana (Guichenot, 1866). Pacific Moonfish. To variously between 35 cm TL (Velasco and Thiel 2002) and 85 cm TL (Franke and Acero 1993). Long Beach, southern California (Miller and Lea 1972) to Chile (Pequeño 1989), including Gulf of California (Smith-Vaniz in Fischer et al. 1995) and Islas Galápagos (Grove and Lavenberg 1997). Inshore (Grove and Lavenberg 1997) and shallow coastal waters (Moser 1996) to 450 m (Franke and Acero 1993). D VIII + I,20–24; A II + I,16–19; LL shields nearly obsolete; GR 8 + 28–32; Vert. 24.

Seriola dorsalis Gill (1863). Yellowtail. To at least 1.5 m (5 ft) TL (Miller and Lea 1972). In eastern Pacific from northern British Columbia (54°35′N, 31°00′W; Nagtegaal and Farlinger 1981) to central Mexico (Robertson and Allen 2015), including Gulf of California (Miller and Lea 1972), Islas Galápagos (Grove and Lavenberg 1997), and Isla Malpelo (Robertson and Allen 2002). Unverified reports from Gulf of Alaska off Kodiak Island and Cordova (Mecklenburg et al. 2002). Primarily epipelagic, recorded from surface to at least 91 m (300 ft) (min.: Miller and Lea 1972; max.: N. Ben-Aderet, pers. comm.). Individuals from the eastern Pacific have recently been referred to as the widely distributed *Seriola lalandi* Valenciennes, 1833. However, we follow Martinez-Takeshita et al. (2015) and limit the distribution of *S. lalandi* to the Southern Hemisphere, resurrecting *S. aureovittata* Temminck & Schlegel (1845) in the northeast Pacific, and *S. dorsalis* in the eastern Pacific. D IV–VII + I,29–39; A O–II + I,19–25; Pect. 19–20; Pelvic I,5; GR 5–10 + 15–22; Vert. 25.

Seriola rivoliana Valenciennes, 1833. Almaco Jack. To 160 cm FL [about 176 cm TL] (IGFA). Circumglobal; Korea (Kim et al. 1997) and southern Japan (Nakabo 2002); Oceanside, southern California (Eschmeyer and Herald 1983) to Cabo Blanco, Peru (Chirichigno and Vélez 1998), including Gulf of California (Smith-Vaniz in Fischer et al. 1995) and Islas Galápagos (Eschmeyer and Herald 1983). Pelagic, at depths of 1–250 m (min.: Kuiter and Tonozuka 2001; max.: Robertson and Allen 2002). D VIII + I,26–33; A II + I,18–21; Pect. 19–22; LLs 167; GR 6–9 + 16–19 = 22–28; Vert. 24.

Trachinotus paitensis Cuvier, 1832. Paloma Pompano. To 50.8 cm TL (Miller and Lea 1972). Redondo Beach, southern California (Miller and Lea 1972) to Chile (Pequeño 1989), including Gulf of California and Islas Galápagos (Miller and Lea 1972). Shallow inshore areas (Miller and Lea 1972) and to 100 m (Amezcua Linares 1996). D VI–VIII,20–27; A II+I (occasionally III),20–24; Pect. 16–18; Pelvic I,5; GR 9–11 + 11–17; Vert. 24.

Trachinotus rhodopus Gill, 1863. Gafftopsail Pompano. To 61 cm TL (Miller and Lea 1972). Zuma Beach, southern California (Miller and Lea 1972) to Callao, Peru (Chirichigno and Vélez 1998), including southern and central Gulf of California (Robertson and Allen 2002) and Islas Galápagos (Miller and Lea 1972). Surface to 30 m (min.: Robertson and Allen 2002; max.: Amezcua Linares 1996). D V–VI + I,19–21; A II + I,17–21; Pect. 18–19; Pelvic I,5; GR 8–10 + 13–16 = 21–26; Vert. 24.

Trachurus symmetricus (Ayres, 1855). Jack Mackerel. To 81.3 cm TL (Miller and Lea 1972). Pacific Ocean south of Aleutian Islands (Mecklenburg et al. 2002 [UW 15469]) and in Gulf of Alaska to Gulf of California (Smith-Vaniz in Fischer et al. 1995) and to Acapulco, Mexico (Palacios-Salgado et al. 2014). Primarily pelagic, surface (Miller and Lea 1972) from surf zone (Carlisle et al. 1960) and offshore to 403 m (Hart 1973). Although *Trachurus murphyi* Nichols, 1920, found off South America, is considered by some authors (e.g., Grove and Lavenberg 1997) to be a subspecies of *T. symmetricus*, DNA evidence indicates it is a separate species (Poulin et al. 2004). D VIII + I,28–38; A II + I,22–33; Pect. 21–24; Pelvic I,5; LLs 87–111, the later 40–55 as enlarged shields; GR 7–15 + 25–42 = 32–57; Vert. 23–25.

Uraspis helvola (Forster, 1801). Whitemouth Jack. To 58 cm TL (Jiménez Prado and Béarez 2004). Indo-Pacific; perhaps southern Kuril Islands (Savinykh and Shevtsov 2001) and southern Japan (Nakabo 2002); Santa Catalina Island, southern California (Miller and Lea 1972), southernmost Gulf of California (J. Snow, pers. comm.), and at a number of more southerly locations (Robertson and Allen 2015) to Ecuador (Béarez 1996), including Islas Galápagos (Grove and Lavenberg 1997). 10–300 m (Robertson and Allen 2002). D V–VIII + I,25–30; A II + I,19–22; Pect. I,22; LL with 32–38 keeled shields; GR 6 + 16 = 22. The Santa Catalina Island specimen was originally identified as *Uraspis secunda* (Fitch 1972). However, *U. secunda* appears to be an Atlantic and Indo-Central Pacific species (W. Smith-Vaniz and R. Robertson, pers. comms. to M. L.).

4a Lateral line with reduced (very stunted), barely perceptible scutes; a black spot on the saddle of the upper region of the caudal peduncle; strongly compressed body: . . . . . *Chloroscombrus orqueta*

4b Well-developed lateral line scutes; caudal peduncle without black spot; body not strongly compressed 5

5a Dorsal accessory branch of the lateral line extends at least to below origin of 2nd dorsal fin, usually farther posteriorly: . . . . . *Trachurus symmetricus*

5b Dorsal accessory branch of the lateral line terminating before origin of dorsal fin. 6

6a Independent 2-rayed finlet at caudle peduncle (dorsal and ventral): . . . . . *Decapterus muroadsi*

6b Second dorsal and anal fins without finlets 7

7a Cleithrum, under the operculum, with a furrow (groove) on the ventral side, a large papilla-like structure immediately above the groove; eye nearly covered by an adipose eyelid, forming a vertical slit on the center of the pupil: . . . . . *Selar crumenophthalmus*

7b Smooth-edge cleithrum; adipose eyelid marginally covering eye but not pupil 8

8a Tongue, roof, and floor of mouth white, the rest black; no teeth on vomer or palatines: . . . . . *Uraspis helvola*

8b Lining of mouth not distinctly black and white; teeth present on vomer and palatines. 9

9a Breast without scales except for a small patch of scales at base of pelvic fins (prepelvic): . . . . . *Caranx caninus*

9b Breast completely scaled. 10

10a Number of scutes in the lateral line 26–42; total number of gill rakers on the lower limb (including rudiments) 15–22; lobe of second dorsal fin with a white tip and its height into fork length 5.0 to 6.6 times in adults: . . . . . *Caranx sexfasciatus*

10b Number of scutes in the lateral line 42–56; total number of gill rakers on the lower limb (including rudiments) 27–30; lobe of second dorsal fin without white tip and its height into fork length 6.0 to 8.0 times in adults. 11

11a In adults, body without dark vertical stripes; scaly basal sheath along the lobes of the dorsal and anal fins with relatively narrow scales, above which the fins are almost entirely covered with small scales; back of the eye covered by a weak adipose eyelid extending to the rear edge of the pupil: . . . . . *Caranx caballus*

11b In adults, body with 8–9 dark incomplete vertical stripes; scaly basal sheath along the lobes of the dorsal and anal fins with relatively wide scales above which the fins are devoid of small scales; back of the eye covered by a weak adipose eyelid that does not reach the posterior edge of the pupil: . . . . . *Caranx vinctus*

12a *From 3b*: *Posterior straight part of lateral line without scutes…*
Caudal-peduncle grooves (or shallow notch) present dorsally and ventrally; base of soft dorsal and anal fins unequal in length with anal-fin base shorter (only about 45–70%) than dorsal-fin base length 13

12b Caudal-peduncle grooves absent; base of soft anal fin as long as, or only slightly shorter than, base of dorsal fin 15

13a Fleshy keel on caudal peduncle well developed; soft anal-fin rays 15–17; body with 5–6 dark vertical bars, extending to bases of dorsal and anal fins: . . . . . *Naucrates ductor*

13b Fleshy keel on caudal peduncle absent to moderately developed; soft anal-fin rays 18–22; body lacking obvious wide vertical bars. 14

14a Longest dorsal soft-ray about 1/2 length of head; relatively slender supramaxilla; caudal fin yellowish; yellow stripe along mid-body; head longer than body depth at origin of dorsal fin: . . . . . *Seriola dorsalis*

Note: *Seriola quinqueradiata* can be differentiated from *S. dorsalis* by 1) the latter's more rounded dorsoposterior corner of upper jaw (Figure 2) and 2) a pectoral fin shorter than pelvic fin versus 1) more angular and 2) almost equal in length.

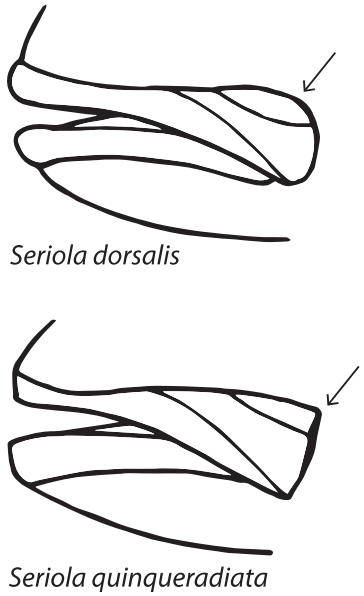

Fig. 2. An illustration comparing the upper jaw shapes of *Seriola dorsalis* and *S. quinqueradiata.* Note the more rounded dorsoposterior corner of the upper jaw of *S. dorsalis.*

14b Longest dorsal soft-ray about 2/3 length of head in fish over 18 cm fork length; relatively broad supramaxilla; caudal fin dark to dusky; black stripe radiating from mandibles, through eye, to 1st dorsal spines; head shorter than body depth at origin of dorsal fin: . . . . . .*Seriola rivoliana*

15a *From 12b*: *Caudal-peduncle grooves absent*…
First 4–5 dorsal and anal soft-rays elongated, longer than head length in fish over 8 cm fork length; in adults, 4–6 incomplete vertical bars extending beyond the lateral line; 22–26 gill rakers (8–10 on upper limb):. . . . . *Trachinotus rhodopus*

15b First 4–5 dorsal and anal soft-rays equal to or shorter than head length; in adults, no vertical bars as described above; 15–18 gill rakers (5–7 on upper limb): . . . . . *Trachinotus paitensis*

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Literature Cited

Allen, G.R. and D.R. Robertson. 1994. Fishes of the tropical eastern Pacific. University of Hawaii Press, Honolulu.

Amezcua Linares, F. 1996. Peces demersales de la platforma continental del Pacífico Central de México. Instituto de Ciencias del Mar y Limnologíca, Universidad Nacional Autónoma de México.

Angulo, A., C.A. Garita-Alvarado, W.A. Bussing, and M.I. López. 2013. Annotated checklist of the freshwater fishes of continental and insular Costa Rica: additions and nomenclatural revisions. Check List 9:987–1019.

Béarez, P. 1996. Lista de los peces marinos del Ecuador continental. Rev. Biol. Trop., 44:731–741.

Beltrán-León, B.S. and R. Rios Herrera. 2000. Estadios tempranos de peces del Pacific Colombiano. Republica de Colombia. Instituto Nacional de Pesca y Acuicultura INPA.

Bond, N.A., M.F. Cronin, H. Freeland, and N. Mantua. 2015. Causes of impacts of the 2014 warm anomaly in the NE Pacific. Geophys. Res. Letters 42, doi:10.1002/2015GL063306.

Carlisle, J.G. Jr., J.W. Schott, and N.J. Abramson. 1960. The barred surfperch (*Amphistichus argenteus* Agassiz) in southern California. Calif. Dep. Fish Game Fish Bull. 109.

Carpenter, K.E. and V.H. Niem (eds.). 1999. The living marine resources of the Western Central Pacific. Vol. 3. Batoid fishes, chimaeras and bony fishes part 1 (Elopidae to Linophrynidae). Vol. 4. Bony fishes part 2 (Mugilidae to Carangidae). FAO, Rome.

Chirichigno, F.N. 1974. Clave para identificar los peces marinos del Peru. Instituto del Mar del Peru Informe, No. 44.

Chirichigno, F.N. and J. Vélez D. 1998. Clave para identificaticar los peces marinos del Peru (segunda edición, revisada y actualizada). Instituto de Mar de Peru. Publicación Especial.

De La Cruz-Agüero, J., M.A. Martínez, V.M. Cota-Gómez, and G. De La Cruz-Agüero. 1997. Catalogo de los peces marinos de Baja California sur. Centro Interdiscipinario de Ciencias Marinas.

Eschmeyer, W.N. and E.S. Herald. 1983. A field guide to Pacific Coast fishes of North America from the Gulf of Alaska to Baja California. Houghton Mifflin, Boston.

Fitch, J.E. 1972. The cottonmouth jack, *Uraspis secunda*, added to the marine fauna of California. Calif. Fish Game, 58:245–246.

Franke, R. and A. Acero P. 1993. Peces carangoideos del Parque Gorgona, Pacifico Colombiano (Osteichthys: Carangidae, Nematistiidae y Coryphaenidae). Rev. Biol. Mar., Valparaiso, 28:51–73

Galván-Magaña, F., F. Gutiérrez-Sánchez, L.A. Abitia-Cárdenas, and J. Rodriquez-Romero. 2000. The distribution and affinities of the shorefishes of the Baja California Sur lagoons. Pp. 383–398 in Aquatic ecosystems of Mexico: status and scope. Ecovision World Monograph Series (M. Munawar, S.G. Lawrence, I. F. Munawar, and Malle, D.F. eds.). Backhuys Publisher, Leiden, The Netherlands.

González-Acosta, A.F., G. De La Cruz-Agüero, J. De La Cruz-Agüero, and G. Ruiz-Campos. 1999. Ictiofauna asociada al manglar del Estero el Conchalito, Ensenada de la Paz, Baja California Sur, México. Oceánides, 14(2):121–131.

Grove, J.S. and R.J. Lavenberg. 1997. The Fishes of the Galápagos Islands. Stanford University Press, Stanford, California.

Hart, J.L. 1973. Pacific Fishes of Canada. Fish. Res. Board Can., Bull. 180.

Jarvis, E.T., H.L. Gliniak, O. Horning, and C. Linardich. 2009. Occurrence of juvenile Mexican lookdown, *Selene brevoortii* (Gill, 1863), in Seal Beach, California. California Fish and Game, 95:188–192.

Jiménez Prado, P. and P. Béarez. 2004. Peces marinos del Ecuador continental/marine fishes of continental Ecuador. SIMBIOE/NAZCA/IFEA TOMO II. Quito.

Kim, Y.S., Y.U. Kim, and G. Ahn. 1997. First record of the carangid fish, *Seriola rivoliana* from Korea. Korean J. Ichthyol., 9:244–247.

Kuiter, R.H. and T. Tonozuka. 2001. Pictorial Guide to Indonesian Reef Fishes. Part 1. Eels–Snappers, Muraenidae–Lutjanidae. Zoonetics, Australia. 302 pp.

Lea, R.N. and R.H. Rosenblatt. 2000. Observations on fishes associated with the 1997–98 El Niño off California. CalCOFI Rep., 41:117–129.

Lea, R.N. and H.J. Walker Jr. 1995. Record of the bigeye trevally, *Caranx sexfasciatus*, and Mexican lookdown, *Selene brevoorti*, with notes on other carangids from California. Calif. Fish Game, 81:89–95.

Martinez-Takeshita, N., C.M. Purcell, C.L. Chabot, M.T. Craig, C.N. Paterson, J.R. Hyde, and L.G. Allen. 2015. A tale of three tails: cryptic speciation in a globally distributed marine fish of the genus *Seriola*. Copeia, 103(1):357–368.

Masuda, H., K. Amaoka, C. Araga, T. Uyeno, and T. Yoshino. 1984. The Fishes of the Japanese Archipelago. Tokai Univ. Press.

Mecklenburg, C.W., T.A. Mecklenburg, and L.K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, Maryland.

Miller, D.J. and R.N. Lea. 1972. Guide to the coastal marine fishes of California. Calif. Dep. Fish Game Fish Bull. 157.

Miller, E.F. and M.D. Curtis. 2008. First occurrence of a Pacific crevalle jack, *Caranx caninus*, north of San Diego, California. Bull. S. Calif. Acad. Sci., 107:41–43.

Moser, H.G. (ed.). 1996. The early stages of fishes in the California Current region. CALCOFI (California Cooperative Oceanic Fisheries Investigations) Atlas No. 33. U.S. Department of Commerce, NOAA, NMFS, Southwest Fisheries Science Center, La Jolla, California.

Mundy, B.C. 2005. Checklist of the Fishes of the Hawaiian Archipelago. Bishop Museum Press, Honolulu, Hawaii.

Myers, R. F. 1999. Micronesian Reef Fishes. Coral Graphics, Barrigada, Guam.

Nagtegaal, D.A. and S.P. Farlinger. 1981. First record of two fishes, *Seriola dorsalis* and *Medialuna californiensis*, from waters off British Columbia. Syesis 13:206–207. [Journal dated 1980 but not issued until 1981.]

Nakabo, T. (ed.). 2002. Fishes of Japan with Pictorial Keys to the Species, English edition. Tokai University Press, Tokyo.

Palacios-Salgado, D. S., A. Ramírez-Valdez, A. A. Rojas-Herrera, J. G. Amores, and M. A. Melo-García. 2014. Marine fishes of Acapulco, Mexico (eastern Pacific Ocean). Mar. Biodiv. 44:471–490.

Parin, N.V. 2003. An annotated catalogue of fish-like vertebrates and fishes of the seas of Russia and adjacent countries: Part 3. Orders Perciformes (excluding suborders Gobioidei, Zoarcoidei and Stichaeoidei) and Tetraodontiformes. J. Ichthyol. 43:S1–S40.

Pequeño R.G. 1989. Peces de Chile lista sistematica revisada y comentada. Rev. Biol. Mar. (Valparaiso) 24:1–132.

Poulin, E., L. Cardenas, C.E. Hernandez, I. Kornfield, and F.P. Ojeda. 2004. Resolution of the taxonomic status of Chilean and California jack mackerels using mitochondrial DNA sequence. J. Fish Biol. 65:1160–1164.

Randall, J. 2007. Reef and Shore Fishes of the Hawaiian Islands. Sea Grant College Program, University of Hawai'i, Honolulu.

Randall, J. and B.A. Carlson. 1999. *Caranx caballus*, a new immigrant carangid fish to the Hawaiian Islands from the tropical eastern Pacific. Pac. Sci. 53:357–360.

Randall, J., G.R. Allen, and R.C. Steene. 1990. Fishes of the Great Barrier Reef and Coral Sea. University of Hawaii Press, Honolulu.

Robertson, D.R. and G.R. Allen. 2002. Shorefishes of the Tropical Eastern Pacific: an Information System. CD-ROM. Smithsonian Tropical Research Institute, Balboa, Panama.

Robertson, D.R. and G.R. Allen. 2008. Shorefishes of the tropical eastern Pacific: an information system. Version 1.0 (2008). Smithsonian Tropical Research Institute, Balboa, Panama. www.neotropicalfish.org/sftep.

Robertson, D.R. and G.R. Allen. 2015. Shorefishes of the Tropical Eastern Pacific: an Information System. Version 2.0. Smithsonian Tropical Research Institute, Balboa, Panama. http://biogeodb.stri.si.edu/sftep/en/pages. Accessed 2 June 2015.

Sadovy, Y. and A.S. Cornish. 2000. Reef fishes of Hong Kong. Hong Kong University Press, Hong Kong.

Savinykh, V.F. 1998. Nekton composition of near-surface waters of the subarctic front zone in the northwest part of the Pacific Ocean according to the data of drift-net catches. J. Ichthyol. 38:18–27.

Savinykh, V.F. and G.A. Shevtsov. 2001. Two new species from Russian fauna from the waters of the southern Kuril Islands. J. Ichthyol. 41:122–124.

Sielfeld, W., J. Laudien, M. Vargas, and M. Villegas. 2010. El Niño induced changes of the coastal fish fauna off northern Chile and implications for ichthyogeography. Rev. Biol. Mar. Oceanog. 45, S1:705–722.

Smith-Vaniz, W. F. 1995. Carangidae. Pp. 940–986 in Guía FAO para la identificación para los fines de la pesca. Pacifico centro-oriental (Fischer, W., F. Krupp, W. Schneider, C. Sommer, K. E. Carpenter, and V. H. Niem eds.). Vol. II, Vertebrados, Parte 1. Vol. III, Vertebrados, Parte 2. FAO, Rome.

Velasco, A. and R. Thiel. 2002. A bilingual field manual for the identification of juvenile fish over soft bottom off the Pacific Coast of Colombia a review from literature. Arch. Fish. Mar. Res. 50:55–118.

Zeballos, J., M. Samame, and M. Robero. 1998. Estructura especiologica demersal observada durante el Crucero de Evaluación de la Merluza entre Puerto Pizarro y Huarmey. BIC José Olaya Balandra 9806-07. Inf. Inst. Mar Perú 138:87–100.