Additional file 1

Marine algae, invertebrates and fishes observed from 2013 to 2018 in central California, southern California, and the western Baja California Peninsula are listed below alphabetically by genus and species. Range data and references are listed for all 29 species, along with type of change (i.e. expansion, extension, reappearances, abundance increases, shifts into new habitats, and range contractions) and comments related to the methods, location and timing of capture, record type (e.g., specimen, photo, personal observation), life history stage, identifying characteristics, and observer anecdotes.

*Achelous* *xantusii* (Stimpson, 1860). Xantus’ swimming crab.

Published range: Morro Bay, CA to Punta Piaxtla, México (Jensen 2014).

Change: Range expansion 370 km northward to Tomales Bay, CA (38.22836111, -122.97172222).

Comments: The genus recently reverted to *Achelous* from *Portunus* based on molecular analyses (Mantelatto et al. 2018). Divers searching for the invasive kelp *Undaria* *pinnatifida* in Monterey Harbor observed this distinctive looking crab on the bottom of the harbor, partially buried in fine sediment and shell debris. A single crab was photographed on 3 June 2016 in Monterey Harbor under H-tier (36.604414° N, -121.891216° W) at a depth of 3 m. Researchers (T. Grimes and R. Eby) at ESNERR trapped a single crab on nine separate dates from June to November 2016, constituting the first record of this species in Elkhorn Slough. In 2016 citizen scientists in the San Francisco bay area using the iNaturalist phone application captured photos of live crabs (later confirmed by experts as *A*. *xantusii*) on three different occasions in three locations: Alameda 15 March (http://www.inaturalist.org/observations/2786987), San Mateo 4 June (http://www.inaturalist.org/observations/3384283), and San Francisco 31 December (http://www.inaturalist.org/observations/4875295). Sadowski et al. (2018) also trapped multiple individuals in Tomales Bay, first near Marshall, CA on 21 and 22 August 2016 and again on 22 November 2016 at a survey site 2 km south of Dillon Beach, CA at the mouth of Tomales Bay. The northernmost record in Tomales Bay listed by Sadowski et al. represents a northward range expansion of 370 km from the previously unpublished northern range record at Morro Bay.

*Alphestes immaculatus* (Breder, 1936). Pacific mutton hamlet.

Published range: Northern Gulf of California to Peru, including the Galapagos Islands (Heemstra and Randall, 1993).

Change: Range expansion 577 km northward to La Bocana, BCS (26.75858°, -113.6963°).

Comments: On 17 October 2016 divers at La Bocana observed a single fish (12 cm total length) at a depth of about 12 m and water temperature of 17°C. This is the first report of this species on the Pacific Coast of Baja California. The previous northern range endpoint was within the Gulf of California, and this record is on the western side of the Baja California Peninsula. The range expansion distance (577 km) along the open coast is a conservative estimate based on a straight-line measurement from the dive site in La Bocana to tip of Cabo San Lucas.

*Aplysia* *californica* J.G. Cooper, 1863. California sea hare.

Published range: Yaquina Bay, OR (Goddard et al. 2016) to El Salvador (Behrens and Hermosillo 2005).

Change: Increased abundance of juveniles and adults.

Comments: Goddard et al. (2016) note observing *A*. *californica* in Monterey Harbor for the first time in 2014 despite having sampled the harbor since 2008. However, we observed several *A*. *californica* in an egg-laying aggregation within Monterey Harbor on 28 April 2011 for each year from 2013 to 2018, prior to the report in Goddard et al. (2016). Adults were also photographed in the harbor during both May and December 2011. Outside the harbor, adults were photographed on 19 July 2011 at Lovers Cove in Monterey Bay. In March and June 2013 several young adults were photographed in Monterey Harbor. An egg-laying aggregation was observed 18 July 2013 on rocks in the Hopkins kelp bed, and adults were again photographed 14 August 2013 within the same kelp forest. In 2014 adults were photographed at Monterey Harbor on 28 March, at Point Lobos Middle Reef on 16 May, and at Hopkins on 3 December. In 2015 and 2016 adults were photographed on multiple dates both in Monterey Harbor and along the open coast of Monterey Bay. On 16 October 2015 snorkelers near the western side of the Highway 1 bridge over Elkhorn Slough found one *A*. *californica* (K. Powell, pers. comm.) among the rocky riprap near the shore’s edge. When handled the *A*. *californica* immediately inked, which is one diagnostic feature of this species that separates it from the similar-looking congener *A*. *vaccaria* and was important to correctly identify the species.

*Aplysia* *vaccaria* Winkler, 1955. Black sea hare.

Published range: Monterey Bay, CA to Gulf of California, México (Behrens and Hermosillo 2005).

Change: Range expansion 25 km northward to Elkhorn Slough, CA (36.809091°, -121.784234°).

Comments: On 14 December 2014 citizen scientists using iNaturalist noted a single *A*. *vaccaria* at the Breakwater (photo verified by J. Goddard). Another was photographed (RJ) on 9 September 2015 just west of the Highway 1 bridge over Elkhorn Slough, which represents the first record of this species in Elkhorn Slough and a range expansion northward by 25 km. Snorkelers on 16 October 2015 examined the same area and found 20-25 *Aplysia* *vaccaria* within 30 min (K. Powell, pers. comm., video https://www.youtube.com/watch?v=9gM\_-JBK\_Sc). At the Vierras study site, which is next to the Highway 1 bridge, two individuals were observed on 8 June 2016 (M. Silberstein and J. Pearse, pers. comm).

*Arbacia* *stellata* (Blainville, 1825). Starry urchin or black sea urchin.

Published range: Northern Channel Islands, CA to Peru (Engle and Richards 2001, Bertsch and Aguilar Rosas 2016).

Change: Range expansion 362 km northward to Cannery Row, Monterey, CA (36.617498°, -121.897466°).

Comments: The black urchin *Arbacia* *stellata* typically occurs in intertidal habitats to depths of 90 m in the Gulf of California, and as far south as Peru and the Galapagos Islands. Prior to the 1997-98 El Niño, the lone California range record was from Newport Bay in southern CA, where 6 black urchins were found during the Velero III cruises between 1931-1941 (Clark 1948). However, during the warm-water ENSO event of 1997-98, several dozen *Arbacia* *stellata* were found in the rocky intertidal and subtidal at 5 of 8 Channel Islands off the coast of southern California (Engle and Richards 2001). At Laguna Beach, CA from 2007 to 2012, divers removed 291 *Arbacia* *stellata* from a *Macrocystis* *pyrifera* restoration project (Burcham and Caruso 2015). *Arbacia* *stellata* (*A*. *incisa* and *Echinocidaris* *incisa* are synonyms) is very common in the Gulf of California, but a live specimen had never been observed in central California prior to 2015.

A PISCO research diver was conducting surveys at the McAbee study site on 4 August 2015 and observed this unusual looking urchin at a depth of 13 m (K. Chan, pers. comm.). *Arbacia* *stellata* is dissimilar from native urchins, and is remarkable due to obvious red splotches along the aboral interambulacra, which is also conspicuously devoid of spines. This northward range expansion, which was confirmed by taxonomists at the California Academy of Sciences examining a voucher specimen (CASIZ 206961), extends the known occurrence of this species by 362 km.

On 2 October 2017 researchers from MexCal saw several *A.* *stellata* in the intertidal at Estero de Punta Banda in Ensenada, BC (31.760841°, -116.620231°) where they have been previously unrecorded. On 7 November 2017 MexCal divers observed large numbers of urchins at about 4 m depth just south of Coral Marina, next to UABC in Bahía de Todos Santos (31.860619°, -116.655303°). It now appears to be the most common urchin in the area adjacent to UABC with densities up to an order of magnitude greater (unpublished data) than those reported by Burcham and Caruso (2015) in Orange County.

*Balistes* *polylepis* Steindachner, 1876. Finescale Triggerfish.

Published Range: Alaska to Chile (Love 2011).

Change: Reappearance.

Comments: More typical of tropical to sub-tropical climates, this triggerfish species is seen north of México during ENSO events, such as the strong one in 1982-83 (Love 2011). Adults were caught by recreational anglers in Monterey June 2014 and in Santa Cruz July 2015, with photographs published in local newspapers but lacking specific location data within Monterey Bay.

*Callinectes arcuatus* (Ordway, 1863). Arched swimming crab.

Published Range: San Francisco Bay (rare north of Los Angeles), CA to Chile (Jensen 2014).

Change: Reappearance and increased abundance in two southern California coastal lagoons.

Comments: The presence of this crab in southern California coastal lagoons has been previously reported during strong ENSO events (Williams et al. 2001). In 2016 and 2017 there was an increase in their abundance at Los Peñasquitos Lagoon (32.930412°, -117.258170°) and South San Diego Bay (32.596023°, -117.118356°) compared to previous years. These changes were documented by TRNERR researchers using bi-monthly minnow traps, and yearly seining as part of the monitoring program, including the South San Diego Bay Wetland Restoration Project. It should also be noted that a very similar swimming crab, *C*. *bellicosus*, also has been reported in California waters, and it is possible that some records of *C*. *arcuatus* could be *C*. *bellicosus*.

*Chromis* *punctipinnis* (Cooper, 1863). Blacksmith.

Published range: Monterey, CA to Punta San Pablo, BC, México (Love 2011).

Change: Increased abundance of young-of-the-year at range endpoint in Monterey (36.609309°, -121.891807°).

Comments: This damselfish is rarely found in Monterey, and reproductive populations are commonly south of Point Conception (Love 2011). A fairly stable relict population (*sensu* Lonhart 2009) of adults persists along the Breakwater in Monterey. However, young-of-the-year (YOY) are very rarely observed in Monterey, and usually only during an ENSO event. Videos of schooling YOY were captured at the Breakwater on 7 October 2015, at Middle Reef in Point Lobos State Marine Reserve on 17 September 2015, and at the Big Creek upcoast PISCO study site in Big Sur on 20 October 2015. These YOY could be either the result of local reproductive success or larval transport from reproductive populations south of Point Conception. Since adults did not exhibit nesting behavior at the Monterey Breakwater, and adult *Chromis* were absent from Point Lobos and Big Creek, the most parsimonious explanation is that larvae were sourced from southern California populations.

*Ctenogobius sagittula* (Günther, 1862). Longtail Goby.

Published range: Marina Del Rey, CA to Perú (Lea and Rosenblatt 2000).

Change: Reappearance near northern range endpoint and increased abundance in several coastal lagoons in southern CA and northern BC (32.930412°, -117.258170°).

Comments: Prior to the 1997-98 ENSO event, the tropical goby *Ctenogobius sagittula* (formerly *Gobionellus longicaudus* and *Gobius longicaudus*) had been observed only once in CA from a single location in San Diego Bay between 1901 and 1905 (Starks and Morris 1907), where several specimens had been collected. It was absent from the Baja California Peninsula prior to 1998 (Ruiz-Campos et al. 1999). During the 1997-98 ENSO event longtail gobies were reported in Mission Bay (Talley 2000) and in Los Peñasquitos Lagoon (Williams et al. 2001), and further north in Santa Margarita River lagoon, Newport Bay, Long Beach Harbor and Marina Del Rey (Lea and Rosenblatt 2000).

TRNERR began monitoring Los Peñasquitos Lagoon in 1986 and South San Diego Bay in 2012, and this species was observed only during the 1997-98 ENSO event in Los Peñasquitos Lagoon. From 2015 to 2017, TRNERR researchers detected longtail gobies in Los Peñasquitos and San Diego Bay using minnow traps and seining as part the monitoring program. In addition, on 3 October 2017 MexCal researchers observed longtail gobies in Estero de Punta Banda, BC using minnow traps.

*Farfantepenaeus* *californiensis* (Holmes, 1900). Brown shrimp.

Published range: San Francisco Bay, CA to Callao, Perú and Galápagos Islands (Jensen 2014).

Change: Reappearance and increase in coastal lagoons of southern CA and northwestern BC (32.930412°, -117.258170°).

Comments: *Farfantepenaeus* *californiensis* (previously *Penaeus californiensis*) was absent from Tijuana Estuary and Los Peñasquitos Lagoon from 1991 to 1996, then appeared during the 1997-98 ENSO event, and was again absent in 1999 (Williams et al. 2000). In 2014 and 2016, a TRNERR monitoring program using seine nets in Los Peñasquitos Lagoon recorded its reappearance and temporary increase. On 3 October 2017, members of MexCal collected specimens in minnow traps at Estero de Punta Banda, where there it had not been recorded in the past (Hechinger et al. 2011), although it is very common in the Gulf of California (Bertsch and Aguilar Rosas 2016).

*Felimida* *macfarlandi* (Cockerell, 1901). MacFarland’s chromodorid.

Published range: Del Monte Beach, Monterey, CA to BC, México (Goddard et al. 2016).

Change: Reappearance at range endpoint (36.608895°, -121.890608°).

Comments: Monterey Bay is the northern limit of this nudibranch formerly in the genus *Chromodoris*. One author (SIL) first recorded it on 20 July 1995 at a depth of 9 m in Otter Cove and again on 12 October 1996 at a depth of 13 m at the Shale Beds, where two were observed mating. During a PISCO survey for fishes, divers captured video of *F*. *macfarlandi* at Lovers Cove on 10 September 2015, first noting a solitary slug and later encountering a cluster of six. Another individual was seen at the Breakwater on 7 October 2015. As noted by Goddard et al. (2016), this nudibranch is rarely found north of Point Conception, and the reappearance at its northern range endpoint may be related to the warm water anomalies.

*Flabellina* *iodinea* (J.G. Cooper, 1863). Spanish shawl.

Published range: Vancouver Island, Canada to Islas Galápagos, Ecuador (Goddard et al. 2016).

Change: New habitat use, from open coast into an estuary (36.809091°, -121.784234°).

Comments: This nudibranch was observed for the first time in the Elkhorn Slough National Estuarine Research Reserve at the Vierras study site on 8 June 2016 (M. Silberstein and J. Pearse, pers. comm.). This very distinctive species rarely occurs north of Monterey Bay (Goddard et al. 2016), and is relatively rare, even in Monterey. The typical habitat is either subtidal rocky reef or rocky tidepools (Goddard et al. 2016). Although Elkhorn Slough consists primarily of mud and sand, with very little natural rocky substrate, the Vierras site, near the mouth of the slough, has adjacent rocky riprap, providing suitable habitat for this species.

*Glottidia* *albida* (Hinds, 1844). White brachiopod.

Published range: Monterey Bay, CA to Golfo de Nicoya, Costa Rica (Emig 2009).

Change: Reappearance at range endpoint (36.809091°, -121.784234°).

Comments: Two individuals were observed in Elkhorn Slough at the Vierras study site on 8 June 2016 (M. Silberstein and J. Pearse, pers. comm.), the first report since the mid-1970s when it was found in the mud at Skipper’s, a study site on the eastern edge of the North Harbor entrance at Moss Landing (Nybakken et al. 1977). In August 2016 (15, 18, 19, and 29th) the US Geological Survey conducted surveys of sea otter prey in Elkhorn Slough. Collections were made using a water-pump powered suction dredge operated by two divers and a topside operator in a skiff. Divers excavated quadrats (0.25 m2) to a depth of about 0.5 m or until encountering compacted clay. A total of 90 samples were taken in the main channel and 53 *Glottidia* were captured (M. Kenner, pers. comm.).

*Hypsypops* *rubicundus* (Girard, 1854). Garibaldi.

Published range: Monterey Bay, CA to southwestern Gulf of California, México (Love 2011)

Change: Reappearance at range endpoint (36.618477°, -121.901495°).

Comments: The type specimen used to describe this bright orange damselfish was collected in Monterey, and since 1854 the northern range endpoint has remained Monterey, even though this visually conspicuous species is essentially absent north of Point Conception (Humann et al. 2008). During ENSO events prior to 2015 there were several unsubstantiated reports by recreational divers of Garibaldi observed in Monterey. On 7 June 2016 staff at the Monterey Bay Aquarium (MBA) diving in the Great Tide Pool (GTP) exhibit found a single juvenile Garibaldi. The Garibaldi, still showing its young-of-the-year coloration, was captured on video by MBA staff (https://vimeo.com/210975864/5042dcb2b9). It was again seen at the GTP on February 2017 (A. Morgan, pers. comm.). The GTP is connected to both the aquarium’s seawater system (outflow) and during high tides to the open ocean. This is, to our knowledge, the only confirmed sighting of this species in Monterey in recent history, and possibly since the original description.

In 2017, three observations of Garibaldi were made 100 km south of Monterey at Jade Cove, Big Sur (M. Guardino, pers. comm.). On 23 June 2017 one adult and one juvenile were observed at a depth of 6 m on the inner reef, and on 10 December 2017 a lone adult Garibaldi was observed a depth of 8 m on the outer reef of an adjacent cove. These sightings constitute the northern-most records of Garibaldi along the open coast of California in recent history.

*Kelletia* *kelletii* (Forbes, 1850). Kellet’s whelk.

Published range: Monterey, CA to Isla Asuncion, BC, México (Zacherl et al. 2003).

Change: Increase of juveniles at range endpoint (36.609309°, -121.891807°).

Comments: Four juvenile *Kelletia* (16-28 mm total length, likely 1-2 yr old) were photographed at McAbee on 12 February 2015. 17 juveniles (20-40 mm) were photographed at the Breakwater on 13 August 2015. *Kelletia* first expanded to re-occupy central California in the 1970s, and adults were reported from multiple locations in Monterey Bay (Herrlinger 1981). It remains unclear whether *Kelletia* recruitment during warm water anomalies results from successful local reproduction or if larvae are transported northward from southern source populations (Zacherl et al. 2003).

*Laminaria* *farlowii* Setchell, 1893. Oar kelp.

Published range: British Columbia, Canada to Bahia del Rosario, BC, México (Abbott and Hollenberg 1976).

Change: Reappearance at California range endpoint (36.63°, -121.921°).

Comments: This beach towel-sized kelp is conspicuous and hard to confuse with other laminariales in central California. Until recently the last collections of specimens from central California were from Stillwater Cove on 6 August 1968 and again on 14 July 1969. During a PISCO survey at the Siren study site on 24 September 2104 an adult *L*. *farlowii* was collected and deposited as a voucher specimen at the Jepson Herbarium, University of California at Berkeley (UC2050577) (C. Gaylord, pers. comm.). A subsequent PISCO survey on 10 September 2015 discovered several more adult *L*. *farlowii* at the Siren study site. The population in Monterey Bay represents the current known northern range endpoint of the species.

The original description of the species (Setchell 1893) indicates the distribution is “shallow water along the coast of California from Santa Cruz and Monterey to San Francisco” based on the observations of two other phycologists. The 19th century specimen collected in Santa Cruz (UC636816), California, remains the only one ever collected from the northern end of Monterey Bay. In British Columbia, 7 specimens labeled *L*. *farlowii* were deposited in 1915, 1967, 1968, and 1992 (University of British Columbia Herbarium), but noted phycologist Louis Druehl (1970) published the following: “The isolated population of *L*. *farlowii* has not been substantiated in collections subsequent to its discovery in 1915.” Recent genetic studies of the Laminariaceae in Canada did not include *L*. *farlowii* (McDevit & Saunders 2010) and there are no samples from the open coast of Washington, Oregon or northern California. Such a disjunct range is rare, and it appears if *L*. *farlowii* actually occurs north of central California, it is very rare and ephemeral. It remains unclear if *L*. *farlowii* will persist in Monterey Bay after this most recent warm water anomaly dissipates, or if this sink population will be lost and populations just south of Point Conception will once again become the northern range endpoint.

*Leptosynapta* *albicans* (Selenka, 1867). White cucumber.

Published range: Bodega Head, CA to BC, México (Light 2007).

Change: Reappearance at range endpoint (36.809091°, -121.784234°).

Comments: This species was observed at the Vierras study site in Elkhorn Slough on 8 June 2016 (J. Pearse and M. Silberstein, pers. comm.). This whitish, synaptid cucumber had not been reported in Elkhorn Slough since MacGinitie and MacGinitie (1949) wrote it “is found in gravelly or shelly or muddy bottoms at mid-tide level and out to 600 ft. It is 2 to 6 in. long. It occurs all along our West Coast.” The northern range limit of *L*. *albicans* is in dispute due to a very similar congener, *L*. *clarki*, which extends from Queen Charlotte Island to central California (Light 2007). The northern range limit for *L*. *albicans* has not been established definitively, but the southern limit is in Baja California and Light (2007) recommends identifying all leptosynaptids in central CA as *L*. *albicans*. The northern-most specimens in the CAS collection are from Tomales Bay (8 found between 1941 and 1963) and Bodega Head (2 found in 1962). From 1969 to 1970 E.C. Haderlie collected and deposited many specimens from various locations in Monterey Bay, with some samples taken at depths of at least 75 m.

*Lobatus galeatus* (Swainson, 1823). Cortez conch.

Published range: Gulf of California to Ecuador (Bertsch and Aguilar Rosas 2016).

Change: Range expansion 580 km northward to La Bocana (26.79325°, -113.6998°).

Comments: Formerly *Strombus* *galeatus*, one individual was observed during a CNH subtidal survey on 18 October 2016 at El Estero, one of the study sites at La Bocana, BCS. Like *Alphestes* *immaculatus*, *L*. *galeatus* occurs on the eastern side of the Baja California Peninsula (Gulf of California), but had not been observed on the western side (Pacific Ocean) until recently.

*Lovenia* *cordiformis* A. Agassiz, 1872. Heart urchin or sea porcupine.

Published range: Point Conception, CA to northern Peru (Bertsch and Aguilar Rosas 2016).

Change: Range extension 378 km northward to Pacific Grove, CA (36.626393°, -121.905207°).

Comments: Historic range records have not extended into central California, and generally this is considered a southern California species, extending southward and through the Gulf of California (Bertsch and Aguilar Rosas 2016).

On 29 June 2016 a diver photographed and collected heart urchins along a transect at a depth of 25 m located offshore and northwest of Hopkins Marine Station (line between 36.626650°, -121.905533° and 36.626167°, -121.904883°; J. Smith, pers. comm.). About 50 individuals were found on the sandy bottom, and potentially hundreds were buried in the sand.

Shallow (<30 m) subitdal sandy habitats in California are poorly studied. It is unclear if this represents an extension or an expansion of 378 km. If the population is stable, then it may be an extension (i.e. an undetected expansion prior to the warm water anomalies) or it could be an expansion that becomes permanent (i.e. self-sustaining). In contrast, if the population does not persist, then it was likely an ephemeral expansion related to the 2013-16 warm water anomalies. As temperatures decline and conditions return to a more typical state, we predict larvae from southern California will not be transported northward and the relict population in Pacific Grove will eventually disappear.

*Lytechinus* *pictus* (Verrill, 1867). White urchin.

Published range: Monterey, CA to Ecuador (Bertsch and Aguilar Rosas 2016).

Change: Increased abundance of juveniles and adults at range endpoint (36.618184°, -121.896835°) and in northern BC.

Comments: Historic range records indicate that white urchins *Lytechinus* *pictus* have been found very rarely as far north as Monterey Bay, and usually at depths below 20 m (Light 2007), but the species is much more common in México. Zigler and Lessios (2004) determined with genetic analyses that *L*. *anamesus* is an ecotype of *L*. *pictus*, the former inhabiting deeper waters than the latter.

White urchins have not been observed in central California kelp forests since at least the early 1990s (SIL, pers. obs.). On 14 July 2015 annual monitoring at the PISCO Cannery Row study site detected *Lytechinus* *pictus* (C. Gaylord, pers. comm.). A second white urchin was observed on 4 August 2015 at the McAbee study site, about 600 m down the coast from the first site.

On 23 November 2015 a diver photographed a single white urchin offshore of Cannery Row at a depth of 8 m (J. Smith, pers. comm.). On 7 April 2016 Smith encountered hundreds of white urchins at Deep Reef (36.62240°, -121.8990°) offshore of Hopkins Marine Station at a depth of 25 m. Most of these white urchins were 2-3 cm in test diameter. During survey dives by Reef Environmental Education Foundation (REEF) on 30 April 2017 white urchins were photographed on bare rock at both the Ballbuster (36.641273°, -121.919521°) and Outer McAbee (36.618184°, -121.896835°) study sites (J. Lavan, pers. comm.).

On 22 November 2017 MexCal divers recorded unusually high densities (about 100 per m2) of white sea urchins at an exposed site at the Todos Santos Islands (31.806200°, -116.808167°) near Ensenada, MX. During the winter of 2017-18, divers affiliated with MexCal found relatively high densities of *L. pictus* at two exposed study sites adjacent to Bahía de Todos Santos: Campo Kennedy (31.702231°, -116.683246°) and Punta San Miguel (31.899967°, -116.732483°). White urchins have not been observed at wave-protected study sites within Bahía de Todos Santos.

*Malacoplax* *californiensis* (Lockington, 1877). California burrowing crab.

Published range: Morro Bay, CA to Golfo Dulce, Costa Rica (Campos and de Campos 2012).

Change: Range expansion 212 km northward to Elkhorn Slough, CA (36.823946°, -121.739847°).

Comments: One crab was captured on 28 October 2016 (S. Fork and RJ) at Eby Dock in Elkhorn Slough, CA during an ESNERR annual survey of benthic crabs. It was later deposited as a voucher specimen at the California Academy of Science (CASIZ 222878). The specimen was caught in a baited minnow trap, placed at a tidal height of 0 ft., relative to MLLW, and soaked for 24 hr. Upon retrieval, all crabs were identified to the species level, sexed and carapace width measured. Campos and de Campos (2012) note that this species creates shallow burrows in the sand and mud of estuaries and protected bays and that even in Baja California, within the center of its geographic distribution, it is rare.

*Medialuna californiensis* (Stendachner, 1876 ). Halfmoon.

Published range: Vancouver, British Columbia to the Gulf of California, México.

Change: Range contraction to Isla Natividad, BCS (27.88399°, -115.17969°) but it remains at Bahía de la Paz inside the Gulf of California, BCS (24.4514889°, -110.5528056°).

Comments: Monitoring programs at Isla San Jerónimo in Punta Baja (29.945542°, -115.812920°) indicate this species remains common. However, since 2006 *M*. *californiensis* has been seen only once south of Punta Baja. These sites include Isla Natividad and Magdalena Bay: on 30 July 2017 divers at Isla Natividad, BCS (27.88399°, -115.17969°) recorded groups (2 to 50 individuals) ranging in size from 20 to 25 cm total length. If this absence persists, it represents a range contraction on both sides of the Baja Peninsula and creates disjunct populations occupying the Pacific Ocean and Gulf of California. Since 2008, this species was rarely observed in the Gulf of California at Bahía de La Paz. If this species is truly absent from the eastern tip of the Baja California Peninsula (lower portion of the Gulf of California), then this would represent a range contraction of at least 765 km (estimated as a straight line from Isla Natividad to Cabo San Lucas) and establish a new southern range endpoint at Isla Natividad on the western side of the peninsula.

*Paralabrax* *clathratus* (Girard, 1854). Kelp Bass.

Published range: Columbia River, OR to Bahia Magdalena, BC, México (Love 2011).

Change: Increase in young-of-the-year.

Comments: Young-of-the-year (YOY) commonly appear in Monterey Bay during El Niño events, and recruited particularly well during the 2013-16 warm water anomalies. Adult kelp bass persist north of Point Conception, CA but YOY kelp bass are observed only during warm water anomalies, suggesting the relict population of adults in central California cannot successfully reproduce when water temperatures are at or below the long-term average.

*Phyllorhiza punctata* (von Lendenfeld, 1884). Australian spotted jellyfish.

Published range: Australia and Western Pacific; globally invasive (Bayha and Graham 2014).

Change: Reappearance at range endpoint (32.611425°, -117.122719°).

Comments: The Australian spotted jellyfish is a tropical species that has invaded many of the world’s oceans (Bayha and Graham 2014), usually transported via ballast water in large ships. The first record of this species in California was in 1981 from Mission Bay and San Diego Bay (Larson and Arneson 1990). In October 2015 TRNERR researchers observed two jellies in South San Diego Bay while monitoring the restored Salt Ponds. This record coincided with several sightings in San Diego Bay and Mission Bay by the general public, including observations in October 2015 and August 2016 captured on iNaturalist.org. Sightings of these large and conspicuous jellies were not reported prior to the 2013-16 warm water anomalies.

*Pseudosquillopsis* *marmorata* (Lockington, 1877). California mantis shrimp.

Published range: Tomales Bay to Islas Galápagos, Ecuador (Light 2007).

Change: New habitat use, from open coast into an estuary (36.824128°, -121.739229°).

Comments: Two live specimens were collected by ESNERR researchers in Elkhorn Slough: the first was collected February 2011 at Whistlestop Lagoon (36.824128°, -121.739229°) and the second on 10 February 2016 at the South Marsh footbridge (36.819934°, -121.737048°). This species had not been observed in Elkhorn Slough prior to 2011.

The California mantis shrimp is rarely encountered north of Point Conception, and specimen records in central California consist of a single juvenile from Monastery Beach in Carmel Bay and a single female from Tomales Bay (Light 2007). Dr. Roy Caldwell, University of California at Berkeley, collected these two specimens (pers. comm.), and he noted the single juvenile was collected from rubble at a depth of 6 m in July 2005. The adult female (124 mm) was found living in a bag of cultured oysters from Tomales Bay in May 1994. The ovaries were developed, as were the cement glands, indicating readiness to lay eggs. Although growth rates are unknown, it is possible this female was ≥4 yr old.

*Semicossyphus* *pulcher* (Ayres, 1854). California Sheephead.

Published range: Monterey Bay, CA to Gulf of California, México (Love 2011).

Change: Increase in young-of-the-year (YOY) at range endpoint (36.609309°, -121.891807°).

Comments: Like some other southern California fishes, including *Chromis* *punctipinnis* and *Paralabrax* *clathratus*, some *S*. *pulcher* adults survive between warm water anomalies. In contrast, YOY and juveniles are absent from central California during periods of average to below average water temperatures. Recent densities of adults in central California are very low, which likely contributes to the lack of local reproductive success. From 1999 to 2015, PISCO completed annual fish surveys (n=2107 30-m long transects, 2 m wide and tall = 120 m3 sampled per transect) at study sites in central California (Santa Cruz to Cambria), and *S*. *pulcher* was sighted 338 times, with some of these representing adult re-sightings between years. Within Monterey Bay itself, 15 *S*. *pulcher* observations were made at the Hopkins study site and 5 at McAbee. The remaining four Monterey Bay sites had low or no sightings: 3 at Lovers Point (2007-2015, no data 2009 and 2010), and none at Cannery Row and Point Pinos (2007-2015, no data 2009 and 2010), or at Otter Point (2006-2015, no data 2009 and 2010).

The appearance of *S*. *pulcher* YOY only during warm water anomalies suggests that the relict population in central California is not self-sustaining and relies on northward transportation of larvae during such events. However, if water temperatures continue to increase, there may be a point in the near future when local reproduction is viable and YOY will be observed annually.

*Sphoeroides annulatus* (Jenyns, 1842). Bullseye Pufferfish.

Published range: Redondo Beach, CA to Pisco, Perú (Love 2011).

Change: Reappearance near northern range endpoint (31.860950°, 116.657867°).

Comments: Sightings of the Bullseye Pufferfish in northern Baja California are very rare. In October 2017 a MexCal researcher observed an adult specimen at 2 m depth while diving just south of Coral Marina Hotel, next to UABC in Bahía de Todos Santos.

*Spirobranchs* *spinosus* Moore, 1923. Christmas tree worm.

Published range: Central CA to BC, México (Bertsch and Aguilar Rosas 2016).

Change: Range extension 16 km northward to Pacific Grove, CA (36.625496°, -121.913745°).

Comments: All historic records of this annelid were collected south of Point Conception, CA, with one exception: a single specimen was collected from Carmel, CA in 1941 (L. Harris, pers. comm.), which established the previous northern range record. Although this species is distinguished by a prominent distal process (spine) on the operculum, it may consist of a multi-species complex (Bertsch and Aguilar Rosas 2016). Since 2010 there have been multiple individual sightings north of Point Conception, CA: Square Black Rock, Big Sur on 9 September 2010; Spruce Creek, Big Sur on 17 October 2011; pinnacle south of Yankee Point, Carmel (36.498474°, -121.945696°) on 19 October 2011; Triple Arches, Big Sur (36.465218°, -121.931978°) 18 October 2013; Dolan Rock, Big Sur (36.078881°, -121.615151°) on 6 December 2013; Monastery downcoast (PISCO site) in Carmel Bay (36.524485°, -121.932952°) on 2 October 2014; Lovers Cove, Pacific Grove (36.625496°, -121.913745°) on 8 March 2018; and Hopkins upcoast (PISCO site) in Monterey Bay (36.620486°, -121.901848°) on 26 June 2018, which sets the new northern range record.

*Uca* *princeps* (Smith, 1870). Princely fiddler crab.

Published range: Ensenada, BC, México to Zamurilla River, Peru (Campos and Campos 2012).

Change: Range expansion 240 km northward to Bolsa Chica, Orange County, California, USA (33.70351, -118.046551).

Comments: *Uca* *princeps* is a large, tropical fiddler crab, easily distinguished from the resident crenulated fiddler crab, *Uca* *crenulata*. The first report of this species were made on iNaturalist in June, 2018 (www.inaturalist.org/observations/13824586), in the salt marsh of Bolsa Chica Ecological Reserve, north of Huntington Beach in Southern California (Rosenberg 2018). In July, 2018, TRNERR researchers collected an adult male in the Tijuana Estuary, while sampling nekton for an assessment of fish health, and subsequently have seen numerous crabs in the estuary. Also, photographs of *Uca* *princeps* in San Diego Bay have been posted to iNaturalist (www.inaturalist.org/observations/15151795). *Uca* *princeps* has apparently been undergoing a northward range expansion within the last decade, with individuals reported in Bahía San Quintin and Ensenada, in BC, México in 2012 (Campos and Campos 2012, E. Campos pers. comm.). The previous northernmost extent was Tortugas Bay, Baja California Sur, México.

References

Abbott IA, Hollenberg GJ. Marine algae of California. Stanford, CA: Stanford University Press; 1976. 827 p.

Bayha KM, Graham WM. Nonindigenous marine jellyfish: invasiveness, invasibility, and impacts. In: Pitt KA, Lucas CH, editors. Jellyfish Blooms. Springer, NY; 2014. p. 46-78.

Behrens DW, Hermosillo A. Eastern Pacific nudibranchs: a guide of the opisthobranchs from Alaska to Central America. Monterey, CA: Sea Challengers; 2005. 137 p.

Bertsch H, Aguilar Rosas LE. Marine invertebrates of northwest México. Ensenada, México. Universidad Autónoma de Baja California, Instituto de Investigaciones Oceanológicas, UABC; 2016. 432 p.

Burcham D, Caruso NL. Abundance, size, and occurrence of *Arbacia* *stellata* in Orange

County, California. Cal Fish Game. 2015;101(3):184-187.

Campos E, Campos A-RD. The intertidal brachyuran crabs from estuaries of the west coast Baja California, México (Crustacea: Brachyura). Mar Biodiv Rec. 2012;5:1-7.

Clark HL. A report on the Echini of the warmer Eastern Pacific based on the collections of the VELERO III. Los Angeles, California: The University of Southern California Publications; 1948. p. 244-246.

Druehl LD. The pattern of Laminariales distribution in the northeast Pacific. Phycologia. 1970;9(3/4):237-247.

Emig CC. Brachiopods. In: Wehrtmann IS, Cortés J, editors. Marine biodiversity of Costa Rica, Central America. Monographiae Biologicae. 86. [Dordrecht]: Springer Verlag; 2009. p. 417-423.

Engle JM, Richards DV. New and unusual marine invertebrates discovered at the California Channel Islands during the 1997-1998 El Niño. Bull So Cal Acad Sci. 2001;100(3):186-198.

Hechinger RF, Lafferty KD, McLaughlin JP, Fredensborg BL, Huspeni TC, Lorda J, et al. Food webs including parasites, biomass, body sizes, and life stages for three California/Baja California estuaries. Ecol. 2011;92(3):791.

Heemstra PC, Randall JE. FAO Species Catalogue. Vol. 16. Groupers of the world (Family Serranidae, Subfamily Epinephelinae). An annotated and illustrated catalogue of the grouper, rockcod, hind, coral grouper and lyretail species known to date. Rome: FAO of the United Nations; 1993. 382 p.

Herrlinger TJ. Range extension of *Kelletia* *kelletii*. Veliger. 1981;24(1):78.

Humann P, DeLoach N, Hall H, McDaniel NG. Coastal fish identification: California to Alaska. Second ed. Jacksonville, Fla.: New World Publications; 2008.

Jensen GC. Crabs and shrimps of the Pacific Coast: a guide to shallow-water decapods from southeastern Alaska to the Mexican border. Bremerton, Washington: MolaMarine; 2014.

Larson RJ, Arneson AC. Two medusae new to the coast of California: *Carybdea* *marsupialis* (Linnaeus, 1758), a cubomedusa and *Phyllorhiza* *punctata* von Ledenfeld, 1884, a rhizostome scyphomedusa. Bull So Cal Acad Sci. 1990;89(3):130-136.

Lea RN, Rosenblatt RH. Observations on fishes associated with the 1997-98 El Niño off California. CalCOFI Report. 2000;41:117-129.

Light SF. The Light and Smith manual: intertidal invertebrates from central California to Oregon, 4th Edition. Carlton JT, editor. Berkeley, Calif.: University of California Press; 2007. 1001 p.

Lonhart SI. Natural and climate change mediated invasions. In: Rilov G, Crooks JA, editors. Biological invasions in marine ecosystems: ecological, management, and geographic perspectives. Ecological Studies. Berlin: Springer; 2009. p. 57-69.

Love MS. Certainly more than you want to know about the fishes of the Pacific Coast: a postmodern experience. Santa Barbara, Calif.: Really Big Press; 2011. 649 p.

MacGinitie GE, MacGinitie N. Natural history of marine animals. New York: McGraw-Hill; 1949. 473 p.

Mantelatto FL, Robles R, Wehrtmann IS, Schubart CD, Felder DL. New insights into the molecular phylogeny of the swimming crabs of the genera *Portunus* Weber, 1795 and *Achelous* De Haan, 1833 (Brachyura: Portunidae) of the Americas. J Crust Biol. 2018;38(2):1-8.

McDevit DC, Saunders GW. A DNA barcode examination of the Laminariaceae (Phaeophyceae) in Canada reveals novel biogeographical and evolutionary insights. Phycologia. 2010;49(3):235-248.

Nybakken JW, Cailliet GM, Broenkow WW. Ecologic and hydrographic studies of Elkhorn Slough, Moss Landing Harbor and nearshore coastal waters: July 1974 to June 1976. Moss Landing Marine Laboratories. 1977.

Rosenberg, MS. New record and range extension of the fiddler crab *Uca* *princeps* (Smith, 1970) (Brachyura, Ocypodidae) from California, USA. J Crust Biol. 2018;38(6):823-824.

Ruiz-Campos G, Castro-Aguirre JL, González-Guzmán S, Sánchez-Gonzáles S. First records of two tropical gobies, *Awaous* *tajasica* and *Ctenogobius* *sagittula* (Pisces Gobiidae), in the continental waters of Baja California, México. Bull So Cal Acad Sci. 1999;98(3):131-136.

Sadowski JS, Gonzalez JA, Lonhart SI, Jeppesen R, Grimes TM, Grosholz ED. Temperature-induced range expansion of a subtropical crab along the California coast. Mar Ecol. 2018;39(5):1-7.

Setchell WA. On the classification and geographical distribution of the Laminaiaceae. Trans Connecticut Acad Arts Sci. 1893;9:333-375.

Starks EC, Morris EL. The marine fishes of southern California. University of California Publications, Zoology. 1907;3(11):159-251.

Talley DM. Ichthyofaunal utilization of newly-created versus natural salt marsh

creeks in Mission Bay, California. Wetlands Ecol Manage. 2000;8:117-132.

Williams GD, West JM, Zedler JB. Shifts in fish and invertebrate assemblages of two southern California estuaries during the 1997-98 El Niño. Bull So Cal Acad Sci. 2001;100(3):212-237.

Zacherl D, Gaines SD, Lonhart SI. The limits to biogeographical distributions: insights from the northward range extension of the marine snail, *Kelletia* *kelletii* (Forbes, 1852). J Biogeogr. 2003;30(6):913-924.

Zigler KS, HA Lessios. Speciation on the coasts of the new world: phylogeography and the evolution of bindin in the sea urchin genus *Lytechinus*. Evolution. 2004;58(6):1225-1241.