

Biological indicator of warming events: Presence of the Cortez angelfish *Pomacanthus zonipectus* at temperate conditions of Bahía de San Quintin, Baja California, Mexico

Jorge A. ROSALES-CASIÁN

Cite this article as:

Rosales-Casián J.A. (2022). Biological indicator of warming events: Presence of the Cortez angelfish *Pomacanthus zonipectus* at temperate conditions of Bahía de San Quintin, Baja California, Mexico. *Aquatic Research*, 5(2), 165-170. <https://doi.org/10.3153/AR22016>

Centro de Investigación Científica y de Educación Superior de Ensenada, B.C. (CICESE). Departamento de Ecología Marina, División de Oceanología. Carretera Ensenada-Tijuana No. 3918, Zona Playitas, C.P. 22860, Ensenada, Baja California, México

ORCID IDs of the author(s):

J.A.R.C. 0000-0002-5546-5791

Submitted: 31.10.2021

Revision requested: 02.02.2022

Last revision received: 07.02.2022

Accepted: 15.02.2022

Published online: 23.03.2022

Correspondence:

Jorge A. ROSALES-CASIÁN

E-mail: jrosales@cicese.mx



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<http://aquatres.scientificwebjournals.com>

ABSTRACT

An individual of the Cortez angelfish, *Pomacanthus zonipectus* (Gill, 1862) was obtained at the temperate Bahía de San Quintin, Baja California, Mexico (Lat. 30.428343, Long. 115.987014), on May 15, 2021. All counts, morphological description and colors of the specimen caught agree with the previous descriptions for the species *P. zonipectus*. The Cortez angelfish is a tropical fish species, and its presence at the temperate environment may possibly be associated with warming events, The Blob-El Niño 2013-2016, or the most recent moderate El Niño 2018-2019. This occurrence constitutes the first record for the Cortez angelfish in the San Quintin area, northern Pacific off Baja California, and after thousands of samplings with different fishing gears beginning in 1993. The Cortez angelfish was recently recorded in August 25, 2016 as new occurrence in Laguna Ojo de Liebre, Baja California Sur, Mexico, also in the same warming event of The Blob-El Niño 2013-2016; from Ojo de Liebre to Bahía de San Quintin represents a northward movement of 355 kilometers and a new record in its distribution.

Keywords: Cortez angelfish, Northward distribution, Temperate lagoon, The Blob, El Niño

Introduction

The Bahía de San Quintín is located in the temperate zone of the Pacific of Baja California, Mexico. However, since 1997 fish species with tropical or subtropical affinity have been recorded in the interior of the lagoon during warming events such as El Niño or The Blob (Rosales-Casián and Ruiz-Campos, 1999; Rosales-Casián, 2004b; Rosales-Casián, 2017).

The fish known as angelfishes belong to the Pomacanthidae family, which contains seven genera with 90 species (Fricke, Eschmeyer, and Van der Laan, 2021), all inhabitants of warm tropical or subtropical waters. According to Allen and Robertson (1998), in the eastern Pacific only four species of angelfishes are known *Holacanthus clarionensis* Gilbert, 1890, *Holacanthus limbaugui*, 1963, *Holacanthus passer* Valenciennes, 1846, and *Pomacanthus zonipectus* (Gill, 1862).

The Cortez angelfish, *P. zonipectus* occurs at depths of 6-12 m to 50 m, and is distributed in the eastern Pacific Ocean, from the northern Gulf of California (Mexico) to Peru in the south, with affinity to Provinces of Cortez, Mexican and Panamic (Horn, Allen, and Lea, 2006; Pyle et al., 2010). As an indicator of its northward movement, in a previous study conducted in 2015-2016, its northernmost new record was in Laguna Ojo de Liebre (Lat. 27°51'28.14" N, Long. 114°14'2.40" W), at the middle of the Pacific of Baja California, Mexico, and was registered during the warming events of The Blob (2013-2015) and the El Niño 2014-2016 (Civico-Collados and Rosales-Casián, 2021; Dorantes-Gilardi and Rivas-Camargo, 2019). The Blob was a mass of warm water observed first in Gulf of Alaska during October 2013, shifted east and extended south to coasts of California (USA and Baja California (Mexico), this event was unprecedented with temperature anomalies reaching 3°C and ending in 2015 (Peterson et al., 2015). The "El Niño" began at the equator in December 2014, extended north through the northeastern Pacific, peaked in November 2015, and ending in June 2016, with positive temperature anomalies from 0.5 °C to 2.6 °C (NOAA's El Niño, available at <http://www.elnino.noaa.gov/>, last accessed 20 September, 2021; Rupic et al., 2018).

The aim of the present study is to document a northward movement of the Cortez angelfish to the temperate environment of the Pacific of Baja California, which represents the first occurrence of this species of the family Pomacanthidae in Bahía de San Quintín, México.

Material and Methods

The Bahía de San Quintín is located 320 km south of the California (USA)–Baja California (México) border (Lat. 30° 28' 59.99" N, Long. 115° 58' 38.60" W), this coastal lagoon is made up of two arms, Bahía Falsa and Bahía San Quintín (Figure 1), the first is shallow with oyster cultures develop there, and in the second arm is the site of El Molino Viejo (The Old Mill), place of departures and arrivals of commercial artisanal fishing and sportfishing boats. It is a coastal lagoon with the presence of a permanent upwelling through the rocky point that forms the mouth; the upwelling fertilizes with nutrients the interior of the lagoon during high tide and in produces a refuge and feeding area for temperate fishes (Gracia-Escobar et al., 2015; Rosales-Casián, 2004a).

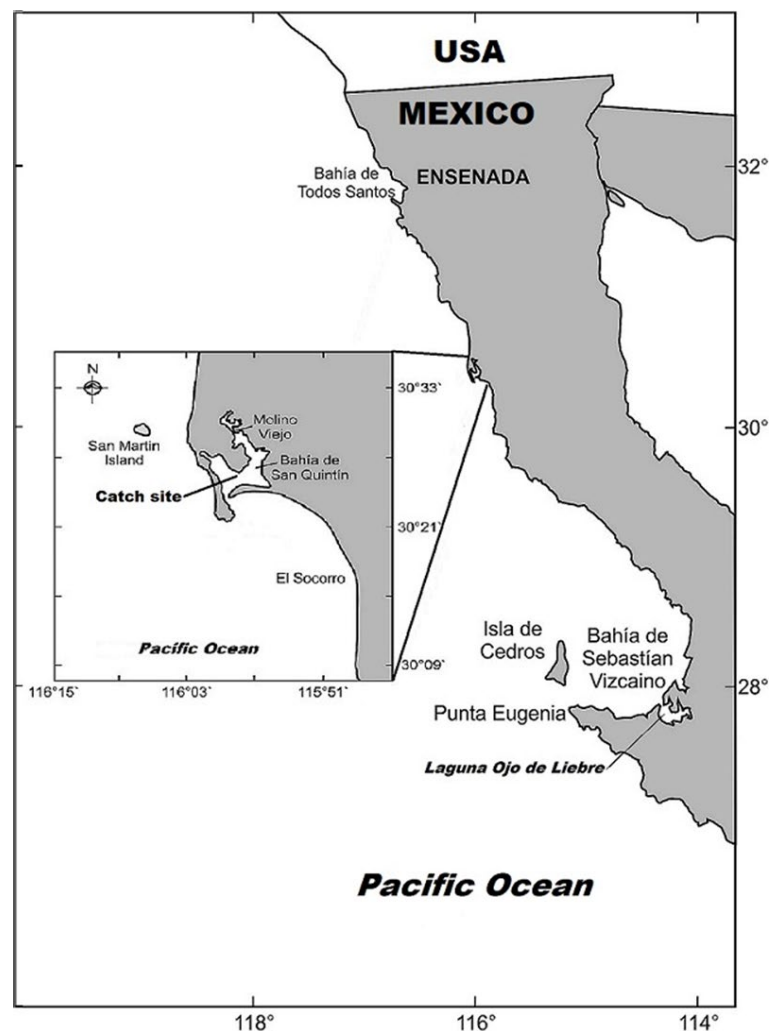


Figure 1. Localization of the Bahía de San Quintín, Baja California, Mexico, and capture site of the Cortez angelfish, *Pomacanthus zonipectus*.

Since 1993, monitoring of the fish in the bay and coast of San Quintin has been carried out, with direct collections using five different fishing gears at sites close to the beach, 5 and 10 meters depth (Rosales-Casián, 1996; Rosales-Casián, 2004a), and also evaluating the commercial (Rosales-Casián and Gonzalez-Camacho, 2003) and sportfishing catch (Rodriguez-Santiago y Rosales-Casián, 2008). These last two activities are carried out on the adjacent external coast, on rocky spots located at distances outside the lagoon mouth from 3 km to sites as far as 80 km.

Before of the sportfishing activity, fishers catch juveniles of Pacific mackerels (*Scomber japonicus*) inside the lagoon to use them as live bait for pelagic fish or on the rocky bottom of the spots; for this, fishermen use the Sabiki hooks formed by a line of five small hooks type lures with plastic “bristles”.

In addition, the commercial or sportfishing fishers also report when a species is unknown to this temperate zone, and in this way the presence of several species that widen their distributions northward during events such as El Niño (Rosales-Casián, 2017), or southward during La Niña (Rosales-Casián and Almeda-Jauregui 2009), have been documented.

Results and Discussion

On May 15, 2021, during our monthly monitoring of the sportfishing catch upon arrival of the boats at the site El Molino Viejo in Bahía de San Quintin, a boat fisher showed a fish species individual unknown to the temperate area. The individual was caught with Sabiki hooks at the beginning of the Bahía Falsa (Lat. 30.42287 N, Long. 115.98496 W), one of the two arms that form Bahía de San Quintin.

This fish species was identified as the Cortez angelfish, *Pomacanthus zonipectus* (Gill, 1862), and was easy to identify due to its body shape and coloration (Figure 2). The description coincides with what is established for this species: 11 dorsal spines and 25 dorsal rays; 3 anal spines and 20 anal rays; 19 pectoral rays; it has a bump on the head, the dorsal fin ends in a point, and it has a strong spine on the lower edge of the operculum; the part of the anterior head grayish in color, has a broad yellow band that crosses the operculum from top to bottom, and a second yellow band between two black bands behind the pectoral fin; the caudal fin pale yellowish color (Allen and Robertson, 1994). Total length (TL) of the individual of Cortez angelfish was 25.5 cm, standard length (SL) was 22.9 cm, and with a weight of 748 g. Sea surface temperature at the coastal zone was 12.8-12.9°C and inside of the bay was 16.1°C.



Figure 2. Individual of the Cortez angelfish, *Pomacanthus zonipectus* (25.5 cm total length) from Bahía de San Quintin, Eastern Pacific of Baja California, Mexico.

The taxonomic classification for this species is: CLASS ACTINOPTERYGII, ORDER PERCIFORMES, Family Pomacanthidae, *Pomacanthus zonipectus* (Gill, 1862), considering the work of Page *et al.*, 2013.

Bahia de San Quintin is an important lagoon due to its high productivity (Lara-Lara and Alvarez-Borrego 1975; Gracia-Escobar *et al.*, 2015); it functions as a nursery ground for different species of fish, and until 1995, a total of 69 species of temperate fish had been identified in the interior of the bay, and 71 species on the external coast at depths less than 10 meters (Rosales-Casián, 1996).

In a previous study that we conducted in 2015-2016, its northernmost record of the Cortez angelfish was in Laguna Ojo de Liebre, Baja California Sur, on August 25, 2016, as a new occurrence during the same warming event 2014-2016 (Civico-Collados and Rosales-Casián, 2021). This new movement of the Cortez angelfish to Bahia de San Quintin in a straight line represents an extension in its northward distribution of 355 kilometers from Laguna Ojo de Liebre.

The Cortez angelfish is considered an omnivorous, generalist and opportunistic species; it can feed on a large number of plant and animal species associated with the bottom (Perez-España, 1994). However, small planktonic crustaceans have also been identified in its stomach contents (Reynolds and Reynolds, 1977), and this may possibly explain why this specimen was caught with Sabiki hooks; with this method, several individuals of Mexican lookdown (*Selene brevoortii*), a Panamic fish species, were captured within the Bahia de San Quintin during the warming event in 2014-2016 (Rosales-Casián, 2017).

But how to explain the presence of the Cortez angelfish in the Bahia de San Quintin? A lagoon considered a cold site due to the presence of a permanent upwelling near the mouth (Rosales-Casián, 2004a). When reviewing the recently history of temperature anomalies, from July 2020 to June 2021, a La Niña event was presented in our area with anomalies from -0.5 °C to -1.3 °C, and the most recent warming events occurred in August 2018 to July 2019 with positive temperature anomalies from 0.5 up to 0.9 °C, and from September 2014 to May 2016 with positive temperature anomalies from 0.5 °C to 2.6 °C (NOAA's El Niño, available at <http://www.elnino.noaa.gov/>, last accessed 20 September, 2021); this last warming was formed by two overlapping events, "The Blob" that began at the Gulf of Alaska and extended to south from 2013 to 2015, and the "El Niño" from 2014-2016 (Civico-Collados and Rosales-Casián, 2021; Dorantes-Gilardi and Rivas, 2019; Robinson, 2016).

Possibly those warming events promoted the angelfish movement towards the temperate zone, similar to movements of others tropical fish species like the Mexican lookdown (*Selene brevoortii*) that was caught in the interior of Bahia de San Quintin by the sportfishing (23 October, 2014 and 11 July, 2015), and also the Cortez bonefish (*Albula gilberti*), and the Pacific tripletail (*Lobotes pacificus*) both caught just off the adjacent shore of the bay with gillnets by the commercial artisanal fishing on 28 March, 2015 (Rosales-Casián, 2017).

It is important to mention that in 36 years of monitoring coastal fishes on the Pacific coast of Baja California, Mexico, (Islas Coronado at border with California (USA) to Laguna Ojo de Liebre, Baja California Sur), in a distance of 660 km, only in the Ojo de Liebre Lagoon the species *P. zonipectus* was identified during the warming event of The Blob-El Niño 2013-2016, also as a new extension in its distribution towards the north (Civico-Collados and Rosales-Casián, 2021).

Regarding its conservation and according to the IUCN Red List category and criteria, the Cortez angelfish is classified as Least Concern (Pyle *et al.*, 2010). They are "catch and release" when caught for recreational anglers and is occasionally retained for subsistence by fishermen (Snow, 2021). However, The Cortez angelfish *P. zonipectus* is an important fish species for the aquarium market, its cultivation can supply the demand, and it will be useful to establish strategies for its fishery management (Arellano-Martinez *et al.*, 2006).

Conclusion

The occurrence of Cortez angelfish in a temperate environment such as Bahía de San Quintin, Mexico is important as a biological indicator of warming signals. This angelfish joins a number of eight tropical fish species that have been recorded in the area during El Niño or The Blob events.

Compliance with Ethical Standard

Conflict of interests: The authors declare that for this article they have no actual, potential or perceived conflict of interests.

Ethics committee approval: This study was conducted in accordance with ethics committee procedures of animal experiments.

Funding disclosure: Funds for this research was provided from the project of Center for Scientific Research and Higher Education of Ensenada (CICESE) headed by Jorge A. Rosales-Casián "Aspectos biológicos del rocot rojo (*Sebastes miniatus*) y el pez blanco (*Caulolatilus princeps*) en San Quintin, B.C., México".

Acknowledgments: -

Disclosure: -

References

- Allen, G.R., Robertson, D.R. (1994). *Fishes of the Tropical Eastern Pacific*. Univ. Hawaii Press, ISBN-13: 9780824816759
- Arellano-Martínez, M., Ceballos-Vásquez, B.P., Hernández-Olalde, L., Galván-Magaña, F. (2006). Fecundity of Cortez angelfish *Pomacanthus zonipectus* (Teleostei: Pomacanthidae) off Espíritu Santo Island, Gulf of California, México. *Ciencias Marinas*, 32(1A), 65-71. <https://doi.org/10.7773/cm.v32i1.64>
- Cívico-Collados, L., Rosales-Casián, J.A. (2021). New fish species added to the ichthyofauna of Laguna Ojo de Liebre, Baja California Sur, México. *Aquatic Research*, 4(4), 343-350. <https://doi.org/10.3153/AR21029>
- Dorantes-Gilardi, M., Rivas-Camargo, D. (2019). Effects of the 2013–2016 Northeast Pacific warm anomaly on physical and biogeochemical variables off northwestern Baja California, derived from a numerical NPZD ocean model. *Deep-Sea Res. II. Top. Stud. Oceanography*, 169-170, 104668. <https://doi.org/10.1016/j.dsr2.2019.104668>
- Fricke, R., Eschmeyer, W.N., Van der Laan, R. (2021). Eschmeyer's Catalog of Fishes: Genera, species, references. (<http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>) (accessed 10. 09. 2021).
- Gracia-Escobar, M.F., Millán-Núñez, R., Valenzuela-Espinoza, E., González-Silvera, A., Santamaría-del-Ángel, E. (2015). Changes in the Composition and Abundance of Phytoplankton in a Coastal Lagoon of Baja California, México, during 2011. *Open Journal of Marine Science*, 5, 169-181. <https://doi.org/10.4236/ojms.2015.52014>
- Horn, M.H., Allen, L.G., and Lea, R.N. (2006). Biogeography. In L.G. Allen, D.J. Pondella and M.H. Horn (Eds.), *The ecology of marine fishes. California and adjacent waters* (p. 3–25). Berkeley, CA: University of California Press. ISBN-13: 978-0520246539. <https://doi.org/10.1525/9780520932470>
- Lara-Lara, J.R., Álvarez-Borrego, S. (1975). Ciclo anual de clorofilas y producción orgánica primaria en Bahía San Quintín, B.C. *Ciencias Marinas*, 2(1), 77-97.
- NOAA's El Niño page. National Oceanographic and Atmospheric Administration. (Retrieved from [https://www.climate.gov/enso/](http://www.https://www.climate.gov/enso/) (accessed 20 September, 2021).
- Page, L.M., Espinosa-Pérez, H., Findley, L.T., Gilbert, C.R., Lea, R.N., Mandrak, N.E., Mayden, R.L. and Nelson, J.S. (2013). *Common and scientific names of fishes from the United States, Canada, and Mexico, 7th edition*. American Fisheries Society, Special Publication 34, Bethesda, Maryland.
- Pérez-España, H. (1994). Hábitos alimentarios del Ángel Real *Holacanthus passer* Valenciennes, 1846 y del Ángel de Cortés *Pomacanthus zonipectus* Gill, 1863 (OSTEICHTHYES: POMACANTHIDAE) en la costa sur-occidental del Golfo de California. Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas (CICIMAR). Master's thesis, 71p.
- Peterson, W., Robert, M., Bond, N. (2015). The warm blob – Conditions in the northeastern Pacific Ocean. *PICES Press*, 23(1) winter, 36-38.
- Pyle, R., Allen, G., Myers, R., Zapata, F., Barraza, E., Robertson, R., Rocha, L.A., Craig, M.T. (2010). *Pomacanthus zonipectus*. *The IUCN Red List of Threatened Species* 2010: e.T165889A6158436. <https://doi.org/10.2305/IUCN.UK.2010-4.RLTS.T165889A6158436.en>
- Reynolds, W.W., Reynolds, L.J. (1977). Observations on food habits of the angelfishes *Pomacanthus zonipectus* and *Holacanthus passer* in the Gulf of California. *California Fish and Game*, 63(2), 124-125.
- Robinson, C.J. (2016). Evolution of the 2014–2015 sea surface temperature warming in the central west coast of Baja California, Mexico, recorded by remote sensing. *Geophysical Research Letters*, 43, 7066-7071. <https://doi.org/10.1002/2016GL069356>
- Rodríguez-Santiago, M.A. and Rosales-Casián, J.A. (2008). Abundance and size composition of vermilion rockfish, *Sebastes miniatus* (Jordan and Gilbert 1880), from sport fishing catches of San Quintín, Ensenada, Baja California, Mexico. *Bulletin of Southern California Academy of Sciences* 107(1), 25-32. [https://doi.org/10.3160/0038-3872\(2008\)107\[25:AASCOV\]2.0.CO;2](https://doi.org/10.3160/0038-3872(2008)107[25:AASCOV]2.0.CO;2)

Rosales-Casián, J.A. (1996). Ichthyofauna of Bahía de San Quintín, Baja California, México, and its adjacent coast. *Ciencias Marinas*, 22(4), 443-458.

<https://doi.org/10.7773/cm.v22i4.875>

Rosales-Casián, J.A. (2004a). Composition, importance and movement of fishes from San Quintín Bay, Baja California, México. *Ciencias Marinas*, 30(1A), 109-117.

<https://doi.org/10.7773/cm.v30i11.116>

Rosales-Casián, J.A. (2004b). Tropical fish species as indicator of 1997-1998 El Niño in Bahía de San Quintín, Baja California, México. *Bull. Bulletin of Southern California Academy of Sciences*, 103(1), 20-23.

Rosales-Casián, J.A. (2017). Biological Indicator of 2014_15 warming conditions: Presence of Mexican look-down (*Selene brevoortii*), Pacific tripletail (*Lobotes pacificus*) and Cortez bonefish (*Albula gilberti*) in the temperate eastern Pacific of Mexico. *CalCOFI Reports*, 58, 105-112.

Rosales-Casián, J.A., Almeda-Jauregui, C. (2009). Unusual occurrence of a green sturgeon *Acipenser medirostris*, at

El Socorro, Baja California, México. *CalCOFI Reports*, 50, 169-171.

Rosales-Casián, J.A., González-Camacho, J.R. (2003). Abundance and importance of fish species from the artisanal fishery on the Pacific coast on Northern Baja California. *Bulletin of Southern California Academy of Sciences*, 102(2), 51-65.

Rosales-Casián, J.A., Ruiz-Campos, G. (1999). Northern range extension of the White grunt, *Haemulopsis leuciscus*. *California Fish and Game*, 85(3), 135-138.

Snow, J. (2016, June 15). Mexico – Fish, Birds, Crabs, Marine Life, Shells and Terrestrial Life. Cortez Angelfish, *Pomacanthus zonipectus*. Retrieved September 5, 2021, from <https://mexican-fish.com/cortez-angelfish/> (accessed 10.20.2021).

Rupic, M., Wetzell, L., Marra, J.J., Balwani, S. (2018). 2014-2016 El Niño assessment Report, An overview of the impacts of the 2014-2016 El Niño on the U.S.-affiliated Pacific Islands (USAPI). NOAA Report, 50 pp.