Latin American Journal of Aquatic Mammals

ISSN: 2236-1057 | Vol. 20 No. 1, April 2025

Status of the offshore California sea lion (*Zalophus californianus*) rookery within the Guadalupe Island Biosphere Reserve, Mexico

Fernando R. Elorriaga-Verplancken[1,*], Tenaya Norris[2], María José Amador-Capitanachi[1], Eunice D. Rodríguez-Rafael[1], Romyna A. Cruz-Vallejo[1], Donaxí Borjes-Flores[3], and Israel Popoca-Arellano[3]

[1]Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN), La Paz, Mexico
[2]The Marine Mammal Center, Sausalito, USA
[3]Comisión Nacional de Áreas Naturales Protegidas (CONANP Reserva de la Biosfera Isla Guadalupe), Ensenada, Mexico

*Corresponding author: felorriaga@ipn.mx

The California sea lion (*Zalophus californianus*; CSL) is an otariid species widely distributed in the Eastern Pacific Ocean, along the west coast of the United States and the Baja California Peninsula, as well as in the Gulf of California (Aurioles-Gamboa & Zavala, 1994; Carretta et al., 2014; Adame et al., 2020). This predator has coastal foraging habits that highly depend on local prey, such as sardines and anchovies (McClatchie et al., 2016). As a result, the largest rookeries of this species are mainly related to the productive California Current Ecosystem off California, where large concentrations of these fish species are available for different consumers (Checkley & Barth, 2009). In this regard, the 2007 population size of CSLs in the Channel Islands and haul-out sites in California was 153,337 individuals and around twice that size for the entire United States CSL distribution (Carretta et al., 2014). The CSL Mexican coast population size from the Pacific Ocean (MCPO) was estimated at around 53,000 individuals in 2010 (Milanés-Salinas, 2012), where there are ten CSL rookeries located in Coronados, Todos Santos, San Martin, San Jerónimo, Guadalupe, San Benito, Cedros, Natividad, Asunción, and Santa Margarita islands (Milanés-Salinas, 2012; Pelayo-González et al., 2021) (Fig. 1). These islands are protected by the Mexican government and classified as natural protected areas or biosphere reserves. However, some colonies that inhabit these islands have declined over the last decades due to a sea surface temperature increase that seems to have impacted trophic dynamics. The CSL rookery from Santa Margarita Island declined around 75% in the last 36 years (Pelayo-González et al., 2021), and the rookery from the San Benito Archipelago declined 50 - 60% after the 2015-2016 El Niño event (Elorriaga-Verplancken et al., 2016). Moreover, the CSL rookeries from the Gulf of California declined around 65% due to ocean warming in this region from 1991 to 2019 (Adame et al., 2020).

Across the species entire range, the CSL rookery located in the Guadalupe Island Biosphere Reserve (GIBR), Mexican Pacific Ocean, is the farthest (around 250 km) one from shore. The Mexican government initiated the protection of Guadalupe Island in 1927 and declared it a sanctuary for pinnipeds and other wildlife in 1975. Due to their biological and ecological importance, this island and its islets were declared a Biosphere Reserve (total area of 4,770 km^2) in 2005. This site provides the opportunity to assess different species' regeneration, succession, and colonization because of its isolation and the low impact of anthropogenic activities. This Biosphere Reserve category is designated to relevant biogeographic areas with one or more ecosystems that have not been significantly altered by human action or need to be preserved or restored (Programa de Manejo de la Reserva de la Biosfera, 2023).

In the presence of these CSL fluctuations or declines throughout its Mexican distribution, this study aims to survey the abundance of the GIBR rookery during different breeding seasons (June-August, 2018-2019, and 2022-2023), expecting lower abundance values relative to previous years, as part of the same pattern that has been reported for the CSL in the Mexican Pacific (Elorriaga-Verplancken et al., 2016; Pelayo-González et al., 2021). This period (summer) presents the highest number of CSLs on land, which allows for more accurate abundance estimations (Aurioles-Gamboa & Zavala, 1994; Elorriaga-Verplancken et al., 2015; Adame et al., 2020). As part of the biological surveys that are constantly coordinated by the GIBR agency, providing significant information in previous years (Sosa et al., 2013; García-Aguilar et

ARTICLE INFO

Manuscript type: Note

Article History
Received: 03 April 2024
Received in revised form: 27 June 2024
Accepted: 07 September 2024
Available online: 21 February 2025
Responsible Editor: Eduardo Morteo

Citation:
Elorriaga-Verplancken, F. R., Norris, T., Amador-Capitanachi, M. J., Rodríguez-Rafael, E. D., Cruz-Vallejo, R. A., Borjes-Flores, D., & Popoca-Arellano, I. (2025). Status of the offshore California sea lion (*Zalophus californianus*) rookery within the Guadalupe Island Biosphere Reserve, Mexico. *Latin American Journal of Aquatic Mammals, 20*(1), 49-53. https://doi.org/10.5597/lajam00345

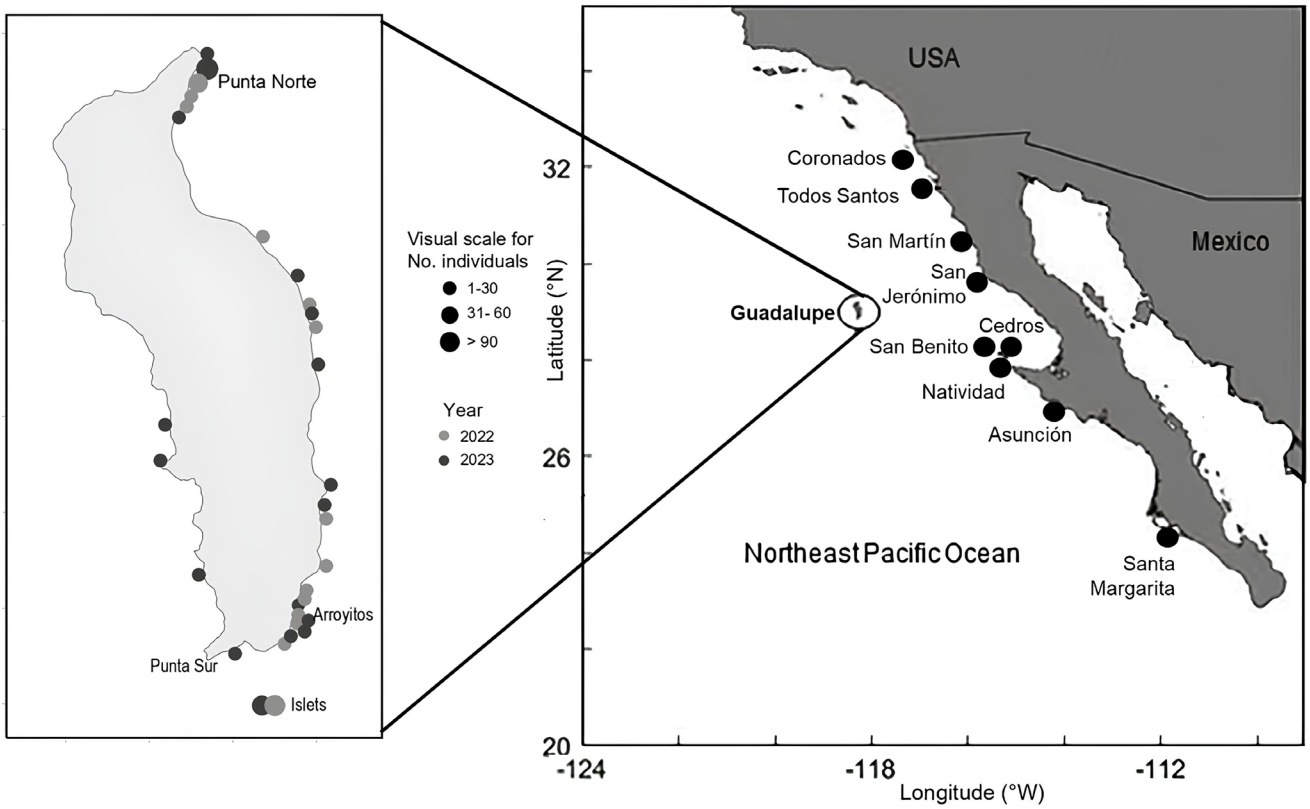

Figure 1. Location of California sea lion (*Zalophus californianus*) rookeries in the Mexican Pacific Ocean and location and size of California sea lions sites within the Guadalupe Island Biosphere Reserve in 2022-2023.

al., 2014; Gallo-Reynoso et al., 2015; 2018), CSLs were counted on land and sea (distance of 30 - 40 m from shore) from a boat and using binoculars in August 2018 - 2019 and 2022 - 2023. Surveyed individuals were classified into six classes, considering morphological features by sex and age (adult male, subadult male, adult female, juvenile, pup, and undetermined) (Le Boeuf et al., 1983). Geographic positions were recorded (2022 - 2023) with a GPS for the CSL sightings along the island and islets.

These surveys revealed the small size of this rookery during the breeding season compared to other rookeries in the MCPO, such as Coronados, Asunción, Cedros, Santa Margarita, and San Benito Islands, where CSL numbers have reached up to around 1,500 - 7,000 individuals (*e.g.*, Milanés-Salinas, 2012; Elorriaga-Verplancken et al., 2016; Pelayo-González et al., 2021). Our CSL counts in GIBR varied between 271 and 321, never exceeding 330 individuals. These were the values that will be further used to compare with previous studies that did not apply correction factors (Le Boeuf et al., 1983; Bonnell & Ford, 1987; for pups and adult females, respectively) to our knowledge. If these correction factors are taken in consideration in our data, the size of the CSL rookery in GIBR was 468 individuals in 2018, 462 in 2019, 428 in 2022, and 434 in 2023.

The most dominant age-classes were adult females and pups, which is typical of a reproductive colony (Aurioles-Gamboa & Zavala, 1994; Elorriaga-Verplancken et al., 2015). However, only a few adult males (not more than five) and approximately 100 pups were recorded in 2022 and 2023 (Table 1). This contrasts with other rookeries, such as the San Benito Archipelago rookery, with around 300 - 400 CSL adult males and 3,000 CSL pups recorded in 2022 or 2023 (Elorriaga-Verplancken & Norris, unpub. data). CSLs were observed scattered throughout the GIBR in 2022 and 2023, especially on the southeast portion of the main island, but mainly on the rocky islets (Zapato and Toro) located south of Guadalupe Island (Figs 1 and 2). This species and the Guadalupe fur seal (*Arctocephalus townsendi*) tend to avoid the west side of the main island due to its higher exposure to strong northwest winds and swell, in contrast with the east side, which is protected by the mountain ridge across the island (Berdegué, 1957; Gallo-Reynoso et al., 2005; Arias-del-Razo et al., 2016). The east side is inhabited by more than 25,000 Guadalupe fur seals (Elorriaga-Verplancken & Norris, unpub. data) throughout a terrestrial habitat (rocky cliffs and boulders) closely related to this species (García-Capitanachi et al., 2017). This dominant occupation by fur seals could explain why CSLs are especially found on the two islets south of the main island, where up to 40% of all CSLs were recorded in the four-year study period.

The low number of CSLs in the GIBR could be concerning, mainly due to the small number of adult males, although subadult males were observed. The possibility of these individuals having a potential role in reproduction due to the low number of bulls (adult males) is not discarded. The CSL abundance in the GIBR remained low over the years, not only based on previous recent assessments (2013 - 2017), which showed between 48 and 324 individuals in the area (Sosa et al., 2013; García-Aguilar et al., 2014; Gallo-Reynoso et al., 2015; 2018), but also over the last decades. Based on the compilation by Gallo-Reynoso et al. (2005), CSL abundances on the GIBR fluctuated from 119 individuals in November 1955 (Berdegué, 1957), 236 in February 1978 (Pierson, 1978), 100 in July 1979 (Le Boeuf et al., 1979), and 80 in July 1993 (Gallo-Reynoso & Figueroa-Carranza, 1992). It must be underlined

Figure 2. California sea lions (*Zalophus californianus*) in rocky areas from the Guadalupe Island Biosphere Reserve.

that some of the lowest abundances reported by these authors coincided with El Niño warm anomalies, which impact otariid colonies, including a declining abundance on the islands due to a negative effect on prey availability that impact foraging trip duration of adult females, as well as their reproductive success and pup body mass (Trillmich & Ono, 1991; Elorriaga-Verplancken et al., 2016; Cruz-Vallejo et al., 2024; Rodríguez-Martínez et al., 2025). These were the abundance values of 1993 (80) and 2016 (48); however, more studies should be performed to fully explore this relationship with environmental variability. This factor would also help us understand why, even though the overall abundance of this CSL rookery was slightly larger in 2018 - 2019, the number of adult females showed a declining trend from 2018 to 2023; however, pups presented the opposite trend (a higher number was observed in 2022 - 2023). A plausible explanation of this finding is that a higher proportion of the mothers (adult females) of those pups in 2022 - 2023 were at sea at the time of counting, compared to 2018 - 2019. This argument prevails even if the correction factor by Bonell and Ford (1987) was applied, by adding a constant 54% of adult females, resulting in 233 females in 2018, 185 in 2019, 148 in 2022, and 139 in 2023. Also, if the correction factor by Le Boeuf et al. (1983) was applied, by adding a constant 100% of pups, resulting in 130 pups in 2018, 184 in 2019, 210 in 2022, and 218 in 2023.

We suggest that the offshore location of the GIBR is the main factor that influences the relatively constant, low CSL abundance in the area. Other larger CSL rookeries in the MCPO are between 3 km and 30 km from the coastline of the Baja California Peninsula, while another rookery in San Benito Archipelago is located 70 km off the coast. These sites allow individuals not only to rest and breed, but also to exploit coastal upwelling areas, such as the Center of Biological Activities in the Gulf of Ulloa or other inshore foraging grounds on the west coast of the peninsula (Lluch et al., 2000; Aurioles-Gamboa et al., 2017; Arias-del-Razo et al., 2019; Rosas-Hernández et al., 2019). In this regard, CSL foraging trips in the California Current Ecosystem typically cover average distances of 84.7 ± 11.1 km (Kuhn & Costa, 2014). However, the CSL rookery at GIBR is a significant geographic outlier because it is 250 km off the peninsula, possibly promoting non-typical offshore foraging habits that should be different from the rest of the coastal CSL rookeries. This could cause a constant, low abundance because of its distance to foraging grounds closer to the coast and/or greater reliance on ephemeral mesoscale features (*e.g.*, fronts and eddies) for foraging, both of which likely result in longer and more energy-demanding foraging trips from the GIRB.

However, no dietary information is available to allow a better understanding of potential dietary differences between nearshore colonies and the GIRB rookery, and how prey availability influences the abundance within the rookeries. Future diet analyses of GIRB CSL should be performed to obtain more information on this species trophic ecology. The main prey items of CSLs from the

Table 1. Abundance of California sea lions (*Zalophus californianus*) in the Guadalupe Island Biosphere Reserve during the breeding seasons (August) from 2018 to 2023.

Year	Adult Males	Subadult Males	Adult Females	Juveniles	Pups	Undetermined	Total
2018	5	16	151	80	65	4	321
2019	4	10	120	74	92	5	305
2022	3	7	96	57	105	3	271
2023	4	16	90	51	109	6	276

San Benito Archipelago (260 km southeast of Guadalupe Island and 70 km off Punta Eugenia in the Baja California Peninsula) from 2014 to 2019 included mainly the epipelagic Pacific sardine (*Sardinops sagax*), the neritic Californian needlefish (*Strongylura exilis*), the mesopelagic North Pacific hake (*Merluccius productus*), the benthopelagic neon flying squid (*Ommastrephes bartramii*), the epipelagic jumbo squid (*Dosidicus gigas*), among others (Rodríguez-Martínez et al., 2025).

We suggest that CSL abundance at this small rookery results from several ecological factors, such as being limited by prey resource availability, as well as terrestrial haul out availability (space) due to the large Guadalupe fur seal abundance in the GIRB. However, this CSL rookery should also benefit from being inside a biosphere reserve with a solid conservation program that does not allow terrestrial disturbances or nearshore human activity, such as fishing. This protection should provide CSL suitable terrestrial habitat for breeding and resting, regardless of what occurs further in the ocean concerning its foraging habits and success. Even regarding trophic ecology, marine reserves positively affect fish biomass on the west coast of the Baja California Peninsula, which could also positively impact the potential prey of CSLs (Arias-del-Razo et al., 2019). Those authors argue that because these conservation areas in regions like the MCPO maintain a healthy marine ecosystem, they could be a factor in the resilience of marine mammals in the presence of climate change scenarios. This could be an important factor in the case of the GIRB CSL colony by providing potential prey in close proximity to the island and islets, given the significant offshore location from which longer foraging trips to inshore foraging grounds should be less suitable or probable. Further studies should include terrestrial habitat use in relation to the Guadalupe fur seal, and dietary studies using telemetry, stable isotopes, and scat analyses to determine the consumption of local resources by CSLs in the GIRB, as well as other potential foraging grounds.

Acknowledgments

We thank Instituto Politécnico Nacional (IPN) through Projects SIP-20181646, 20195860, 20220080, and 20232004; *Commander*, U.S. Pacific Fleet; Marine Mammal Commission research award 21-044 and The Marine Mammal Center for the financial support (field and analyses). We also thank the Secretaría de Medio Ambiente y Recursos Naturales through the Dirección General de Vida Silvestre en México for granting us the research permits: DGVS/002460/18, 11794/19, 08074/21, 02213/23, as well as Comisión Nacional de Áreas Naturales Protegidas (CONANP)–Reserva de la Biosfera Isla Guadalupe for their valuable support and coordination. We also thank Secretaría de Marina (SEMAR; Mexican Navy) for their support in the field. FREV thanks IPN for the received support through the fellowship EDI.

References

Adame, F. K., Elorriaga-Verplancken, F. R., Beier, E., Acevedo-Whitehouse, K., & Pardo, M. (2020). The demographic decline of a sea lion population followed multi-decadal sea surface warming. *Scientific Reports, 10*, 10499. https://doi.org/10.1038/s41598-020-67534-0

Arias-del-Razo, A., Heckel, G., Schramm, Y., & Pardo, M. (2016). Terrestrial habitat preferences and segregation of four pinniped species on the islands off the western coast of the Baja California Peninsula, Mexico. *Marine Mammal Science, 32*(4), 1416-1432. https://doi.org/10.1111/mms.12339

Arias-del-Razo A., Schramm, Y., Heckel, G., Sáenz-Arroyo, A., Hernández, A., Vázquez, L., & Carrillo-Muñoz, A. I. (2019). Do marine reserves increase prey for California sea lions and Pacific harbor seals? *PLoS ONE, 14*(6), e0218651. https://doi.org/10.1371/journal.pone.0218651

Aurioles-Gamboa, D., & Zavala, A. (1994). Algunos factores ecológicos que determinan la distribución y abundancia del lobo marino *Zalophus californianus*, en el Golfo de California. *Ciencias Marinas, 20*(4), 535-553.

Aurioles-Gamboa, D., Pablo-Rodríguez, N., Rosas-Hernández, M. P., & Hernández-Camacho, C. J. (2017). Guadalupe fur seal population expansion and its post-breeding male migration to the Gulf of Ulloa, México. In J. J. Alava (Ed.), *Tropical Pinnipeds* (pp. 105-133). CRC Press.

Berdegué, J. (1957). Redescubrimiento de la foca fina (*Arctocephalus townsendi*, Merriam) en Isla Guadalupe, México; con otras notas acerca de la biología de otros pinnípedos existentes en esas aguas. *Revista de la Sociedad Mexicana de Historia Natural*, 18, 173-198.

Bonnell, M. L., & Ford, R. G. (1987). California sea lion distribution: a statistical analysis of aerial transect data. *Journal of Wildlife Management, 51*(1):13-20. https://doi.org/10.2307/3801621

Carretta J. V., Oleson, E., Weller, D. W., Lang, A. R., Forney, K. A., Baker, J., Hanson, B., Martien K., Muto, M. M., Orr, A. J., Huber, H., Lowry, M. S., Barlow, J., Lynch, D., Carswell, L., Brownell Jr, R. L., & Mattila, D. K. (2014). *U.S. Pacific marine mammal draft stock assessments:* 2013 (Publication No. NOAA-TM-NMFS-SWFSC-532). NOAA Technical Memorandum, National Oceanic and Atmospheric Administration.

Checkley, D. M., & Barth, J. A. (2009). Patterns and processes in the California Current System. *Progress in Oceanography, 83*(1-4), 49-64. https://doi.org/10.1016/j.pocean.2009.07.028

Cruz-Vallejo, R. A., Elorriaga-Verplancken, F. R., Rosales-Nanduca, H., Hernández-Camacho, C. J., Moncayo-Estrada, R., Gómez-Gutiérrez, J., González-Armas, R., Rodríguez-Rafael, E. D., & González-López, I. (2024). Abundance, isotopic amplitude, and pups body mass of California sea lions (*Zalophus californianus*) from the southwest Gulf of California during anomalous warming events. *Marine Biology, 171*, 133. https://doi.org/10.1007/s00227-024-04446-x

Elorriaga-Verplancken, F. R., Ferretto, G., & Angell, O. C. (2015). Current status of the California sea lion (*Zalophus californianus*) and the northern elephant seal (*Mirounga angustirostris*) at the San Benito Archipelago, Mexico. *Ciencias Marinas, 41*(4), 269-281. https://doi.org/10.7773/cm.v41i4.2545

Elorriaga-Verplancken, F. R., Sierra-Rodríguez, G. E., Rosales-Nanduca, H., Acevedo-Whitehouse, K., & Sandoval-Sierra, J. (2016). Impact of the 2015 El Niño-Southern Oscillation on the abundance and foraging habits of Guadalupe fur seals and California sea lions from the San Benito Archipelago, México. *PLoS ONE, 11*(5), e0155034. https://doi.org/10.1371/journal.pone.0155034

Gallo-Reynoso, J. P., & Figueroa-Carranza, A. L. (1992). *Report of an expedition to Isla de Guadalupe, Baja California, Mexico, Summer 1992.* University of California, Santa Cruz.

Gallo-Reynoso, J. P., Le Boeuf, B. J., Figueroa, A. L., & Maravilla-Chávez, M. O. (2005). Los pinnípedos de Isla Guadalupe. In K. Santos del Prado & E. Peters (Eds.), *Isla Guadalupe. Restauración y Conservación* (pp.135-141). Instituto Nacional de Ecología (INE-SEMARNAT).

Gallo-Reynoso, J. P., Barba, I., Pérez, I., Masper, A., & Coria, E. (2015). *Monitoreo de las especies de pinnípedos en la RB Isla Guadalupe* (Publication No. PROMOBI/RBIG/05/2015). Programa de Monitoreo Biológico (PROMOBI).

Gallo-Reynoso J. P., Barba-Acuña, I., Coria-Galindo, E., Villegas-Amtmann, S., & Ortega-Borchardt, A. (2018). *Protección y conservación de las tres especies de Pinnípedos de Isla Guadalupe y la detección de sus principales amenazas vinculadas a sus procesos reproductivos, de reclutamiento y alimentación* (Publication No. PROCER/CER/134/2018). Programa de Conservación de Especies en Riesgo (PROCER).

García-Aguilar, M. C., Gallo, J. P., Barba, I., Pérez, J., Guevara, D., & Zihel, E. (2014). *Monitoreo de las especies de Pinnípedos en la Reserva de la Biosfera Isla Guadalupe* (Publication No. PROMOBI/RBIG/02/2014). Programa de Monitoreo Biológico (PROMOBI).

García-Capitanachi, B., Schramm, Y., & Heckel, G. (2017). Population fluctuations of Guadalupe fur seals (*Arctocephalus philippii townsendi*) between the San Benito Islands and Guadalupe Island, Mexico, during 2009 and 2010. *Aquatic Mammals, 43*, 492–500. https://doi.org/10.1578/AM.43.5.2017.492

Kuhn, C. E., & Costa, D. P. (2014). Interannual variation in the at-sea behavior of California sea lions (*Zalophus californianus*). *Marine Mammal Science, 30*(4), 1297–1319. https://doi.org/10.1111/mms.12110

Le Boeuf, B. J., Gisiner, R., Riedman, M., & Keit, E. (1979). *Report of a Scripps Institute of Oceanography Expedition to the Gulf of California and the Pacific Ocean west of Baja California,* 21 June-21 July 1979. University of California, Santa Cruz.

Le Boeuf, B., Aurioles-Gamboa, D., Condit, R., Fox, C., Gisiner, R., Romero, R., & Sinsel, F. (1983). Size and distribution of the California sea lion (*Zalophus californianus*) population in México. *Proceedings of the California Academy of Science, 43*(7), 77-85.

McClatchie, S., Field, J., Thompson, A. R., Gerrodette, T., Lowry, M., Fiedler, P. C., Watson, W., Nieto, K. M., & Vetter, R. D., (2016). Food limitation of sea lion pups and the decline of forage off central and southern California. *Royal Society of Open Science, 3*(3), 150628. https://doi.org/10.1098/rsos.150628

Milanés-Salinas, M. A. (2012). *Abundancia y distribución del lobo marino de California* (Zalophus californianus) *en el Pacífico Mexicano* [Master's thesis, Universidad Autónoma de Baja California].

Pelayo-González, L., González-Rodríguez, E., Ramos-Rodríguez, A., & Hernández-Camacho, C. J. (2021). California sea lion population decline at the southern limit of its distribution during warm regimes in the Pacific Ocean. *Regional Studies in Marine Science, 48*, 102040. https://doi.org/10.1016/j.rsma.2021.102040

Pierson, M. O. (1978). *Report of a Scripps Institution of Oceanography Expedition to Baja California Islands, February 9-20, 1978*. University of California, Santa Cruz.

Programa de Manejo de la Reserva de la Biosfera Isla Guadalupe. (2013). Secretaría de Medio Ambiente y Recursos Naturales.

Rodríguez-Martínez, M. I., Moreno-Sánchez, X. G., Moncayo-Estrada, R., & Elorriaga-Verplancken, F. R. (2025). Impact of anomalous ocean warming on the abundance and foraging habits of the California sea lion (*Zalophus californianus*) from the San Benito Archipelago in the Mexican Pacific. *Journal of Mammalogy, 106*(1), 72-84. https://doi.org/10.1093/jmammal/gyae122

Rosas-Hernández, M. P., Aurioles-Gamboa, D., & Hernández-Camacho, C. J. (2019). Specialized foraging habits of adult female California sea lions *Zalophus californianus. Marine Mammal Science, 35*(4), 1463-1488. https://doi.org/10.1111/mms.12603

Sosa, N. O., Gallo, J. P., Furundarena, A., Medrano, L., Rodríguez, C., García, E., & García, M. (2013). *Monitoreo del Tiburón Blanco* (Carcharodon carcharias) *en la Reserva de la Biosfera Isla Guadalupe* (Publication No. PROMOBI/DRPBCPN/03/2013). Programa de Monitoreo Biológico (PROMOBI).

Trillmich, F., & Ono, K. (1991). *The effects of El Niño on pinniped populations in the eastern Pacific.* Springer-Verlag