

NOTE

New colony of Guadalupe fur seals (*Arctocephalus townsendi*) discovered on El Farallón de San Ignacio Island, Gulf of California

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Guadalupe fur seals (*Arctocephalus townsendi*) have established a second haul-out in the Gulf of California on El Farallón de San Ignacio Island, along the mainland coast of Mexico (Figures 1 and 2). Unlike the smaller, seasonal site first used in 2019–2020 on Las Ánimas Islet (Figure 1; Elorriaga-Verplancken et al., 2021), Guadalupe fur seals appear to have been using El Farallón since 2014. In 2020 there were 492 fur seals present at El Farallón in January, and 771 in November—the majority of which were juveniles. The discovery of this new haul-out at El Farallón de San Ignacio Island brings the total number of sites where this species of fur seal is known to rest and breed to just four. With only a single breeding colony (rookery) on Guadalupe Island, Guadalupe fur seals remain vulnerable and may require additional protections in the southern Gulf of California to secure their future.

Guadalupe fur seals were hunted for their furs and declared extinct in the late 19th century. It was therefore an unexpected surprise when 14 individuals were discovered in 1950 on Guadalupe Island (Hubbs, 1956). Since then, the population has grown and began hauling out at a second location (San Benito Islands) in the late 1990s (Maravilla-Chavez & Lowry, 1999). The San Benito Islands were a former breeding area in the 19th century, and are currently a large and well-established resting colony (haul-out)—with small numbers of births occurring during the annual breeding season (June–August; Gallo-Reynoso, 1994; Figure 1). However, numbers of births have been too few to classify this site as a rookery.

The current populations at Guadalupe and San Benito Islands total ~ 41,000 individuals and have grown at an annual rate of 10%–11% per year (Hernández-Camacho & Trites, 2018). Guadalupe and San Benito Islands are two of five locations where Guadalupe fur seals were once thought to breed (Figure 1) and represent <50% of the 100,000 Guadalupe fur seals thought to have been present before hunting (Fleischer, 1978; Hamilton, 1951).

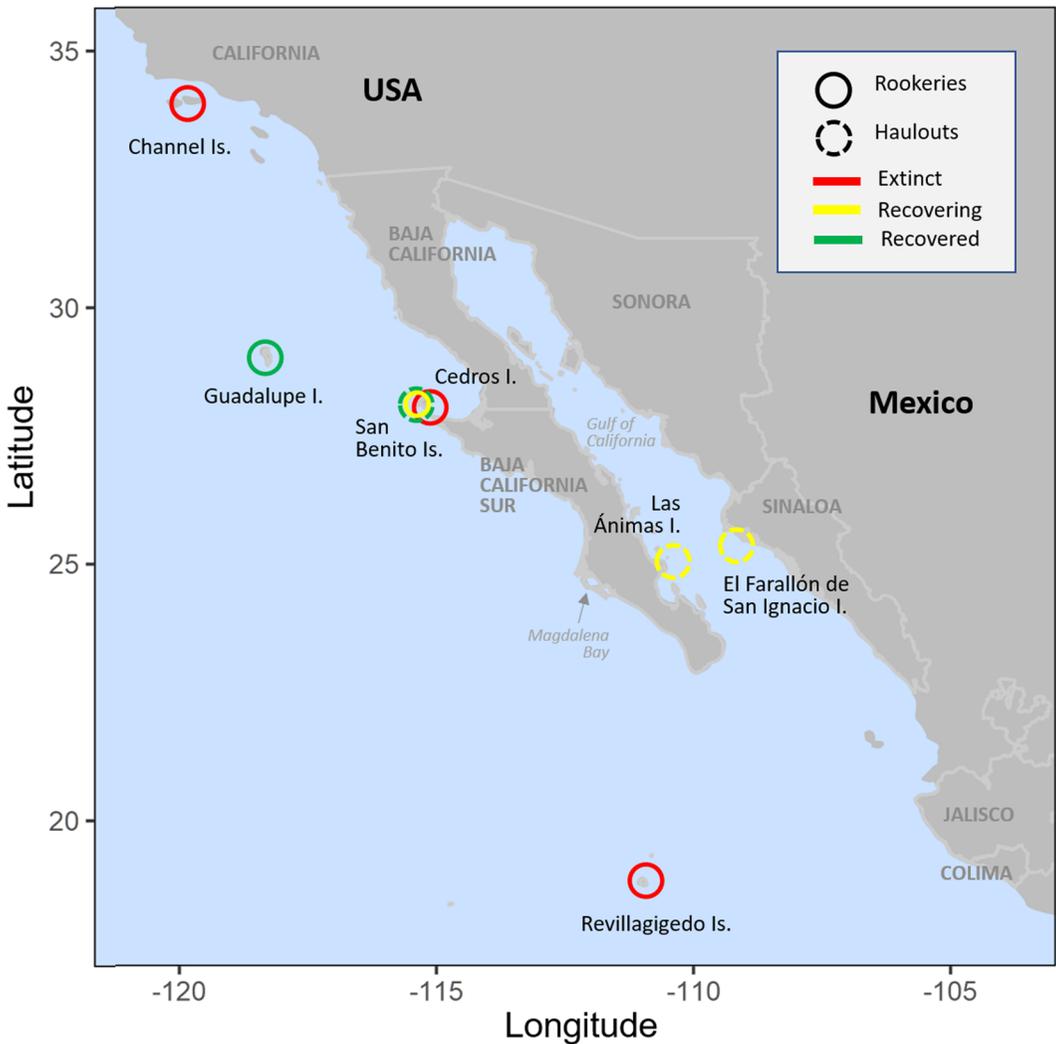


FIGURE 1 Current and historical distribution of the Guadalupe fur seal based on historical records (Mexico) and archeological data (from the California Channel Island and coast of California; Rick et al., 2009). Locations of known haul-outs (dashed circles) and rookeries (solid circles) of Guadalupe fur seals show those that are extinct (red), those that appear to be recovering (yellow), and those that have recovered (green).

Archeological data and records of Guadalupe fur seals killed on different islands suggest that the breeding colonies of Guadalupe fur seals were once distributed from the Revillagigedo Islands, Mexico, to the California Channel Islands (Figure 1; Etnier, 2002; Hamilton, 1951; Hubbs, 1956; Rick et al., 2009). The main breeding colonies are believed to have been on the Channel Islands, Guadalupe Island, San Benito Archipelago, Cedros Island, and Revillagigedo Archipelago (Hubbs, 1956; Le Boeuf & Bonnell, 1980). Unfortunately, there is no historical information on possible nonbreeding sites (haul-outs) that Guadalupe fur seals once used.

In March 2019, 12 juvenile Guadalupe fur seals were found on Las Ánimas Islet, in the southwest Gulf of California (Figure 1) over 1,000 km south of Guadalupe and San Benitos Islands (Elorriaga-Verplancken et al., 2021). Total numbers at Las Ánimas Islet increased to 73 juveniles in February and 57 in March 2020, with >100 in August 2020 (Elorriaga-Verplancken et al., 2021). However, a visit to the islet in October 2020 found no fur seals, suggesting this incipient haul-out may only be used during winter and summer.

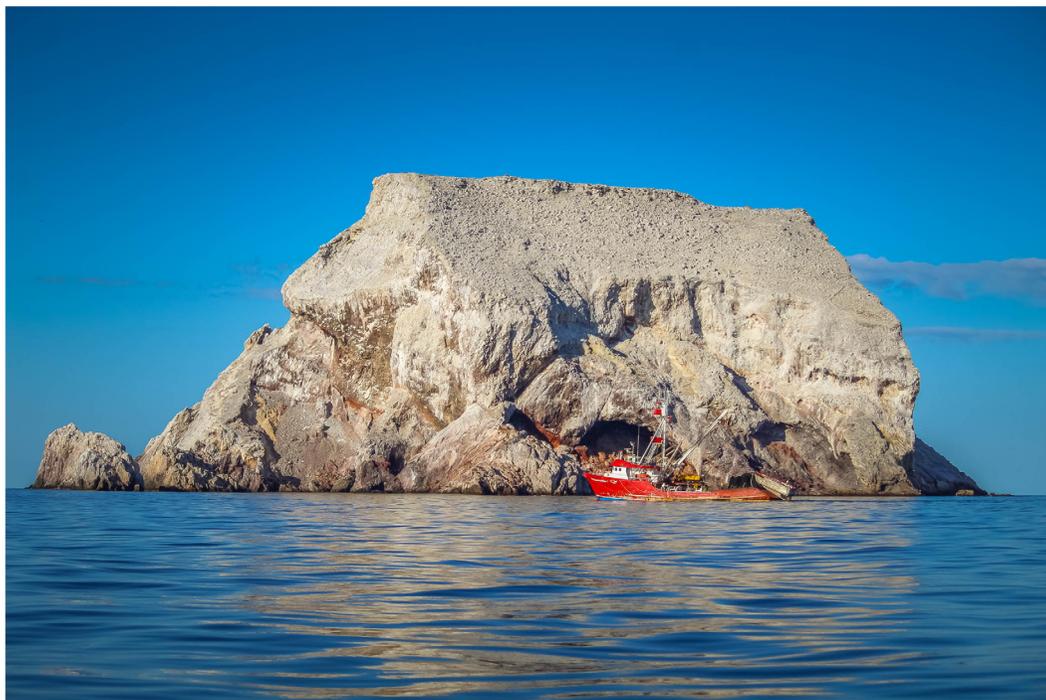


FIGURE 2 The east and north sides of El Farallón de San Ignacio Island (Sinaloa, Mexico). The seine boat passing in front of one of the steep rocky haul-outs used by Guadalupe fur seals participates in the sardine fishery. Photo: Jorge Paul Orduño García.

The colony of Guadalupe fur seals we discovered in 2014 on the southeast side of the Gulf of California at El Farallón de San Ignacio Island began forming five years before the Las Ánimas colony was noted (Table 1, Figure 2). We were uncertain at that time whether the few animals we initially saw were an anomaly and returned to the island for the past 6 years to confirm their continued presence, growth and establishment of a permanent colony. This small arid island is comprised of steep jagged rocks (536 m diameter and 142 m high) and is home to ~500 California sea lions (*Zalophus californianus*). It is surrounded by deep water (>3,000 m), except for the rocks to the north (Maluf, 1983). Fur seals using the island tend to climb up the steep rocks to rest (Figure 3), and animal densities are highest on the east and southeast sides of the island.

In December 2008, a single adult male Guadalupe fur seal was observed ashore at El Farallón de San Ignacio Island. We returned to the island in 2014 and 2016 to count California sea lions and recorded Guadalupe fur seals on all visits (Table 1). We observed fewer than 10 juvenile fur seals during our first visit (June 2014), and quadruple this number two years later (June 2016; Table 1). The fur seals were on land and in the water and were counted using binoculars from a boat positioned 40 m from the island.

Starting in April 2019, we increased our observation effort by making monthly counts (except in August, November, and December 2019). In addition to binoculars, we also deployed a drone (DJI Spark) to take overhead pictures and videos for counting big groups of animals in the water. Fur seals were again found on all visits to the island (between 23 and 292 juveniles, subadults, and adult males; Figure 4). We classified most individuals in the water as undetermined because of the difficulty to identify the age- and sex-classes of the resting animals (Figure 5). COVID-19 pandemic restrictions further limited us to making just two visits to El Farallón (October and November) after the visit in January 2020. We observed 492 individuals in January, a single juvenile in October, and 771 in November (Table 1). The majority of all animals seen at El Farallón de San Ignacio have been juveniles, and all have appeared to be in good body condition.

TABLE 1 Counts of Guadalupe fur seals at the Farallón de San Ignacio Island, Sinaloa, Mexico showing adult males, subadult males, mature females, pups, male and female juveniles, and undetermined sexes and age classes.

Date	Adult male	Subadult male	Female	Juvenile	Pup	Undetermined	Total
December 14, 2008	1	0	0	0	0	0	1
June 22, 2014	0	0	0	2	0	4	6
April 30, 2016	1	0	0	2	0	6	9
July 1, 2016	1	0	0	0	0	21	22
April 4, 2019	4	0	5	22	0	37	68
May 21, 2019	4	0	9	40	0	157	210
June 11, 2019	3	0	9	21	0	259	292
July 27, 2019	3	0	3	9	0	8	23
September 13, 2019	0	0	0	14	0	14	28
November 13, 2019	5	0	20	140	0	117	282
January 1, 2020	0	0	0	382	0	110	492
October 14, 2020	0	0	0	1	0	0	1
November 25, 2020	12	8	58	378	0	315	771

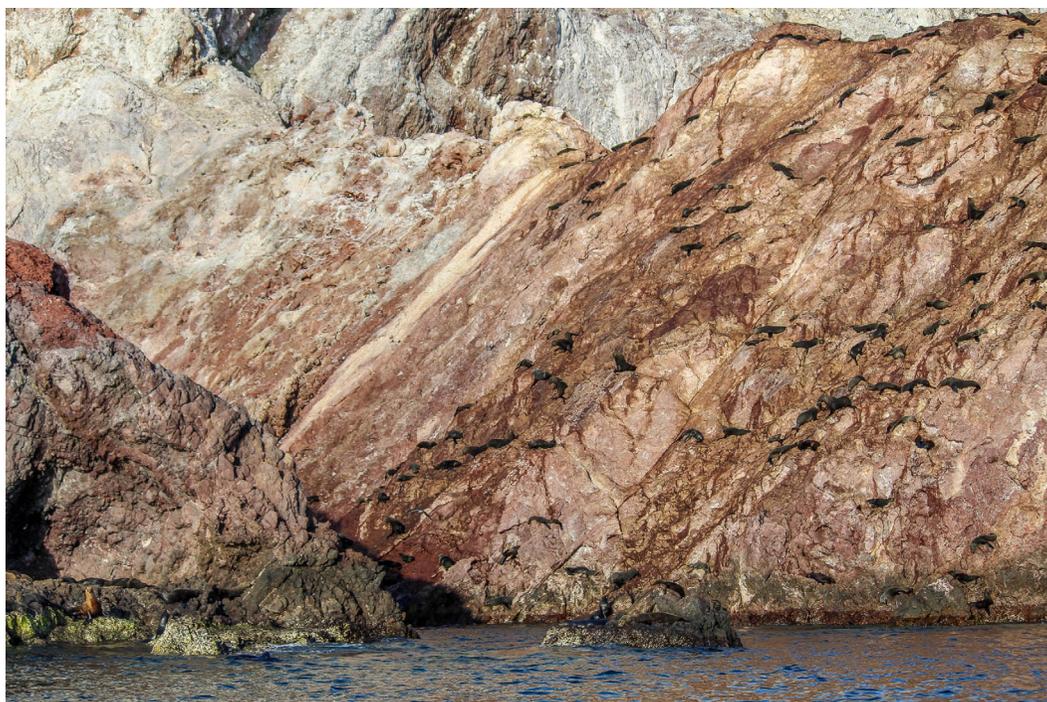


FIGURE 3 The northeast haul-out of Guadalupe fur seals at El Farallón de San Ignacio Island showing the steepness of the terrain and the extent to which the fur seals climb and distance themselves from each other. Photo: Jorge Paul Orduño García.

The haul-out at El Farallón de San Ignacio shows strong seasonality, with highest numbers (>250 individuals) occurring from May to June (spring) and from November to January (fall-winter), with smaller numbers of animals present the rest of the year (<30). In contrast, fur seal numbers peak at the San Benito Archipelago during the



FIGURE 4 Juvenile and subadult Guadalupe fur seals along the northeast side of El Farallón de San Ignacio Island (May and June 2020). Photo: Jorge Paul Orduño García.



FIGURE 5 Artisanal fishermen catch fish using handlines around the margins of the east side of El Farallón de San Ignacio Island while a group of Guadalupe fur seal rafts near the haul-out (May and June 2020). Photo: Jorge Paul Orduño García.

breeding season (July to August, >3,500 individuals), and drop the rest of the year (until reaching <50) (Sierra-Rodríguez, 2015). In contrast, the few counts of the Las Ánimas haul-out have been higher during summer, but are insufficient to draw a conclusion at this time about the seasonal use of this site. However, the proximity of the Las

Ánimas haul-out to El Farallón de San Ignacio makes seasonal use a likely possibility. So far, the available data show the number of individuals using the Las Ánimas haul-out is highest during summer. Between the two new haul-outs, there were ~ 400 Guadalupe fur seals present in southern Gulf of California in the summer of 2019—and substantially more during the summer of 2020.

Since the early 1990s, Guadalupe fur seals have been reported north of Guadalupe Island. Juveniles, subadults, and adults have been reported with increased frequency over the past two decades along the coast of California (Hanni et al., 1997; Melin & Delong, 1999; Stewart et al., 1993). The northernmost records are ~2,300 km to the north along the coastlines of Washington (D'Agnese et al., 2020), Vancouver Island, and the city of Vancouver (Vancouver Aquarium¹). These sightings of juveniles, subadults, and adult males appear to correspond to an increase in the Guadalupe fur seal population, and likely reflect their return to feeding areas used prior to commercial hunting in the 1800s (D'Agnese et al., 2020).

Sightings of Guadalupe fur seals south of Guadalupe Island have been less frequent than northern sightings. The southernmost sightings have come >1,500 km south of Guadalupe Island off the coast of Jalisco and Colima (near Puerto Vallarta; Ortega-Ortiz et al., 2019). They are also being seen with increasing frequency in Magdalena Bay (Baja California Sur) and in the Gulf of California mostly during the last half of the year when postbreeding migration occurs (Aurioles et al., 1993; Aurioles-Gamboa et al., 2017; Elorriaga-Verplancken et al., 2021; Elorriaga-Verplancken, Rosales-Nanduca, et al., 2016). The most extralimital sighting of a subadult male (in apparently good body condition) was reported in the Galapagos Archipelago (Páez-Rosas et al., 2020).

Records of free-ranging Guadalupe fur seal tagged with satellite tags in Guadalupe Island and rehabilitated animals tagged on the coast of California showed that these animals feed mainly in oceanic waters north and south of the sites where they were released, traveling up to 600 km in the case of females during the summer breeding season (Gallo-Reynoso et al., 2008) and up to ~1,500 km for juveniles and subadult and adult males in winter (Amador-Capitanachi, 2018). The immature and adult males appear to travel longer distances on average than females during their annual migrations (Aurioles et al., 1993).

Since 2015, there has been high variability in numbers of individuals counted from one year to the next at the San Benito Islands—as well as unusual numbers of stranded Guadalupe fur seals showing signs of malnutrition along the coast of California² (Carretta et al., 2019). Strandings of Guadalupe fur seals along the Baja peninsula at Bahía Magdalena (2003–2005) were highest from August to September (following the June–August breeding season when they start their migration) and lower during other months (Aurioles-Gamboa et al., 2017). Most of these individuals were adult and subadult males. Collectively, the reported strandings of Guadalupe fur seals along the Baja and California coastlines suggest extreme climatic events, such as the Blob in 2014 and the 2015 El Niño, may be making it difficult for fur seals to acquire sufficient prey (Aurioles-Gamboa et al., 2017; Carretta et al., 2019; Elorriaga-Verplancken, Sierra Rodríguez, et al., 2016; Hanni et al., 1997).

The number of fur seals using the southern Gulf of California has increased notably since 2019. However, their presence in this region does not seem to be associated with the increase in sea surface temperatures as occurred during the anomalous dispersal of Guadalupe fur seals to northern areas during the Blob (which originated in the northeastern Pacific Ocean in 2014). Instead, the formation of the two new haul-outs of fur seals at Las Ánimas and San Farallón de San Ignacio—barely 137 km apart—suggests this is a new feeding area for Guadalupe fur seals.

Guadalupe fur seals feed mainly on opalescent inshore squid (*Loligo opalescens*), Humboldt squid (*Dosidicus gigas*), purpleback squid (*Stenoteuthis oualaniensis*), and *Onychoteuthis* spp. (Aurioles-Gamboa & Camacho-Ríos, 2007). Humboldt squid are a migratory species that is generally present in the southern part of the Gulf of California during winter (December–March) as it migrates to the coast of Sonora. They begin to move towards the center of the Gulf of California and then southwards in fall (September–December; Morales-Bojórquez et al., 2001). This suggests that the highest concentrations of squid in the southern Gulf of California coincide with when the highest number of fur seals have been seen at El Farallón de San Ignacio Islands (i.e., fall–winter: November–January).

Summer air temperatures at El Farallón (which average $32^{\circ}\text{C} \pm 10^{\circ}\text{C}$ in the Gulf of California) are much warmer than along the western Pacific coast of the Baja California peninsula (where they average $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$) (Cody

et al., 2000; García, 2004)—and presumably pose thermoregulatory challenges for the Guadalupe fur seals, as they do for the California sea lions that inhabit the Gulf of California (Bohórquez-Herrera et al., 2014). Unfortunately, the adaptive capacity of Guadalupe fur seals to control their body temperatures when ambient temperature exceeds their thermoneutral zone is unknown—as is whether the apparent extreme environmental conditions experienced at El Farallón might ultimately limit continued use of this new haul-out site.

The recent presence of Guadalupe fur seals at Las Ánimas Islet and El Farallón de San Ignacio Islands in the southern Gulf of California doubles the number of terrestrial locations where this vulnerable species is known to occur. The significant number of seals now using this region also points to the need to develop a conservation policy that addresses the importance of the southern Gulf of California as a feeding ground for Guadalupe fur seals. Both haul-outs are in protected areas known as Islands and Protected Areas of the Gulf of California or *Áreas de Protección de Flora y Fauna Islas del Golfo de California*. However, the management plan for these Protected Areas does not consider the needs of Guadalupe fur seals since they were previously considered to be occasional visitors (Aurioles et al., 1993; Elorriaga-Verplancken, Rosales-Nanduca, et al., 2016).

The Guadalupe fur seal haul-out of Farallón de San Ignacio occurs in an area that is also important to artisan fisheries. Fishing is economically important in this region and employs large numbers of people directly or collaterally through transportation, marketing, and product preparation (Madrado & Bringas, 2017). This may result in interactions between fur seals and artisan fisheries (Figure 5), and could result in the entanglement and death of some animals (such as the few entangled and injured juveniles we observed in May and June 2019).

The new haul-outs of Guadalupe fur seals in the southern Gulf of California will need regular monitoring to document their growth and possible changes in body conditions, age and sex-composition, and breeding potential. Effort should also be put into searching the Gulf of California for other possible haul-outs to better understand the distribution and recovery of Guadalupe fur seals. Although this species escaped extinction once, it remains vulnerable. It only has one breeding colony (rookery) and is susceptible to changes in prey availability.

The formation of new haul-outs gives hope for continued recovery of Guadalupe fur seals. However, our optimism for the future of this endangered species is tempered by the recent unusual mortalities of Guadalupe fur seals reported along the coast of North America (see Endnote 2), and by the ocean warming events that are occurring with increasing frequency in the North Pacific (Hernández-Camacho & Trites, 2018).

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AUTHOR CONTRIBUTIONS

María del Carmen Gutiérrez-Osuna: Conceptualization; funding acquisition; investigation; methodology; project administration; writing-original draft; writing-review & editing. **Jesús Díaz-Gaxiola:** Investigation; methodology. **Andrew Trites:** Conceptualization; visualization; writing-review & editing. **Claudia J. Hernández-Camacho:** conceptualization; visualization; writing-original draft; writing-review & editing.

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ENDNOTES

¹ <https://www.cbc.ca/news/canada/british-columbia/guadalupefurseal-vancouveraquarium-stranded-1.3417075>

² <https://www.fisheries.noaa.gov/national/marine-life-distress/2015-2021-guadalupe-fur-seal-unusual-mortality-event-california>

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