GUADALUPE FUR SEAL (*Arctocephalus townsendi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

Commercial sealing during the 19th century reduced the once abundant Guadalupe fur seal to near extinction in 1894 (Townsend 1931). Prior to the harvest it ranged from Monterey Bay, California, to the Revillagigedo Islands, Mexico (Hanni *et al*. 1997, Repenning *et al.* 1971; Figure 1). The prehistoric distribution of Guadalupe fur seals during the Holocene was apparently quite different from today, as the archeological record indicates Guadalupe fur seal remains accounted for 40%-80% of all pinniped bones at the California Channel Islands (Rick *et al*. 2009). The live capture of two adult males (and killing of ~ 60 more animals) at Guadalupe Island in 1928 established the continued existence of the species (Townsend 1931). Guadalupe fur seals pup and breed mainly at Isla Guadalupe, Mexico. In 1997, a second rookery was discovered at Isla Benito del Este, Baja California (Maravilla-Chavez and Lowry 1999) and a pup was born at San Miguel Island, California (Melin and DeLong 1999). Since 2008, individual adult females, subadult males, and between one and three pups have been observed annually on San Miguel Island (NMFS, unpublished data). The population at Isla Benito del Este is now well-established, though very few pups are observed there. Population increases at Isla San Benito are attributed to immigration of animals from Isla Guadalupe (Aurioles-Gamboa *et al.* 2010, García-Capitanachi 2011). Along the U.S. West Coast, strandings occur almost annually in California waters and animals are increasingly observed in Oregon and Washington waters. In 2015-2016, Guadalupe fur seal strandings totaled approximately 175 animals along the coast of California (compared with approximately 10 animals annually in prior years), and NMFS declared an Unusual Mortality Event. Most strandings involved animals less than 2 years old with evidence of malnutrition. Individuals have stranded or been sighted inside the Gulf of California and as far south as Zihuatanejo, Mexico (Hanni et al. 1997 and Aurioles-Gamboa and Hernadez-Camacho 1999) and another in 2012, at Cerro Hermoso, Oaxaca, Mexico (Esperon-Rodriguez and Gallo-Reynoso 2012). Recent video records of pinnipeds hooked in the mouth from international waters west of the California Current involving the shallow set Hawaii longline fishery were independently reviewed by pinniped experts and at least one animal in early 2016 was identified as a Guadalupe fur seal. Guadalupe fur seals that stranded in central California and treated at rehabilitation centers were fitted with satellite tags and documented to travel as far north as Graham Island and Vancouver Island, British Columbia, Canada (Norris *et al.* 2015). Some satellite-tagged animals traveled far offshore outside the U.S. EEZ to areas 700 nmi west of the California / Oregon border. The population is considered to be a single stock because all are recent descendants from one breeding colony at Isla Guadalupe, Mexico.

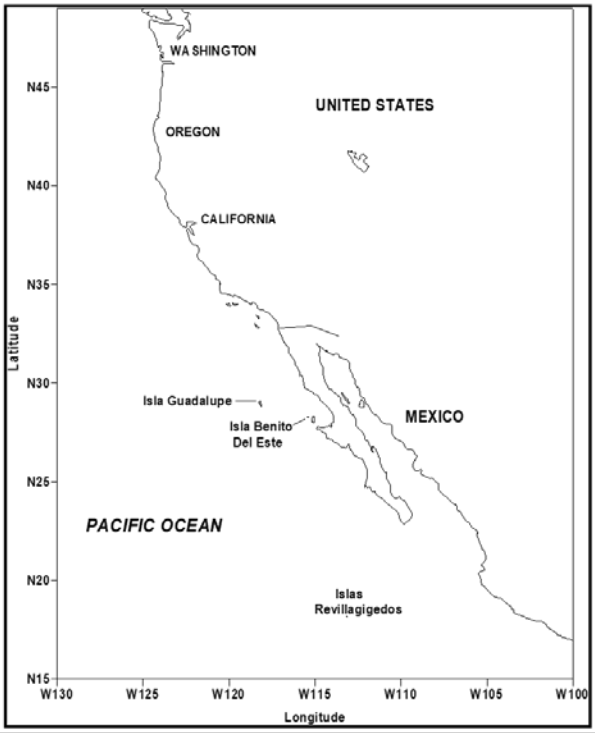

Figure 1. Geographic range of the Guadalupe fur seal, showing location of two rookeries at Isla Guadalupe and Isla Benito Del Este.

POPULATION SIZE

Population size prior to commercial harvests in the 19th century is unknown, but estimates range from 20,000 to 100,000 animals (Fleischer 1987). García-Aguilar *et al*. (2018) estimate current population size is approximately one-fifth of its historical pre-exploitation size. The most recent estimate of population

size is based on pup count data collected in 2013 and a range of correction factors applied to pup counts to account for uncounted age classes and pre-census pup mortality (García-Aguilar *et al.* 2018). The 2013 estimates are based on 4,924 pups counted from a boat survey of Isla Guadalupe and corrected for pre-census mortality, resulting in an estimated 9,768 pups (range 8,863 – 10,869) born. García-Aguilar *et al.* (2018) estimated total population size by scaling up pup counts assuming two different total population size to pup count ratios (3.5:1 and 4.5:1) that have been used as defaults for other pinniped populations (Harwood and Prime 1978). Resulting estimates were 34,187 individuals (range 31,019–38,043), and 43,954 individuals (range 39,882–48,912). These estimates do not include animals at San Benito Island, for which Elorriaga-Verplancken *et al.* (2016) counted a maximum of 3,710 animals (including 28 pups) and 1,494 animals (16 pups) in July of 2014 and 2015, respectively. García-Aguilar *et al*. (2018) and Elorriaga-Verplancken *et al.* (2016) note that the San Benito Island rookery is represented almost exclusively by immature animals migrating from Guadalupe Island, and that negligible numbers of pups are produced at San Benito.

Minimum Population Estimate

The minimum population size is taken as the lower bound of the estimate provided by García-Aguilar *et al*. (2018) using a population size:pup count ratio of 3.5, or 31,019 animals.

Current Population Trend

Counts of Guadalupe fur seals have been made sporadically since 1954 and are compiled by Seagars (1984), Fleischer (1987), Gallo (1994), Torres et al. (1990), and García-Capitanachi (2011). Historic counts vary in reliability in that some census efforts represent partial counts, either of age classes or lack complete spatial coverage of Guadalupe Island. A more recent study, based on only pup counts between 1984 and 2013 at Guadalupe Island, resulted in an estimated annual rate of increase of 5.9% (range 4.1–7.7%) (García-Aguilar *et al*. 2018) (Figure 2). This estimate of annual rate of increase does not include years prior to 1984 when the population was considerably smaller and higher population growth rates would be expected as the population recovered from historic anthropogenic removals.

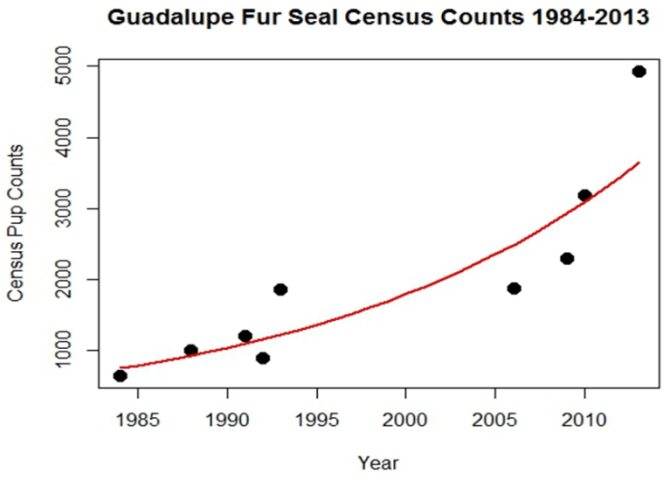

Figure 1. Guadalupe fur seal census counts through time.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reported annual growth rates of 21% at Isla San Benito over an 11-year period are too high and likely result from immigration from Isla Guadalupe (Esperón-Rodríguez and Gallo-Reynoso 2012). The maximum net productivity rate is assumed to be equal to the maximum annual growth rate observed between 1955 and 1993 (13.7%) when the population was at a very low level and should have been growing at nearly its maximum rate (Gallo 1994).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) for this stock is calculated as the minimum population size (31,019) times one half the maximum net growth rate observed for this species (½ of 13.7%) times a recovery factor of 0.5 (for a threatened species, Wade and Angliss 1997), resulting in a PBR of 1,062 Guadalupe fur seals per year. The vast majority of this PBR would apply towards incidental mortality in Mexico as most of the population occurs outside of U.S. waters. The fraction of this stock that occurs in U.S. waters and the amount of time spent in U.S. waters is unknown, thus, a proration factor for calculating a PBR in U.S. waters is not available.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fisheries Information

Table 1. Summary of available information on the incidental mortality and serious injury of Guadalupe fur seals in commercial fisheries and other unidentified fisheries that might take this species.

Fishery Name	Year(s)	Data Type	Percent Observer Coverage	Observed Mortality and Serious Injury (and non-serious injuries)	Estimated Mortality and Serious Injury (CV)	Mean Annual Takes (CV)
CA driftnet fishery for sharks and swordfish	2013-2017	observer	12%-37%	0	0	0
CA set gillnet fishery for halibut/white seabass and other species	2013-2017	observer	<10%	0	0	0
Hawaii Shallow Set Longline Fishery	2013-2017	observer	100%	2 (2)	2 (0)	0.4 (0)
Unidentified fishery interactions, including generic gillnets of unknown origin	2013-2017	strandings	n/a	4 (1)	≥ 4	≥ 0.8
Minimum total annual takes						≥ 1.2

No Guadalupe fur seals have been observed entangled in California gillnet fisheries between 1990 and 2017 (Julian and Beeson 1998, Carretta *et al*. 2004, Carretta *et al*. 2016b, Carretta *et al*. 2019a, 2019b), although stranded animals have been found entangled in gillnet of unknown origin (see 'Other mortality' below). Gillnets have been documented to entangle marine mammals off Baja California (Sosa-Nishizaki *et al*. 1993), but no recent bycatch data from Mexico are available.

Guadalupe fur seals occasionally are observed hooked in the Hawaii shallow set longline fishery (100% observer coverage, Table 1). Between 2013 and 2017 there were 2 serious and 2 non-serious injuries involving this species (Carretta *et al*. 2019a). These interactions occurred outside of the U.S. EEZ, west of the California Current.

Other mortality and serious injury

There were 13 records of human-related deaths and/or serious injuries to Guadalupe fur seals from stranding data for the most recent 5-year period of 2013-2017 (Carretta *et al.* 2016a, Carretta *et al*. 2019a). These strandings included entanglement in marine debris and shootings. The average annual observed human-caused mortality and serious injury of Guadalupe fur seals for 2013-2017 from non-fishery sources is 2.6 animals annually (13 animals / 5 years). Observed human-caused mortality and serious injury for this stock very likely represents a fraction of the true impacts because not all cases are documented. No correction factors to account for undetected mortality and injury are currently available for pinnipeds along the U.S. west coast.

STATUS OF STOCK

The Endangered Species Act lists the Guadalupe fur seal as a threatened species, which automatically qualifies this stock as "depleted" and "strategic" stock under the Marine Mammal Protection Act. There is insufficient information to determine whether fishery mortality in Mexico exceeds the PBR for this stock, but given the observed growth of the population over time, this is unlikely. The total U.S. commercial fishery mortality and serious injury for this stock (≥1.2 animals per year) is less than 10% of the calculated PBR for the entire stock, but it is not currently possible to calculate a prorated PBR for U.S. waters with which to compare serious injury and mortality from U.S. fisheries. Therefore, it is unknown whether total U.S. fishery mortality is insignificant and approaching zero mortality and serious injury rate. The

combined annual serious injury and mortality from commercial fisheries (≥1.2) and other sources (≥2.6) is 3.8 animals per year, which is less than the range-wide PBR of 1,062 animals for this stock. The population was estimated to grow at 5.9% annually for the period 1984 to 2013 (García-Aguilar *et al*. 2018).

REFERENCES

Aurioles-Gamboa, D. and C. J. Hernadez-Camacho. 1999. Notes on the southernmost records of Guadalupe fur seal, Arctocephalus townsendi, in Mexico. Mar. Mamm. Sci. 15:581-583.

Aurioles-Gamboa, D., Elorriaga- Verplancken, F. and Hernández-Camacho, C.J. 2010. Guadalupe fur seal population status on the San Benito Islands, Mexico. Marine Mammal Science 26(2): 402-408.

Aurioles-Gamboa, D. 2015. Arctocephalus townsendi. The IUCN Red List of Threatened Species 2015: e.T2061A45224420. http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T2061A45224420.en

Carretta, J.V., T. Price, D. Petersen, and R. Read. 2004. Estimates of marine mammal, sea turtle, and seabird mortality in the California drift gillnet fishery for swordfish and thresher shark, 1996-2002. Marine Fisheries Review 66(2):21-30.

Carretta J.V., V. Helker, M.M. Muto, J. Greenman, K.Wilkinson, D. Lawson, J. Viezbicke, and J. Jannot. 2019a. Sources of Human-related Injury and Mortality for U.S. Pacific West Coast Marine Mammal Stock Assessments, 2013-2017. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-616. 150 p.

Carretta, J.V., J.E. Moore, and K.A. Forney. 2019b. Estimates of marine mammal, sea turtle, and seabird bycatch from the California large-mesh drift gillnet fishery: 1990-2017. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-619. 76 p.

Elorriaga-Verplancken, F. R., G. E. Sierra-Rodríguez, H. Rosales-Nanduca, K. Acevedo-Whitehouse, and J. Sandoval-Sierra. 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, Mexico. PLoS One 11:e0155034.

Esperón-Rodríguez, M. and Gallo-Reynoso, J.P., 2012. Analysis of the re-colonization of San Benito Archipelago by Guadalupe fur seals (*Arctocephalus townsendi*). Latin American Journal of Aquatic Research, 40(1), pp.213-223.

Fleischer, L. A. 1987. Guadalupe fur seal, *Arctocephalus townsendi*. In J. P. Croxall and R. L. Gentry (eds.). Status, biology, and ecology of fur seals. Proceedings of an international symposium and workshop. Cambridge, England, 23-27 April 1984. p. 43-48. U.S. Dept. of Commerce, NOAA, NMFS, NOAA Tech. Rept. NMFS 51.

Gallo, J. P. 1994. Factors affecting the population status of Guadalupe fur seal, *Arctocephalus townsendi* (Merriam, 1897), at Isla de Guadalupe, Baja California, Mexico. Ph.D. Thesis, University of California, Santa Cruz, 199 p.

García-Aguilar, M.C., F.R. Elorriaga-Verplancken, H. Rosales-Nanduca, and Y. Schramm. 2018. Population status of the Guadalupe fur seal (*Arctocephalus townsendi*). Journal of Mammalogy, 99(6):1522–1528, 2018.García-Capitanachi, B. 2011. Estado de la población de lobo fino de Guadalupe (Arctocephalus townsendi) en Isla Guadalupe e Islas San Benito. MC Thesis dissertation. Facultad de Ciencias Universidad de Baja California, México.

Hanni, K. D., D. J. Long, R. E. Jones, P. Pyle, and L. E. Morgan. 1997. Sightings and strandings of Guadalupe fur seals in central and northern California, 1988-1995. J. of Mamm. 78:684-690.

Harwood, J., and J. H. Prime. 1978. Some factors affecting the population size of the British grey seal populations. Journal of Applied Ecology 15:401–411.

Julian, F. and M. Beeson. 1998. Estimates for marine mammal, turtle, and seabird mortality for two California gillnet fisheries: 1990-95. Fish. Bull. 96:271-284.

Maravilla-Chavez, M. O. and M. S Lowry. 1999 Incipient breeding colony of Guadalupe fur seals at Isla Benito del Este, Baja California, Mexico. Mar. Mamm. Sci. 15:239-241.

Melin, S. R. and R. L. DeLong. 1999. Observations of a Guadalupe fur seal (*Arctocephalus townsendi*) female and pup at San Miguel Island, California. Mar. Mamm. Sci. 15:885-888.

Norris, T., G. DeRango, R. DiGiovanni, and C. Field. 2015. Distribution of and threats to Guadalupe fur seals off the California coast. Poster presented at the Society of Marine Mammalogy Biennial meeting. San Francisco, CA.

Repenning, C. A., Peterson, R. S. and Hubbs, C. L. (1971) Contributions to the Systematics of the Southern Fur Seals, with Particular Reference to the Juan Fernández and Guadalupe Species, in Antarctic

Pinnipedia (ed W. H. Burt), American Geophysical Union, Washington, D. C.. doi: 10.1029/AR018p0001.

Rick, T.C., DeLong, R.L., Erlandson, J.M., Braje, T.J., Jones, T.L., Kennett, D.J., Wake, T.A. and Walker, P.L., 2009. A trans-Holocene archaeological record of Guadalupe fur seals (Arctocephalus townsendi) on the California coast. Marine Mammal Science, 25(2), pp.487-502.

Seagars, D. J. 1984. The Guadalupe fur seal: a status review. National Marine Fisheries Service, Southwest Region, Admin. Rep. SWR-84-6. 29pp.

Sosa-Nishizaki, O., R. De la Rosa Pacheco, R. Castro Longoria, M. Grijalva Chon, and J. De la Rosa Velez. 1993. Estudio biologico pesquero del pez (*Xiphias gladius*) y otras especies de picudos (marlins y pez vela). Rep. Int. CICESE, CTECT9306.

Torres-G., A., A. Aguayo-L., and N. Valdez-T. 1990. Tamaño y distribucion de la poblacion del lobo fino de Guadalupe, *Arctocephalus townsendi* (Merriam, 1897), durante el verano de 1988. [Abstracts] XV Reunion internacional para el estudio de los mamiferos marinos, 18-20 April 1990. La Paz, B. C. S., Mexico.

Townsend, C. H. 1931. The fur seal of the California islands with new descriptive and historical matter. Zoologica 9:443-457.