Guadalupe Fur Seal Population Census and Tagging in Support of Marine Mammal Monitoring Across Multiple Navy Training Areas in the Pacific Ocean

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14. ABSTRACT

We conducted a Guadalupe fur seal (GFS) population survey at San Benito Archipelago (SBA), México from July 11-14, 2018. For the three islands in this archipelago, land-based surveys were used for all areas of the coastline accessible by foot (all of Middle Island and most of West Island). Surveys from a small boat <50 m from shore were used when land-based surveys were not possible (all of East Island and a small section of West Island). A total of 539 GFS were counted on SBA, and 84% of these animals were juveniles. GFS density was greatest on the north side of West Island (land section 3). Only 23 pups (<1 month old) were observed on SBA. No correction factor was applied in these data, and survey methods and total survey time were similar to those of previous studies (13.6 h for 2018 survey vs. 15.5 h for 2010 survey; García-Capitanachi et al. 2017).

The GFS population survey at Guadalupe Island (GI), México was conducted from July 30-August 4, 2018. Boat-based surveys were used for the entire island, excluding Punta Sur (surveyed on foot), as well as four nearby islets and all rocky outcrops. At GI, most GFS pups had been born by late July and represented 51% of the total number of animals counted. Most adult males already had departed the rookery by late July and were underrepresented in our census data. Our survey methods differed from other GFS census efforts at GI because we had two individuals counting pups and traveled more slowly during our boat-based surveys. However, the total survey time (32.7 h) was similar to previous studies (32.5 h; García-Capitanachi et al. 2017). Because of differences in survey methods, we did not apply substrate-based correction factors, and instead only corrected for the number of adult females using the number of pups (1:1 ratio) to estimate a minimum GFS population estimate for GI of 29,208 individuals in 2018.

Combining the GI and SBA data, the minimum GFS population estimate in 2018 was 29,747 individuals.

In November 2018, 15 adult female, 10 juvenile female, and 10 juvenile male GFS were captured at Punta Sur, GI. SPLASH10-F tags were attached to the dorsal pelage of each seal. From mid-November 2018 to early January 2019, 15 adult females, most of which were lactating and/or observed with an approximately four-month-old pup, remained <800 km from the mainland coast of North America and primarily traveled north of GI. Eight females made multiple foraging trips during the tracking period, and six of these animals traveled south or west of GI on at least one trip. These females had shorter duration trips (20 ± 1 d) and did not travel as far from GI (477 ± 84 km) as the other seven females that have made only one trip thus far (duration: 35 ± 4 d; distance from GI: 1,159 ± 113 km). However, total distance traveled was similar for adult females that have made one (2,499 ± 336 km) and greater than one (2,657 ± 228 km) foraging trip. Juvenile females also primarily dispersed north of GI with shorter trip durations (7 ± 1 d) and distances (distance from island: 89 ± 26 km; total distance: 970 ± 132 km) for the only two animals that traveled south and made greater than one foraging trip (Figure 3b; Table 5). The other eight juvenile females have traveled approximately 800-1,250 km from the island (1,050 ± 54 km) and 1,350-3,250 km total (2,266 ± 188 km), and only one of these animals has returned to GI (after 51 days at-sea). All of these animals remained within 500 km of the mainland coast, and some also spent time in continental-shelf waters (seafloor depth <200 m).

Whereas some adult and juvenile females exhibited more "resident" foraging behavior (remained close and returned to GI), all juvenile males dispersed >600 km from GI and have not returned to the island, excluding two very short initial foraging trips made by two males. For the single long-distance trip for all males, there was little variability in trip duration (36 ± 2 d), distance from the island (1,003 ± 64 km), and total distance traveled (2,016 ± 114 km). Juvenile males also used habitat <500 km from the mainland coast with two traveling >1,100 km south of the island.

Additional data collection efforts included during the summer population survey at SBA, nine pups (<1 month old) were captured for ongoing trophic ecology studies. A juvenile male GFS with a packing strap partially embedded in the skin around its neck was observed on West Island; the debris was sucessfully removed from the seal. Additionally, all other pinniped species were counted during our surveys at SBA (4,506 California sea lions, 280 northern elephant seals, and 20 harbor seals). Forty pups (<1 month old) also were captured at Punta Sur during the summer population survey at GI for ongoing trophic ecology studies, and all other pinniped species were counted during our surveys at GI (321 California sea lions and 139 northern elephant seals).

15. SUBJECT TERMS
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Project Overview

Guadalupe fur seals (GFS; *Arctocephalus townsendi*) were thought to be extinct in the early 1900s. The population has been increasing since rediscovery of this species in 1949, but is currently approximately 80% less than the pre-exploitation level. As the population continues to recover, GFS are increasingly common in their historical range extending from central México to Washington State. However, relatively little is known about this species compared with other more abundant pinnipeds that also use the California Current System. Accurate and current population estimates are lacking because GFS censuses have been sparse and sporadic, and there is a paucity of data on the at-sea movements of this species because few GFS have been tracked using telemetry instruments. The goal of this project, therefore, is to better understand GFS abundance, behavior, distribution, and habitat use and determine the degree to which this recovering population uses U.S. Navy training and testing ranges in the North East Pacific. There are two principle components of this project: (1) updating overall population information for GFS, and (2) tracking the at-sea movement patterns of GFS using satellite transmitters. In 2018, censuses were performed at both the main rookery (Guadalupe Island, México) and the primary recolonization site (San Benito Archipelago, México) during the breeding season, and satellite tags were deployed on GFS at Guadalupe Island during the non-breeding season.

This preliminary report summarizes effort from late June 2018 through early January 2019.

Figure 1. Guadalupe fur seals observed at Guadalupe Island, México in summer 2018.
(Permit #: SGPA/DGVS/002460/18; Photo credit: Tenaya Norris)

Population Surveys, Summer 2018

Methods

We conducted a GFS population survey at San Benito Archipelago, México from July 11-14, 2018 (Figure 2). For the three islands in this archipelago, land-based surveys were used for all areas of the coastline accessible by foot (all of Middle Island and most of West Island). Surveys from a small boat <50 m from shore were used when land-based surveys were not possible (all of East Island and a small section of West Island). All counts were performed by the same individual to maintain consistency with previously collected GFS census data at San Benito Archipelago (Elorriaga-Verplancken et al. 2016).

The GFS population survey at Guadalupe Island, México was conducted from July 30-August 4, 2018 (Figure 3). Boat-based surveys were used for the entire island, excluding Punta Sur (surveyed on foot), as well as four nearby islets and all rocky outcrops. All non-pups were counted and classified by the individual with the most experience assigning GFS to demographic groups during visual surveys. Two other observers counted all pups, and pup counts were repeated or averaged for sections of the coastline with significant differences between the two counters because population size frequently is extrapolated from pup counts.

Various correction factors can be applied to pinniped count data to account for animals missed during visual surveys. A correction factor based on substrate type during boat-based surveys has been developed to estimate GFS abundance at Guadalupe Island (García-Capitanachi et al. 2017). Therefore, we recorded substrate types: large boulder, medium boulder, high platform, low platform, pebble beach, and wall (Figure 4).

Figure 2. Map of San Benito Archipelago with the three land (sections 1-3) and boat (B) surveys indicated for West Island.

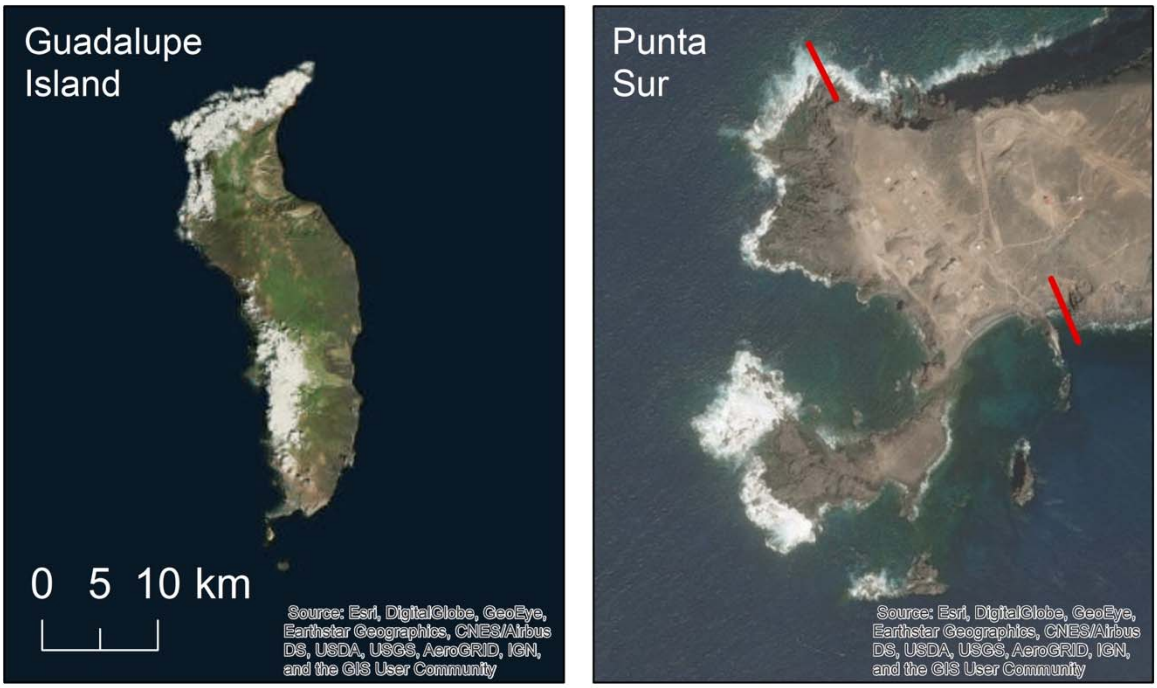

Figure 3. Boat-based surveys were used to count Guadalupe fur seals at Guadalupe Island, except the southern tip (Punta Sur, demarcated by the red lines in the right panel) was surveyed on foot.

Figure 4. Examples of the six substrate type classifications recorded during the boat-based surveys at Guadalupe Island.

Results

A total of 539 GFS were counted on San Benito Archipelago, and 84% of these animals were juveniles (Table 1). GFS density was greatest on the north side of West Island (land section 3). Only 23 pups (<1 month old) were observed on San Benito Archipelago. No correction factor was applied in these data, and survey methods and total survey time were similar to those of previous studies (13.6 h for 2018 survey vs. 15.5 h for 2010 survey; García-Capitanachi et al. 2017).

At Guadalupe Island, we counted 26,217 GFS during our surveys (Table 2). Most GFS pups had been born by late July and represented 51% of the total number of animals counted. However, by late July, most adult males already had departed the rookery and were underrepresented in our census data. Substrate types often were mixed and changed frequently during the surveys (every ~100 m in some areas). In these cases, we used the more conservative substrate type category (*i.e.*, the substrate with the lesser correction factor from García-Capitanachi et al. 2017). Therefore, the majority of the shoreline was classified as medium boulders during our surveys (*i.e.,* mixed large and medium boulders). Our survey methods differed from other GFS census efforts at Guadalupe Island because we had two individuals counting pups and traveled more slowly during our boat-based surveys (Borjes Flores pers. comm.). However, the total survey time (32.7 h) was similar to previous studies (32.5 h; García-Capitanachi et al. 2017). Because of differences in survey methods, we did not apply substrate-based correction factors, and instead only corrected for the number of adult females using the number of pups (1:1 ratio) to estimate a minimum GFS population estimate for Guadalupe Island of 29,208 individuals in 2018.

Combining the Guadalupe Island and San Benito Archipelago data, the minimum GFS population estimate in 2018 was 29,747 individuals.

Table 1. Number of Guadalupe fur seals observed on land or in the nearshore waters at San Benito Archipelago during the 2018 breeding season.

Island/ Section	Date	Start Time	End Time	Adult Males	Subadult Males	Adult Females	Juveniles	Pups	Total
Middle Island	7/11	09:50	13:00	0	1	2	1	5	9
East Island	7/12	15:00	16:55	0	6	0	51	0	57
West Island, total				0	48	4	403	18	473
Land section 1	7/11	16:31	17:55	0	5	1	10	3	19
Land section 2	7/12	12:20	14:05	0	1	1	1	1	4
Boat section	7/13	12:45	13:24	0	3	0	46	0	49
Land section 3	7/14	05:43	10:26	0	39	2	346	14	401
Total				**0**	**55**	**6**	**455**	**23**	**539**

Table 2. Number of Guadalupe fur seals observed on land or in the nearshore waters at Guadalupe Island during the 2018 breeding season. For boat-based surveys, substrate type was recorded.

	Adult Males	Subadult Males	Adult Females	Juveniles	Pups	Unknown	Total
Boat surveys							
Large boulder	11	49	935	165	832	10	2,002
Medium boulder	151	291	6,467	1031	9,769	86	17,795
High platform	0	3	108	23	13	2	149
Low platform	0	3	50	29	160	0	242
Pebble beach	1	9	121	33	555	0	719
Wall	1	7	86	75	4	0	173
Water	11	69	1,885	81	6	120	2,172
Land survey	7	26	741	133	2,045	13	2,965
Total	**182**	**457**	**10,393**	**1,570**	**13,384**	**231**	**26,217**

Satellite Tagging, Fall 2018

Methods

In November 2018, 15 adult female, 10 juvenile female, and 10 juvenile male GFS were captured at Punta Sur, Guadalupe Island (Table 3). Once captured using a modified hoop net, animals were manually restrained in the net until a cone was placed over the head to administer isoflurane gas anesthesia. Anesthesia averaged 31 minutes (range: 25-43 minutes) and was performed by a veterinarian with pinniped anesthesia experience. A satellite-linked time-depth recorder (SPLASH10-F-297 tag, 130 g, 86x55x26 mm or SPLASH10-F-238 tag, 217 g, 105x56x30 mm; Wildlife Computers, Redmond, WA) was attached to the dorsal pelage of each seal using 10-min epoxy resin (ITW Devcon, Danvers, MA; Figures 5-6). The larger 238 tag has twice the battery power of the 297 tag, but all other components are identical for two tag models. The larger tag model was attached to animals weighing >43.5 kg (*i.e.,* tag weight <0.5% animal body weight). Plastic identification tags were attached to the trailing edge of both fore-flippers of each animal (same number on both flippers); and weight, morphometric measurements, blood, fur, one vibrissa, and swabs (nasal, rectal, and genital) also were collected from all satellite-tagged animals for health and trophic ecology studies. Juvenile and adult females were differentiated using lactation/nursing status and/or body size.

Many of the animals observed in November were molting. We ensured animals had completed their molt before proceeding with anesthesia and satellite tagging. Silver fur indicated the animal had recently molted, and we pulled on the undercoat and guard hair at multiple sites on the animal's body, and particularly at the satellite tag application site, to make sure no hair easily came out.

The SPLASH10-F tags were programmed to optimize high-quality location data. The 297 tags were programmed to transmit messages 300 times per day via the Argos Data Collection and Location Service during periods with the greatest satellite coverage for the area we expected this species to use (02:00-05:59 and 16:00-18:59 GMT). The 238 tags were programmed with a daily transmission allowance of 350 during these periods: 02:00-05:59, 14:00-14:59, and 16:00-18:59 GMT because of their greater battery power. All other tag settings were the same for both tag models with transmissions attempted every 45 s during seal surfacings ("wet" mode) and every 90 s after the tag wet/dry sensor was dry for ≥5 min ("haulout" mode). To conserve battery power, transmissions paused when the tag was dry for ≥48 hours. Fastloc™ GPS locations were attempted at 4-h intervals with a maximum of one successful (signal received by ≥4 satellites) and four failed transmissions per hour (maximum of 24 attempts and 6 successful transmissions per day). These tags also collected dive data every 1 s for dives >2 m in depth and >20 s in duration, with transmitted dive depth data binned into 14 frequency histograms (upper bin limit: 4, 8, 12, 16, 20, 25, 30, 40, 60, 80, 100, 150, 200, and >200 m) for four 6-h periods (start times: 01:00, 07:00, 13:00, and 19:00 GMT). The tags transmitted messages collected over the previous two days with GPS locations transmitted as the top priority.

Argos locations were filtered to remove inaccurate location estimates based on maximum swim speed (removed locations with velocities >2.5 m/s; McConnell et al. 1992) and path tortuosity (removed locations with turn angle >155º, if incoming and outgoing path was >5 km, or >165º, if incoming and outgoing path was >2.5 km; Freitas et al. 2008, Norris et al. 2017). Locations categorized as invalid (Location Class Z; Argos 2016), and those that were >100 m inland of the coastline (for North American continent only, excluding all islands) also were

removed. Additional location processing steps, including those needed to use transmitted GPS data, and other spatial and dive data analyses have not been performed yet.

Filtered Argos tracks were used to calculate foraging trip statistics. Trips were classified as departures from Guadalupe Island that were >5 km in maximum distance from land, lasted >48 hours, and had >3 at-sea locations. Locations ≤200 m of Guadalupe Island were considered on-land. All trips were included in these trip statistics, regardless of whether or not the animal returned to the island. Trip distance from Guadalupe Island was the great circle path distance between the last location on land and the farther location from the island for each trip, and total trip distance was calculated as sum of the straight line distances between consecutive locations for each trip. Means are reported along with standard error.

Results

Adult females

From mid-November 2018 to early January 2019, 15 adult females, most of which were lactating and/or observed with an approximately four-month-old pup, remained <800 km from the west coast of North America and primarily traveled north of Guadalupe Island (Figure 7). Eight females made multiple foraging trips during the tracking period (Table 4), and six of these animals traveled south or west of Guadalupe Island on at least one trip. These females had shorter duration trips (20 ± 1 d) and did not travel as far from Guadalupe Island (477 ± 84 km) as the other seven females that have made only one trip thus far (duration: 35 ± 4 d; distance from Guadalupe Island: 1,159 ± 113 km). However, total distance traveled was similar for adult females that have made one (2,499 ± 336 km) and greater than one (2,657 ± 228 km) foraging trip.

Juvenile females

Juvenile females also primarily dispersed north of Guadalupe Island with shorter trip durations (7 ± 1 d) and distances (distance from island: 89 ± 26 km; total distance: 970 ± 132 km) for the only two animals that traveled south and made greater than one foraging trip (Figure 8; Table 5). The other eight juvenile females have traveled approximately 800-1,250 km from the island (1,050 ± 54 km) and 1,350-3,250 km total (2,266 ± 188 km), and only one of these animals has returned to Guadalupe Island (after 51 days at-sea). All of these animals remained within 500 km of the mainland coast, and some also spent time in continental-shelf waters (seafloor depth <200 m).

Juvenile males

Whereas some adult and juvenile females exhibited more "resident" foraging behavior (remained close and returned to Guadalupe Island), all juvenile males dispersed >600 km from Guadalupe Island and have not returned to the island, excluding two very short initial foraging trips made by two males (Figure 9; Table 6). For the single long-distance trip for all males, there was little variability in trip duration (36 ± 2 d), distance from the island (1,003 ± 64 km), and total distance traveled (2,016 ± 114 km). Juvenile males also used habitat <500 km from the mainland coast with two traveling >1,100 km south of the island.

Table 3. Fifteen adult (A) and 20 juvenile (J) Guadalupe fur seals were captured at Guadalupe Island in November 2018. Platform transmitting terminals (PTT) 177364-177373 are SPLASH10-F-238 tags (n = 10) and 177374-177398 are SPLASH10-F-297 tags (n = 25). SN = serial number assigned by the tag manufacturers (Wildlife Computers)

	Date	Age class	Sex	Weight (kg)	Length (cm)	Axillary Girth (cm)	Flipper tag #	Satellite tag PTT	Satellite tag SN
1	11/15	J	M	22.8	113.0	67.0	77V	177374	18A0298
2	11/15	A	F	43.5	142.0	87.0	78V	177375	18A0299
3	11/15	J	M	30.3	119.0	78.0	79V	177376	18A0300
4	11/15	A*	F	61.0	153.0	97.5	80V	177364	18A0268
5	11/15	A	F	43.9	140.0	83.0	81V	177365	18A0269
6	11/15	A	F	47.2	140.0	90.0	82V	177366	18A0270
7	11/16	J	F	29.6	128.0	70.0	83V	177377	18A0301
8	11/16	A	F	54.6	141.0	95.0	84V	177367	18A0271
9	11/16	J	F	23.6	118.0	67.0	86V	177378	18A0302
10	11/16	J	F	21.4	108.0	67.0	85V	177379	18A0304
11	11/16	A	F	40.5	139.0	81.0	87V	177380	18A0305
12	11/17	A	F	45.1	143.0	87.0	88V	177368	18A0272
13	11/17	J	F	22.8	119.0	66.0	89V	177381	18A0317
14	11/17	J	M	29.6	118.0	75.0	90V	177382	18A0318
15	11/17	A	F	66.0	150.0	105.5	91V	177369	18A0273
16	11/17	J	F	23.9	115.0	70.0	92V	177383	18A0319
17	11/18	A	F	39.6	139.0	81.0	93V	177384	18A0320
18	11/18	A	F	35.7	138.0	81.0	94V	177385	18A0321
19	11/18	J	F	36.2	130.0	79.0	95V	177386	18A0341
20	11/18	J	M	26.0	110.0	73.5	96V	177387	18A0323
21	11/18	J	F	32.8	122.0	75.5	97V	177388	18A0324
22	11/19	A	F	53.4	148.0	95.0	98V	177370	18A0274
23	11/19	A*	F	58.6	148.0	94.0	99V	177371	18A0275
24	11/19	J	M	28.5	115.0	73.5	100V	177389	18A0326
25	11/19	J	M	23.0	109.0	67.5	101V	177390	18A0327
26	11/20	J	M	22.9	116.0	64.0	102V	177391	18A0328
27	11/20	J	F	24.0	107.0	71.5	103V	177392	18A0329
28	11/20	A	F	43.5	142.0	82.0	104V	177393	18A0330
29	11/20	J	M	28.1	124.0	70.0	106V	177394	18A0331
30	11/21	J	M	35.6	130.0	75.0	107V	177395	18A0332
31	11/21	J	F	23.6	119.0	65.5	108V	177396	18A0333
32	11/21	A	F	59.2	149.0	98.0	109V	177372	18A0276
33	11/21	J	M	26.1	111.0	73.0	110V	177397	18A0334
34	11/21	J	F	29.2	121.0	73.0	111V	177398	18A0335
35	11/22	A	F	54.5	150.0	88.0	112V	177373	18A0277

* Based on body size, lactation/nursing status unknown.

Figure 5. Photograph of juvenile male Guadalupe fur seal with a SPLASH10-F-297 satellite transmitter attached.
(Permit #: SGPA/DGVS/002460/18; Photo credit: Jeff Harris)

Figure 6. Photograph of adult female Guadalupe fur seal with a SPLASH10-F-238 satellite transmitter attached.
(Permit #: SGPA/DGVS/002460/18; Photo credit: Jeff Harris)

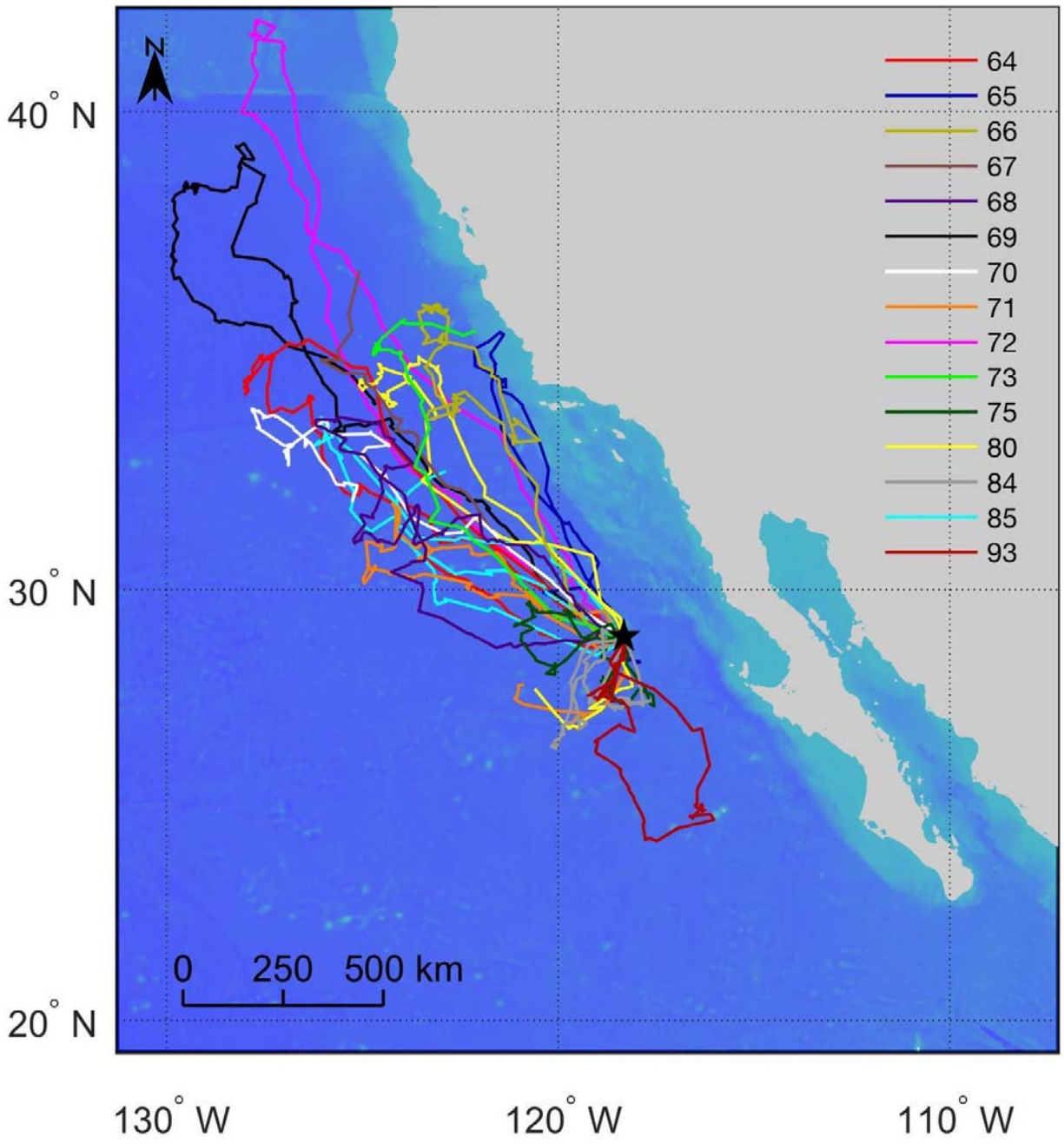

Figure 7. Filtered Argos tracks for 15 adult female Guadalupe fur seals between mid-November 2018 and early January 2019.
(Last two digits of PTT indicated in legend for each animal track; Bathymetric depths <2,000 m indicated by light blue shading; black star marks location of Guadalupe Island at 29.03ºN, 118.28ºW)

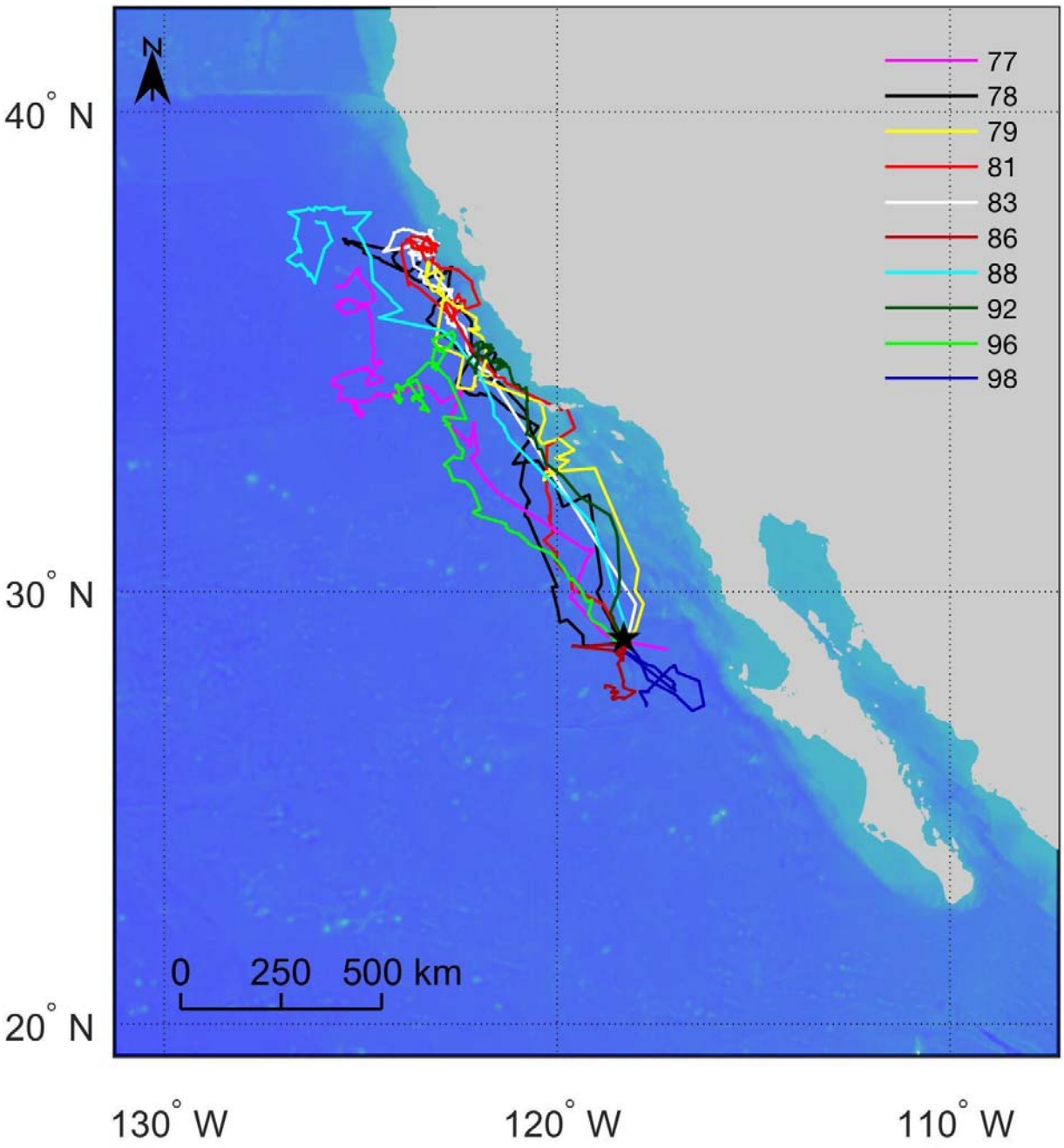

Figure 8. Filtered Argos tracks for 10 juvenile female Guadalupe fur seals between mid-November 2018 and early January 2019.
(Last two digits of PTT indicated in legend for each animal track; Bathymetric depths <2,000 m indicated by light blue shading; black star marks location of Guadalupe Island at 29.03ºN, 118.28ºW)

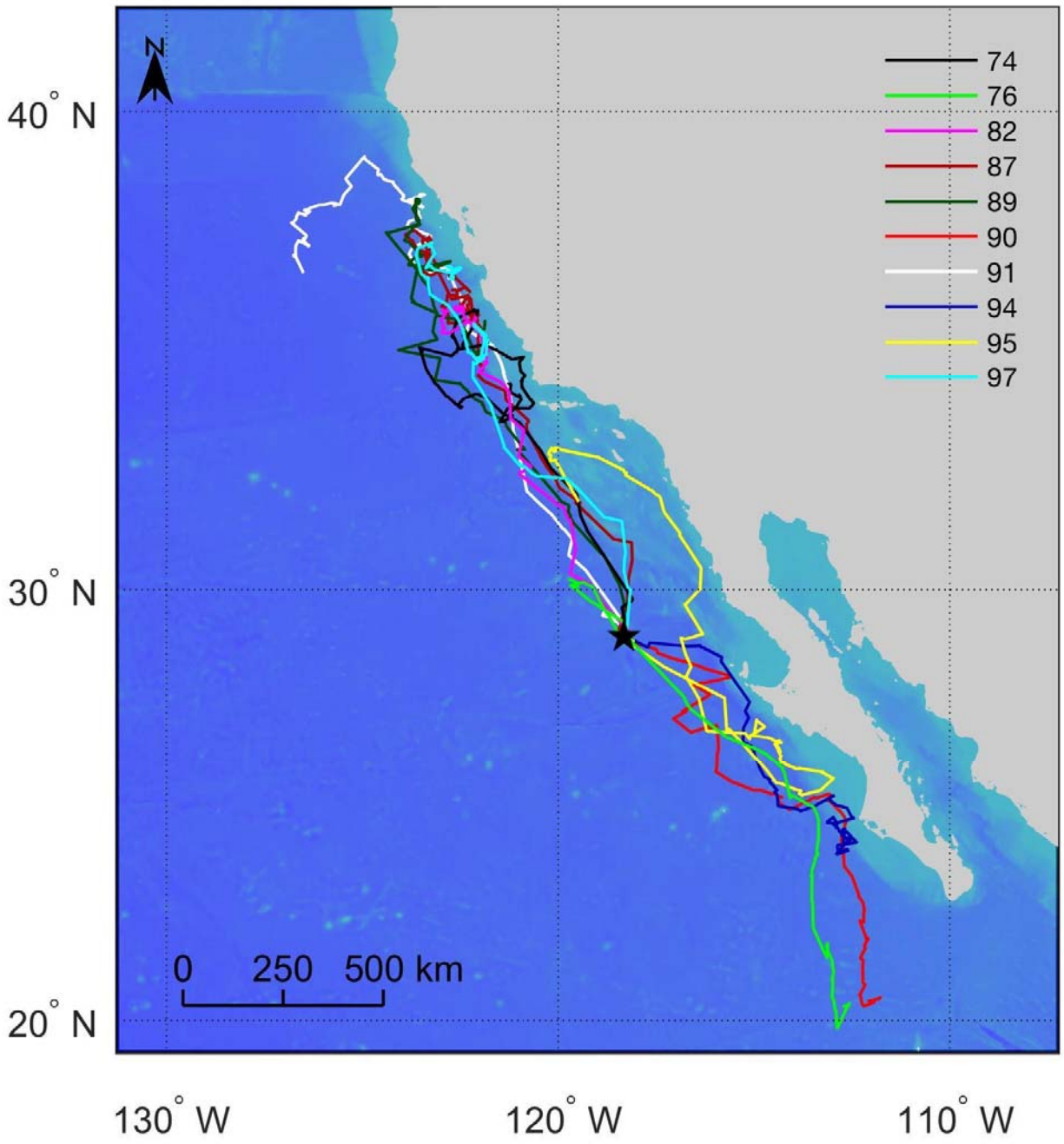

Figure 9. Filtered Argos tracks for 10 juvenile male Guadalupe fur seals between mid-November 2018 and early January 2019.
(Last two digits of PTT indicated in legend for each animal track; Bathymetric depths <2,000 m indicated by light blue shading; black star marks location of Guadalupe Island at 29.03ºN, 118.28ºW)

Table 4. Foraging trip summary for 15 adult female Guadalupe fur seals tagged on Guadalupe Island (GI) in mid-November 2018.

PTT	Last uplink date	Trip #	Departure date	Return date	Duration (d)	Distance from GI (km)	Total distance (km)
177364	01/03/19	1	11/23/18	12/25/18	32	1,116	3,034
		2	12/28/18	--	6	531	599
177365	12/29/18	1	11/20/18	12/17/18	27	802	2,132
		2	12/20/18	12/25/18	5	72	203
		3	12/26/18	12/29/18	3	67	114
177366	01/07/19	1	11/27/18	--	41	939	2,519
177367	12/14/18	1	11/23/18	--	21	1,086	1,394
177368	01/07/19	1	11/22/18	01/06/19	45	921	3,129
177369	01/07/19	1	11/26/18	--	42	1,498	3,300
177370	01/03/19	1	11/27/18	--	37	1,065	2,001
177371	01/07/19	1	11/26/18	12/24/18	28	682	2,113
		2	12/26/18	--	12	314	627
177372	01/07/19	1	11/27/18	--	41	1,667	3,630
177373	12/27/18	1	12/06/18	--	21	938	1,519
177375	01/07/19	1	11/17/18	12/08/18	21	277	1,087
		2	12/10/18	01/05/19	26	182	826
177380	01/07/19	1	11/23/18	12/26/18	33	898	2,523
		2	12/30/18	--	8	265	562
177384	01/07/19	1	11/19/18	12/03/18	14	184	468
		2	12/05/18	12/25/18	20	327	944
		3	12/05/18	--	33	179	467
177385	01/07/19	1	11/18/18	12/18/18	30	916	2,291
		2	12/23/18	--	15	666	1,001
177393	01/07/19	1	11/24/18	12/19/18	25	522	1,706
		2	12/22/18	--	16	168	561

Table 5. Foraging trip summary for 10 juvenile female Guadalupe fur seals tagged on Guadalupe Island (GI) in mid-November 2018.

PTT	Last uplink date	Trip #	Departure date	Return date	Duration (d)	Distance from GI (km)	Total distance (km)
177377	01/07/19	1	11/18/18	--	50	1,094	2,516
177378	01/07/19	1	11/17/18	01/07/19	51	1,166	3,263
177379	01/07/19	1	11/30/18	--	38	1,019	2,077
177381	01/07/19	1	11/21/18	--	47	1,088	2,389
177383	01/07/19	1	11/23/18	--	45	1,102	2,365
177386	01/07/19	1	12/01/18	12/03/18	2	9	38
		2	12/04/18	12/09/18	5	13	35
		3	12/10/18	12/15/18	5	7	60
		4	12/16/18	12/21/18	5	134	291
		5	12/26/18	--	12	150	414
177388	01/07/19	1	12/09/18	--	29	1,269	2,114
177392	01/07/19	1	12/08/18	--	30	803	1,384
177396	01/07/19	1	11/22/18	--	46	861	2,019
177398	01/07/19	1	11/25/18	11/27/18	2	16	41
		2	12/01/18	12/05/18	4	11	40
		3	12/10/18	12/21/18	11	178	425
		4	12/23/18	--	15	255	596

Table 6. Foraging trip summary for 10 juvenile male Guadalupe fur seals tagged on Guadalupe Island (GI) in mid-November 2018.

PTT	Last uplink date	Trip #	Departure date	Return date	Duration (d)	Distance from GI (km)	Total distance (km)
177374	01/07/19	1	12/01/18	--	37	853	1,940
177376	01/07/19	1	12/05/18	12/13/18	8	204	453
		2	12/17/18	--	21	1,154	1,484
177382	01/07/19	1	12/08/18	--	30	906	1,496
177387	01/07/19	1	11/28/18	--	40	1,097	2,329
177389	01/07/19	1	11/30/18	--	38	1,129	2,417
177390	01/06/19	1	11/27/18	--	40	1,140	1,985
177391	01/07/19	1	11/22/18	--	46	1,289	2,444
177394	01/05/19	1	11/25/18	11/27/18	2	10	31
		2	11/27/18	--	39	783	1,600
177395	01/07/19	1	11/30/18	--	38	637	2,569
177397	01/07/19	1	12/03/18	--	35	1,043	1,897

Additional Animal Handling and Data Collection

During the summer 2018 population survey, nine pups (<1 month old) were captured at San Benito Archipelago for ongoing trophic ecology studies (Table 7). A juvenile male GFS with a packing strap partially embedded in the skin around its neck was observed on West Island, land section 3. This circumferential entanglement was removed by sneaking up on the animal and cutting the plastic while the animal was sleeping. Additionally, all other pinniped species were counted during our surveys at San Benito Archipelago (4,506 California sea lions, 280 northern elephant seals, and 20 harbor seals). Forty pups (<1 month old) also were captured at Punta Sur during the summer population survey at Guadalupe Island for ongoing trophic ecology studies (Table 8), and all other pinniped species were counted during our surveys at Guadalupe Island (321 California sea lions and 139 northern elephant seals).

In fall 2018, we collected weights and fur from 39 pups (approximately four-month-old), eight of which were captured with adult females that were satellite tagged, for ongoing trophic ecology studies (Table 9). We also collected data and samples from five non-pups that we determined were molting after we captured them, and therefore unsuitable for satellite-tagging, as well as two non-pups that had alopecia (*i.e.,* hair loss; a common health finding observed in stranded GFS) for stable isotope and health assessment sampling (Table 10). Only two GFS with entanglements were observed during the fall trip: (1) a pup with line encircling its neck that was not cutting into the skin was captured and disentangled, and (2) an adult female with an entanglement scar was captured, but there was no embedded material found and the wound was healed (no treatment/disentanglement necessary).

Table 7. Data collected from nine pups at San Benito Archipelago in summer 2018.

	Island	Sex	Weight (kg)	Length (cm)	Axillary Girth (cm)	Samples collected/Notes
1	Middle	F	5.9	71.0	45.0	fur
2	Middle	M	8.0	65.0	50.0	fur
3	West	F	9.5	73.0	54.5	fur
4	West	M	9.4	69.5	56.0	fur
5	West	M	7.9	72.0	51.5	fur
6	West	--	--	--	--	fur, small size so minimized handling
7	West	M	6.7	71.0	47.0	fur
8	West	F	9.1	71.0	54.0	fur
9	West	F	5.5	59.0	41.0	fur, feces

Table 8. Data collected from 40 pups captured at Guadalupe Island in summer 2018.

	Sex	Weight (kg)	Length (cm)	Axillary Girth (cm)	Samples collected/Notes
1	F	6.5	72.0	45.0	fur
2	M	6.0	75.0	44.0	fur
3	M	8.8	78.0	49.0	fur
4	F	9.6	75.0	53.0	fur
5	F	7.3	72.5	47.5	fur
6	F	5.3	69.0	44.5	fur
7	M	4.3	68.5	36.0	fur
8	F	6.7	75.0	45.0	fur
9	M	11.0	77.0	53.0	fur
10	F	12.0	80.5	62.0	fur
11	F	10.7	77.5	59.0	fur
12	F	~4	58.0	32.0	fur, dead (weight estimated)
13	M	6.5	64.0	48.0	fur
14	M	6.7	73.5	44.0	fur
15	M	6.9	73.0	49.0	fur
16	F	8.9	75.0	51.0	fur
17	F	6.5	71.0	44.0	fur
18	M	8.3	77.5	48.0	fur
19	M	11.0	81.5	56.0	fur
20	M	6.5	72.0	44.0	fur
21	M	9.4	83.0	51.5	fur
22	M	7.6	72.5	46.0	fur
23	F	11.7	80.0	55.0	fur
24	F	~4	73.5	33.5	fur, dead (weight estimated)
25	M	~4	65.0	32.0	fur, dead (weight estimated)
26	F	7.5	75.0	46.0	fur
27	F	8.5	68.5	48.0	fur
28	F	7.5	75.5	50.0	fur
29	F	9.5	75.0	53.0	fur
30	M	8.2	73.0	49.0	fur
31	M	10.7	81.5	53.0	fur
32	F	8.7	73.5	49.0	fur
33	M	6.6	70.0	46.0	fur
34	M	8.2	68.0	49.0	fur
35	M	10.0	81.0	52.0	fur
36	F	6.5	73.5	44.5	fur
37	F	5.3	74.0	37.0	fur
38	M	8.8	80.0	46.0	fur
39	F	8.0	70.5	51.0	fur
40	M	9.0	77.0	49.0	fur

Table 9. Weights for 39 approximately four-month-old pups that were captured with and without adult females that were satellite tagged in November 2018.

	Weight (kg)	Sex	Dam's number from Table 3
1	13.1	M	2
2	10.8	M	11
3	6.9	--	15
4	17.0	--	17
5	16.7	M	18
6	13.8	M	22
7	10.4	M	28
8	8.8	F	32
9	10.2	M	--
10	10.0	F	--
11	12.2	M	--
12	11.9	F	--
13	8.2	M	--
14	10.4	M	--
15	14.9	M	--
16	12.5	F	--
17	11.3	F	--
18	10.6	M	--
19	16.6	M	--
20	13.1	F	--
21	14.7	F	--
22	6.5	F	--
23	16.9	M	--
24	13.2	M	--
25	13.4	M	--
26	13.2	F	--
27	11.7	M	--
28	13.5	M	--
29	9.6	M	--
30	13.2	M	--
31	11.7	F	--
32	13.2	F	--
33	9.8	F	--
34	15.4	F	--
35	10.8	M	--
36	11.5	F	--
37	15.1	F	--
38	12.9	F	--
39	18.9	M	--

Table 10. Data collected from seven adult (A), juvenile (J), and yearling (Y) Guadalupe fur seals that were captured but not satellite tagged because of fur condition in fall 2018.

	Date	Age class	Sex	Weight (kg)	Length (cm)	Axillary Girth (cm)	Flipper tag #	Samples collected	Notes
1	11/15	A	F	60.7	148.0	--	76V	fur	molting
2	11/15	Y	F	18.7	101.0	--	--	--	molting
3	11/15	A	F	33.3	--	--	--	--	molting
4	11/16	A	F	63.3	--	--	--	--	molting
5	11/18	Y	M	~20	--	--	--	blood, fur	alopecia
6	11/20	J	M	21.2	105.0	65.0	105V	blood, fur, vibrissa, swabs	alopecia
7	11/20	J	M	29.0	--	--	--	--	molting

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