2019 Southern Sea Otter (*Enhydra lutris nereis*) Stranding Report

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Executive Summary

The number and distribution of stranded southern sea otters in 2019 (n=427) were similar to recent years. The first quarter was unusually busy, with record-setting months in February (n=51) and March (n=68). This was largely attributed to greater than average numbers of stranded subadults during February – May. Conversely, there were lower than average numbers of stranded adults during July – October. There were 7 extralimital strandings (6 to the north, 1 to the south), defined as occurring outside of the established geographic range of regularly occupied habitat. Causes of strandings also were consistent with recent years, with no unusual findings or patterns.

Background

Stranded (live sick or injured and dead beachcast or floating) southern sea otters (*Enhydra lutris nereis*) have been systematically recorded, recovered, and examined since 1968. This effort was initiated by the California Department of Fish and Wildlife (CDFW) and has since expanded to include collaborators in the Sea Otter Stranding Network: the Monterey Bay Aquarium (MBA), The Marine Mammal Center (TMMC), and the U.S. Geological Survey (USGS), with support from other organizations. The MBA and TMMC lead rehabilitation efforts. Necropsies are conducted by CDFW and TMMC.

Reports of stranded sea otters are called in by the public, beach officials, biologists, and community science volunteers. Each report is investigated, and if confirmed to be a sea otter, is given a sequential sea otter number (SO#). Most reported stranded otters are recovered and receive a basic or detailed necropsy.

Annual and Monthly Strandings

During 2019, 427 stranded southern sea otters were confirmed, which is similar to 2018 (n=428) and substantially lower than 2017 (n=467) and record-setting 2016 (n=474). Ninety-two percent (n=394/427) of cases were recovered (unrecovered cases were verified by photographs or came from trusted sources). Although the first quarter of 2019 started off busy, with February and March registering record numbers for those months, the rest of the months were near or below the 3- and 5-year averages (Table 1). The last quarter of 2019 had the fewest monthly strandings in more than a decade.

Condition of Stranded Sea Otters

The condition of each animal is assessed at recovery. Condition codes are defined as:

Alive: moribund, injured, or abandoned.

Fresh: freshly dead; fur does not pull out easily, may or may not be in rigor.

Moderate: moderately decomposed; not in rigor, fur pulls out when tugged.

Advanced: advanced decomposition; fur sloughing or easily removed from skin, accumulation of gases in cavity and tissues (bloated), tissues liquefying, maggots likely present.

Mumm/Skel: mummified, fragmented, or skeletal remains; old dried carcass.

Unknown: condition of carcass unknown (generally because carcass was not recovered).

The most common condition of stranded sea otters in 2019 was fresh dead (34.4%, n=147), followed by advanced decomposition (22.4%, n=96), moderate decomposition (17.1%, n=73), alive (16.6%, n=71), mummified/fragmented (7.7%, n=33), and unknown (1.6%, n=7). This is consistent with a trend of increased percentages of live and fresh dead otters in recent years, possibly because the ubiquity of smart phones expedites reporting, species verification, and recovery of stranded animals.

Sex and Age Class Composition of Strandings

Age class and sex is determined for each stranded sea otter, when possible. Sex is determined by genitalia, or when needed/possible, through examination of internal organs and/or pelvic morphology. Age class is determined using dentition, total length (TL), pelage, and skull characteristics and are defined as:

Pup: all or most teeth are deciduous, TL 40-90cm, natal pelage, no sagittal crest, all skull sutures open; age range 0-3 months.

Immature: some deciduous and some permanent teeth present, TL 80-105cm, all or nearly all natal pelage shed; age range 4-11 months.

Subadult: all deciduous teeth shed and little to no tooth wear evident, TL 95-115cm (females)/100-125cm (males), full adult pelage, Basioccipital-basisphenoid suture open but most other sutures closed; age range 1-3 years.

Adult: slight to obvious tooth wear, TL >105cm (females)/>115cm (males), pelt with some grizzle (typically), sutures closed, Lambdoidal and Sagittal crests developing; age range 4-9 years.

Aged Adult: severe tooth wear, TL same as adult category, pelt generally with extensive grizzle, Lambdoidal and Sagittal crests well developed; age range ≥10 years.

Unknown: age class could not be determined, generally due to missing skeletal components or because the carcass was not recovered.

In 2019, more stranded sea otters were female (47.1%, n=201) than male (42.9%, n=183; Table 2), which has only occurred 13 times in the 52 years of data collection and last occurred in 2010. However, 2019 also had a record number of cases where sex could not be determined (10.1%, n=43). This is likely a result of an increase in photographs accompanying stranding

reports, which has increased species verification of cases that cannot be recovered, but rarely allows for confirmation of sex.

The composition of stranded sea otters by age class in 2019 differed from previous years, with a lower than usual proportion of adults (28.8%, n=123) and a higher than usual proportion of subadults (27.2%, n=116; Table 2). Historically (1968-2018), adults accounted for an average of 41.8% of annual strandings whereas subadults accounted for an average of 16.9%. The increase in subadults occurred primarily during February-May, with an average of 16 stranded subadults per month during that time frame, compared to a monthly average of 6.9 per month during the previous 5 years (2014-2018). In contrast, adult strandings were well below average during July-October, averaging 7.8 per month in 2019 compared to 18.1 per month during those months 2014-2018. The percentage of pups in the 2019 assemblage was also slightly elevated compared to the last two years (Table 2).

Geographic Distribution of Strandings

The location of each stranded sea otter is recorded and assigned an As-The-Otter-Swims (ATOS) number. ATOS values are consecutive numbers representing geographic points every 0.5 kilometers on a smoothed 5-fathom bathymetric contour line along the coast of California. The nearest ATOS point is determined for each stranded sea otter location using ATOS maps or is calculated from GPS coordinates. This geographic reference system was initiated prior to the widespread use of GPS. Continued use of this system allows for analyses of current and historic data on comparable spatial scales.

The geographic distribution of strandings during 2019 was similar to recent years, with the greatest numbers occurring between Capitola and Cypress Point in the north, and between Cayucos and Pt. Sal in the south (Table 3). These are the regions of the southern sea otter range with greatest public use of the coast, presumably resulting in a greater proportion of stranded animals being found and reported. The percentage of cases north of Cape San Martin, the historic dividing line of the range, was also consistent with previous years (54.8%; Table 3).

The majority (420/427) of strandings occurred within the established southern sea otter range in 2019 (Fig. 1), with 7 extralimital strandings; 6 to the north of the established range, and 1 to the south (Table 4). Additionally, one carcass was recovered from San Nicolas Island (SNI), which is not considered extralimital, but is a rare location to recover a carcass. Only 3 other carcasses have been recovered from SNI, so the recovery of a fresh carcass here is noteworthy.

Cause of Strandings

Cause of stranding (COS) is determined by conducting a necropsy (animal autopsy). These COS data are preliminary and subject to change as necropsy investigations are finalized. Here, only primary COS is reported, though many otters have one or multiple contributing COS. Contributing COS are important to consider for detailed sea otter health and population

analyses but are beyond the scope of this report. Some COS may be under-represented in this report because diagnosis requires histopathology and/or testing, which are in progress. Causes of strandings are grouped into the following categories for this summary:

Unknown: primary COS and presence/absence of trauma could not be determined, usually due to severity of decomposition, scavenging, or because the carcass was not recovered. This category includes dead dependent pups observed with their mothers.

Unknown, with trauma: primary COS could not be determined, but some form of trauma was evident (this includes lacerations of unknown origin and dependent pups with trauma).

Unknown, no trauma: primary COS could not be determined, but no trauma was evident (and carcass condition was suitable to determine presence of trauma).

Shark bite: primary COS was suspected or confirmed shark bite (as indicated by multiple stab-like wounds, shark tooth fragments, or diagnostic white shark tooth scratch patterns on bones).

Anthropogenic: primary COS was confirmed or suspected to be directly human-related such as gunshot, fishing line entanglement, boat strike, net- or trap-drowned, research-related, or oil spill-related.

Dependent animal: primary COS for pups and smaller immature otters (TL<95cm) for which maternal separation is the most likely COS (no trauma or other apparent COS).

Misc: primary COS does not fall into other categories (shark bite, dependent animal); COS in this category include conditions such as acanthocephalan peritonitis, end lactation syndrome, mating trauma, intraspecific fight trauma, cardiomyopathy, domoic acid toxicosis, toxoplasmosis, sarcosystosis, coccidioidomycosis, gastric torsion, and natural seep oiling (source confirmed or suspected).

Shark bite continued to be the most common COS in 2019 (29.5%, n=126/427; Fig. 2). Of the immature and older cases from which the presence/absence of trauma could be discerned, and the source of trauma identified, 53.1% (n=126/237) of the cases stranded with shark bite wounds. The next most common stranding category was unknown (23.8%, n=102/427), then misc. (16.6%, n=71/427) and dependent animals (16.4%, n=70/427). Additional COS findings are summarized in Fig. 2.

Acknowledgements

The continued monitoring of sea otter stranding and mortality patterns in California is only possible due to the commitment and dedication of the staff and volunteers of the stranding network partner organizations. Continued thanks to staff and volunteers at CDFW, our core partners at the MBA, and the staff and volunteers from TMMC. We would also like to acknowledge the contributions of personnel from the Channel Islands Marine & Wildlife Institute, California State Parks, Point Blue Conservation Science, Elkhorn Slough National

Estuarine Research Reserve, The Nature Conservancy–Dangermond Preserve, Vandenberg Air Force Base, Harbor Patrol/Harbor Districts of Santa Cruz, Moss Landing, Monterey, Morro Bay, and Port San Luis, BeachCOMBERS, BeachWatch, PG&E-Diablo Canyon, Tenera Environmental, California Academy of Sciences, UC Santa Cruz, Moss Landing Marine Labs, other members of the NOAA Marine Mammal Health and Stranding Response network, Sea Otter Savvy, the U.S. Geological Survey, the U.S. Fish and Wildlife Service, and other organizations that contribute to this effort. We would also like to thank the general public for reporting stranded sea otters in California, and to California taxpayers for supporting research and conservation efforts by donating to the California Sea Otter Voluntary Tax Contribution Fund.

Data Availability and Use

Southern sea otter stranding data and stranding summaries from 2019 onward can be downloaded here. The downloadable Excel data file includes a tab of metadata explaining the data fields. Please read the metadata carefully to understand the limitations of these data. Note that cause of stranding category assignment is based on assessment at gross necropsy and may change after microscopic examination or other tests are completed. In many cases animals have multiple factors that contribute to the cause of stranding; here only the primary cause of stranding category, as determined during gross necropsy, is reported.

Users of this dataset should contact CDFW if they have any questions or prior to any use of these data in scientific studies. Information on causes of mortality from detailed necropsies conducted at the MWVCRC can be found on our Sea Otter Necropsy Program page. General information on sea otters stranding in California prior to 2019 can be found at the USGS sea otter stranding page.

Table 1. Monthly number of stranded southern sea otters for 2019 (bottom row), with 2016-2018 data and 3-, 5-, and 10-year averages for comparison. The total number of strandings also is expressed as a percentage of the spring count and the population index (3-year average), which are available at https://pubs.usgs.gov/ds/1118/ds1118.pdf. Bolded numbers indicate highest recorded values (1968-2019).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% of spring count	% of spring 3-yr avg
Highest recorded	**38**	**51**	**68**	**63**	**58**	**49**	**63**	**54**	**55**	**42**	**29**	**29**	**474**	**17.4**	**14.7**
10 yr avg (2009-2018)	23.8	29.4	37.3	33.9	34.1	27.9	36.7	36.5	36.0	32.3	21.8	22.4	372.1	12.4	12.5
5 yr avg (2014-2018)	24.8	32.6	41.4	38.8	45.0	35.2	47.8	43.8	39.0	32.4	24.2	22.6	427.6	13.7	13.7
3 yr avg (2016-2018)	25.0	38.7	47.0	45.0	55.7	44.0	53.3	45.0	30.0	29.0	23.0	20.7	456.3	14.6	14.3
2016	19	40	48	43	57	42	**63**	**54**	27	**42**	16	23	**474**	13.1	14.5
2017	34	43	52	46	**58**	41	46	48	33	21	26	19	467	**17.4**	**14.7**
2018	22	33	41	46	52	**49**	51	33	30	24	27	20	428	13.9	13.7
2019	30	**51**	**68**	59	56	37	25	26	31	16	15	13	427	13.7	14.4

Table 2. Age class and sex of stranded southern sea otters in 2019. 2018 and 2017 data are provided for reference. F=female, M=male, Unk=unknown. PUP=pup (estimated age 0-3 months), IMM=immature (estimated age 4-11 months), SUBAD=subadult (estimated age 1-3 years), ADULT=adult (estimated age 4-9 years), AGED AD.=aged adult (estimated age ≥10 years), UNK=unknown.

	2019					**2018**					**2017**				
Age Class	**F**	**M**	**Unk**	**Total**	**% of Total**	**F**	**M**	**Unk**	**Total**	**% of Total**	**F**	**M**	**Unk**	**Total**	**% of Total**
PUP	36	28	5	69	16.2	24	27	8	59	13.8	17	25	12	54	11.6
IMM	33	35	3	71	16.6	30	38	1	69	16.1	25	34	4	63	13.5
SUBAD	44	68	4	116	27.2	24	61	4	89	20.8	41	65	3	109	23.3
ADULT	71	46	6	123	28.8	83	92	6	181	42.3	81	111	1	193	41.3
AGED AD.	16	3	1	20	4.7	9	9	0	18	4.2	18	10	1	29	6.2
UNK	1	3	24	28	6.6	0	2	10	12	2.8	3	1	15	19	4.1
Total	**201**	**183**	**43**	**427**		**170**	**229**	**29**	**428**		**185**	**246**	**36**	**467**	

Table 3. Number of stranded southern sea otters by geographic area in 2019 (bold numbers). Totals are provided for 2017 and 2018 for comparison. The shaded area of the table represents the areas north of Cape San Martin, the historical north-south dividing line of the sea otter range.

	Month														
Geographic Region	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**2019 Total**	**2018 Total**	**2017 Total**
N of Pt. Año Nuevo	1	2	0	1	1	2	0	1	2	0	0	0	**10**	13	11
Año Nuevo - Capitola	2	3	6	2	2	1	2	1	3	0	1	2	**25**	18	20
Capitola - Moss Landing	5	3	15	2	1	2	2	2	6	2	2	0	**42**	34	53
Moss Landing - Monterey Wharf #2	3	9	12	12	9	7	7	4	3	5	0	0	**71**	66	89
Monterey Wharf # 2 - Cypress Pt.	6	5	5	9	6	4	2	2	4	0	0	1	**44**	28	47
Cypress Pt. - Rocky Pt.	1	8	5	4	5	2	1	5	0	1	3	0	**35**	32	20
Rocky Pt. - Salmon Creek	0	0	0	1	1	1	0	0	0	2	2	0	**7**	2	3
Salmon Creek - Cambria	3	3	8	1	3	1	0	1	2	0	1	3	**26**	22	31
Cambria - Cayucos	1	0	2	4	3	0	0	2	0	0	1	0	**13**	8	15
Cayucos - Hazard Canyon	0	4	8	14	10	10	3	2	6	1	1	1	**60**	77	81
Haz. Canyon - Pismo Pier	4	5	3	2	2	2	5	5	3	3	1	2	**37**	50	39
Pismo Pier - Pt. Sal	1	6	3	7	10	4	1	0	1	2	2	3	**40**	66	50
Pt. Sal - Pt. Conception	3	3	1	0	3	1	1	1	1	0	0	0	**14**	10	7
SE of Pt. Conception	0	0	0	0	0	0	0	0	0	0	1	1	**2**	2	1
San Nicolas Island	0	0	0	0	0	0	1	0	0	0	0	0	**1**	0	0
Total	**30**	**51**	**68**	**59**	**56**	**37**	**25**	**26**	**31**	**16**	**15**	**13**	**427**	**428**	**467**
% North of Cape San Martin (shaded)	60.0	58.8	63.2	52.5	44.6	51.4	56.0	57.7	58.1	62.5	53.3	23.1	**54.8**	45.1	52.0

Table 4. Extralimital sea otter strandings during 2019. ATOS values less than 162 represent northern extralimitals (n=6) and ATOS values greater than 1154 represent southern extralimitals (n=1). ATOS values are consecutive numbers representing geographic points every 0.5 kilometers on a smoothed 5 fathom line along the coast of California. M=male, U=unknown.

SO#	Date	County	ATOS	Condition	Sex	Age Class	Primary COS
9155-19	19-Jan-19	MARIN	-100	ADVANCED DECOMPOSITION	U	UNKNOWN	UNKNOWN
9192-19	15-Feb-19	SAN MATEO	62	ADVANCED DECOMPOSITION	F	SUBADULT	MISC
9430-19	26-Jun-19	SAN MATEO	84	MODERATE DECOMPOSITION	F	SUBADULT	SHARK BITE
9478-19	20-Aug-19	SAN MATEO	145	ADVANCED DECOMPOSITION	M	SUBADULT	SHARK BITE
8714-19	18-Sep-19	SONOMA	-215	FRESH	M	SUBADULT	SHARK BITE
9515-19	29-Sep-19	SAN MATEO	88	MODERATE DECOMPOSITION	M	SUBADULT	SHARK BITE
9545-19	27-Nov-19	SANTA BARBARA	1225	ALIVE	M	ADULT	ANTHROPOGENIC

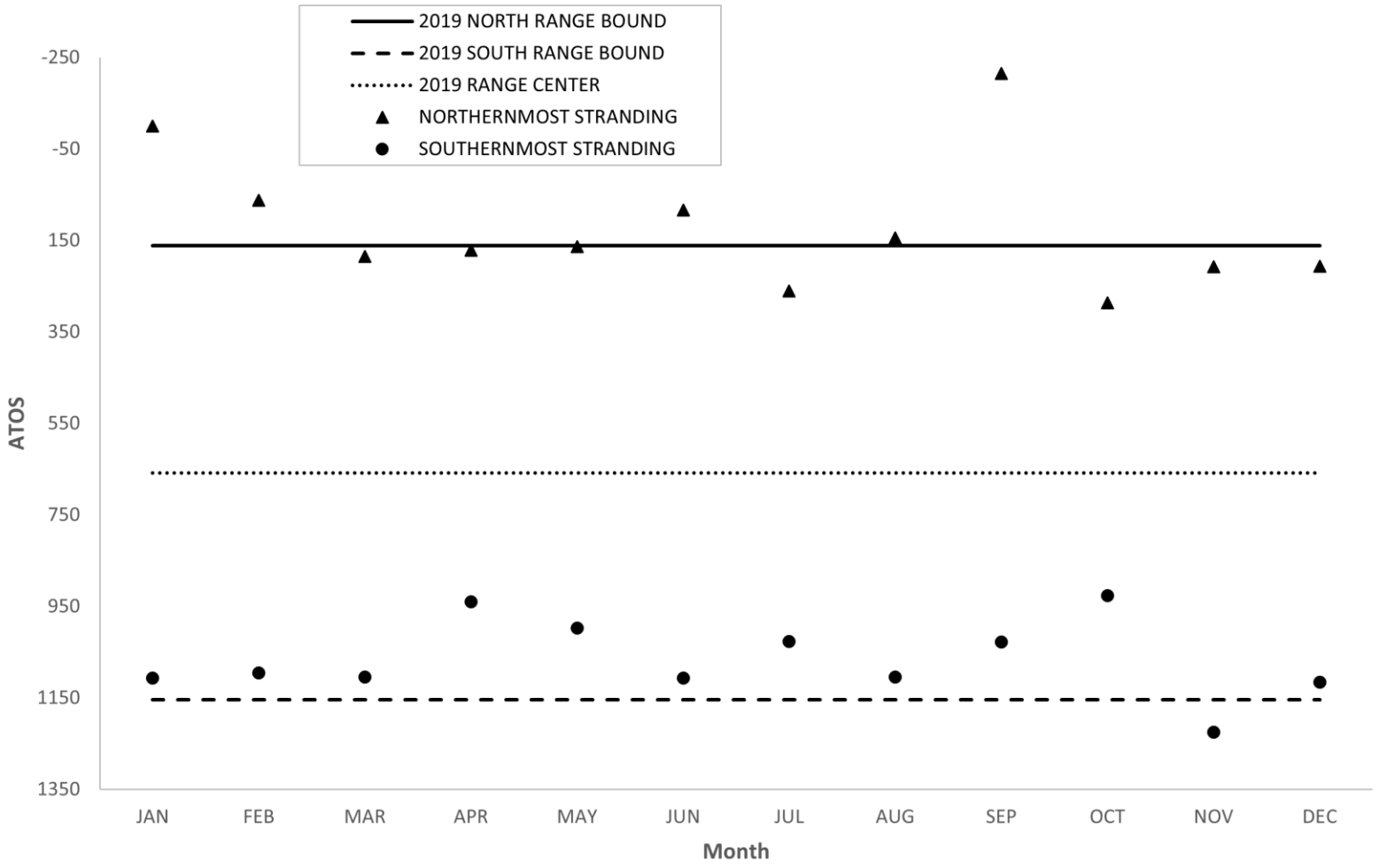

Figure 1. Monthly geographic spread of southern sea otter strandings during 2019, represented by the northernmost (triangle) and southernmost (circle) ATOS point for each month. ATOS values are consecutive numbers representing geographic points every 0.5 kilometers on a smoothed 5 fathom line along the coast of California. The official 2019 sea otter northern range boundary (ATOS 162; solid line), southern range boundary (ATOS 1154; dashed line), and the range center (ATOS 658; dotted line) are plotted for reference. Range data were provided by USGS.

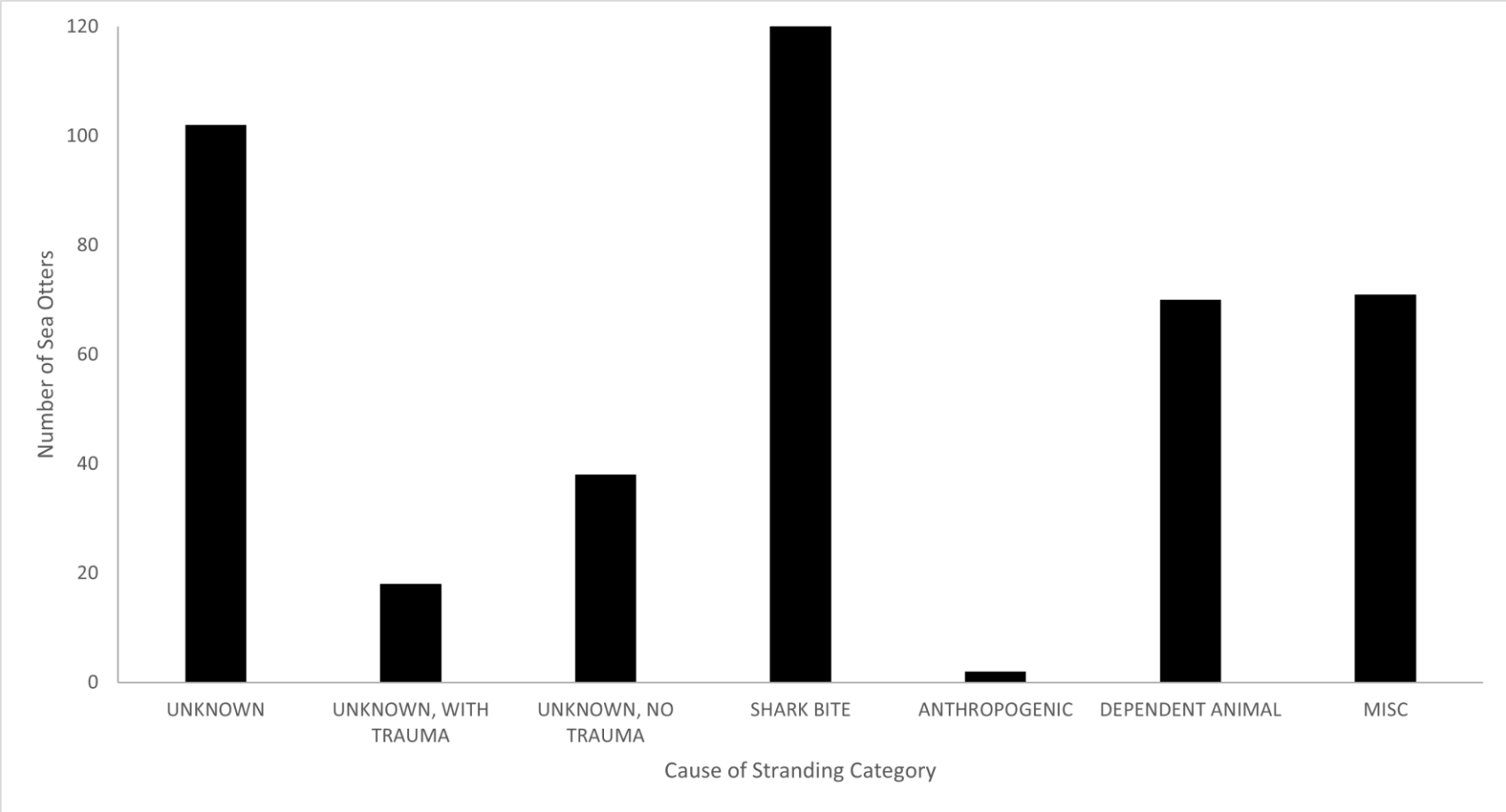

Figure 2. Primary causes of stranding (COS) of southern sea otters during 2019 (n=427). These data are preliminary and subject to change as cases are finalized. Cases coded with a suspect or pending qualifier are included with confirmed cases. Cases are grouped by related COS; categories are defined in the main text of this report. In many cases more than one health condition contributed to stranding. Here only the primary cause is represented.