2021 Southern Sea Otter (*Enhydra lutris nereis*) Stranding Report

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April 2022

Executive Summary

The number of documented stranded southern sea otters in 2021 was 312. Monthly strandings in 2021 were lower for most months compared to the recent 3-, 5-, and 10-year averages, except for March, which was well above recent averages for that month. The distribution of strandings by region in 2021 was similar to 2020, with the greatest numbers occurring between Año Nuevo (San Mateo County) and Rocky Point (Monterey County) in the north, and between Salmon Creek (Monterey County) and Pt. Sal (Santa Barbara County) in the south. There were 4 extralimital strandings (1 to the north, 3 to the south), and 13 tagged stranded sea otters were recovered in 2021. There was a pulse of suspected *Sarcocystis neurona* cases (fatal infections by a single-celled parasite originating from land-based opossums) in San Luis Obispo County in the spring. Other notable cases include an entrapment in a crayfish trap in Monterey County.

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 generally 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 (gross) or detailed necropsy.

The purpose of this report is to provide a general overview of stranding activity over the previous year, with some comparisons to previous years provided for reference. Detailed information and statistical analyses are not included in this report. The data presented in this report are accurate at the time of writing. As cases are reviewed and finalized, some information may change. All percentages and averages are rounded to the nearest whole number.

Annual and Monthly Strandings

During 2021, 312 stranded southern sea otters were confirmed, which represents a 13% increase in strandings compared to 2020 (n=277), a 27% decrease compared to 2019 (n=427) and 2018 (n=428), and a 34% drop compared to record-setting 2016 (n=474). Ninety percent (n=283/312) of the 2021 cases were recovered (unrecovered cases were verified by photographs or came from trusted sources), which is consistent with recent years.

Monthly strandings in 2021 were generally lower for every month compared to the previous 3-, 5-, and 10-year averages, except for March, which was much higher than the previous 3-, 5-, and 10-year averages (Table 1). The increase in March was mostly attributed to a pulse of suspected *Sarcocystis neurona* cases in San Luis Obispo County. The ongoing COVID-19 pandemic may have affected strandings in 2021, but the extent cannot be quantified and is not further discussed in this report.

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 2021 was fresh dead (31%, n=97), followed by advanced decomposition (24%, n=75), alive (19%, n=58), moderate decomposition (16%, n=51), mummified/fragmented (7%, n=23), and unknown (3%, n=8). This breakdown is very similar to 2020.

Sex and Age Class Composition of Stranded Sea Otters

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 2021, more stranded sea otters were male (47%, n=145) than female (41%, n=129, Table 2), which is common, having occurred 41 out of the last 54 years of data collection. However, similar to 2020, 2021 also had a large percentage of cases where sex could not be determined (12%, n=38). 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 2021 was similar to 2020 (Table 2). Once again there was a greater percentage of younger otters (pup, immature, and subadult; 66%, n=206) than adult (adult and aged adult; 27%, n=83) animals, which is a shift from previous years (2009-2018) when older otters accounted for more than 50% of all strandings.

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 distribution of strandings by region in 2021 was similar to 2020, with the greatest numbers occurring between Año Nuevo (San Mateo County) and Rocky Point (Monterey County) in the north, and between Salmon Creek (Monterey County) and Pt. Sal (Santa Barbara County) in the south (Table 3). These are the regions of the southern sea otter range with greatest public access to and use of the coast, presumably resulting in a greater proportion of stranded animals being found and reported. The number of strandings were similar in 2021 to 2020 in most of the 15 geographic regions, except for the section between Cayucos and Hazard Canyon. In this area there was an 81% increase in strandings between 2020 and 2021 (Table 3), though in the years prior to 2020 this area had a similar (or greater) number of strandings as in 2021. Surveillance of this section by snowy plover monitors and others has been consistent for many years (even during the height of COVID-19 in 2020 and 2021), so changes in stranding numbers

are likely not due to changes in detection/reporting. The percentage of cases north of Cape San Martin, the historical north/south dividing line of the range, was slightly less than previous recent years (45%; Table 3).

The geographic spread of strandings in 2021 was similar to 2020. During most months there was at least one stranding near the northern boundary of the sea otter range, whereas strandings near the southern range boundary were less frequent (Fig. 1). This differs from 2019, when there were strandings near the southern range boundaries more frequently. The majority (99%, n=308/312) of known strandings in 2021 occurred within the established southern sea otter range (Fig. 1), with 4 extralimital strandings, 1 to the north of the established range, and 3 to the south (Table 4). Two of the extralimital animals were female and 1 was male; the sex of the 4th extralimital could not be determined.

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 the 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 microscopic examination of tissues and/or testing, which are in progress. During 2021, 22 animals received a full diagnostic necropsy, 17 received detailed postmortem examinations with limited sampling, and the remaining 244 recovered animals received brief external and/or internal field-level examinations. 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).

For the first time in many years, shark bite was not the most common primary COS, but came in as a close second (28%, n=87/312) behind unknown (29%, n=90/312; Fig. 2). The percentage of unknown COS cases was similar in 2021 to recent years (29% in 2020, 24% in 2019). Of the immature and older age classes from which the presence/absence of trauma could be discerned, and the source of trauma identified, 44% (n=87/199) of the cases stranded with shark bite wounds. The next most common stranding category was unknown with no trauma (16%, n=49/312), followed by "misc." (12%, n=38/312) and dependent pups without trauma (11%, n=35/312). The greater proportion of unknown causes of death may be related to reduced necropsy and histopathology effort in 2021 due to COVID-19 restrictions and precautions.

There was a pulse (n=29) of suspected *Sarcocystis neurona* cases in San Luis Obispo County between late February and early April 2021. More detailed necropsies and sampling were conducted on a subset of the freshest cases. Microscopic examination confirmed severe acute systemic sarcocystosis (*Sarcocystis neurona* presumed) in 2 otters during the pulse. The remaining 27 animals were coded conservatively as unknown-no trauma, but microscopic examination is pending for 11 of those and the COS will be updated after the cases are finalized.

Other notable stranding causes were 2 anthropogenic cases in Monterey County. The first anthropogenic case was a severely decomposed immature male that was recovered in a crayfish trap at Zmudowski State Beach in April 2021. The cause of death was found to be drowning due to entrapment. The case was investigated but the source/owner of the trap was not determined. The second anthropogenic case was a live subadult female with a subacute circumferential monofilament entanglement wound. At the time of this report, the animal is still undergoing rehabilitation with hopes of release in 2022 if possible. 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. Special thanks to TMMC and USFWS for conducting additional necropsies in 2021. Continued thanks to staff and volunteers at CDFW, our core partners at the

Monterey Bay Aquarium, 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 2021 (bottom row), with 2018-2020 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, for years that a count was conducted (there was no count in 2020 or 2021). Bolded numbers indicate highest recorded values (1968-2021). Percentages and averages are rounded to the nearest whole number.

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**	**15**
10-yr. avg (2011-2020)	27	34	39	37	41	31	37	36	35	30	22	21	389	13	13
5-yr. avg (2016-2020)	26	38	45	45	53	40	42	36	27	24	21	17	415	13	13
3-yr. avg (2018-2020)	25	36	42	46	51	38	34	26	25	19	22	15	377	12	12
2018	22	33	41	46	52	**49**	51	33	30	24	27	20	428	14	14
2019	30	**51**	**68**	59	56	37	25	26	31	16	15	13	427	14	14
2020	23	24	16	33	44	29	25	18	13	17	23	12	277	n/a	n/a
2021	24	28	58	32	28	30	24	30	17	16	14	11	312	n/a	n/a

Table 2. Age class and sex of stranded southern sea otters in 2021. 2020 and 2019 data are provided for reference. F=female, M=male, Unk=unknown. For age class definitions see the southern sea otter stranding protocol. Percentages and averages are rounded to the nearest whole number.

	2021					2020					2019				
Age Class	**F**	**M**	**Unk**	**Total**	**% of Total**	**F**	**M**	**Unk**	**Total**	**% of Total**	**F**	**M**	**Unk**	**Total**	**% of Total**
PUP	21	17	9	47	15	13	23	8	44	16	36	28	5	69	16
IMM	20	33	3	56	18	11	40	2	53	19	33	35	3	71	17
SUBAD	34	66	3	103	33	14	42	3	59	21	44	68	4	116	27
ADULT	45	21	1	67	22	44	46	4	94	34	71	46	6	123	29
AGED AD.	9	7	0	16	5	8	4	1	13	5	16	3	1	20	5
UNK	0	1	22	23	7	2	1	11	14	5	2	3	23	28	7
Total	**129**	**145**	**38**	**312**		**92**	**156**	**29**	**277**		**201**	**183**	**43**	**427**	

Table 3. Number of stranded southern sea otters by geographic area in 2021 (totals in bold). Totals are provided for 2019 and 2020 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. Percentages are rounded to the nearest whole number.

	Month														
Geographic Region	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**2021 Total**	**2020 Total**	**2019 Total**
N of Pt. Año Nuevo	0	1	0	0	0	1	1	2	0	0	1	1	**7**	7	10
Año Nuevo - Capitola	2	2	3	0	1	0	1	3	0	2	3	2	**19**	25	25
Capitola - Moss Landing	3	0	3	4	0	3	3	2	2	5	2	0	**27**	21	42
Moss Landing - Monterey Wharf #2	6	6	3	5	6	5	2	3	1	3	1	0	**41**	39	71
Monterey Wharf # 2 - Cypress Pt.	1	4	3	4	1	2	3	4	4	0	1	1	**28**	37	44
Cypress Pt. - Rocky Pt.	3	1	3	2	1	0	0	1	0	1	0	1	**13**	17	35
Rocky Pt. - Salmon Creek	1	1	0	1	2	0	0	0	0	0	0	0	**5**	4	7
Salmon Creek - Cambria	2	2	6	3	4	3	0	1	4	1	0	3	**29**	17	26
Cambria - Cayucos	1	1	1	0	1	2	3	2	0	0	1	0	**12**	6	13
Cayucos - Hazard Canyon	2	6	22	5	7	8	5	6	1	0	2	3	**67**	37	60
Haz. Canyon - Pismo Pier	1	2	5	3	1	3	4	3	5	1	0	0	**28**	33	37
Pismo Pier - Pt. Sal	2	2	7	5	2	3	2	2	0	3	2	0	**30**	29	40
Pt. Sal - Pt. Conception	0	0	0	0	1	0	0	1	0	0	1	0	**3**	3	14
SE of Pt. Conception	0	0	2	0	1	0	0	0	0	0	0	0	**3**	2	2
San Nicolas Island	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1
Total	**24**	**28**	**58**	**32**	**28**	**30**	**24**	**30**	**17**	**16**	**14**	**11**	**312**	**277**	**427**
% North of Cape San Martin (shaded)	67	54	26	50	39	37	42	50	41	69	57	46	45	54	55

Table 4. Extralimital sea otter strandings during 2021. ATOS values less than 162 indicate northern extralimitals (n=1) and ATOS values greater than 1154 indicate southern extralimitals (n=3). Range boundaries are based on the 2019 census because no census was conducted in 2020 and 2021.

SO#	Date	County	Location	ATOS	Condition	Sex	Age Class	Primary Cause of Stranding
10080-21	30-Aug-21	SAN MATEO	MONTARA	61	ADV DECOMP	F	SUBADULT	UNKNOWN
9933-21	27-Mar-21	SANTA BARBARA	EL CAPITAN	1199	ADV DECOMP	U	UNKNOWN	UNKNOWN
9929-21	25-Mar-21	SANTA BARBARA	MONTECITO	1281	ALIVE-EUTH	M	AGED ADULT	SUSPECT DA OR PROTOZOAL - PENDING
9980-21	09-May-21	VENTURA	RINCON PARKWAY	1338	ADV DECOMP	F	ADULT	UNKNOWN, NO TRAUMA

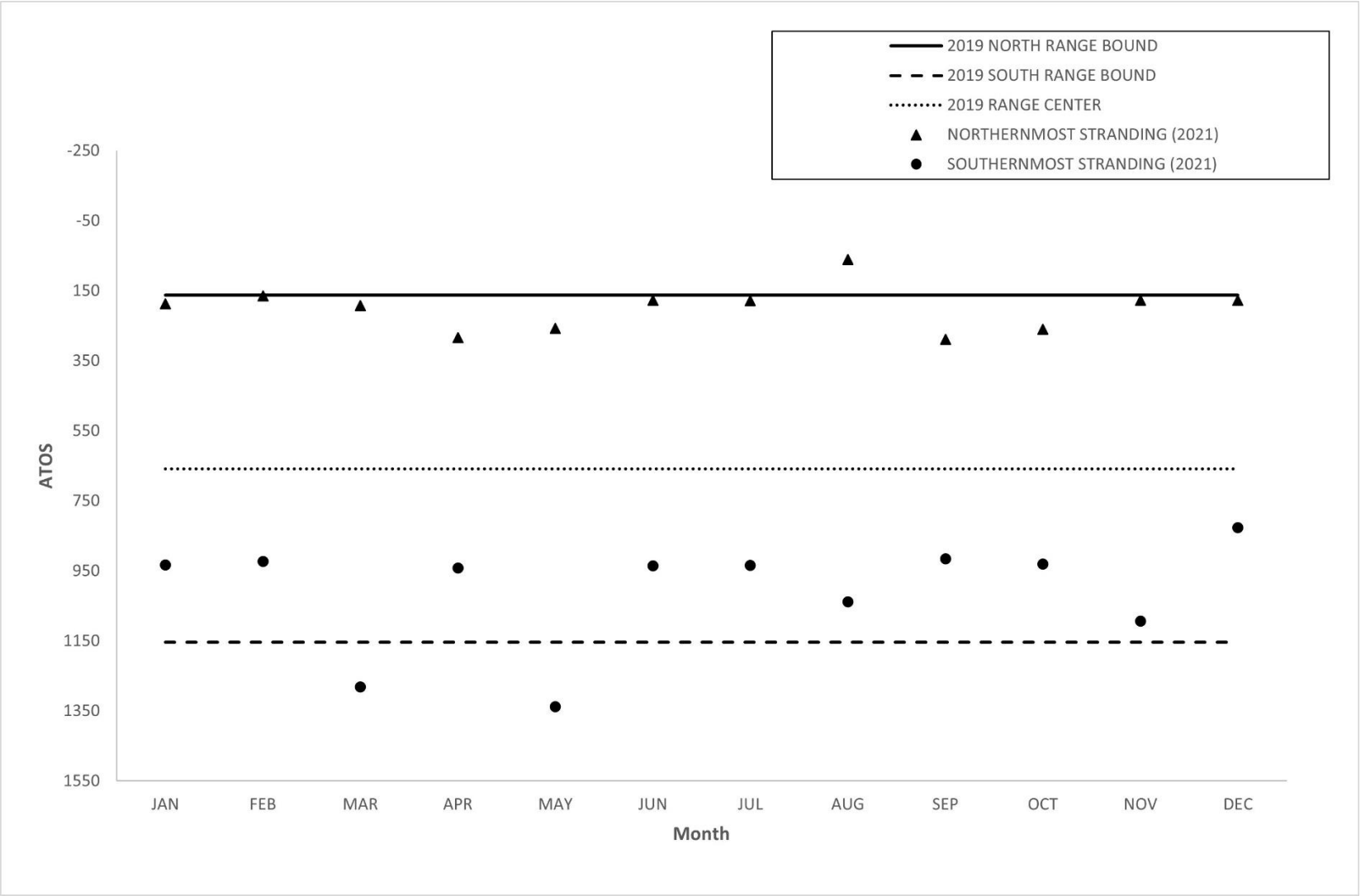

Figure 1. Monthly geographic range of southern sea otter strandings during 2021, represented by the northernmost and southernmost ATOS point for all stranded sea otters each month. The official 2019* sea otter northern range boundary (ATOS 162), southern range boundary (ATOS 1154), and the range center (ATOS 658) are plotted for reference. *No survey was conducted in 2020 or 2021, so 2019 range boundary data were used. Range data were provided by USGS.

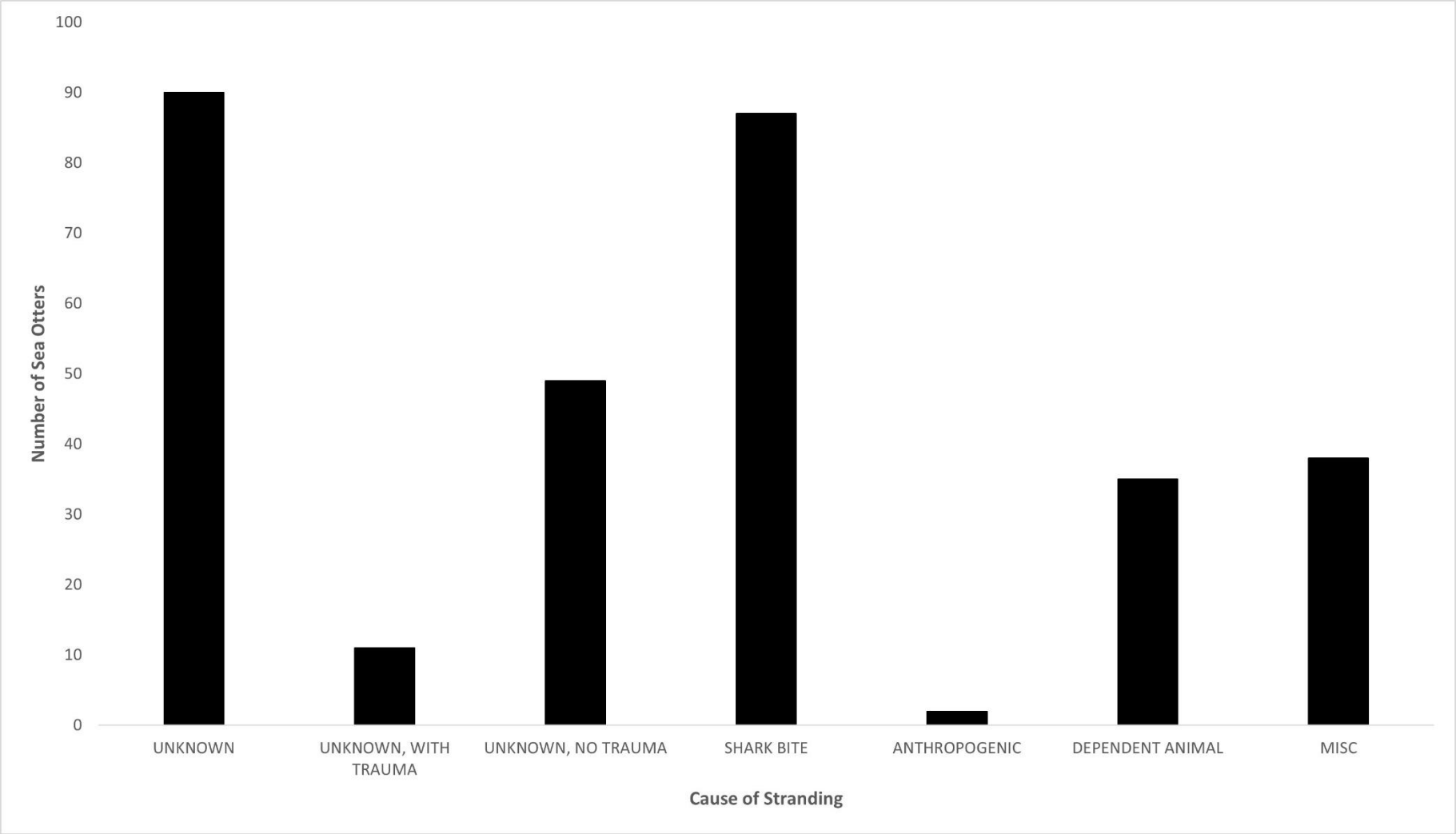

Figure 2. Primary causes of stranding (COS) of southern sea otters during 2021 (n=312). These data are preliminary and subject to change as cases are finalized. Cases coded with a suspect or pending qualifier are included with confirmed cases. Cases are grouped by related COS; categories are defined in the main text of this report. In many cases, more than one heath condition contributed to stranding. Here only the primary cause is represented. Because most COS assessments of stranded sea otters are based solely on gross necropsy, some common conditions such as domoic acid intoxication and protozoal disease that require microscopic examination for case identification and confirmation may be under-estimated.