2022 Southern Sea Otter (*Enhydra lutris nereis*) Stranding Report

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Executive Summary

The number of documented stranded southern sea otters in 2022 was 266, the lowest value since 2009. Monthly strandings in 2022 were generally similar or lower for every month compared to the previous 3-, 5-, and 10-year averages. The distribution of strandings by region in 2022 was similar to 2021, with the greatest numbers occurring between Año Nuevo (San Mateo County) and Rocky Point (Monterey County) in the north, and between Cayucos (San Luis Obispo County) and Pt. Sal (Santa Barbara County) in the south. The percentage of cases north of Cape San Martin, the historical north/south dividing line of the range was 53%. There were 2 extralimital strandings, both to the north of the established range. During the spring there was a pulse of suspected *Sarcocystis neurona* cases in San Luis Obispo County and an uptick of pup mortalities in Monterey County. Interesting causes of strandings in 2022 include toxoplasma-related steatitis, and a thoracic tumor.

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 past 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. Percentages and averages are rounded to the nearest whole number.

Annual and Monthly Strandings

During 2022, 266 stranded southern sea otters were confirmed, which represents a 15% decrease in strandings compared to 2021 (n=312), a 4% decrease compared to 2020 (n=277), and a 44% drop compared to record-setting 2016 (n=474). This was the lowest stranding count since 2009. Eighty-nine percent (n=237/266) of the 2022 cases were recovered (unrecovered cases were verified by photographs or came from trusted sources), which is consistent with

recent years. Monthly strandings in 2022 were generally similar or lower for every month compared to the previous 3-, 5-, and 10-year averages (Table 1).

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 2022 was fresh dead (32%, n=85), followed by advanced decomposition (22%, n=59), moderate decomposition (21%, n=56), alive (16%, n=42), mummified/fragmented (5%, n=14), and unknown (4%, n=10). This breakdown is very similar to 2021 except for a slightly reduced proportion of live strandings (21% in 2021) and slightly increased proportion of moderately decomposed carcasses (16% in 2021).

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 2022, more stranded sea otters were male (49%, n=130) than female (39%, n=105, Table 2), which has occurred 42 out of the last 55 years of data collection. Like 2021, 2022 also had a large percentage of cases where sex could not be determined (12%, n=31). 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 2022 was similar to 2021 (Table 2). Once again there was a greater percentage of younger (pup, immature, and subadult; 62%, n=166) than older (adult and aged adult; 30%, n=81) otters, 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 2022 was similar to 2021, with the greatest numbers occurring between Año Nuevo (San Mateo County) and Rocky Point (Monterey County) in the north, and between Cayucos (San Luis Obispo County) and Pt. Sal (Santa Barbara County) in the south (Table 3). These are the regions of the southern sea otter range with the greatest public access to and use of the coast, presumably resulting in greater numbers of stranded otters being reported. The number of strandings were similar in 2022 to 2021 in most of the 15 geographic regions (Table 3). Exceptions include the section between Cypress Pt. and Rocky Pt, where there was an 130% increase in reported strandings between 2021 and 2022, and between Salmon Creek and Cambria, where there was a 62% decrease in strandings during the same timeframe (Table 3). The increase between Cypress Pt. and Rocky Pt. was likely attributed to a pulse of stranded pups in March near Carmel. The percentage of cases north of Cape San Martin, the historical north/south range dividing line was 53%, which is typical (Table 3).

The geographic spread of strandings in 2022 was smaller than 2021. During most months there was at least one stranding near the northern boundary of the sea otter range (Pigeon Point, San Mateo County), whereas there were no reported strandings near the south end of the range

(Gaviota, Santa Barbara County) all year (Fig. 1). The southernmost stranding in 2022 was just north of Point Conception in September; during other months the most southern stranding was near Pismo Beach. This continues the recent trend of fewer strandings near the southern range boundary. The majority (99%, n=264/266) of reported strandings in 2022 occurred within the established southern sea otter range (Fig. 1). The two extralimital strandings were both slightly to the north (within 20 km) of the established range (Table 4). One of the extralimital animals was male; the sex of the other 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 2022, 21 animals received a full diagnostic necropsy, 19 received detailed postmortem examinations with limited sampling, and the remaining 197 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).

As in many recent years, shark bite was the most common primary COS (33%, n=89/266; Fig 2). Of the immature and older age classes for which the presence/absence of trauma could be discerned, and the source of trauma identified, 57% (n=89/156) of the cases stranded with shark bite wounds. The next most common COS category was unknown (26%; n=70/266), followed by "misc." (14%, n=37/266), dependent pups without trauma (13%, n=34/266) and unknown without trauma (11%; n=29/266; Fig. 2). There was 1 anthropogenic COS in 2022, which was a suspected vessel strike (Fig. 2).

There was a pulse (n=22) of suspected *Sarcocystis neurona* cases in San Luis Obispo County between late January and late April 2022. More detailed necropsies and sampling were conducted on a subset (n=14) of the freshest cases. For 2 of those cases, the primary COS was determined to be systemic toxoplasmosis with steatitis. Parasite genotyping for these two cases and two other steatitis cases revealed a highly pathogenic strain of *Toxoplasma gondii* not previously documented in sea otters or other marine wildlife (Miller et al. 2023). Histology is pending for the other cases and the COS will be updated as cases are finalized. For the uptick (n=7) of stranded pups near Carmel in March, 4 cases were examined in more detail but no unusual findings or clear patterns were detected; the increase in strandings did not correspond with severe weather conditions that often cause maternal/pup separations. One other notable cause of stranding was a case with a thoracic tumor. 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 Padraig Duignan, Maggie Martinez, and Barbie Halaska at The Marine Mammal Center (TMMC) and the staff at the U.S. Fish and Wildlife Service (USFWS) National Fish and Wildlife Forensic Laboratory for conducting necropsies. Continued thanks to CDFW staff and volunteers (Melissa Miller, Francesca Batac, Katherine Greenwald, Angelina Reed, Sierra Fullmer, Mary Gomes, Amy Wells, Ron Brost, Sean Kam, and Laird Henkel), our core partners at the Monterey Bay Aquarium (especially Jessica Fujii, Teri Nicholson, Sandrine Hazan, Leilani Konrad, and Mike Murray), and the staff and volunteers from TMMC and the Channel Islands Marine & Wildlife Institute, who are too numerous to name individually. We also acknowledge the contributions of personnel from California State Parks, Point Blue Conservation Science, Elkhorn Slough National Estuarine Research Reserve, The Nature Conservancy–Dangermond Preserve, Vandenberg Space 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

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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 2022 (bottom row), with 2019-2021 data and 3-, 5-, and 10-year averages for comparison. Bolded numbers indicate highest recorded values (1968-2021). Averages are rounded to the nearest whole number.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Highest recorded	**38**	**51**	**68**	**63**	**58**	**49**	**63**	**54**	**55**	**42**	**29**	**29**	**474**
10-yr. avg (2012-2021)	26	33	42	37	41	33	38	35	33	27	21	20	386
5-yr. avg (2017-2021)	27	36	47	43	48	37	34	31	25	19	21	15	382
3-yr. avg (2019-2021)	26	34	47	41	43	32	25	25	20	16	17	12	339
2019	30	**51**	**68**	59	56	37	25	26	31	16	15	13	427
2020	23	24	16	33	44	29	25	18	13	17	23	12	277
2021	24	28	58	32	28	30	24	30	17	16	14	11	312
2022	16	34	40	25	20	25	20	18	26	18	12	12	266

Table 2. Age class and sex of stranded southern sea otters in 2022. 2021 and 2020 data are provided for reference. F=female, M=male, Unk=unknown. For age class definitions see the southern sea otter stranding protocol. Percentages are rounded to the nearest whole number.

	2022					**2021**					**2020**				
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	18	21	17	9	47	15	13	23	8	44	16
IMM	19	21	1	41	15	20	33	3	56	18	11	40	2	53	19
SUBAD	16	58	4	78	29	34	66	3	103	33	14	42	3	59	21
ADULT	39	28	3	70	26	45	21	1	67	22	44	46	4	94	34
AGED AD.	9	2	0	11	4	9	7	0	16	5	8	4	1	13	5
UNK	1	4	14	19	7	0	1	22	23	7	2	1	11	14	5
Total	**105**	**130**	**31**	**266**		**129**	**145**	**38**	**312**		**92**	**156**	**29**	**277**	

Table 3. Number of stranded southern sea otters by geographic area in 2022 (totals in bold). Totals are provided for 2020 and 2021 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**	**2022 Total**	**2021 Total**	**2020 Total**
N of Pt. Año Nuevo	0	1	0	0	0	0	1	1	1	1	0	0	**5**	7	7
Año Nuevo - Capitola	1	3	0	1	1	1	1	3	1	1	1	2	**16**	19	25
Capitola - Moss Landing	4	0	2	1	2	3	1	0	4	1	2	3	**23**	27	21
Moss Landing - Monterey Wharf #2	3	8	8	1	1	3	1	2	3	4	2	1	**37**	41	39
Monterey Wharf # 2 - Cypress Pt.	2	5	4	3	2	3	4	2	0	0	3	1	**29**	28	37
Cypress Pt. - Rocky Pt.	1	4	12	5	0	2	1	1	0	2	0	2	**30**	13	17
Rocky Pt. - Salmon Creek	0	0	0	0	0	0	0	1	1	0	0	0	**2**	5	4
Salmon Creek - Cambria	1	1	2	1	1	0	0	0	0	4	1	0	**11**	29	17
Cambria - Cayucos	0	2	0	0	0	1	4	2	0	0	0	0	**9**	12	6
Cayucos - Hazard Canyon	1	4	7	8	7	6	4	5	5	3	1	1	**52**	67	37
Haz. Canyon - Pismo Pier	1	2	2	2	3	4	0	1	7	2	2	1	**27**	28	33
Pismo Pier - Pt. Sal	2	4	3	3	3	2	3	0	3	0	0	1	**24**	30	29
Pt. Sal - Pt. Conception	0	0	0	0	0	0	0	0	1	0	0	0	**1**	3	3
SE of Pt. Conception	0	0	0	0	0	0	0	0	0	0	0	0	**0**	3	2
San Nicolas Island	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0
Total	**16**	**34**	**40**	**25**	**20**	**25**	**20**	**18**	**26**	**18**	**12**	**12**	**266**	**312**	**277**
% North of Cape San Martin (shaded)	69	62	65	44	30	48	45	56	38	50	67	75	**53**	45	54

Table 4. Extralimital sea otter strandings during 2022. ATOS values less than 162 indicate northern extralimitals (n=2) and ATOS values greater than 1154 indicate southern extralimitals (n=0). Range boundaries are based on the 2019 census because the census was canceled or incomplete 2020 -2022.

SO#	Date	County	Location	ATOS	Condition	Sex	Age Class	Primary Cause of Stranding
10302-22	6-July-2022	SAN MATEO	SAN GREGORIO	122	ALIVE	M	SUBADULT	SHARK BITE, SUSPECTED
10336-22	1-Sep-2022	SAN MATEO	POMPONIO	126	ADV DECOMP	U	UNKNOWN	UNKNOWN

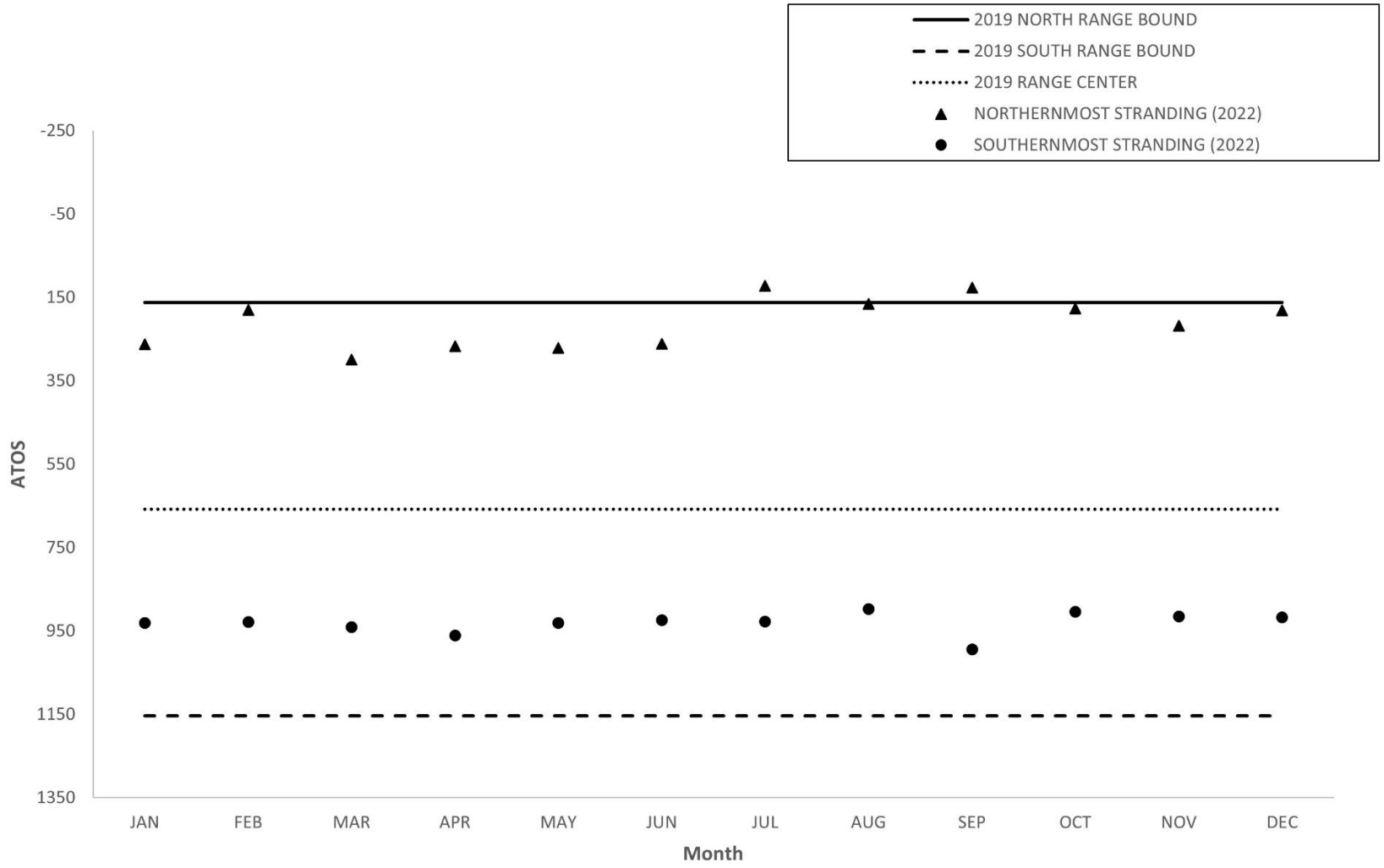

Figure 1. Monthly geographic range of southern sea otter strandings during 2022, represented by the northernmost and southernmost ATOS point for all stranded sea otters each month. The official 2019* sea otter northern range boundary (ATOS 162), southern range boundary (ATOS 1154), and the range center (ATOS 658) are plotted for reference. *2019 range boundary data were used because the census was canceled or incomplete 2020 -2022. Range data were provided by USGS.

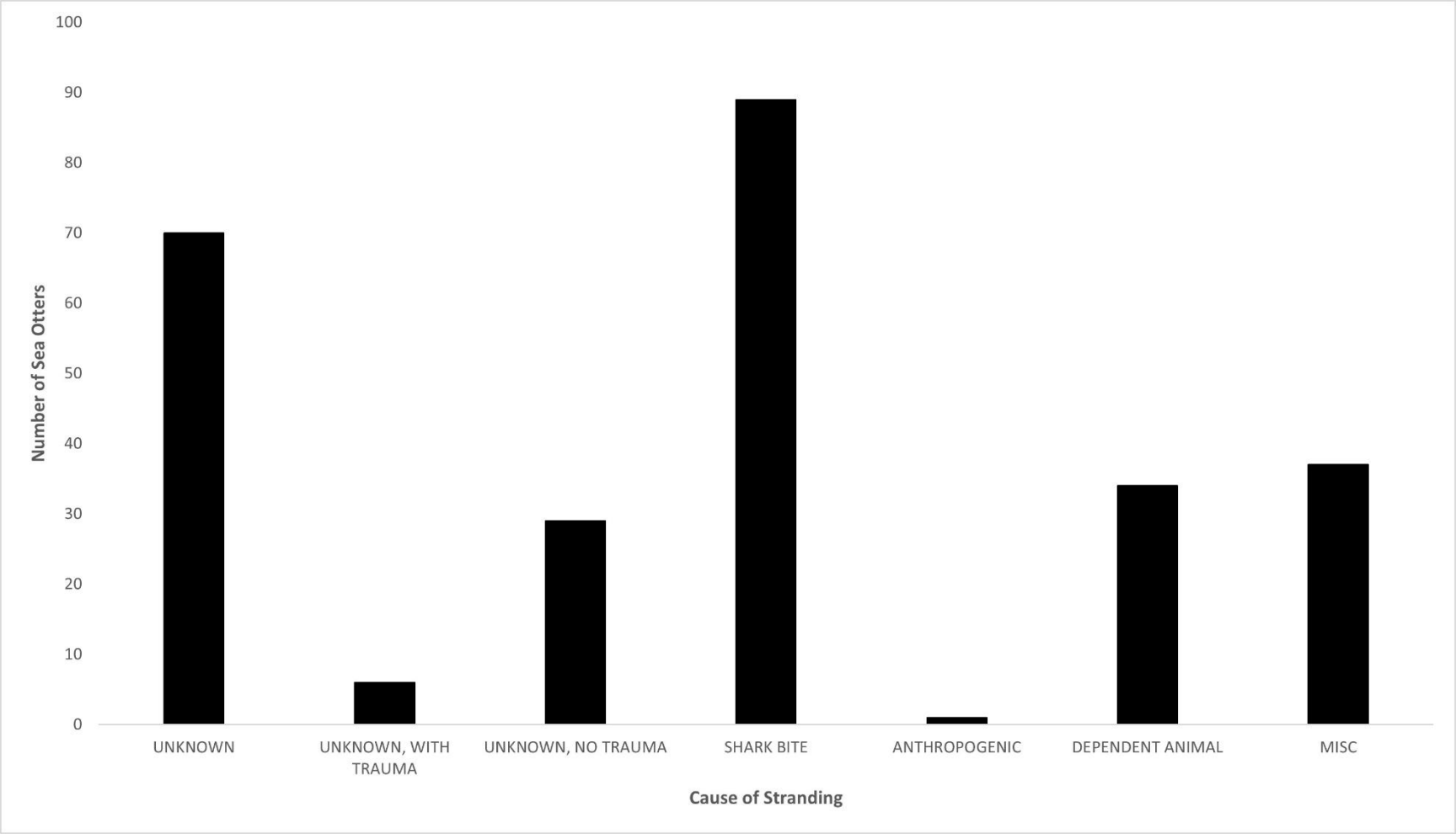

Figure 2. Primary causes of stranding (COS) of southern sea otters during 2022 (n=266). These data are preliminary and subject to change as cases are finalized. Cases coded with a suspect or pending qualifier are included with confirmed cases. Cases are grouped by related COS; categories are defined in the main text of this report. In many cases, one or more contributing COS are present. 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 are likely under-estimated.