Summary of Southern Sea Otter Mortality Investigations in 2014

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SUMMARY

Three hundred forty-eight southern sea otter carcasses were examined by California Department of Fish and Wildlife scientists during 2014. Forty-six of those animals will have histopathology completed in addition to a gross necropsy, including eight wild tagged study animals, one animal outside the subspecies' normal range, 20 fresh-dead animals collected from throughout the sea otter range in California as "random-source" cases for full postmortem examinations, and 17 animals that had histology samples taken due to other special circumstances. The remaining 302 otters received basic gross examinations. Of the 20 random-source cases, 55% (n=11) were confirmed or suspected shark bite cases. This is an increase from 36% (n = 8) of random fresh cases that were shark bitten during 2013. The primary cause of death for the remaining nine random-source sea otters encompassed additional mortality categories, including presumed boat-strike for one animal. Microscopic examination (histopathology) and supplemental testing are required to diagnose some health conditions affecting sea otters. Thorough microscopic examination will be performed for all random source sea otters necropsied during 2014. Our understanding of factors contributing to sea otter mortality continues to evolve through time as additional knowledge is gained, new disease processes are identified, and more diagnostic tests become available.

INTRODUCTION/BACKGROUND

The California Department of Fish and Wildlife (CDFW) has been investigating causes of mortality in southern sea otters *(Enhydra lutris nereis)* since 1968, initiated in response to State Senate Concurrent Resolution 74. Investigating causes of sea otter mortality is important for: 1) identifying factors limiting population recovery, 2) informing best achievable care of captive sea otters, including animals recovered during oil spills, 3) tracking mortality trends and better characterizing disease processes and emerging threats, and 4) assessing, and when possible, mitigating anthropogenic sources of mortality. Although it is not a primary focus of the California Department of Fish and Wildlife, investigations of sea otter mortality can also help identify emerging health risks for humans living along the land-sea interface of California.

Investigations of sea otter mortality are currently conducted by the Department's Office of Spill Prevention and Response, at the Marine Wildlife Veterinary Care & Research Center (MWVCRC) in Santa Cruz, in collaboration with partners at the United States Geological Survey (USGS), the Monterey Bay Aquarium (MBA), and occasionally The Marine Mammal Center. These groups collectively respond to every report of a stranded sea otter, which may be recovered dead or alive. Most stranding recoveries in California involve collection and examination of dead otters (Pattison et al. 1997, Kreuder et al. 2003, Miller et al. 2013). Of the few that strand alive, most die soon after stranding or are humanely euthanized. Sea otters that strand alive with treatable health conditions undergo rehabilitation at MBA and may be released or maintained in captivity. The extent of examination and sampling of cases has varied over the years, but from 2010 through 2012, every 3rd fresh-dead otter older than 1 year was examined by a pathologist at the MWVCRC, and more abbreviated necropsies were performed on all other cases. In 2013, the sampling protocol was reduced to every 4th fresh-dead otter older than 1 year to be examined by a pathologist at the MWVCRC with histology (histology was limited in 2013, but a full suite of histology samples was taken in 2014).

In addition, all tagged wild study animals and other animals of interest receive full detailed necropsies at the MWVCRC. All other cases received gross necropsies that were completed by a sea otter biologist and/or veterinary pathologist, and in some cases, samples for limited histopathology or diagnostic testing were collected, depending on the nature of each case and collaborator requests. Thorough microscopic examination will be performed for all random source sea otters necropsied during 2014.

METHODS

Stranding Response

During 2014, biologists from the CDFW, USGS, and MBA, and in rare cases other colleagues, responded to 386 strandings of live and dead sea otters throughout California. Sea otters were recovered primarily from San Mateo County southward through Santa Barbara County (the current established southern sea otter range). Three extralimital strandings (sea otters found outside the established range limits) were also recovered and examined in 2014.

Of the 386 stranded sea otters recovered during 2014, 375 animals were found dead, stranded alive and died later, or were euthanized. Eleven live-stranded animals were successfully rehabilitated at the MBA. MWVCRC staff performed postmortem examinations on 90% (n=348) of stranding cases during 2014. Basic gross examination data for all stranded animals is archived by USGS. Additional information on all 2014 strandings (i.e., age, sex, and location) can be found in the California Sea Otter Stranding Network annual report, provided by USGS at: http://www.werc.usgs.gov/project.aspx?projectID=232.

Detailed Postmortem Examinations

Detailed necropsies were performed by a veterinary pathologist and/or technical staff at the MWVCRC on 46 sea otters (plus one fetus) during 2014. These included eight tagged wild otters that had been observed extensively during field investigations, one stranded animal that had been rehabilitated and released by MBA, 20 random-source animals (every 4th fresh wild otter carcass), and 17 animals that had histology samples taken due to an unusual/atypical presentation or other special circumstances.

Detailed necropsies performed at the MWVCRC generally included a thorough gross necropsy, a standard suite of photographs, collection of major tissues for microscopic examination (histology), collection of swabs for bacterial and/or fungal culture, sample archiving for longer-term study and ongoing research, and collection of samples for additional diagnostic tests (e.g., potential exposure to biotoxins such as domoic acid) pending future funding. During 2014 samples for full histopathology were collected for each random fresh case selected. Postmortem radiographs were performed for some cases, as directed by the history, stranding location, and case presentation. Preliminary results presented in this report may be revised following completion of additional tests. In some cases, the cause of mortality is listed as "possible" (suspected, but further testing required to confirm, where possible, or final confirmation not possible due to test or sample limitations), or "presumptive" (based on sufficient indirect evidence).

The majority of results discussed below are limited to the 20 random-source animals receiving detailed necropsies during 2014. Necropsy results for tagged and special request animals will be provided to the submitting entities. Findings for tagged study animals will be summarized as part of final reports for applicable field studies.

RESULTS

Random-Source Necropsies

Because a systematic sampling scheme is used to select for random-source sea otters for detailed necropsy (every 4th fresh animal), these necropsies provide a relatively unbiased index of current causes of sea otter mortality. However, due to relatively small sample size and age-specific sampling bias (current diagnostic efforts are focused on subadult, adult and aged adult animals), the diverse range of factors that are affecting the southern sea otter population during any given year may not be fully represented. During 2014, fresh, random-source animals were unevenly distributed by county of stranding (Table 1) with three strandings in Santa Cruz, eleven in Monterey, and six in San Luis Obispo Counties. One or two fresh, random cases were submitted for postmortem examination each month, except for March and September, when three cases were submitted each month. A summary of preliminary causes of mortality based on gross necropsy findings is provided in Table 2.

Table 1. Number of random-source source sea otter necropsies by month and county of stranding.

Month	Santa Cruz	Monterey	San Luis Obispo	TOTAL
January		1		1
February	1	1		2
March	2		1	3
April		2		2
May		1		1
June		1		1
July		1		1
August			2	2
September		1	2	3
October		2		2
November			1	1
December		1		1
TOTAL	3	11	6	20

Table 2. Primary cause of death for 20 fresh-dead, random-source wild southern sea otters examined at the CDFW MWVCRC during 2014 (based on gross necropsy findings).

Cause of Mortality (Type)	Number	Percent
Shark Bite (Death due to shark trauma or secondary bacterial infection)	11	55%
Cardiomyopathy (Heart failure)	2	10%
Acanthocephalan Peritonitis (Abdominal thorny-headed worm infection)	2	10%
Disseminated Intravascular Coagulation (Blood clotting problems-can be associated with infection)	1	5%
Dystocia (Difficulties during pup birth)	1	5%
End Lactation Syndrome (Death due to the high metabolic cost of reproduction in females)	1	5%
Domoic Acid Intoxication - Presumptive (Marine biotoxin poisoning)	1	5%
Boat Strike	1	5%
Total	20	100%

More than a half (55%) of the random-source otters that received full necropsy examinations died with suspected (8) or confirmed (3) shark bite. Shark bite trauma is confirmed by the presence of shark teeth or characteristic parallel scratches found on bones. Shark-bitten sea otters were recovered from Santa Cruz (3), Monterey (5), and San Luis Obispo Counties (3), and more were male (10) than female (1). Shark bite cases occurred in February, March, May, and August through November, with two cases each month except in May, August, and November, when there was one random fresh case each month. All of these shark bite cases are presumed to have resulted from attacks by great white sharks *(Carcharodon carcharias),* based on observed trauma (Figure 1). Death from shark bite can occur acutely due to trauma and blood loss, or more chronically due to bacterial infection of the bite wounds.

In addition to shark trauma, there was one random fresh boat strike trauma case. The boat strike case was recovered in Monterey Harbor near the inner harbor boat launch in July 2014 (Figure 2).

Direct Anthropogenic Cases

Cases with a direct anthropogenic suspected cause of death included the boat strike case mentioned above (an adult male) as well as one gunshot case identified during gross necropsy of a moderately decomposed carcass (not part of the random-source sampling). The gunshot case was an immature female that was found at Sunset State Beach (Santa Cruz County) in September 2014.

Extralimital Cases

Carcasses collected outside the normal range of the subspecies (not included as random-source animals) in 2014 included an adult male collected in August at the Humboldt Bay South Spit (Humboldt County; >400 km north of the northern range periphery for southern sea otters), an adult male collected in December at Rodeo Beach (Marin County; approximately 75 km north of the northern range periphery), and an adult female collected in March at Malibu (Los Angeles County; approximately 150 km

southeast of the southern range periphery). All of these cases were in a state of advanced decomposition, making determination of the cause of death difficult. For the case from Humboldt County, genetic testing was completed by the Seattle Aquarium (Dr. Shawn Larson), indicating that this animal was a northern sea otter (*E. lutris kenyoni*). The normal range of this subspecies extends south to central Washington (>600 km north of Humboldt Bay). The other two extralimital animals are presumed to be southern sea otters.

DISCUSSION

Since 2009, shark-associated sea otter mortality has increased significantly, and shark bite has continued to be the leading cause of death for southern sea otters during 2014. Studies to determine why there has been an increase in shark bite mortality in recent years are in progress.

It is important to note that acute lesions, including shark bite or boat strike, may mask significant, underlying disease. Many of the otters that died from shark bite during 2014 had other significant, pre-existing health problems that could have eventually led to their death, had the animals had not been killed by sharks. It should also be noted that biotoxins are important contributors to cardiovascular disease in sea otters, and many cases of cardiovascular disease in sea otters may result from chronic or recurrent biotoxin exposure.

Consistent with past mortality surveys, infectious disease continues to be an important cause of death for southern sea otters: 10% (n=2) of fresh, random-source otters with full necropsies succumbed to acanthocephalan (thorny-headed worm) infection of the abdomen or secondary bacterial infections as a primary cause of death. Additional animals had bacterial infection, as a contributing cause of death. It is also important to note that some key infectious causes of sea otter death, such as single-celled protozoan parasites (e.g. *Toxoplasma gondii* and *Sarcocystis neurona*), can only be visualized through microscopic examination of tissues. Additional animals with infectious agents as primary or contributing causes of death may be identified during subsequent detailed microscopic examination and testing.

Relatively few cases of direct anthropogenic cause of death were identified in 2014, although as discussed in the 2013 report (Miller et al. 2013), other causes of sea otter death (or morbidity), such as bacterial infection, protozoal encephalitis and domoic acid exposure may be indirectly anthropogenic.

DISCLAIMER

Information in this report is preliminary and should not be cited without permission from the CDFW. Microscopic examination and supplemental testing is required to diagnose some health conditions affecting sea otters. Because testing is still being completed, and because our understanding of factors contributing to sea otter mortality evolves through time as greater knowledge is gained, categories may be revised for future mortality summaries.

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Figure 1. Right tibial (calf) bone from a sea otter. Shark attack was confirmed at gross necropsy through visualization of fine, parallel scratches on the bone surface consistent with contact with a serrated white shark tooth. A shark tooth fragment was recovered at this site. Great white sharks (*Carcharodon carcharias*) are the only local large sharks known to possess these fine serrations along both tooth edges.

Figure 2. Left tibia and fibula from a sea otter: Compound fracture of both bones is consistent with high-energy trauma, such as boat strike.