SENTINELS OF THE SEA: What Stranding Sea Lion Pups Signify about the Health of Our Oceans

Introduction

The past four years have been declared Unusual Mortality Events (UMEs) by the National Oceanic and Atmospheric Association (NOAA Fisheries) for California Sea Lions after record numbers of pups washed ashore in Southern California. The number of strandings from January-May 2015 was over ten times the average for this same period during 2004-2012 indicating that something has truly gone awry in the oceans off the California coast.

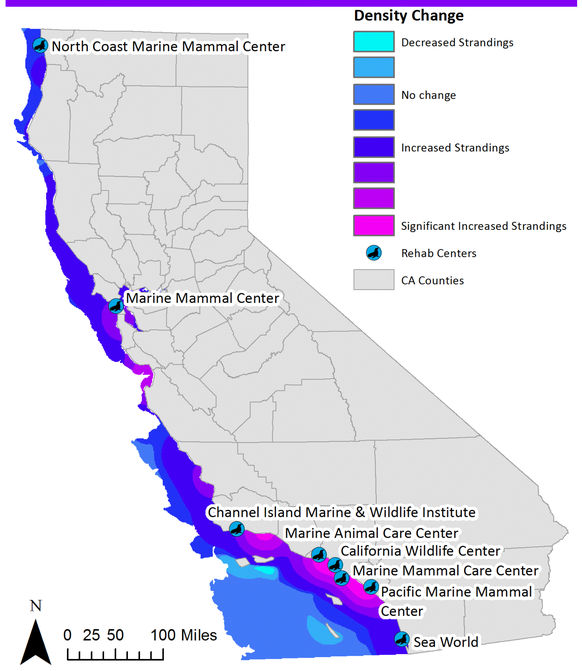
Sea lion pups are reared mainly on the rookeries of the Channels Islands off the California Coast.

They are born in June and remain with their mothers for approximately a year. For the first six months of their lives, they are completely dependent upon their mothers and they aren't normally weaned until about 11 months at which point some of the weaker ones start washing up on the coast around May or June. What is particularly startling about the strandings of the past four years is that pups started stranding as early as December of the year they were born, with the biggest influx occurring in March of the next year. This indicates that they were being weaned off from their mothers after as early as six months of age.

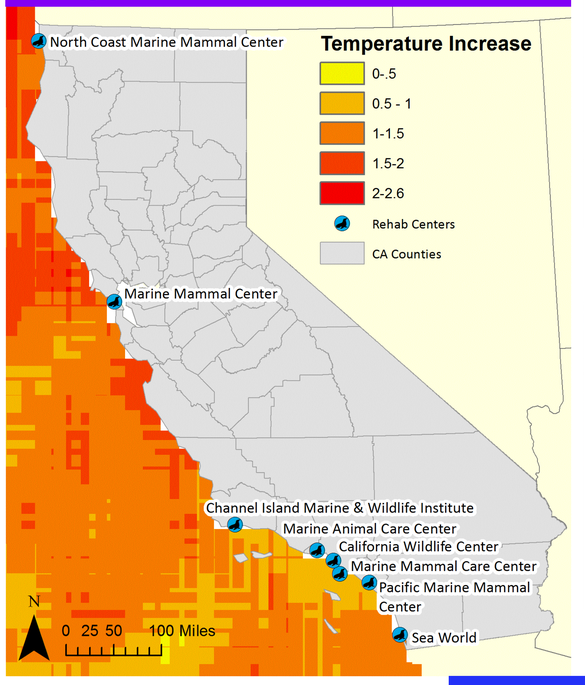
The NOAA, with the help of marine mammal rehabilitation facilities, is partaking in ongoing research to determine the cause of these UMEs but water temperature and prey availability seem to be the major culprits at hand. El Nino years have been increasing the water surface temperature and pushing sardine and anchovy populations further out from the coast in search of cooler waters. This results in sea lion mothers having to travel further offshore to find food or resorting to finding more available prey, such as market squid and rockfish, which are lower in fat content and might not be enough to provide adequate nutrition in the sea lion mother's milk.

This analysis will utilize the data NOAA collected from the marine mammal stranding network, in order see if there truly is a correlation between the warming sea surface temperatures and sea lion stranding densities.

Change in Pup Stranding Density 2012-2015



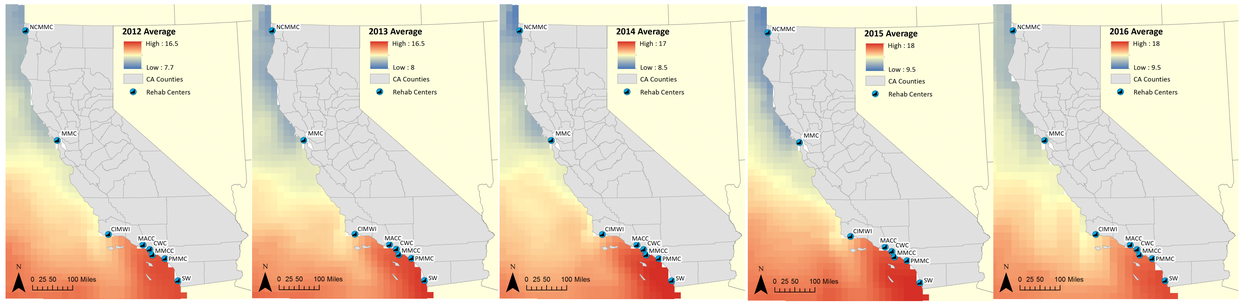
Change in Sea Surface Temperature 2012-2015



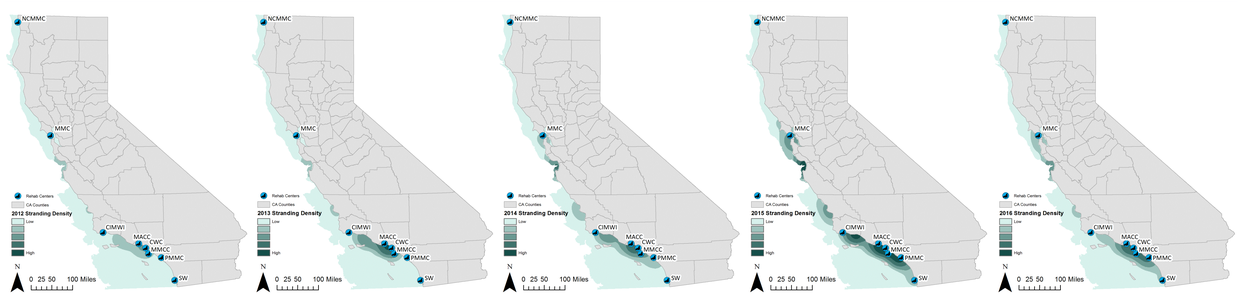
Emaciated California Sea Lion Pup washed up ashore.

Sea Lion pups released at Nicholas Canyon beach after rehabilitation at California Wildlife Center.

Sea Surface Temperatures (Degrees Celsius)



Stranding Densities



Bivariate Analyses

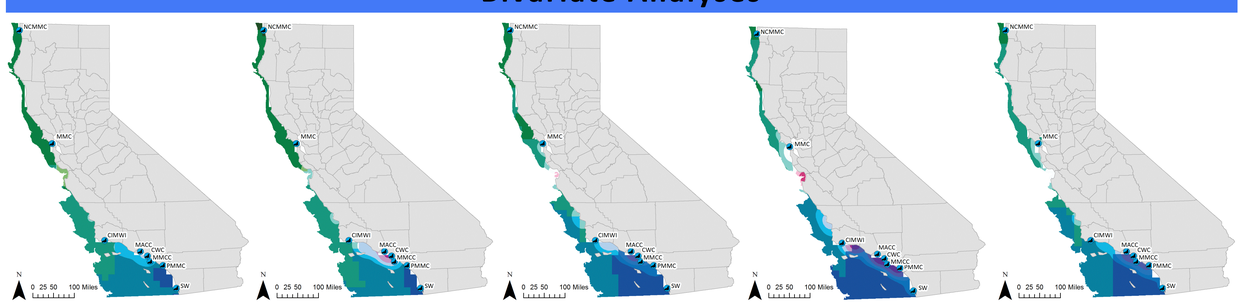


Figure 1.

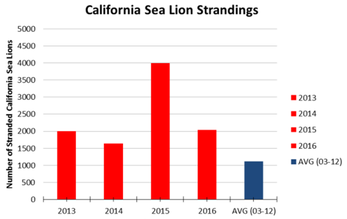
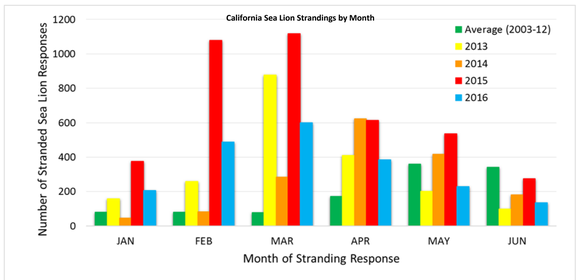
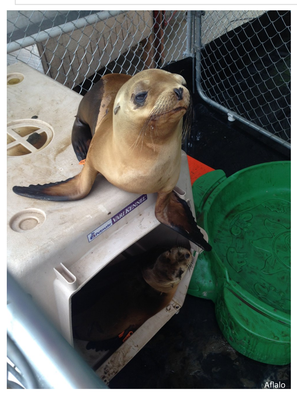


Figure 2.





Cartographer: Roxane Aflalo, MCM Candidate '17

Data Sources: NOAA, ESRI, US Census, CA Department of Fish & Wildlife

Projection: NAD 1983 California (Teale) Albers (Meters)

MCM 591, December 2016

Methods

NOAA data was imported into ArcMap utilizing Display XY Data with the given latitudes and longitudes. Due to human errors inputting the data, only approximately 8000 of the 1200 points for 2012-2016 were usable. Once inputted into ArcMap, the data set was separated into years and all the sea lions that weren't pups or yearlings were selected. The Kernel Density tool was used to create the stranding density maps. For sea surface temperatures, the data was downloaded as net cdfs for every single day of the year for 2012-2015. The 1st and 15th day of each month from January through June (when most sea lion pups strand) were selected and then averaged together for each year through raster calculator. A bivariate analysis was then used by reclassifying all the densities and temperatures to the same values and using raster calculator.

		California Sea Lion Pup Stranding Density (Low to High)				
		1	2	3	4	5
Temp (Low to High)	10	11	12	13	14	15
	20	21	22	23	24	25
	30	31	32	33	34	35
	40	41	42	43	44	45
	50	51	52	53	54	55

Discussion

Southern California saw the highest increases in stranding densities with hot spots centered around the Channel Islands, Los Angeles, Long Beach, San Pedro, San Diego. In the most severe year (2015), Northern California hot spots included the Bay Area and Monterey Bay. Sea surface temperature analysis displayed that warming trends are occurring especially throughout the Southern portions of California, with temperature increases ranging from 0.5-2.5 degrees Celsius. This would explain why Southern California experienced higher densities of pup strandings than Northern California. These trends support the hypothesis that sea lion pups are stranding due to decreasing prey availability as a result of increasing water temperature. As water temperature increases, sardine and anchovy populations are moving further off the coast in search of cooler waters and sea lions are being forced to forage on less nutritious prey.

NOAA in association with the Stranding Network and California Rehabilitation Centers should continue to monitor these sea lion strandings closely in the upcoming years. Data should be consistently input in the same units (as there were issues with units in this project). Recommendations for future research include monitoring anchovy and sardine populations, monitoring sea lion populations to account for the pup decline, and looking into how the warming temperatures are affecting other parts of the ocean ecosystem.