In-Water Resting Posture

Shortfin Mako Shark

1. Fresh Lesion

2. Healing Lesion

3. Scared Lesion

Shark-inflicted lesions on California sea lions (*Zalophus californianus*) at San Miguel Island, California: A new phenomenon

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ABSTRACT

Shark-inflicted lesions on California sea lions (*Zalophus californianus*) were observed in unprecedented numbers on San Miguel Island (SMI), California, from February to September 2011. Prior to this time period (1972-2010), there was little observational evidence of shark predation on SMI sea lions. We documented 134 living animals with lesions including 95 adult females, 36 juveniles and 3 adult males. Lesion condition (fresh, healing, scarred) was used to assess the peak period of shark predation; 88% of all freshly inflicted lesions occurred in June and July. Based on distinct lesion patterns, 40 of the lesions could be assigned to the shortfin mako shark (*Isurus oxyrinchus*) and 13 to sub-adult white sharks (*Carcharodon carcharias*). Shark predation on California sea lions at SMI is ecologically important and may signify the return of apex predators following the cessation the California drift gillnet fishery (1981-1991) in the Southern California Bight. Adult female and juvenile survival drives California sea lion population growth and if predation persists on these age classes it may emerge as a key factor in population dynamics.

INTRODUCTION

Predation of pinnipeds by sharks is regularly observed in nature and considered a source of mortality for most temperate and tropical pinniped species. San Miguel Island, California (SMI) is a known rookery for six Pacific pinniped species. Since implementation of the federal Marine Mammal Protection Act (1972), most pinniped populations at SMI have grown at exponential rates and large numbers of pinnipeds are present on the island year-round. Sharks have historically inhabited the waters surrounding SMI, yet significant shark predation on pinnipeds has not been observed. Here, we describe the recent occurrence of shark inflicted lesions and scars on California sea lions at the SMI rookery. The recent interaction between California sea lions and sharks may be explained by a combination of two factors: the presence of a shark cohort that has reached a size sufficient for marine mammal predation and the sharks discovery of the California sea lion population as a prey resource.

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Figure 1. Assigned condition of shark-inflicted lesions during each month, normalized by days of observation.

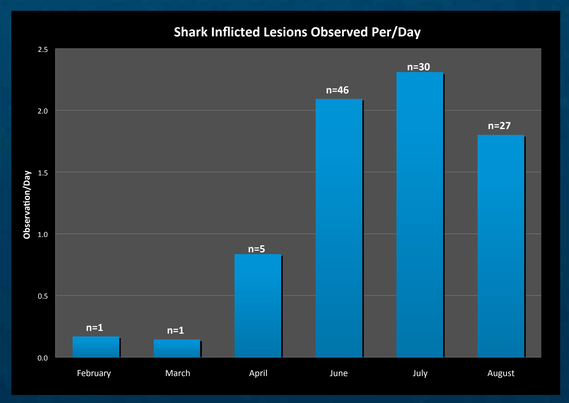

Figure 2. Monthly rate of shark-inflicted lesions observed on California sea lions from February to August 2011 on San Miguel Island, CA. (Total number of lesions observed each month noted by n.)

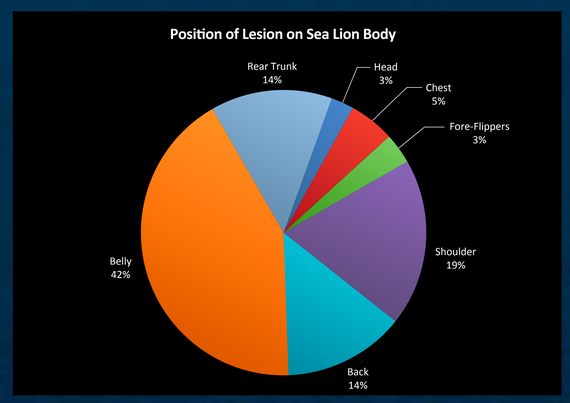

Figure 3. Position of injuries attributed to sharks on the body of 134 California sea lions at San Miguel Island, CA, between February and August, 2011.

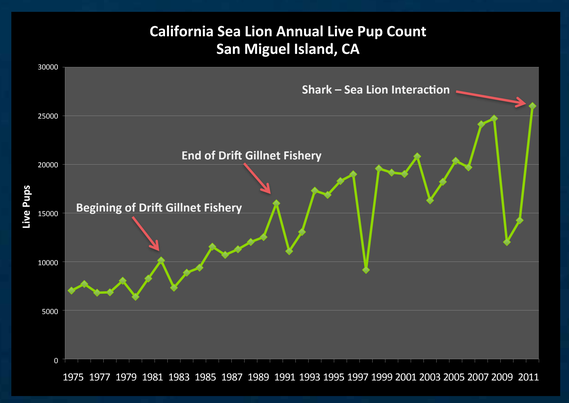

Figure 4. Annual California sea lion pup production on San Miguel Island, CA, from 1975 to 2011. Included is the beginning of the California drift gillnet fishery in relationship to the shark - California sea lion interaction of 2011.

METHODS

- Opportunistic photos of California sea lions with shark lesions were taken at San Miguel Island, California during 69 days of survey effort between February and August 2011.
- Photos of lesions on sea lions were assigned to four categories:
  1. Fresh: flesh was raw or bleeding
  2. Healing: flesh pink and showed signs of healing
  3. Scar: wound was completely healed with scarring
  4. Unknown: probable shark.
- Lesions were assigned to the shark species responsible based on lesion patterns.
- California sea lions with lesions were assigned age and sex classes. Regions of the body where lesions occurred were assigned as follows: belly, rear trunk, head region, chest, fore-flipper, shoulder and back (Fig. 3).

RESULTS

- 134 individual California sea lions with shark inflicted lesions were observed.
- No mortalities due to shark inflicted lesions were observed.
- Peak of shark / sea lion interaction occurred in June (n=16) and July (n=22), which made up 88% of all fresh lesions observed (Fig. 1).
- Age and sex of California sea lions with observed lesions: Adult females (72%), juveniles (26%) and adult males (2%).
- The position of lesions on California sea lion bodies were most frequently observed on the belly (42%) and shoulder (19%) (Fig. 2).
- 53 shark-inflicted lesions were assigned to a shark species: 75% to shortfin mako and 25% juvenile white sharks.
- White shark lesions occurred more frequently on the rear trunk of the animal whereas lesions assigned to the shortfin mako were predominantly on the belly and shoulder.

CONCLUSIONS

- In forty years of observation this is the first large scale California sea lion/ shark interaction documented in the Southern California Bight. While shark predation on California sea lions is not uncommon in the northern part of their range (Monterey Bay north to British Columbia, Canada) it is rarely observed in the Channel Islands.
- Our documentation of 134 shark inflicted lesions on California sea lions represents only live animals that escaped predation and reached SMI, giving only a minimum index of the interaction because mortality could not be assessed.
- Most shark attacks occurred on adult female and juvenile California sea lions during June and July, the peak of California sea lion abundance at SMI. Adult male California sea lions are mostly inaccessible to sharks while in the Southern California Bight.
- Most lesions occurred on the belly and shoulder of sea lions, suggesting sharks are targeting California sea lions while they are resting at the surface (Photo above). Their in-water resting posture makes them exceptionally vulnerable to predatory attacks from below, consistent with the shortfin mako and white shark hunting strategy.
- The high percentage of shortfin mako shark attacks may reflect an increased abundance of adults of this shark species around SMI resulting from the closure of the drift gillnet fishery in 1991 (Fig. 4). Assuming high survivorship after the closure of the drift gillnet fishery, sharks may now be capable of marine mammal predation.
- In recent years, disease and environmental perturbations have been the primary regulators of the California sea lion population but the return of sharks as apex predators to the food web of the California Bight may represent a new population regulator for California sea lions at SMI.

Background photo by Mark Conlin Southwest Fisheries Science Center, National Marine Fisheries Service, NOAA