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Proceedings of the Vertebrate Pest Conference

Title

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Permalink

<https://escholarship.org/uc/item/19r1v16g>

Journal

Proceedings of the Vertebrate Pest Conference, 23(23)

ISSN

0507-6773

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Publication Date

2008

DOI

10.5070/V423110649

Preliminary Observations of the Effectiveness of Non-Lethal Deterrence Methods for California Sea Lions and Pacific Harbor Seals along the Coast of California

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ABSTRACT: Since the Marine Mammal Protection Act (MMPA) of 1972 became a law, many pinniped populations have increased and expanded their range along the west coast of the United States (e.g., California sea lion, Pacific harbor seal, northern elephant seal, northern fur seal, Steller sea lion, etc.). Pinnipeds live primarily in the ocean but rely on coastal areas for important components of their existence (i.e., pupping and resting). As pinniped populations increase along the California coast, numbers of animals hauling out on beaches, rocky substrates, and non-traditional areas such as marinas, docks, and bait receivers have also increased. Confrontations between humans and pinnipeds are escalating. The National Marine Fisheries Service is assigned by the Federal Government to actively manage these species and their interactions with humans. These confrontations have been, in part, a result of competition between people and pinnipeds for prime coastal areas/habitat. The human responses to these interactions have included modification of marine areas used by these animals, but have also included harassment that can lead to injury or death of the animals. Pinnipeds, however, are fully protected from harm under the MMPA. The MMPA Amendments of 1994 provided new authority to citizens of the United States to deter marine mammals from damaging private property, endangering public safety, or damaging public property. A number of non-lethal deterrence methods exist, including physical barriers such as fences and negative stimuli such as sprinkler systems, rubber shot, and acoustics. In most cases, seals and sea lions become habituated to deterrence methods over time. We discuss preliminary results of the use of non-lethal techniques along the coast of California to exclude seals and sea lions from hauling out on marinas, docks, and bait receivers. Preliminary observations indicate that the placement of physical barriers and sprinkler systems has resulted in consistent non-lethal deterrence of sea lions from bait receivers and docks.

KEY WORDS: deterrence, harbor seal, humans, Marine Mammal Protection Act, non-lethal, *Phoca vitulina*, pinnipeds, sea lions, seals, *Zalophus californianus*

Proc. 23rd Vertebr. Pest Conf. (R. M. Timm and M. B. Madon, Eds.)
Published at Univ. of Calif., Davis. 2008. Pp. 181-185.

INTRODUCTION

Pinnipeds live primarily in the ocean but rely on coastal areas for pupping, nursing, molting, mating, resting, and escaping predators or other dangers. As coastal development continues, seals and sea lions are losing access to historically important natural haul-out and breeding sites, but are gaining new haul-out sites on man-made structures. Haul-out sites in areas not traditionally used by pinnipeds are now commonly used by California sea lions (*Zalophus californianus*) and Pacific harbor seals (*Phoca vitulina richardii*). These include marinas, docks, bait receivers, and other available structures such as floating bait receiver pens, jetties, oil platforms, offshore buoys, and piers. This use can lead to physical damage of structures, sinking of vessels, and to negative or aggressive interactions with humans.

Since the Marine Mammal Protection Act of 1972 became law (MMPA 1972), many pinniped populations have increased along the West Coast of the United States and expanded their range (e.g., California sea lion; Pacific harbor seal; northern elephant seal, *Mirounga agustirostris*; northern fur seal, *Callorhinus ursinus*; and Steller sea lion, *Eumetopias jubatus*). Historically, both Pacific harbor seals and California sea lions were harvested and hunted for bounties, and their populations were reduced to significantly low levels. The MMPA provided protective measures for continued recovery of both of these pinniped populations. Figure 1 represents the geographic

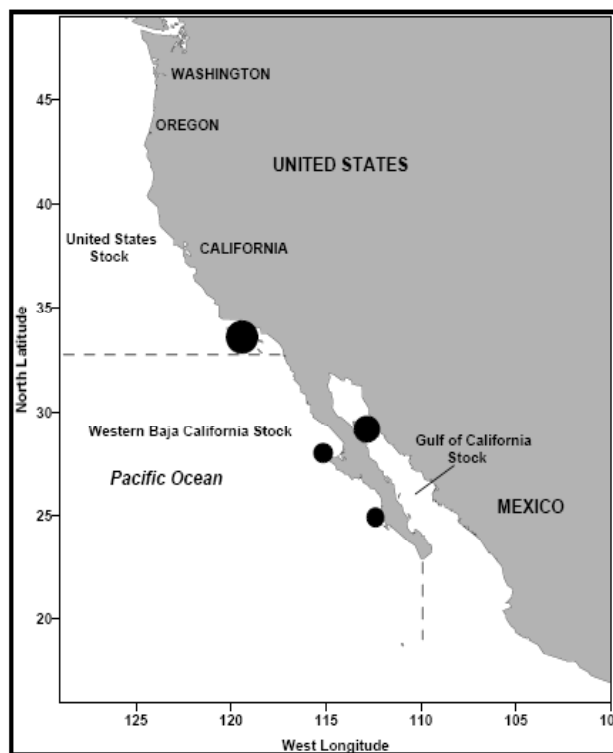


Figure 1. Geographic range of California sea lions showing stock boundaries and locations of major rookeries.

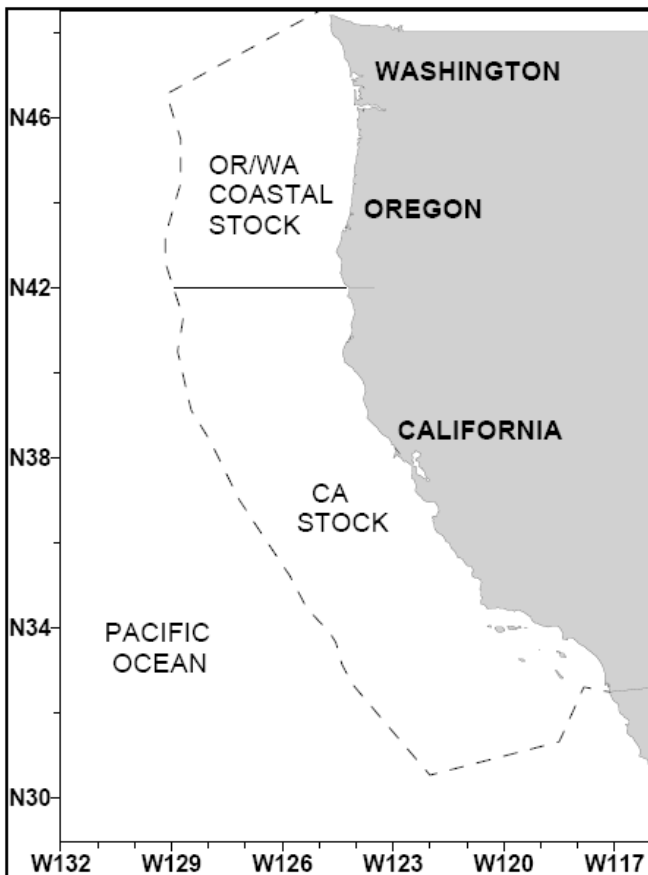


Figure 2. Stock boundaries for the California and Oregon/Washington coastal stocks of harbor seals. Dashed line represents the U.S. Exclusive Economic Zone (in Carretta et al. 2007).

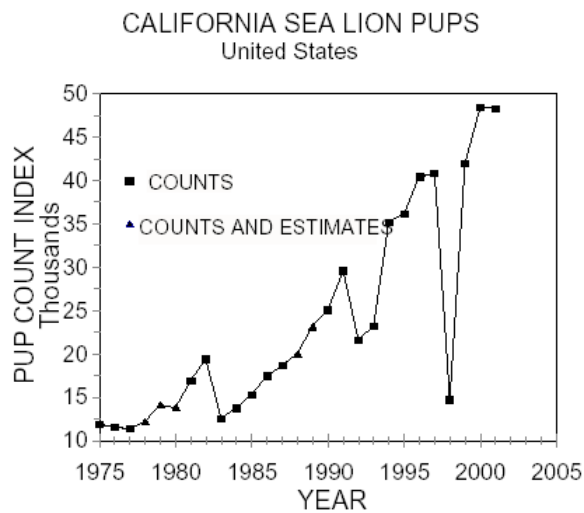


Figure 3. U.S. pup count index for California sea lions (1975-2001) (in Carretta et al. 2007).

range of California sea lions, showing stock boundaries and locations of major rookeries, and Figure 2 represents the boundaries for the California and Oregon/Washington coastal stocks of harbor seals. Numbers of California sea lions (Figure 3) and Pacific harbor seals (Figure 4) have

Harbor Seals: CA Haulout Counts

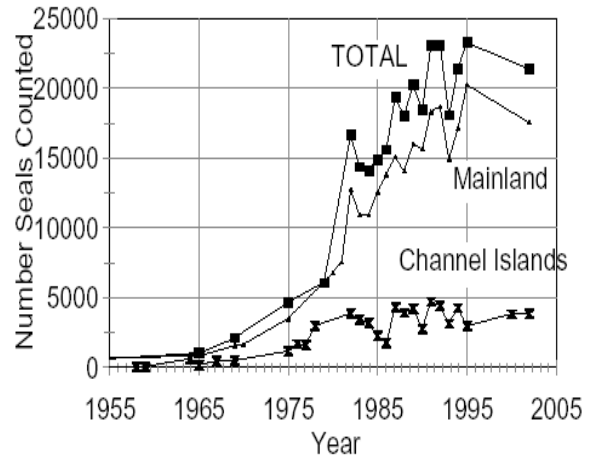


Figure 4. Harbor seal haulout counts in California during May/June (Hanan 1996, R. Read CDFG unpublished data, NMFS unpublished data from 2002 and 2004 surveys) (in Carretta et al. 2007).

increased since the MMPA was established in 1972, and the populations are now considered stable. The California sea lion population is estimated at 237,000 to 244,000 individuals, and the harbor seal population (California stock) is estimated at 34,233 individuals (Carretta et al. 2007). These increases in the population size have been accompanied by a growing number of interactions with humans, raising concerns by private citizens and government officials, who are seeking ways to protect the animals as well as to protect property, fishing gear, and catch from damage by seals and sea lions.

Although there is little published information on the nature and extent of these types of interactions between humans and pinnipeds, the impacts can sometimes include damage and/or loss of use to marinas, docks, vessels, and bait receivers. Human and pinniped interactions can also incur increased costs in protecting property, human injuries (bites), and injuries or fatalities to seals and sea lions.

In 1994, amendments to the MMPA (60 FR 22345; NMFS and WDFW 1995) broadened the authorization for use of non-lethal deterrence measures. Section 101.a.4.A.ii granted new authority for owners (or their agents) of private property to legally deter marine mammals from damaging private property, and Section 101.a.4.A.iv granted new authority to government employees to deter marine mammals from damaging public property— as long as such measures do not result in the death or serious injury of an animal.

A 1999 Report to Congress (NOAA 1999) included specific recommendations for management measures to address pinniped conflicts with human activities by developing safe and effective non-lethal deterrent technologies. The four recommendations were: 1) Implement site-specific management authority that would allow state and federal officials to lethally remove pinnipeds, where necessary to protect ESA-listed salmon and other marine resources; 2) Develop safe and effective non-lethal deterrent technologies; 3) Reconsider the prior MMPA authorization that allowed commercial fishers to

lethally take pinnipeds as a last resort to protect their catch and gear, in specific fishery areas where economic impacts are occurring; and 4) Implement the studies necessary to obtain additional information on the expanding pinniped populations and their impacts on other resources, especially ESA-listed salmonids.

As a result, NMFS has worked with the states of California, Oregon, and Washington to test and evaluate the effectiveness of various non-lethal measures to deter the animals from interactions with humans. Much of the work took place in confined sites where resource conflicts were occurring between sea lions with steelhead and salmon (e.g., the California sea lion conflicts at the Ballard Locks and the Willamette Falls fish ladder, in Washington State); thus, measures could be more easily tested and evaluated on identifiable (tagged) individuals. In some situations, marine mammals exposed to common deterrent measures, used by fishers to protect gear and catch from predation, have become habituated to these measures, such as seal control firecrackers (seal bombs) and other pyrotechnics, acoustic devices that emit high level sounds, and tactile harassment (striking the animal with projectiles, rocks, marbles etc., thrown or launched from a slingshot), and vessel chase (see Fraker 1994, NMFS and WDFW 1995, NOAA 1997). Note that deterrent efforts involving noise stimuli are based on the assumption that noise can be used to startle, warn, scare, or cause physical distress to pinnipeds, moving them out of areas. In addition to the above-mentioned measures, marina owners have also tried plastic construction fencing, placing people on docks banging pots and pans, loud music, water hoses, and simulations of killer whale calls, all with little or no result.

To date, no safe, effective preventative measures or techniques to keep pinnipeds from hauling out have been found to provide long-term resolution. In order to reduce damaging and costly pinniped interactions in those circumstances where other non-lethal measures are no longer effective, new more effective methods are needed. Here, we briefly report on a workshop (see below) and discuss preliminary assessments of the effectiveness of several pinniped deterrent methods that recently have been tried.

MATERIALS AND METHODS

Bait receivers at 4 locations were chosen for preliminary evaluation of 2 deterrent methods. First, the bait receivers at King's Harbor in Redondo Beach, CA (installed in August 2005) and at "C" dock in Monterey Bay, CA (installed in November 2004) were equipped with physical barriers. Second, the bait receivers at Ervingham Bros. Bait Co. in San Diego Bay and at Marina Del Rey Sportfishing, Inc., Marina Del Rey, CA, were equipped with sprinkler systems, installed in May 2005 and January 2008, respectively.

At all 4 locations, we investigated trends in haul-out behavior by seals and sea lions at the marinas and bait receivers. Information on presence or absence of seals and sea lions, numbers of individuals, and haul-out preferences were collected. Much of this information was collected in the form of verbal accounts from marina or bait receiver owners and employees. Information on



Figure 5. Bait receiver in Redondo Beach, California after installation of fence. Shown here is PVC piping on top of the galvanized aluminum fencing bolted to the dock with standposts, with 2 access gates for personnel and patrons to access the bait.

behavior was collected, as was identification of sex and age-class. If tagged individuals were encountered, tag identification numbers also were collected.

Physical Barrier

In Redondo Beach, the 4-foot-high fence used $\frac{3}{4}$ -inch galvanized aluminum metal bars and stand posts, with less than an 18-inch gap between the base and/or bars (Figure 5), and PVC piping was placed around the uppermost horizontal bar. PVC piping was slightly larger in diameter than the galvanized pipe. Any pressure applied to PVC would cause it to roll on the galvanized pipe and prevent animals from getting over the fence. In areas where smaller animals were attempting to haul out, a mesh fencing was used to prevent animals from entering under the barrier. Gates were also included at Redondo Beach location (see Figure 5). The barrier placed at the Monterey Bay location was slightly different than the one placed at the Redondo Beach location; the fencing design included $\frac{3}{4}$ -inch aluminum pipes bolted to the dock with stand posts, with green construction fencing placed on the interior of fence and PVC piping around the uppermost horizontal bar (Figure 6).



Figure 6. Dock in Monterey Bay, California after installation of fence. Shown here is PVC piping on top of aluminum fencing bolted to the dock, with green construction fencing on the dock side. At the end of the dock is a removable plywood structure to permit the release of a trapped animal, should it gain access to the dock.

Sprinkler System

A variety of different sprinkler types were tested to determine which type worked best in the marine environment. The sprinkler system at the San Diego bait receiver used ocean water. A stainless steel pump was installed at the bait barge and was surrounded by a mesh bag, to discourage fouling of the pump mechanism by encrusting organisms. At Marina Del Rey, hoses for the sprinklers were attached to the city-supplied fresh water system. The sprinkler system at Marina Del Rey used infrared motion detection and sprinkled intermittently when sea lions or birds came onto the receiver. We are still testing the sprinklers at Marina Del Rey.

Non-Lethal Deterrence Workshop

In an effort to gather more information on conflicts with pinnipeds nationwide, a 2-day workshop was held in La Jolla, California on December 8-9, 2005. Participants included scientists, members of academia, marine mammal management, national and international government representatives, law enforcement, marina owners, fishers, and members of the public. Day One of the workshop included presentations and a round table discussion. Day Two was closed to the public and included government representatives, management, and law enforcement, in an effort to provide recommendations for developing guidelines for non-lethal deterrence methods.

RESULTS

Physical Barrier

The heavy-duty fencing installed at the bait receiver located in Redondo Beach and the dock at Monterey Bay was of sufficient height to keep seals and sea lions of all age classes from gaining access. It withstood the weight of multiple individuals (with large male sea lions weighing up to approximately 390 kg), yet was accessible to human foot traffic and the docking of vessels. The galvanized metal worked well in the marine environment, and the PVC piping prevented animals from climbing over the fencing. Following installation, seals and sea lions no longer hauled out at the bait receiver in Redondo Beach and the dock in Monterey. Individuals that were excluded from these haul-out sites did not leave the area completely, but relocated to other haul-out sites within the marina.

Sprinkler Systems

Seals and sea lions did not haul out at the bait receivers located in San Diego and Marina Del Rey while sprinkler systems were operating. In one location, the sprinkler system had to be removed after running for two months, due to concerns over electrical problems with the salt water spray hitting the overhead lighting system. It was more than 4 months after the sprinkler system was removed before animals returned to that area of the bait receiver. At the Marina Del Rey location, no seals or sea lions have been observed to haul out since the sprinkler system was installed, and the infrared motion detection appears to be a suitable alternative to manual operation of the system.

Non-Lethal Deterrence Workshop

The 2005 workshop resulted in guidelines for the non-

lethal deterrence of Pacific harbor seals and California sea lions, for property owners and those engaging in fishing activities. Those guidelines were posted at the following website: <http://swr.nmfs.noaa.gov/deter/index.htm>.

DISCUSSION

Fencing was successful at deterring sea lions from hauling out at both locations, but modifications to the design may be necessary to accommodate accessibility and safety concerns for humans at the location. Sprinkler systems were successful in deterring seals and sea lions from hauling out at both locations, but several modifications to the system may be necessary for use in the marine environment; for example, finding an alternative power source, and selecting sprinklers that can withstand the marine environment for a long period of time.

There has been difficulty in finding an effective, long-term approach to eliminating or reducing pinniped haul-outs on non-natural habitats. In many cases, individuals become habituated to the deterrence method (see Fraker 1994, NMFS and WDFW 1995, NOAA 1997).

A number of deterrent devices have been used by the fishing community; these have relied on acoustics (see Jefferson and Curry 1996) and/or a combination of noise and visual effects to startle marine mammals or warn them away from conflict locations. Examples include pyrotechnics and acoustic deterrent devices, which project impulsive and/or high-intensity sounds to startle or induce a pain response in nuisance or problem animals. These have been used on animals that were actively preying on fishing gear or catch, but with limited success (Shaughnessy et al. 1981, Gearin et al. 1986, Geiger and Jeffries 1987, Hanan 1989). In addition, physical barriers of various types have been used with limited success. For example, a small number of sea lions have been kept from hauling out on a dock at the Shilshole Marina, Washington, using a fence-like structure that was placed on a dock where sea lions were known to haul out. Although marina officials indicated that sea lions did not return to the dock where the structure was placed (Cleone Maines, Shilshole Bay Marina, pers. commun., April 2004), there were no studies to document the continued effectiveness of this structure.

During our experiments, in all cases the seals and sea lions excluded from haul-out sites relocated to other areas nearby, or they established "new" haul-out sites. However, the attractant (i.e., food source) was not removed from the area, so it was not expected that the animals would leave the area completely. The information gathered from these experiments will be used to design more robust non-lethal deterrence measures that could be more broadly applicable for those marinas with ongoing nuisance pinniped interactions, then posted on our website to share with the public. We hope to use this information to expand investigations of non-lethal deterrence measures, as a means to remove animals from a variety of areas where interactions occur.

As a result of the Non-lethal Deterrence Workshop, NMFS is developing formal guidelines and regulations for safely and legally deterring marine mammals. NMFS expects to publish these formal guidelines in the near future. NMFS has established a website (<http://swr.nmfs.noaa.gov/deter/index.htm>) describing methods and techniques

that have been found useful for deterring problem seals and sea lions that are damaging property, fishing gear, or catch. The website has been extremely useful for NMFS staff, marina owners, bait receiver operators, fishers, and those dealing with pinniped interactions. The website is continually updated with new deterrence measures as we gather more information from the public.

The observations presented here are preliminary; however, the placement of physical barriers and sprinkler systems each have resulted in consistent non-lethal deterrence of sea lions from bait receivers and docks. We continue to seek new technologies and methods in an effort to develop safe and effective non-lethal deterrent methods that address human interactions with pinniped populations along the California coast.

ACKNOWLEDGEMENTS

The authors thank the National Marine Fisheries Southwest Regional Office, Northwest Regional Office, and Office of Protected Resources (Silver Spring, MD) and the following individuals: Christina Fahy, Tim Price, Ken Hollingshead, Garth Griffin, Brent Norberg, and Sarah Dunsford. The participants of the Non-Lethal Deterrence Workshop 2005 in La Jolla, California are thanked for providing valuable information and ideas. A special thanks to Rick Oeffinger of Marina Del Rey Sportfishing, Inc., Buck Ervingham and Tom Tomkins of Ervingham Bros. Bait Co., and the City of Redondo Beach for allowing us to experiment on their bait receiver, and the City of Monterey's Harbor Master Steve Scheiblauber for allowing us to experiment on their docks. We are particularly grateful to those individuals who face these interactions on a daily basis and continue to work with us to find solutions.

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