Diving behavior of harbor seals, specifically the number of dives per depth range made by seals, determined by satellite-linked time-depth recorder (TDR) and GPS receivers, near Protection Island, WA, 2009 (Seal_response_to_prey project)

Website: https://www.bco-dmo.org/dataset/3804
Version: 29 Nov 2012
Version Date: 2012-11-29

Project
» Responses of Seals and Sea Lions to Increased Rockfish Density (Seal_response_to_prey)

Contributors	Affiliation	Role
Acevedo-Gutierrez, Alejandro	Western Washington University (WWU)	Lead Principal Investigator
Bromaghin, Jeffrey F	United States Geological Survey (USGS)	Co-Principal Investigator
Jeffries, Steven J	Washington Department of Fish and Wildlife	Co-Principal Investigator
Kennish, John M	University of Alaska, Anchorage (UAA)	Co-Principal Investigator
Lance, Monique M	Washington Department of Fish and Wildlife	Co-Principal Investigator
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Dataset Description

In 2009, the diving behavior of harbor seals was monitored near Protection Island, in WA state. Data include the number of dives made per individual per depth range. The number of dives are summarized into four 6-hour time periods per day.

Related publications:
Thomas, AC; Lance, MM; Jeffries, SJ; Miner, BG; Acevedo-Gutierrez, A. 2011. Harbor seal foraging response to a seasonal resource pulse, spawning Pacific herring. Marine Ecology-Progress Series, v.441. p. 225. DOI: 10.3354/meps09370
Thomas, A. 2010. The behavioral response of harbor seals to seasonal prey pulses of spawning Pacific herring. MSc thesis, Department of Biology, Western Washington University, Bellingham, WA. Available from Alejandro Acevedo's lab website.

Methods & Sampling

Five harbor seals were captured and tagged on Protection Island during from 12 to 13 January 2009. A

combined satellite-linked time-depth recorder (TDR) and Fastloc GPS receiver (Wildlife Computers, model MK10AF) was epoxied to each animal's pelage on the dorsal midline.

The TDR sensor was set to sample every 10 seconds and record only dives greater than 2 meters in depth or greater than 30 seconds in duration. The tags summarized the TDR diving data of each animal into four 6-hour time periods: 0400 to 0959, 1000 to 1559, 1600 to 22159, and 2200 to 0359 local time (morning, day, evening, and night, respectively). During the study period, sunrise always occurred in the morning period and sunset always occurred in the evening period. Maximum dive depth histograms tallied dives into twelve depth bins: 2-10, 10-20, 20-50, 50-100, 100-150, 150-200, 200-250, 250-300, 300-350, 350-400, 400-500, and greater than 500 m.

Data Processing Description

BCO-DMO made the following modifications to the dataset:
- Changed parameter names to conform to BCO-DMO conventions;
- Replaced blanks with 'nd';
- Separated original date/time column into separate date and time columns;
- Transposed columns to rows for each of the depth bins.

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Data Files

File
seal_diving_depth.csv (Comma Separated Values (.csv), 1.17 MB) MD5:def905bd0f1197d51f586c664db7f8ca Primary data file for dataset ID 3804

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Parameters

Parameter	Description	Units
seal_id	Unique seal identification.	unitless
pttno	PTT tag number.	unitless
inst	Name of the instrument. MK10 = Wildlife Computers MK10 TDR tag.	unitless
date	Date (local time).	mm/dd/yy
time	Local time, 24-hour clock. The tags summarized the diving data of each animal into four 6-hour time periods.	HHMM
lat	Latitude, in decimal degrees. Positive = North.	decimal degrees

lon	Longitude, in decimal degrees. Positive = East.	decimal degrees
num_bins	Number of bins (depth ranges) which the data falls in.	integer
total_num_dives	Total number of dives recorded during the time period.	integer
depth	Depth range, in meters. 10 = 0-10 m, 20 = 10-20 m, 50 = 20-50 m, 100 = 50-100 m, 150 = 100-150 m, 200 = 150-200 m, 250 = 200-250 m, 300 = 250-300 m, 350 = 300-350 m, 400 = 350-400 m, 500 = 400-500 m, gt_500 = greater than 500 m.	meters
num_dives	Number of dives to the specified depth range during the 6-hour time period.	unitless

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Instruments

Dataset-specific Instrument Name	Wildlife Computers TDR
Generic Instrument Name	Wildlife Computers Time-Depth Tag (TDR)
Dataset-specific Description	A combined satellite-linked time-depth recorder (TDR) and Fastloc GPS receiver (Wildlife Computers, model MK10AF) was epoxied to each animal's pelage on the dorsal midline.
Generic Instrument Description	Time depth recorders (TDR's) manufactured by Wildlife Computers, Redmond WA) are designed for studies of seals, penguins, fish, and marine mammals. Standard TDR's are mounted externally on the animal's body, where they record temperature and depth. See more information from the manufacturer.

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Deployments

Seal_Captures

Website	https://www.bco-dmo.org/deployment/58849
Platform	shoreside San_Juan_Islands
Start Date	2007-04-04
End Date	2009-08-03
Description	Locations of seal captures and tagging for the project 'Responses of Seals and Sea Lions to Increased Rockfish Density' (PI: Alejandro Acevedo-Gutiérrez) In 2007 - 2008, seals were captured in Padilla Bay (approx. 48.5165, -122.5168), Bird/Belle Rocks (approx. 48.4860, -122.7602), and Protection Island (approx. 48.1278, -122.9306). In 2009, seals were captured on Protection Island . References: Thomas, AC; Lance, MM; Jeffries, SJ; Miner, BG; Acevedo-Gutierrez, A. 2011. Harbor seal foraging response to a seasonal resource pulse, spawning Pacific herring. Marine Ecology-Progress Series, v.441. p. 225. DOI: 10.3354/meps09370 Ward, EJ; Levin, PS; Lance, MM; Jeffries, SJ; Acevedo-Gutierrez, A. 2012. Integrating diet and movement data to identify hot spots of predation risk and areas of conservation concern for endangered species. Conservation Letters, v.5, p. 37. DOI: 10.1111/j.1755-263X.2011.00210.x

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Project Information

Responses of Seals and Sea Lions to Increased Rockfish Density (Seal_response_to_prey)

Website: http://biol.wwu.edu/mbel/?page=research

Coverage: Salish Sea, USA and Canada

From NSF proposal:
This project is a collaborative study of the responses of harbor seals and other mammalian predators to changes in prey density in Puget Sound. The general study approach will involve multi-year field estimates to observe the responses of predators to rockfish density in protected areas, candidate marine reserves, and unprotected sites.

The collaborating investigators will estimate 1) rockfish density using visual and mark and recapture techniques; 2) predator abundance using aerials surveys and dedicated land observations; and 3) predator food consumption using scat to describe diet, tagging of harbor seals to describe individual foraging sites, and population-based and individual bioenergetics models to describe consumption of rockfish. The investigators will also take into account confounding factors that might explain predator behavior, such as environmental variables and alternative prey, by creating a GIS database from available information from the area. The different field observations and database estimates are explicitly linked through a common hypothesis and coordinated methodologies, and their results will be integrated into a model describing the impact of predation on rockfish populations. The responses of top predators to changes in prey density and their impact on fish populations of interest are unknown. This study will evaluate the effectiveness of MPAs as fish refugia, offer a framework for the management and conservation of marine resources, and provide an exciting opportunity for students to participate in ecological and conservation research.

Hypotheses:
1) Harbor seals and other pinniped species show aggregative responses to changes in prey density. Hence, their abundance will increase with fish density.

2) Harbor seals and other pinniped species show Type 2 or 3 functional responses to changes in prey density. Thus, their consumption rate of a particular prey type follows an asymptotic or sigmoidal curve relative to the prey's density, respectively.
3) Predation by harbor seals and other pinniped species is sufficiently intense that it impedes recovery of depleted fish populations.

Objectives:
1) Quantify the number of harbor seals and other pinniped species in relation to rockfish density and other environmental (confounding) factors.
2) Estimate the consumption rate of harbor seals and other pinniped species in relation to rockfish density and other prey species.
3) Correlatively estimate the influence of predation by harbor seals and other pinniped species on survivorship and population size of rockfish.

Publications resulting from this NSF award:
Bjorland, R. H., Pearson, S. F, Jeffries, S. J, Lance, M. M., Acevedo- Gutiérrez, A. & Ward, E. J. 2015. Stable isotope mixing models elucidate sex and size effects on the diet of a generalist marine predator. Marine Ecology Progress Series 526: 213-225. DOI: 10.3354/meps11230
Bromaghin, J. F., Lance, M. M., Elliott, E. W., Jeffries, S. J., Acevedo-Gutierrez, A. & Kennish, J. M. 2013. New insights into the diets of harbor seals in the Salish Sea of western North America revealed by quantitative fatty acid signature analysis. Fishery Bulletin 111: 13-26. DOI: 10.7755/FB.111.1.2
Buzzell, B.1, Lance, M. & Acevedo-Gutiérrez, A. 2014. Spatial and temporal variation in river otter (Lontra canadensis) diet and predation on rockfish (Genus Sebastes) in the San Juan Islands, Washington. Aquatic Mammals 40: 150- 161. DOI: 10.1578/AM.40.2.2014.150
Howard, S., Lance, M., Jeffries, S. & Acevedo-Gutierrez, A. 2013. Fish consumption by harbor seals (Phoca vitulina) in the San Juan Islands, WA. Fishery Bulletin 111: 27-41. DOI: 10.7755/FB.111.1.3
Lance, M. M., Chang, W.-Y., Jeffries, S. J., Pearson, S. F. & Acevedo-Gutierrez, A. 2012. Harbor seal diet in northern Puget Sound: implications for the recovery of depressed fish stocks. Marine Ecology Progress Series 464:257-271. DOI:10.3354/meps09880
Luxa, K. & Acevedo-Gutierrez, A. 2013. Food habits of harbor seals (*Phoca vitulina*) in two estuaries in the central Salish Sea. Aquatic Mammals 39: 10- 22. DOI: 10.1578/AM.39.1.2013.10
Peterson, S., Lance, M. M., Jeffries, S. J. & Acevedo-Gutierrez, A. 2012. Long distance movements and disjunct spatial use of harbor seals (*Phoca vitulina*) in the inland waters of the Pacific Northwest. PLoS ONE 7: e39046. DOI: 10.1371/journal.pone.0039046
Thomas, AC; Lance, MM; Jeffries, SJ; Miner, BG; Acevedo-Gutierrez, A. 2011. Harbor seal foraging response to a seasonal resource pulse, spawning Pacific herring. Marine Ecology-Progress Series, v.441. p. 225. DOI: 10.3354/meps09370
Ward, EJ; Levin, PS; Lance, MM; Jeffries, SJ; Acevedo-Gutierrez, A. 2012. Integrating diet and movement data to identify hot spots of predation risk and areas of conservation concern for endangered species. Conservation Letters, v.5, p. 37. DOI: 10.1111/j.1755-263X.2011.00210.x
Wilson, K.2, Lance, M., Jeffries, S. & Acevedo-Gutiérrez, A. 2014. Fine-scale variability in harbor seal foraging behavior. PLoS ONE 9: e92838. DOI: 10.1371/journal.pone.0092838.

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Funding

Funding Source	Award
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