Apr 26th, 4:00 PM - 4:30 PM

Startling Seals to Save Salmon: Assessing effectiveness of an acoustic deterrent with a statistical application of CReSS-SALSA 2D

Laura Bogaard
Oceans Initiative

ALT TEXT for Laura Bogaard's Poster, Titled: " Startling Seals to Save Salmon: Assessing the effectiveness of an acoustic deterrent with a statistical application of CReSS-SALSA 2D"

Introduction and background: (No photos)
The aim of this study is to use Targeted Acoustic Startle Technology (TAST) to deter harbor seals (Phoca vitulina) from preying on endangered Chinook salmon (Oncorhynchus tsawytscha) near the fish ladder of the Ballard Locks in Seattle, Washington, and ultimately to increase the survival of in-migrating salmon as they return to their spawning habitat. Response variables were fish count passing through the ladder, seal distance to the device, predation rate, and spatial occurrence probability. This analysis investigated the final response variable using a species distribution modelling technique, Complex regional Spatial Smoother (CReSS), with automated knot selection using a spatially adaptive localized smoothing Algorithm (SALSA).

Methods: (No Photos)

1. Collect data from platform (ignoring detectability)
2. Continuously scan study area in 30-minute periods, recording behavior, distance and angle to each sighting
3. Clean data and format to binary presence-absence datum over a grid
4. Set initial GLM model with all candidate covariates
5. Assess for covariate collinearity
6. Check for correlated model residuals (runs test)
7. Test for temporal correlation with day and hour
8. Run SALSA 1D and save best model
9. Take best 1D model and add spatial component with SALSA 2D
10. If there is residual correlation fit the model with a blocking structure
11. Fit GEE with and without interaction effect
12. Diagnostics and model selection
13. Predict to a spatial grid of the study area
14. Estimate uncertainty using boot-strap resamples of predictions.

TAST: (Photo of TAST control pod, with underwater speakers and cables)
TAST is a non-lethal deterrent that can deter food-motivated seals up to 30-40m. TAST is target specific, has fewer environmental side effects, and is less likely to lead to habituation compared to traditional acoustic deterrent devices. How does it work? Activates startle reflex in seal's brain, produces a frequency that is sensitive to the seal, and operates at low duty cycle with signals emitted at random

Ballard Locks, Washington State, USA:
Satellite photo of the study area depicting the Ballard Locks overlaid with a rectangle divided into six observation sections.

Results:

Model generated predictions for spatial occurrence probability within the study area for both treatment conditions. The model predicted that when the TAST is off, seals have up to a 46% chance of surfacing within 50m of the TAST, and when the device is on the maximum occurrence probability falls to 32%.
The figure shows two side by side panels with two heat maps of the rectangular study area. The intensity of the heat map corresponds with the probability that a seal will occur in each grid square. The TAST OFF panel has a higher concentration of maximum occurrence probability within 50 m of the device, when compared to the TAST ON panel.

Takeaways: Photo: Close up of a seal swimming upside-down with a salmon in its mouth.
The model predicted that overall, seal presence probability (number of seals) did not change as a result of the TAST, but rather the spatial distribution of seals seen in the study area was shifted further from the TAST and was more spread out when the TAST was on.
Unpublished, additional modelling from the project suggested that the TAST facilitated more salmon passing through the locks, a significant decrease in predation rate, and a significant increase in observed distance.

Acknowledgements: Field Support: Asila Bergman, Andrea Mendez-Bye, Amina Cesario, Erin Ashe; Site access: Army Corps of Engineers; Financial support: Puget Sound Partnership; Equipment: GenusWave, Oceans Initiative; Professional support: Thomas Gotz, Marena Salerno-Collins, Long live the Kings; perspective: Muckleshoot Indian Tribe, WDFW

References:

Götz, T., & Janik, V. M. (2013). *Marine Ecology Progress Series*, *492*, 285–302.

Götz, T., & Janik, V. M. (2015). *Animal Conservation*, *18*(1), 102–111.

Götz, T., & Janik, V. M. (2016). *Animal Conservation*, *19*(3), 212–221.

Schakner, Z. A., & Blumstein, D. T. (2013). *Biological Conservation*, *167*, 380–389.

Scott-Hayward LAS, Oedekoven CS, Mackenzie ML, Walker CG, Rexstad E (2013). University of St. Andrews. Contract with Marine Scotland: SB9 (CR/2012/05)

Walker, C. G., Mackenzie, M. L., Donovan, C. R., & O'Sullivan, M. J. (2011). *Journal of Statistical Computation and Simulation*, *81*(2), 179–191.