Presentation Abstracts

Module 5: Thursday, September 3rd | 9:00 am – 1:00 pm

West Coast Entanglement Science Workshop, August – September 2020

https://www.opc.ca.gov/west-coast-entanglement-science-workshop/

Session: Understanding and framing risk and tradeoff decisions

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Assessing humpback whale entanglement risk off California and Oregon

Jessica V. Redfern, Samuel M. Woodman, Jameal Samhouri, Blake Feist, Lauren Saez, Dan Lawson, Karin A. Forney

Presenter: Karin A. Forney, Marine Mammal & Turtle Division, Southwest Fisheries Science Center, NOAA

The increase in humpback whale entanglements off the U.S. West Coast beginning in 2014 is a management concern because these foraging whales belong to breeding populations off Mexico and Central America that are listed as threatened and endangered, respectively, under the U.S. Endangered Species Act. Understanding potential causes and the effectiveness of management measures is crucial for reducing entanglement risk in the future. In our study, we use data on fishing effort derived from PacFIN-informed Vessel Monitoring System (VMS) data and dynamic whale distribution models (see presentation by Forney et al.) to estimate the risk of entanglement for humpbacks along the U.S. West Coast from 2009 – 2019. We use historical entanglement observations to validate our risk measure. Our analyses show that the periods of greatest estimated risk during 2014-2016 correspond well to the periods of increased observed entanglements. Based on this concordance, we further assess entanglement risk during those years under various hypothetical management scenarios. Specifically, we assessed whether delayed opening and early closures could have reduced the risk of entanglements. While both options reduced risk, our analyses highlight the importance of understanding and managing how fishing effort is redistributed when delayed openings occur. Our analyses also suggest that optimal management solutions are likely to be region specific.

Chasing the moving target of sustainability: understanding tradeoffs between fisheries and conservation goals in a changing ocean

Jameal Samhouri, Briana Abrahms, Blake Feist, Mary Fisher, Karin Forney, Elliott Hazen, Dan Lawson, Owen Liu, Jessica Redfern, Lauren Saez, Sam Woodman

Environmental variability and climate change are twin challenges for achieving conservation goals and sustainable management of natural resources. The role of heatwaves in the ocean have come to light recently as a major type of environmental disturbance, yet their ramifications for social and ecological processes are not well understood. In this study we examine how a marine heatwave (MHW) in the Northeast Pacific affected tradeoffs between conservation goals for two of the region's most iconic species-- blue and humpback whales-- and sustainability goals for one of the US West Coast's most valuable fisheries-- the Dungeness crab fishery. We conducted a retrospective analysis of relative risk of entanglement in fishing gear for blue and humpback whales and relative revenue to the California Dungeness crab fishery from 2009-19 under both status quo management and a broad set of hypothetical, alternative management scenarios. Combining several state-of-the-art models and data sets on whale distributions and fishing vessel movements (fish ticket-informed Vessel Monitoring System data), we found that on average, the MHW period during 2014-18 saw a 20% increase in revenue to the fishery but a doubling or tripling of risk to blue and humpback whales, respectively, compared to 2009-14 and 2018-19.

We use spatial analysis to ask whether delayed openings, early closures, depth restrictions, and fishing effort reduction could have mitigated risk of entanglement while protecting fishing revenues over this same ten-year time period. Examination of these alternative management scenarios shows that the tradeoffs between whale risk and fishery revenue grew more stark during the MHW, with anticipated conservation benefits of management interventions increasing but the expected costs to the fishery escalating even moreso. On average, the expected reduction in risk to whales increased by as much as 20% during the MHW period, but the expected decline in revenue to the crab fishery more than tripled in some cases. The tradeoff analysis framework we present here provides a transparent approach for evaluating the effectiveness of management interventions designed to improve the lofty aims of fisheries sustainability while meeting mandates for the conservation of individual species. It also emphasizes that one-size-does-not-fit-all time periods, regions, species, or elements of a fishery, underscoring the importance of multicriteria decision approaches to navigating these uncharted waters. More generally this case study highlights how conservation concerns and tradeoffs with extractive uses can be exacerbated by extreme climate events and suggests that management solutions that balance across multiple objectives must be robust to environmental variability.

An MSE-based approach for identifying strategies that maximize catch while minimizing whale entanglements and toxin contamination in the California Dungeness crab fishery

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The California Dungeness crab fishery has suffered several recent shutdowns due to (1) the contamination of crabs with toxins produced by harmful algal blooms (HABs) and (2) the entanglement of whales in crab fishing gear. We developed a management strategy evaluation (MSE) model to simulate these dual threats and measure the ability for current and alternative management strategies to maximize catch while minimizing whale entanglements and the public health risk posed by toxin contamination. Our retrospective model simulates management over the whale and toxin dynamics of the 2014/15 to 2018/19 fishing seasons (5 seasons) using predictions of historical humpback whale distributions (Forney et al. in prep) and historical toxin contamination (Free et al. in review). We evaluate both static and dynamic management strategies for minimizing whale entanglements. The static strategies include (1) immediate state-wide gear reductions and (2) fixed closures based on historical migration patterns. The dynamic strategies employ various management actions (i.e., zonal closures or gear reductions) in response to different management triggers (i.e., an observed entanglement or the results of a whale abundance survey). We evaluate the robustness of these strategies under multiple procedures for managing the public health risk of domoic acid contamination (i.e., management actions based on current vs. expanded domoic acid sampling programs). Our preliminary results indicate that immediate gear reductions maximize catch while reducing entanglements to levels similar to or lower than zonal closures across all domoic acid management scenarios. Zonal closures result in more entanglements than expected because they displace fishing effort elsewhere and concentrate overlap between whales and fishing gear. Mid-season gear reductions (i.e., in response to a trigger) are ineffective, because they are generally triggered after effort in this derby fishery has already been greatly reduced.

Development of a software tool for testing management scenarios and quantifying entanglement risk to North Atlantic Right Whales in the American lobster fishery.

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Over the past year, staff at the Northeast Fisheries Science Center and Greater Atlantic Regional Fisheries Office have been developing and using a Decision Support Tool (DST) to approximate the entanglement risk to North Atlantic Right Whales from the American lobster fishery. The DST models entanglement risk as the product of vertical line density, vertical line threat, and whale density at 1Nm and monthly resolution. For a given model run, the users can specify management scenarios that remove or redistribute traps, change trawl configurations, and change numbers and strengths of endlines as well as constrain the spatial domain and fleet examined in the model run with output including estimated decrease in entanglement threat from the management scenario. Trap densities and gear configurations are largely derived from fishery dependent data sources while the spatiotemporal distribution of whales come from aggregated aerial survey data or species distribution models based on survey data.

The third component of risk, “gear threat”, quantifies how entanglement threat varies across different gear configurations, which was desirable to include given the variety of gear configurations present throughout the fishery and the hope of addressing entanglement risk by modifying gear. However, quantifying gear threat is very difficult as entanglements are necessarily complex events, are rarely witnessed, and most observed entanglement injuries and mortalities retain little or none of the original gear, making it difficult to know the what the whale actually encountered. Currently, we are quantifying gear threat on a relative scale based solely on rope breaking strength as there is some literature suggesting that stronger ropes tend to result in more severe entanglements. We built the gear threat model from discrepancy between the observed and expected distribution of rope strengths from documented entanglements but can hopefully be improved upon in the future as more data become available.