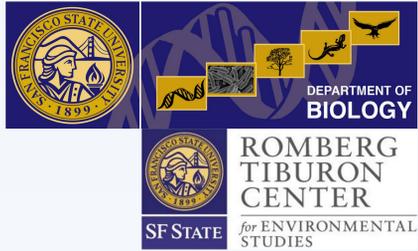


Understanding coastal habitat dynamics by analysis of harbor seal habitat use



Authors: Karen Backe, Ellen Hines, Karina Nielson, Zoe-Statman-Weil, Elinor Twohy
 Romberg Tiburon Center For Environmental Studies, San Francisco State University
 Contact: kbacke@mail.sfsu.edu



Introduction/ Background

Harbor seals (*Phoca vitulina richardii*) are a federally protected marine mammal species widely distributed along the west coast of North America (Lowry 2008). These central place foragers require terrestrial habitat called "haul-outs" within 10km of a foraging site (Grigg 2009). Haul-outs are necessary for activities important to individual and species survival including resting, pupping, and molting. Seals exhibit a moderately high degree of site fidelity inter- and intra-annually (Suryan and Harvey 1997). Haul-out selection is fundamentally limited by slope, aspect, and access to prey (Allen *pers. comm.*, Cordes and Thompson 2013). Within those constraints, harbor seals show flexibility in substrate choice, including rocky reefs, intertidal sandbars, pocket beaches, tidal flats, and estuaries (Lowry 2008).

Estuaries provide a myriad of ecosystem services, including providing critical habitat for juvenile commercially important fish species and supporting biodiverse communities. Estuaries are also directly important to local human communities. Estuaries face a plethora of pressures, including habitat alteration, water quality issues stemming from agricultural and timber industry runoff, development, infrastructure, and flood risk management practices (Merrifield 2011). Increases in sea level rise and storm surge associated with climate change pose unknown alterations to coastlines and coastal habitats (Arkema 2013). As a result of geophysical and ecological constraints on haul-out choice, harbor seal haul-outs are a useful conditional indicator of coastal climate change impacts.

Research Questions

Spatial Scope: Fine-scale case study, comparing two estuaries on the California coast - the Russian River Estuary (Sonoma County) and the Eel River Estuary (Humboldt County)

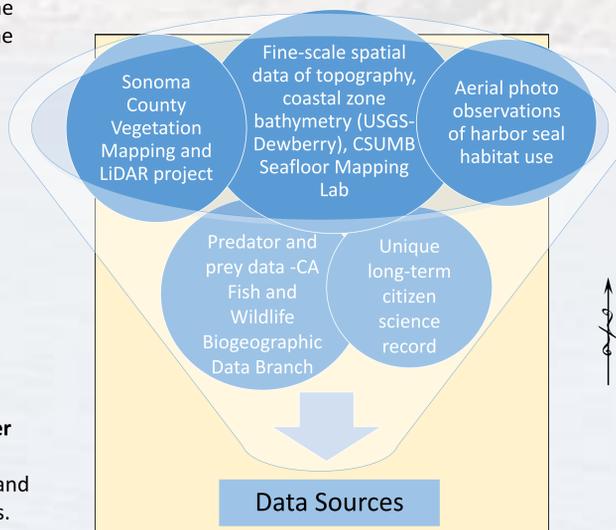
Research Question 1: How will harbor seal habitat on a bar-built estuary physically change due to climate change?

Objectives: Modeling physical habitat changes to coastal habitats given IPCC climate change projections, including:

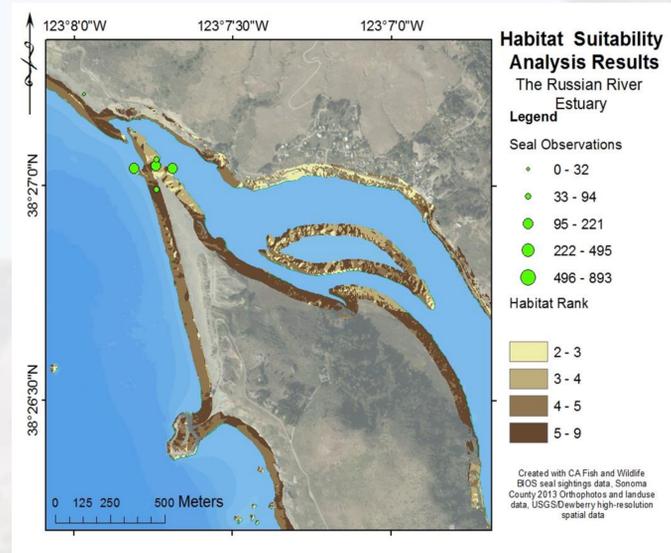
- Sea level rise
- Storm surge (wave model)
- Tidal range
- Rainfall
- Sediment transport, erosion, accretion
- Flood risk management responses

Research Question 2: How will the predicted physical changes alter harbor seal habitat availability and quality?

Objectives: Model physically available harbor seal haul-outs and rank sites based on quality, given the modeled IPCC scenarios. Habitat quality measured by patterns of use (presence/absence) and abundance, relative to habitat size



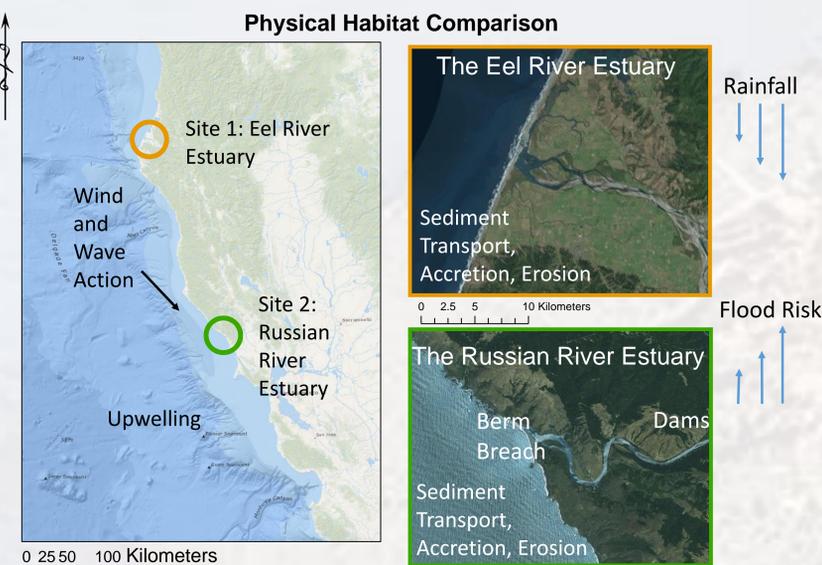
Species Distribution Model



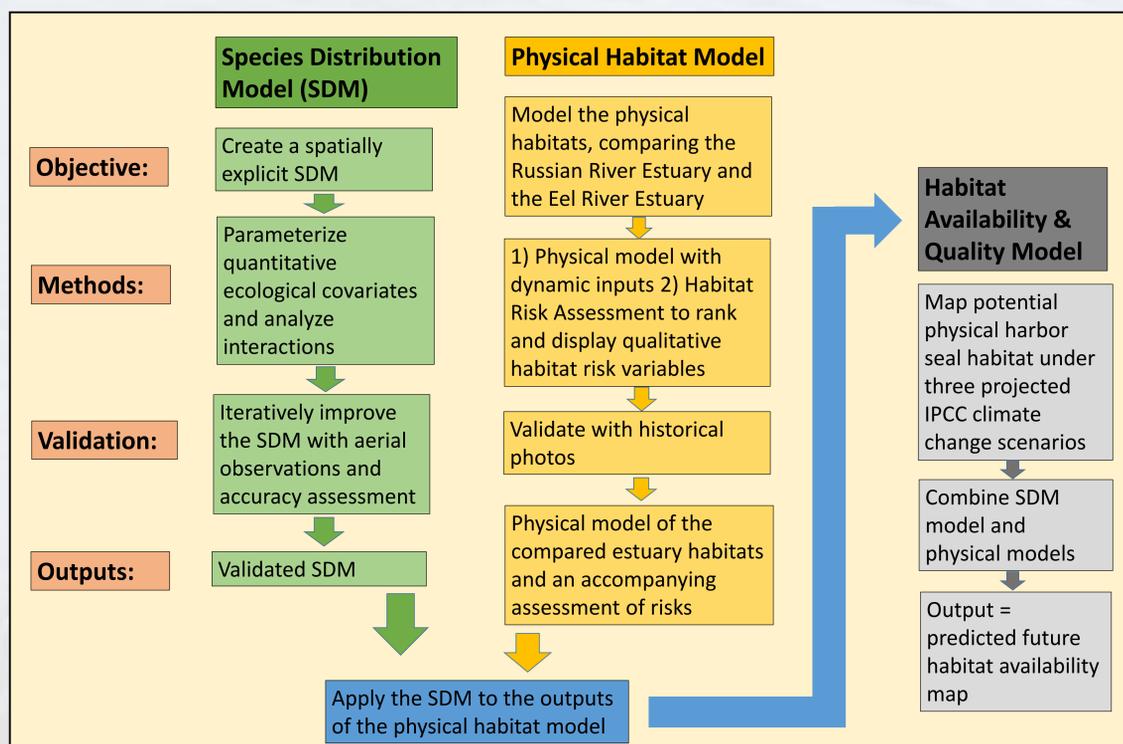
This map shows a piece of the coastline reflecting preliminary results of a geographic information systems (GIS) model. This model weights factors correlated with harbor seal haul-out use, including slope, aspect, and proximity to human disturbance, using values derived from the literature, interviews with experts, and measurements from haul-out photographs.

Physical Habitat Model:

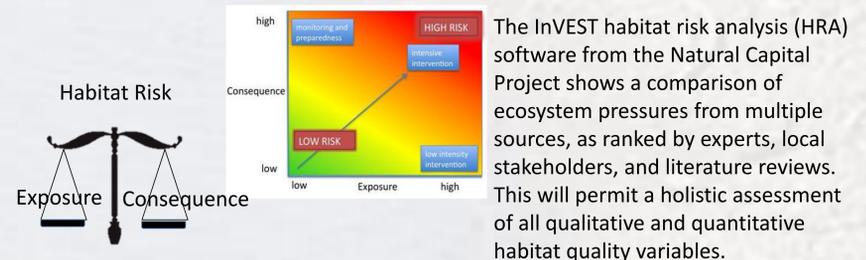
A fine-scale case study of two estuaries on the CA Coast: The Russian River Estuary (Sonoma County) and the Eel River Estuary (Humboldt County). These estuaries are in the same analysis of risk network as described by Merrifield et al, 2011, and have recorded and current populations of harbor seals using terrestrial haul-outs.



Methods



Habitat Risk Analysis



Conclusions

Understanding climate change impacts on coastal habitats can be analyzed by patterns of terrestrial habitat use by harbor seals, a conditional indicator species.

This research has adaptive management applications, by delineating probable areas of future high risk and high quality coastal habitat under climate change scenarios.

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