Improving Descriptions of Critical Habitat for Steller Sea Lions

Andrew W Trites
North Pacific Universities Marine Mammal Research Consortium
What physical or biological features are essential to the conservation of the species?

- Rookeries & Haulouts
- Feeding areas
Rookeries
how big?
> 100 pups?
> 25 pups?

Rookeries
how big?
Haulouts

- Year-round
- Winter
- Summer

>200 SSL
>100 SSL?
Feeding Areas
Summer & Other Seasons
Available Data

- Census Counts
- Telemetry
- Diets – prey
- Physical Enviro.
- Physiology
- Predation
- POP

MODELS
Regional Population Trends

Telemetry
1990s Diet Composition

Physical Environment

Sea surface height

7 cluster result
Available Data

4 Types of MODELS

- Census Counts
- Telemetry
- Diets – prey
- Physical Enviro.
- Physiology
- Predation
- POP
Predictive Environmental Envelope Models

- **Deductive** – based on published information on animal behavior
- **Predictions** – joint probability of accessibility and suitability
- **Incorporates** – oceanographic covariates (e.g., distance from rookery – *accessibility*; ocean depth – *suitability*; etc.)
- **Validation** – POP – presence only used to validate model


Two-Part Hurdle Model

• **Deductive** – based on animal presence & group size (aerial surveys)

• **Predictions** – probability of encountering an animal; expected group sizes; expected numbers

• **Incorporates** – covariates: number of times sampled; distance to different habitat types, etc.

• **Validation** – ?

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Bayesian Spatial Occupancy Model

- **Deductive** – based on telemetry
- **Predictions** – complex Bayesian model that is conditionally autoregressive – accounts for spatial correlation between neighboring cells
- **Incorporates** – oceanographic & fishery covariates (e.g., pollock CPUE, water temperature, primary production, etc.)
- **Validation** – ?

Cox Proportional Hazards Model

- **Deductive** – based on telemetry
- **Predictions** – habitat is defined by the risk of leaving a foraging area; considers time-to-event: first passage time
- **Incorporates** – covariates: oceanographic data (water temp, sea surface height, mixed layer depth, etc.)
- **Validation** – ?

Likelihood curves to translate physical variables into habitat suitability (Pr) for SSL

SD = mean distance travelled during the breeding (17 km) and non-breeding (133 km) seasons (Merrick & Loughlin 1997)
Habitat model
Seasonal predictions vs. critical habitat

Gregr & Trites. 2008. MEPS
Habitat model
Seasonal predictions vs. critical habitat

Non-breeding

Gregg & Trites. 2008. MEPS
Non-breeding Habitat model
Adult Females
Breeding
Model Complexity
Model Validation
POP Data

- No effort
- Boat bias?
- Reliability?
- Males > Females?
Available Data

- Census Counts
- Telemetry
- Diets – prey
- Physical Enviro.
- Physiology
- Predation
- POP
Considerations

• Seasonal habitat?
• Size of rookeries & haulouts to include?

• Weighted by prob of extinction?
• 95%tile protected?
Who is essential for the conservation of the species?

- All animals?
- Juveniles?
- Adult females?
- Bulls?
Adult Females
Going Forward

- Use all available data
- Build alternative models
- Make transparent assumptions
- Be inclusive