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Oil spill preparedness planning: filling critical species data gaps using habitat suitability modelling

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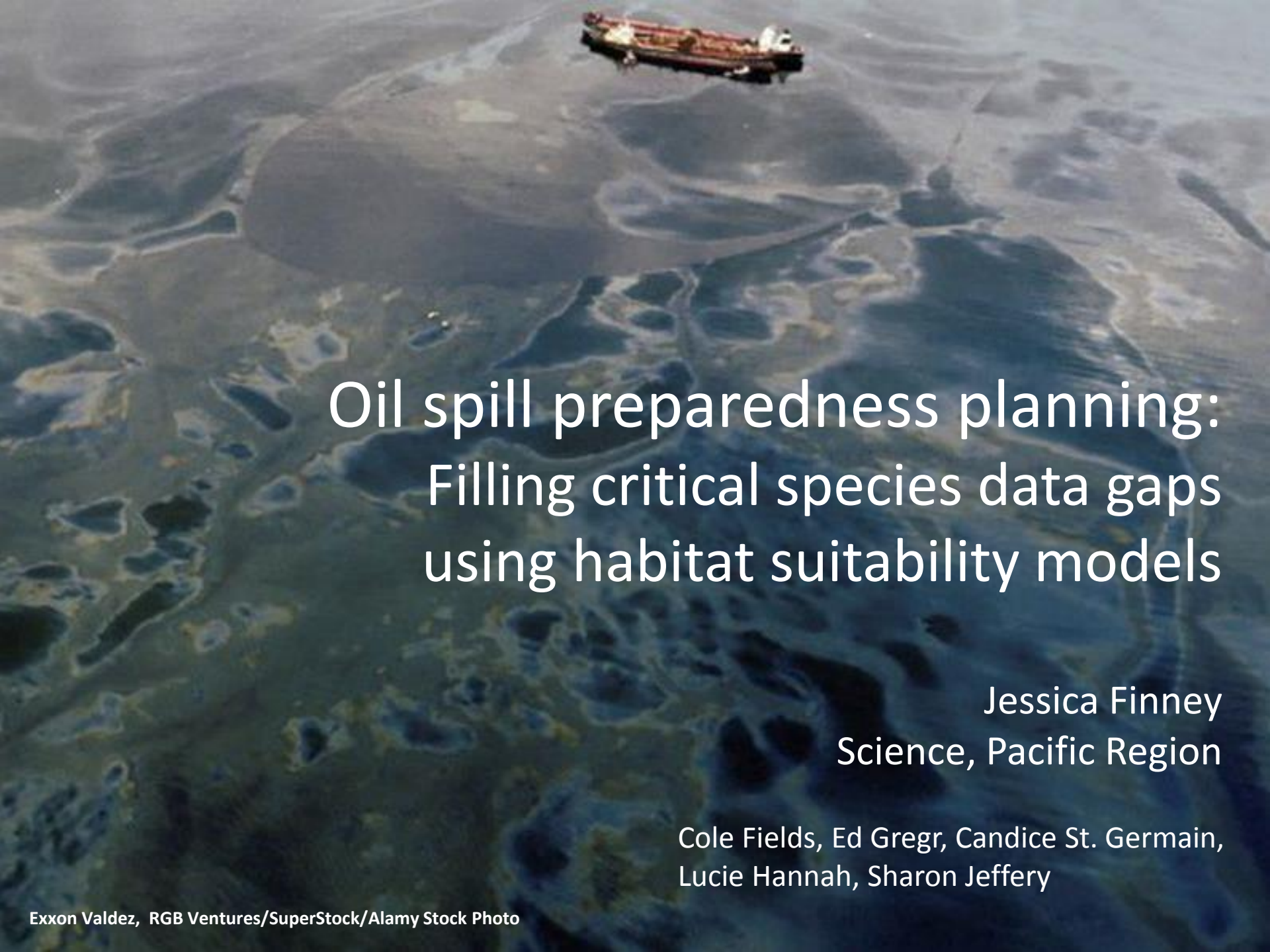
St. Germain, Candice; Finney, Jessica; Fields, Cole; Gregr, Edward; Hannah, Lucie; and Jeffery, Sharon, "Oil spill preparedness planning: filling critical species data gaps using habitat suitability modelling" (2018). *Salish Sea Ecosystem Conference*. 419.

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Speaker

Candice St. Germain, Jessica Finney, Cole Fields, Edward Gregr, Lucie Hannah, and Sharon Jeffery

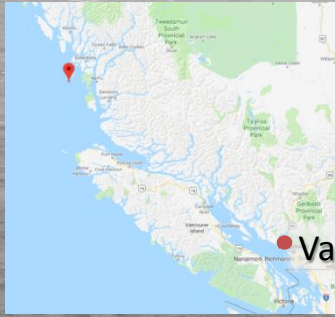
An aerial photograph showing a large-scale oil spill in the ocean. The spill is visible as a complex, multi-colored pattern of dark blue, brown, and yellowish-green patches, indicating different concentrations and types of oil. A large oil tanker ship is visible at the top center of the image, likely the source of the spill. The text is overlaid on the lower half of the image.

Oil spill preparedness planning: Filling critical species data gaps using habitat suitability models

Jessica Finney
Science, Pacific Region

Cole Fields, Ed Gregr, Candice St. Germain,
Lucie Hannah, Sharon Jeffery

Emergency Response: Stranded fuel barge in the Central Coast



Vancouver



B.C. Spill Response
@SpillsInfoBC

Following

#JakeShearer fuel barge anchored 25 nautical miles SW of #BellaBellaBC near Goose Island. @SpillsInfoBC response officers staged to deploy. Incident details: ow.ly/CP6530gPnKS

Canadian Coast Guard @CCG_GCC

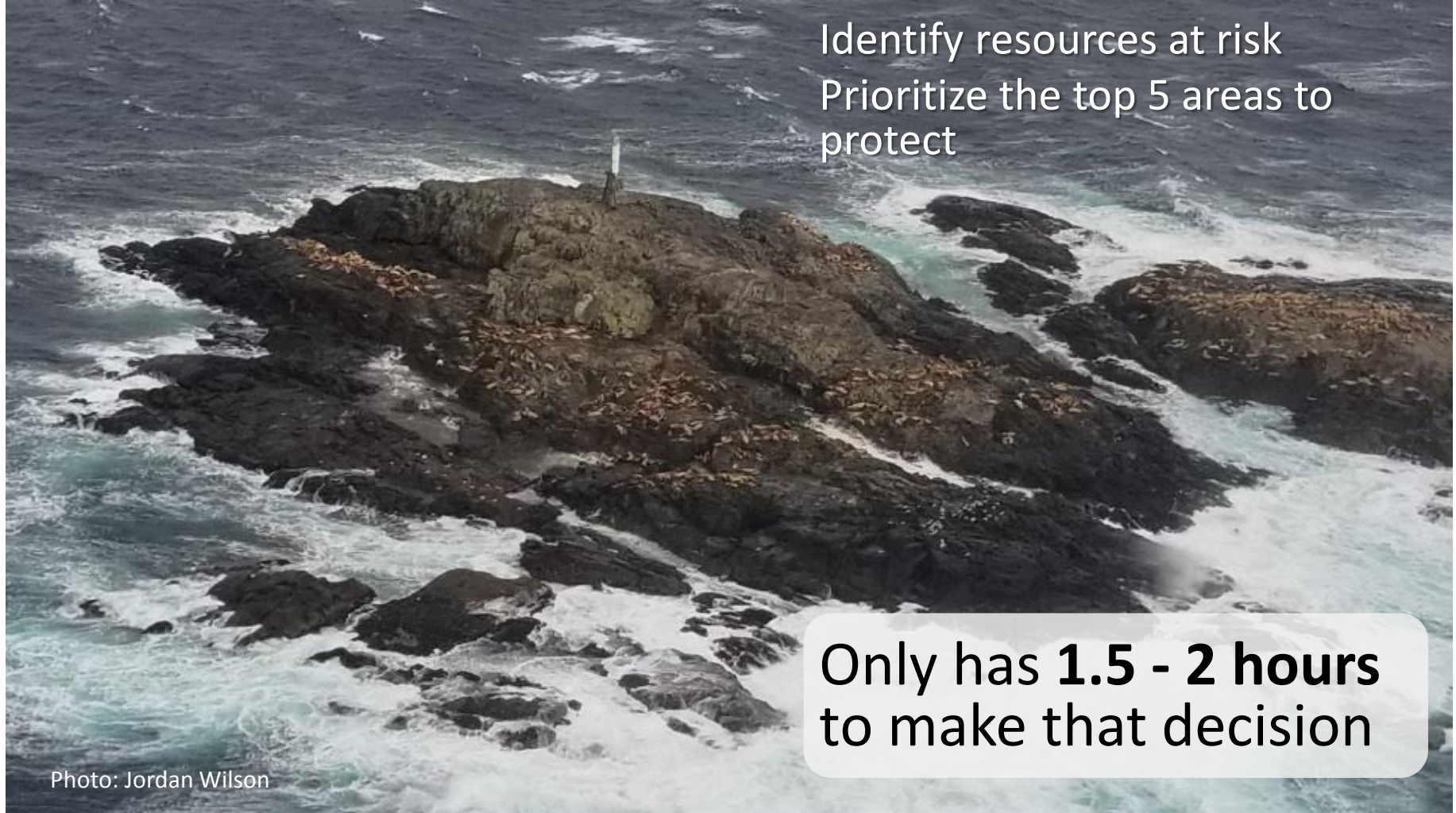
CCGS Gordon Reid is on scene responding with #partners to an incident involving a barge Jake Shearer that became separated from its tug south of Goose Island in Queen Charlotte Sound #BC. @SpillsInfoBC @VicJRCC_CCCOS

10:02 PM - 26 Nov 2017

Photo: Jordan Wilson



Emergency Response: Stranded fuel barge in the Central Coast



Identify resources at risk
Prioritize the top 5 areas to protect

Only has **1.5 - 2 hours** to make that decision

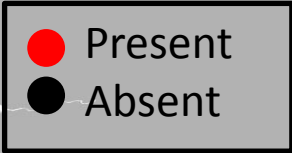
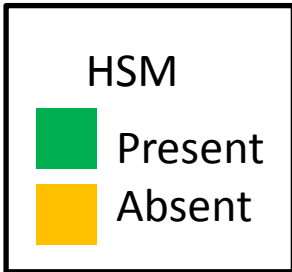
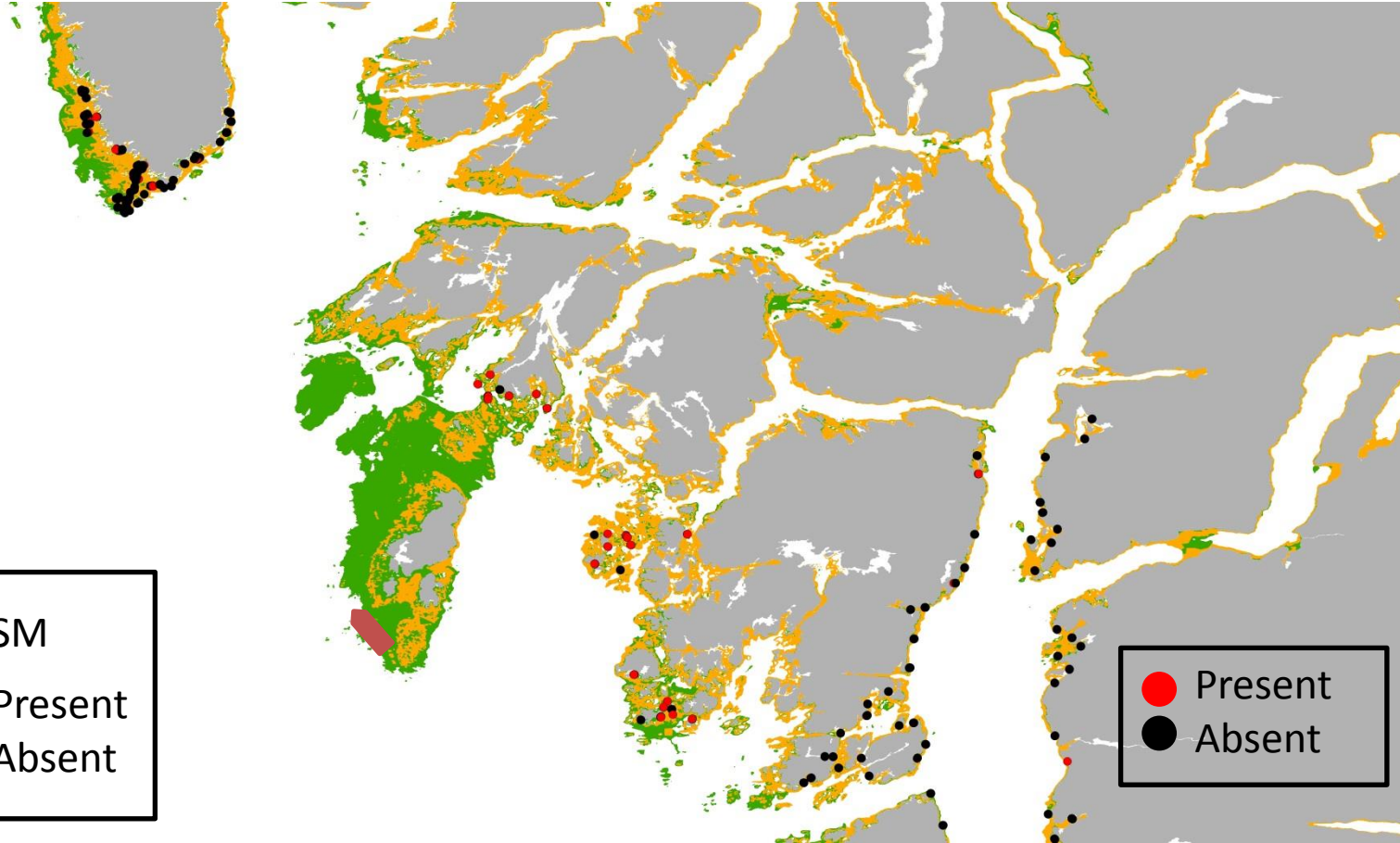
Photo: Jordan Wilson



Emergency Response: Stranded fuel barge in the Central Coast



Emergency Response: Stranded fuel barge in the Central Coast



Emergency Response: Stranded fuel barge in the Central Coast

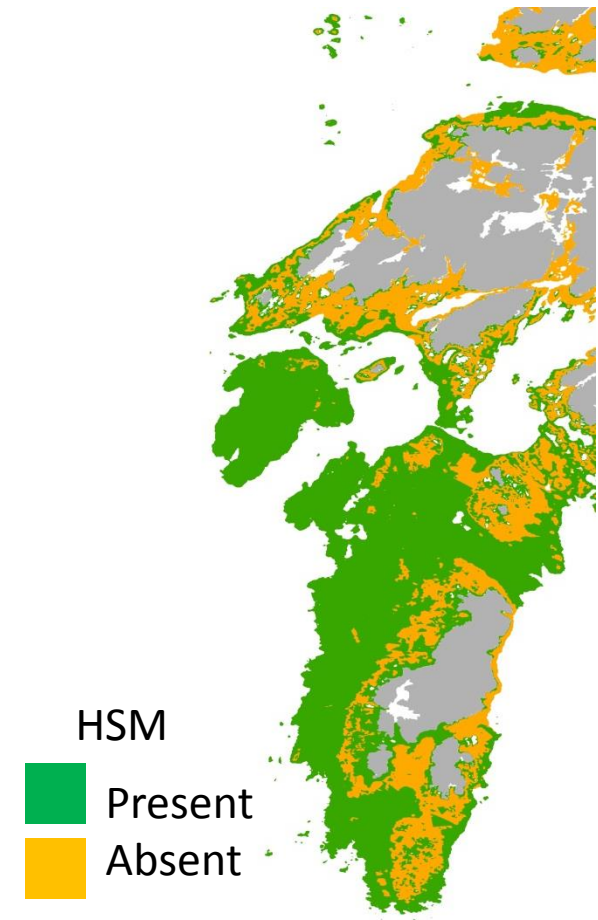


Photo: Jordan Wilson



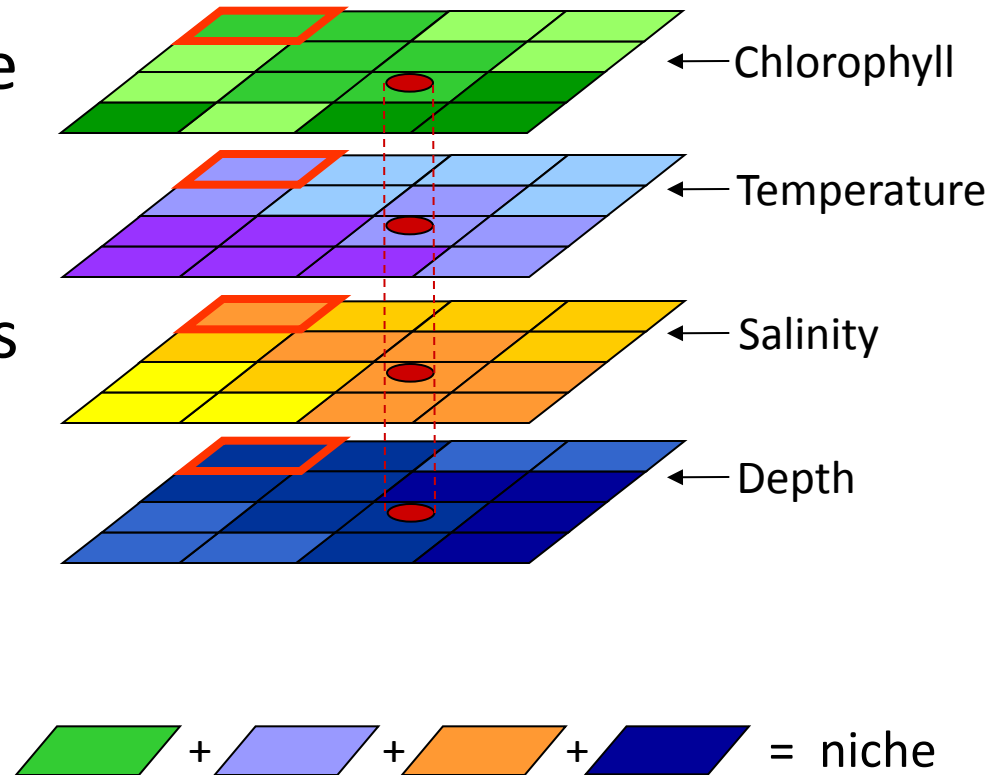
Outline

- Habitat Suitability Models
- Habitat Modelling Workbook
 - Environmental and species data
 - Modelling algorithms
 - Model evaluation
 - Interpretation and application of results
- Summary



Habitat suitability models

- Use algorithms to relate species data to background environmental variables
- Create maps predicting suitable habitat and/or abundance



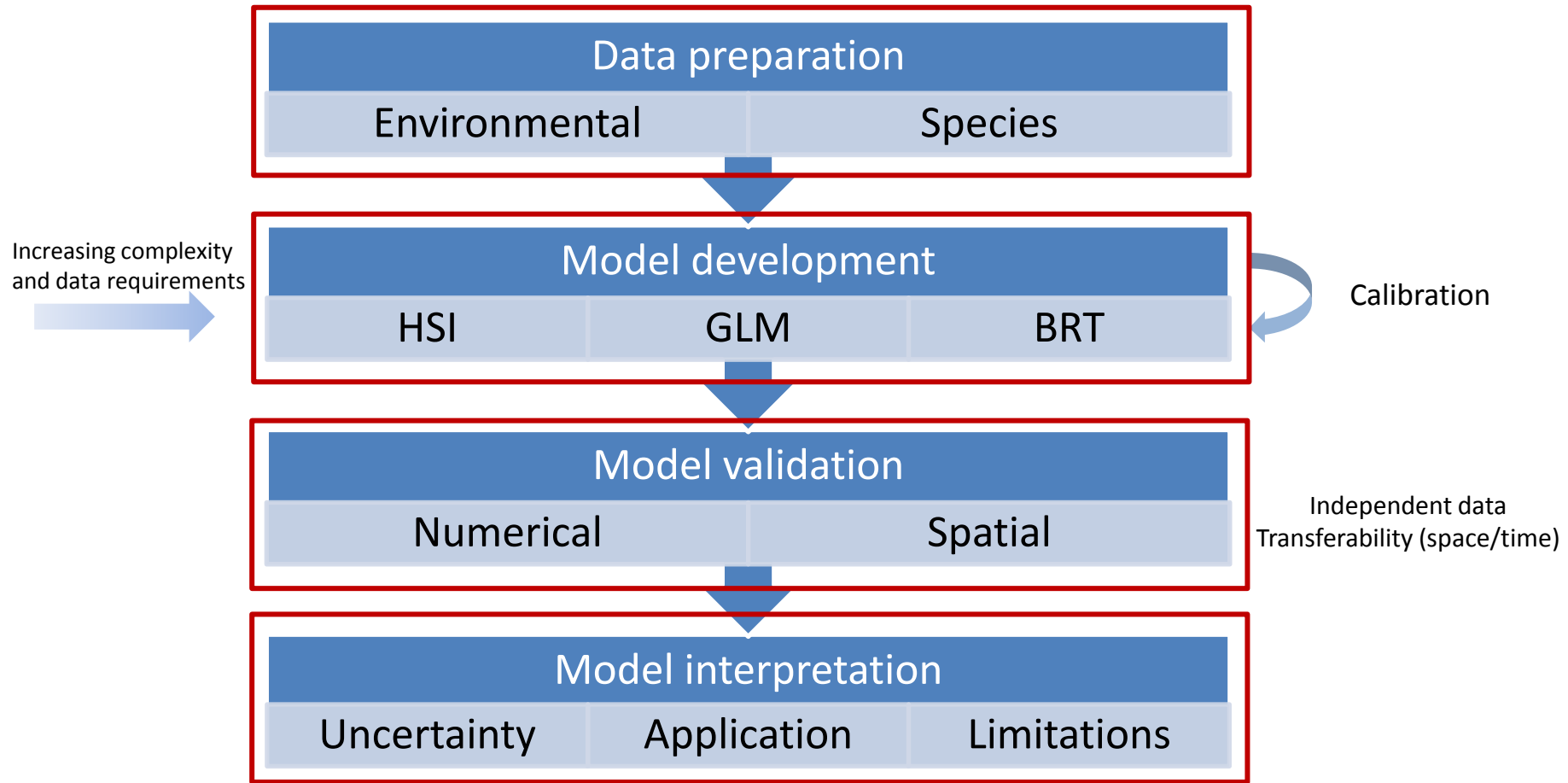
Habitat Modelling Workbook

Intent:

- Fill critical species data gaps
- Support the use of best practices
- Support consistent development and validation



Habitat Modelling Workbook



Habitat modelling workbook:

Data preparation

- Environmental data
 - Spatial resolution
 - Temporal resolution
 - Relevance to species
- Species data
 - Presence only vs. presence/absence
 - Prevalence
 - Number of records
 - Bias – spatial, temporal, sampling, etc.



Habitat modelling workbook:

Environmental data

Bathymetric derivatives

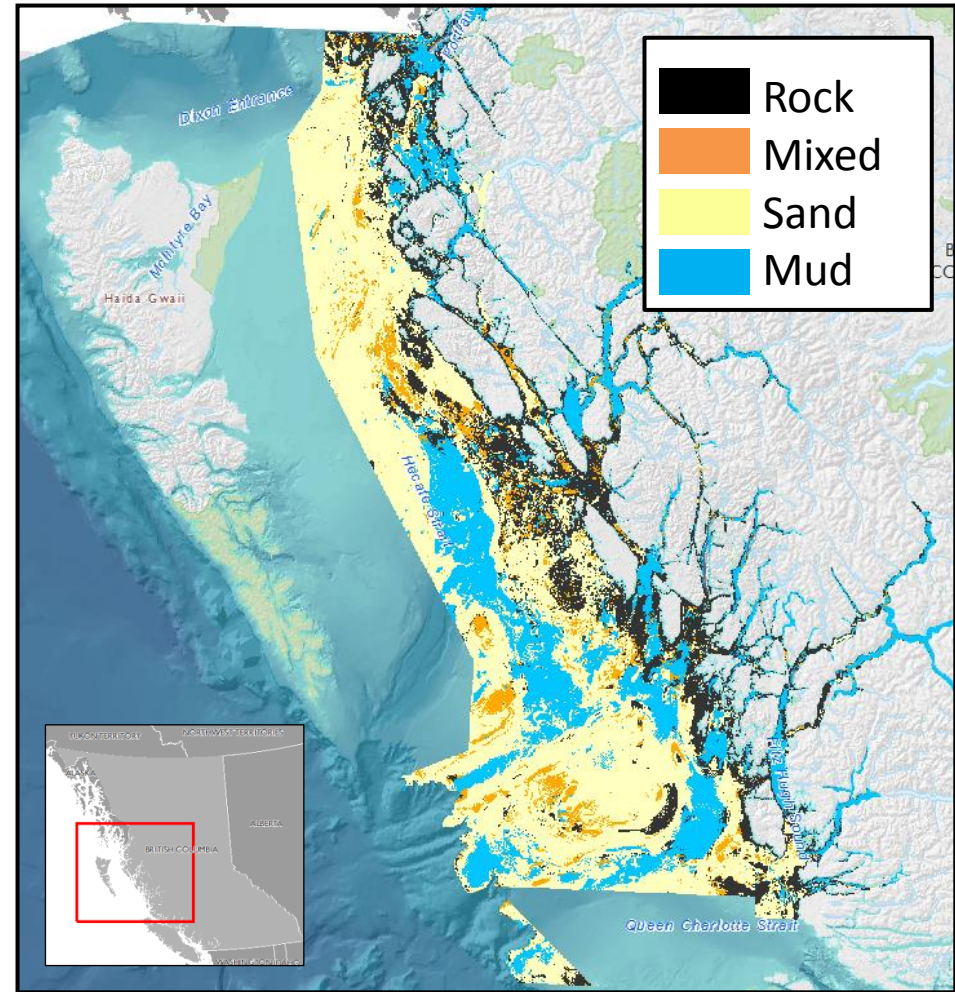
- Bottom type/bottom patches
- Depth
- BPI
- Slope

Ocean circulation derivatives

- Tidal velocity
 - Temperature
 - Salinity
 - Current speed
- } Seasonal values

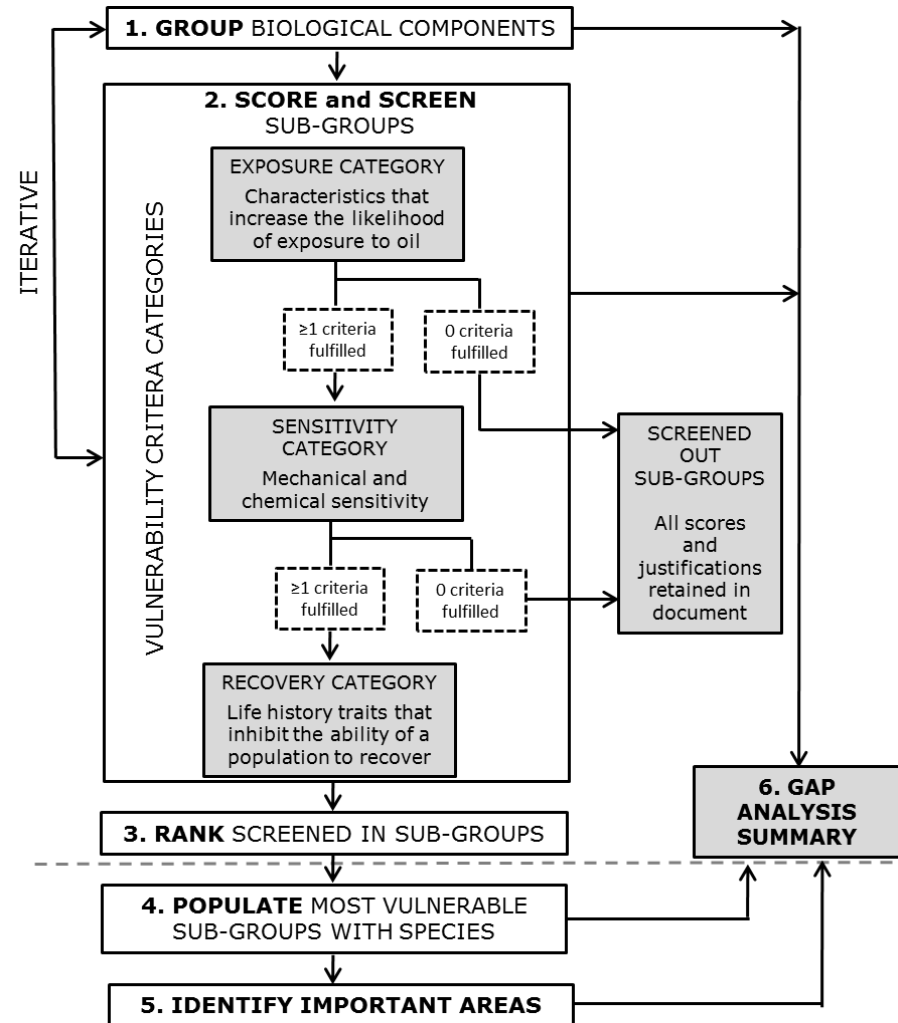
Remote sensing derivatives

- Chlorophyll *a* conc.



Habitat modelling workbook: Species data – Oil vulnerability framework

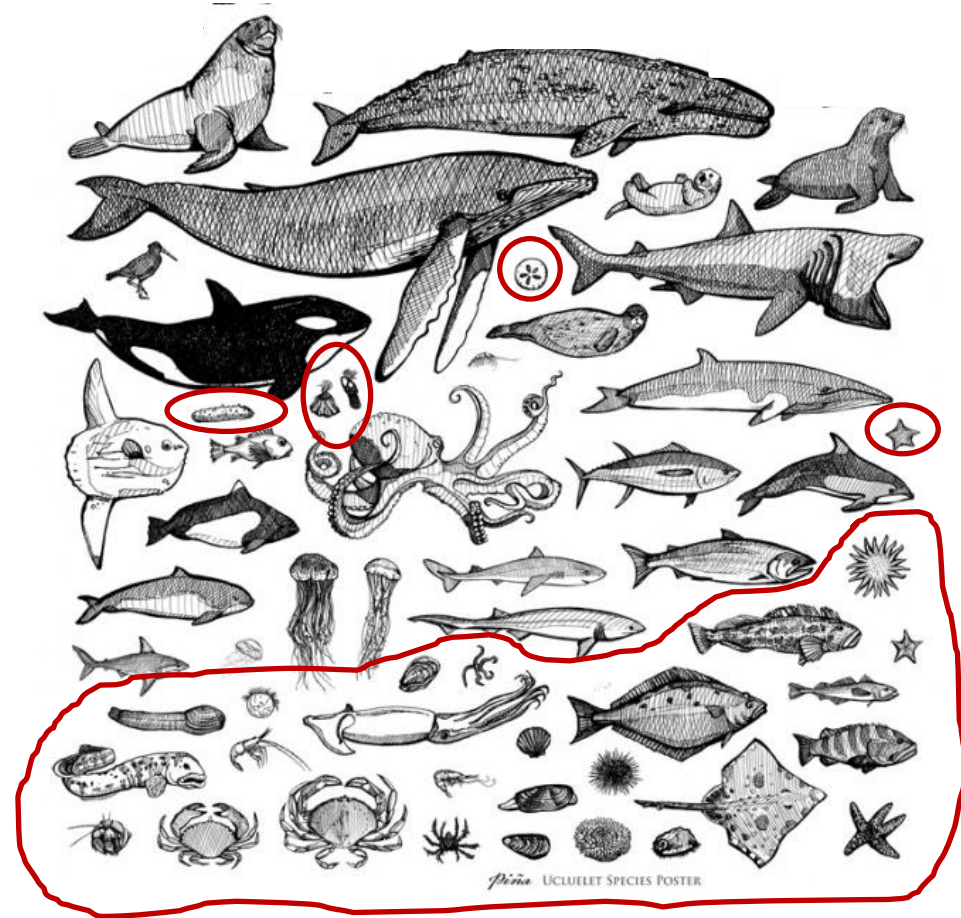
- National framework to identify marine organisms **most vulnerable** to ship-source oil spills (2015)
- Framework applied in Pacific Region (2016-17)
- Adapted frameworks applied in Quebec and Maritimes Regions (2016-17)



Habitat modelling workbook:

Species data

- Benthic species
- Species listed in:
 - Species vulnerable to oil
 - Conservation priorities for MPAs



Habitat modelling workbook:

Species data

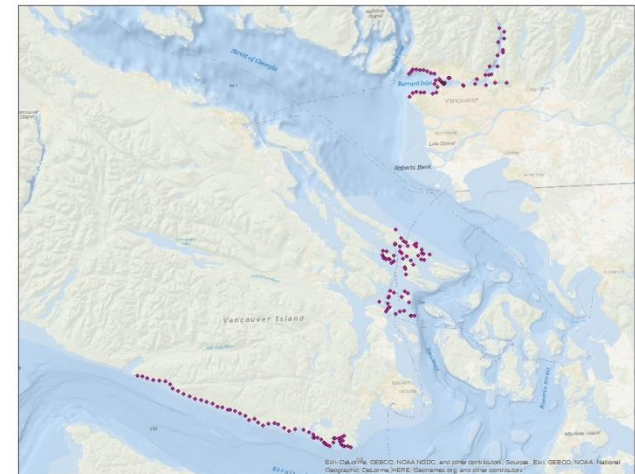
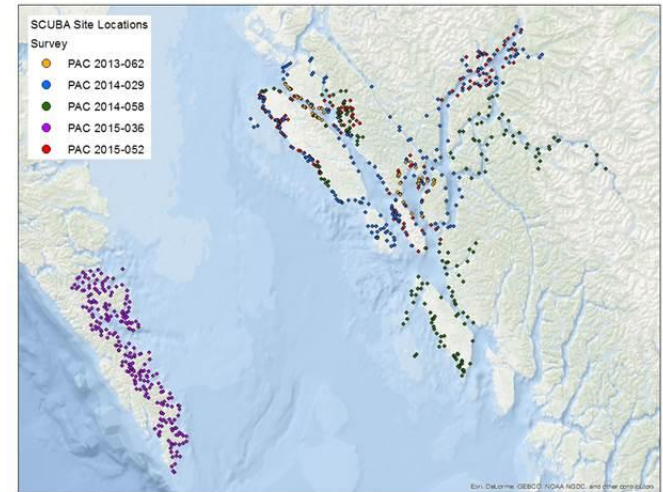
- 12 initial species
- Represent a diversity of:
 - Life history characteristics
 - Habitats
 - Data availability



Habitat modelling workbook:

Species data – Benthic habitat mapping dive surveys

- About 920 transects since 2013
- Record presence/absence of:
 - 102 invertebrate species
 - 61 algae species



Habitat modelling workbook:

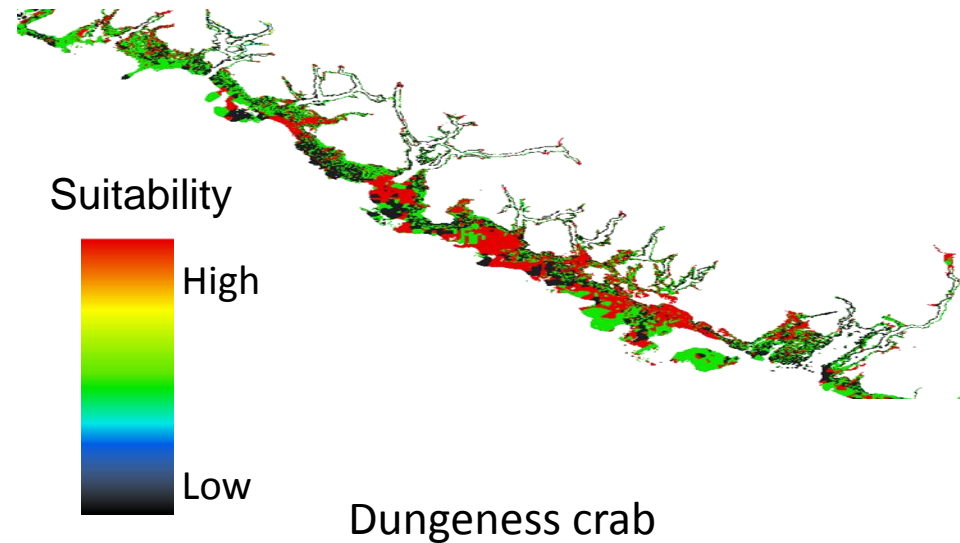
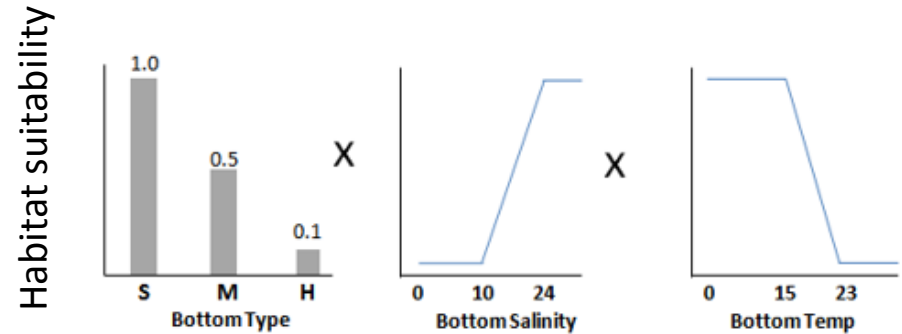
Model development

- Tiered approach to modelling
- Three models with increasing complexity and data requirements
- You don't always need a Cadillac, sometimes an old Civic will do



Habitat modelling workbook: Model development – HSI

- Habitat Suitability Index (HSI)
 - Based on hypothesised species-habitat relationships
 - Low complexity
 - Low data requirements



Habitat modelling workbook:

Model development – GLM and BRT

- Generalized Linear Models (GLMs)
 - Regression-based method
 - “Medium” complexity
- Boosted Regression Trees (BRTs)
 - Tree-based machine learning method
 - “High” complexity



Habitat modelling workbook:

Model interpretation

- Calibration
 - During model building
 - Based on variance explained
- Validation
 - Testing completed model
 - How well the model meets study objectives
- Key transferability assumptions:
 - Stationarity
 - Representativity



Conducting consistent analyses: **Habitat Modelling Workbook**

- Interpretation of results
- Representing uncertainty
- Application of results



Summary

- HSMs help fill in data gaps
- Outputs:
 - Habitat suitability maps for 12 species
 - Habitat suitability modelling workbook
 - Code to facilitate model building
 - Environmental and species data layers



Summary

- Provides consistency in approach Regionally
- Provides a framework to model species distributions for a range of data situations
- Guidance on how to describe uncertainty



Summary

- This process will highlight additional gaps in knowledge
- Applications beyond oil spill response
 - Marine spatial planning, e.g., MPAs, EBSAs
 - Fisheries management
 - Risk assessments
 - Species at risk



Questions



Photo: Jordan Wilson

