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

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Speaker
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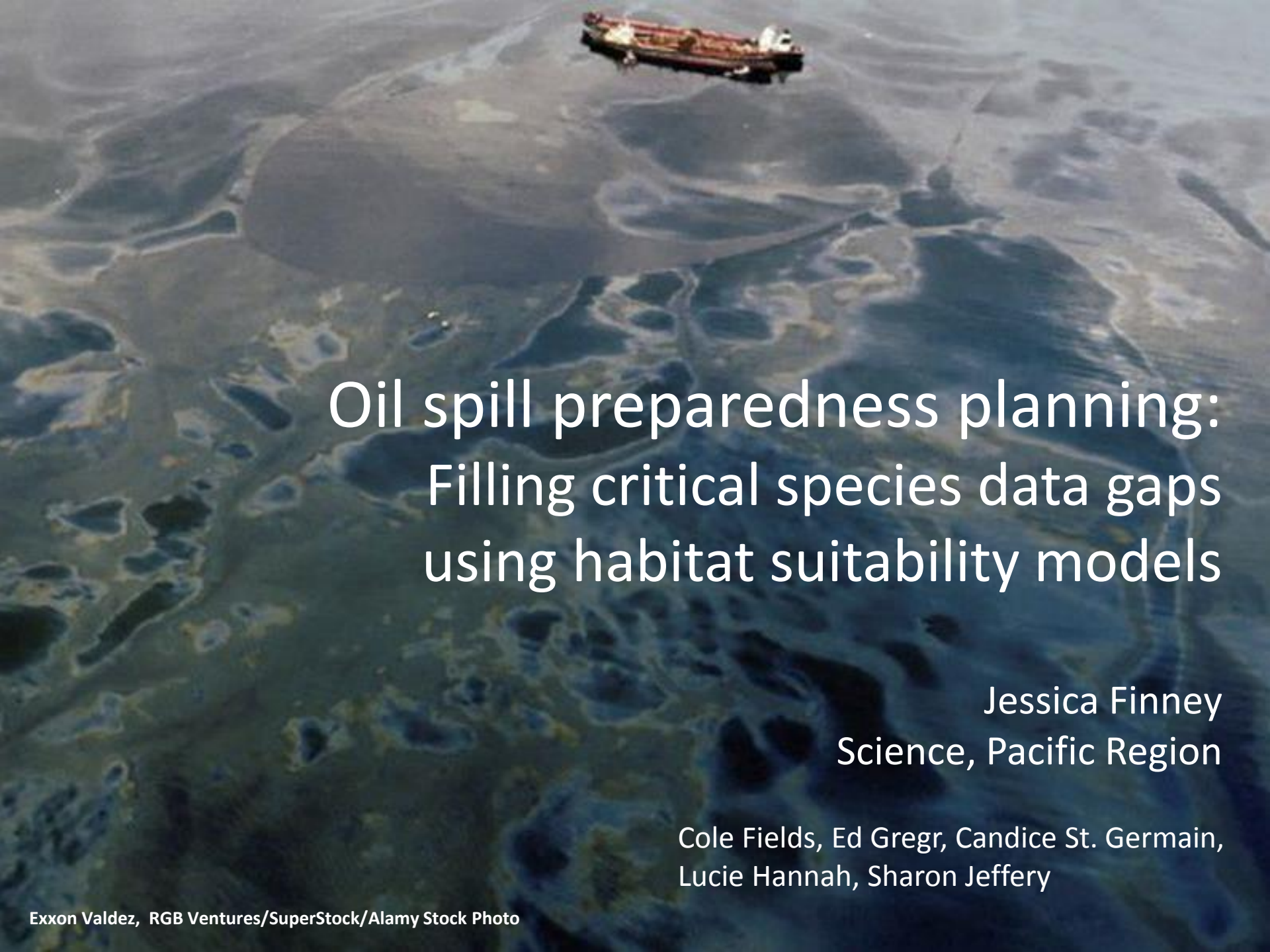

Oil spill preparedness planning: Filling critical species data gaps using habitat suitability models

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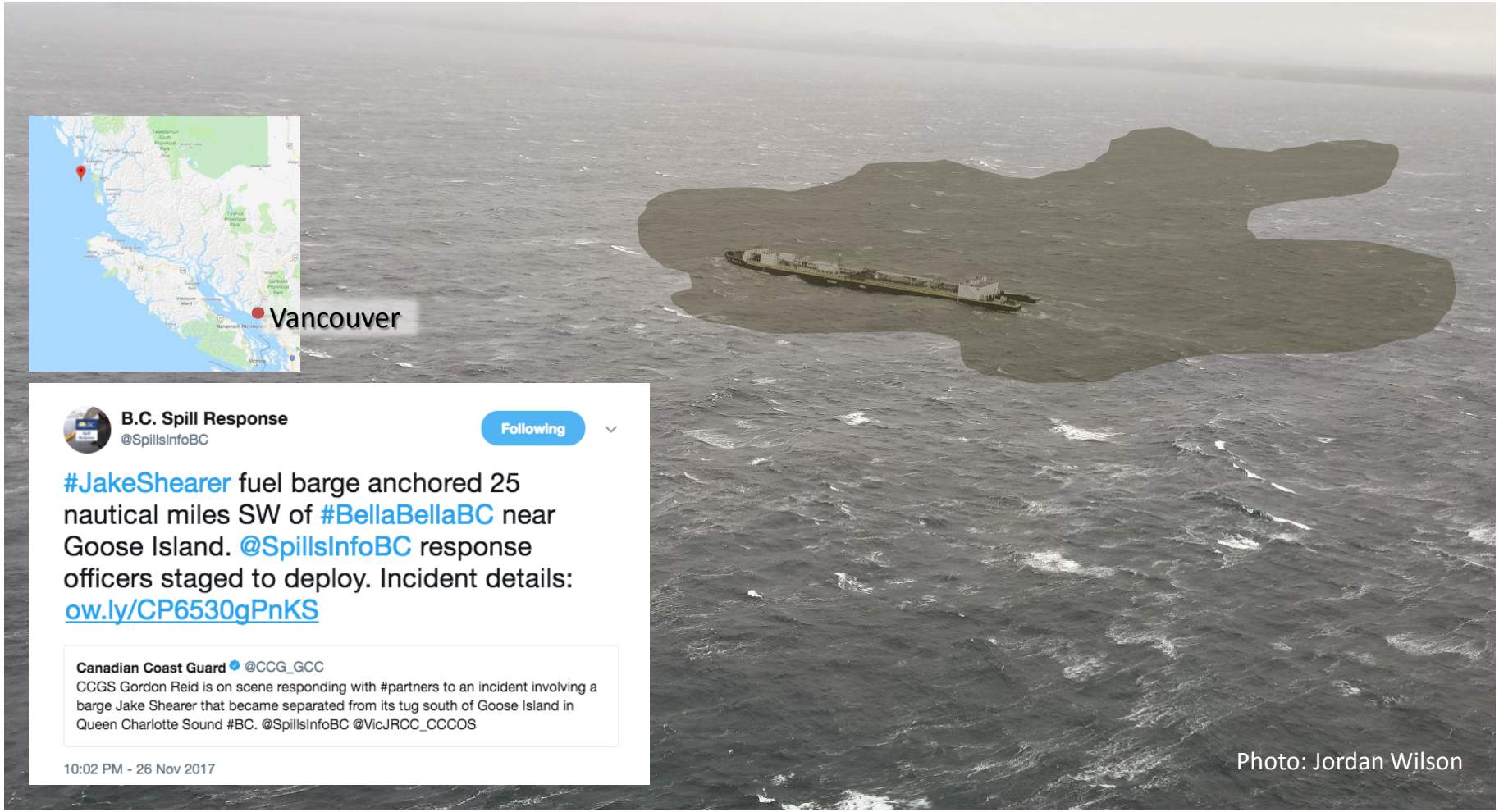
Exxon Valdez, RGB Ventures/SuperStock/Alamy Stock Photo

Emergency Response:

Stranded fuel barge in the Central Coast



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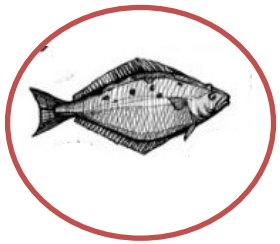

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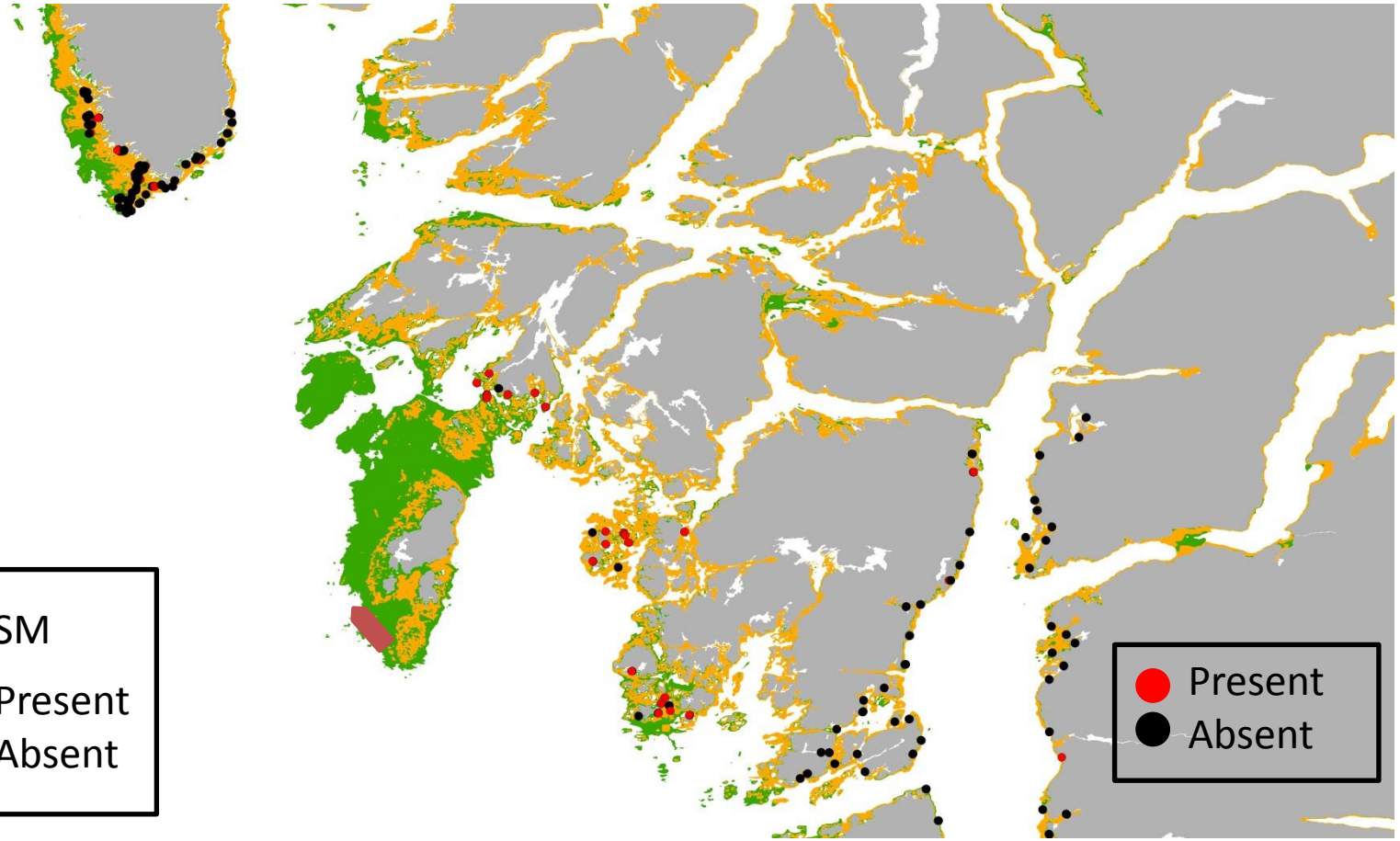
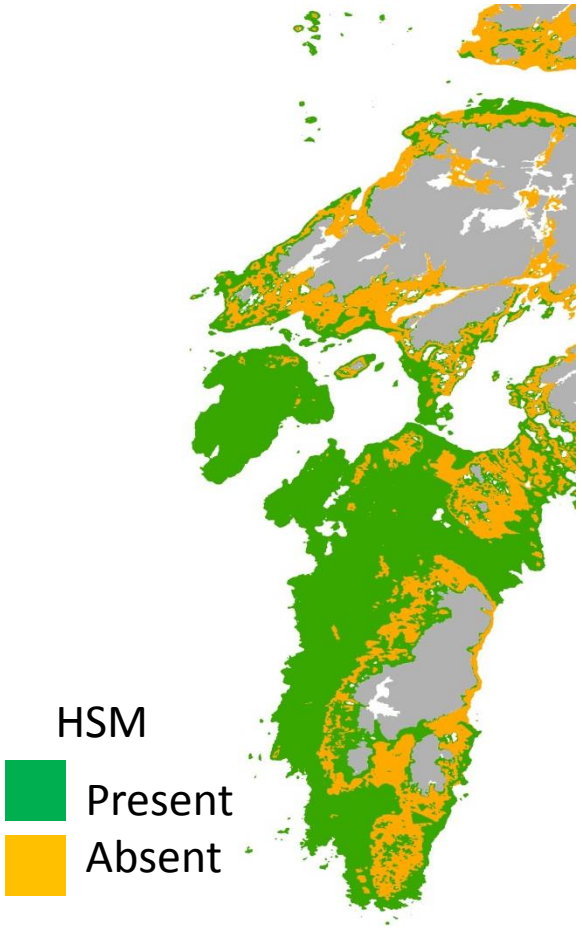


Emergency Response:

Stranded fuel barge in the Central Coast

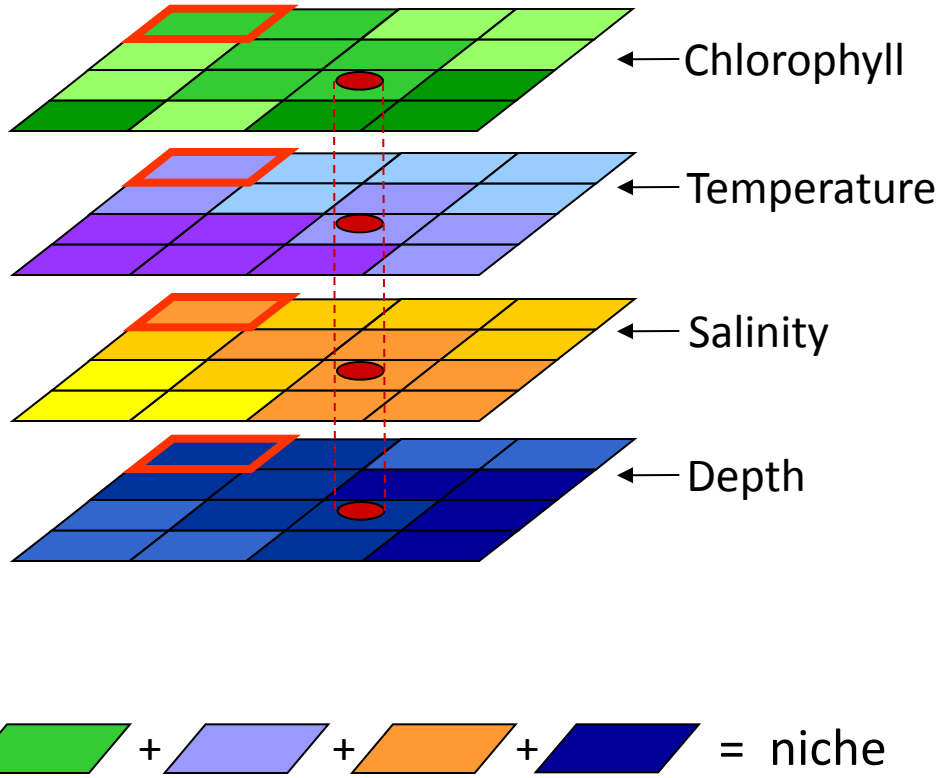
Outline

- 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

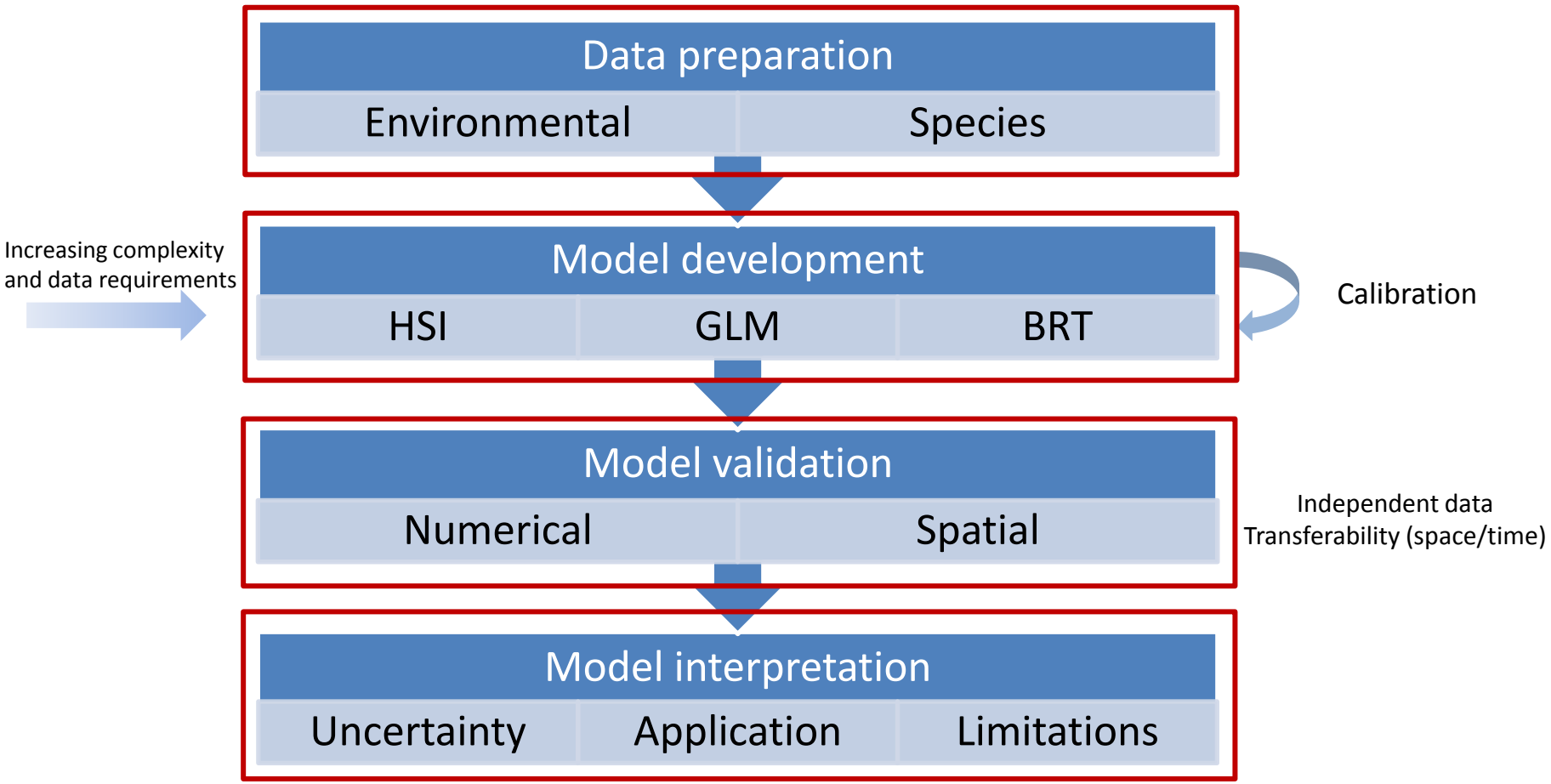


Habitat Modelling Workbook

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.

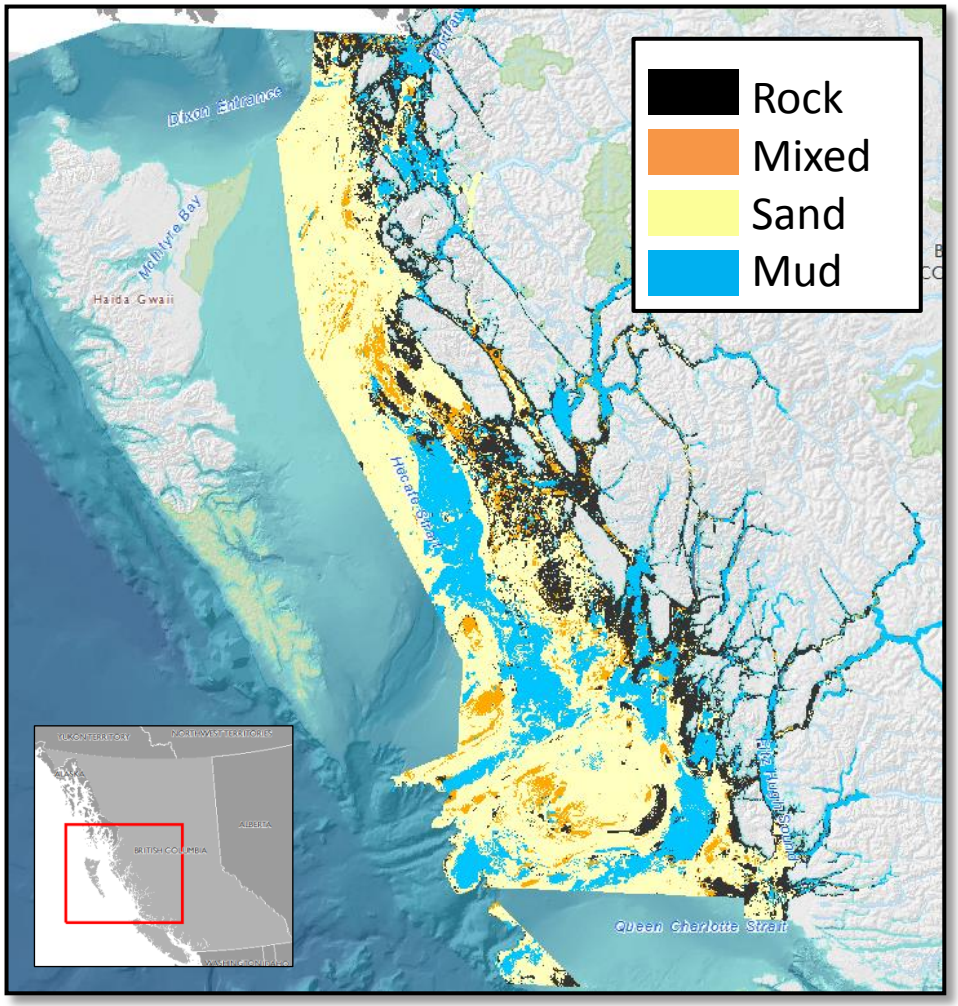
Habitat modelling workbook:
Environmental data

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

Ocean circulation derivatives
- Tidal velocity
- Temperature
- Salinity
- Current speed

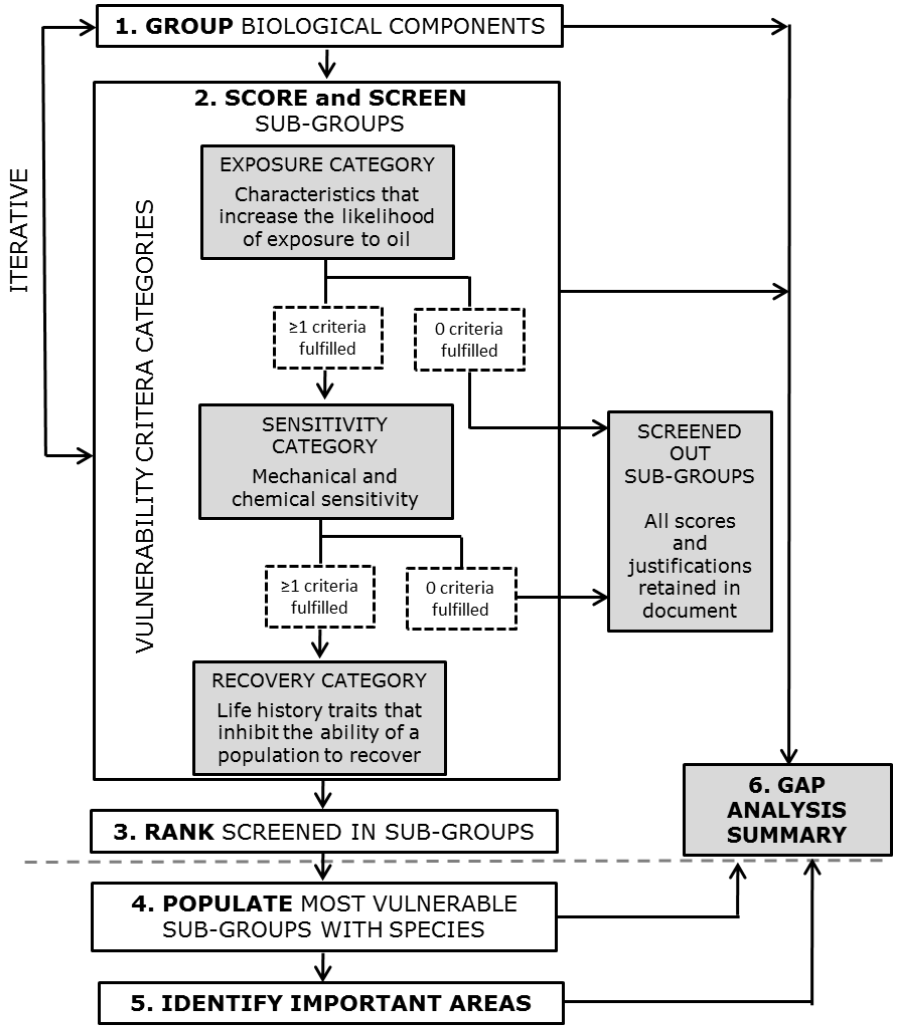
} Seasonal values

Remote sensing derivatives
- Chlorophyll *a* conc.



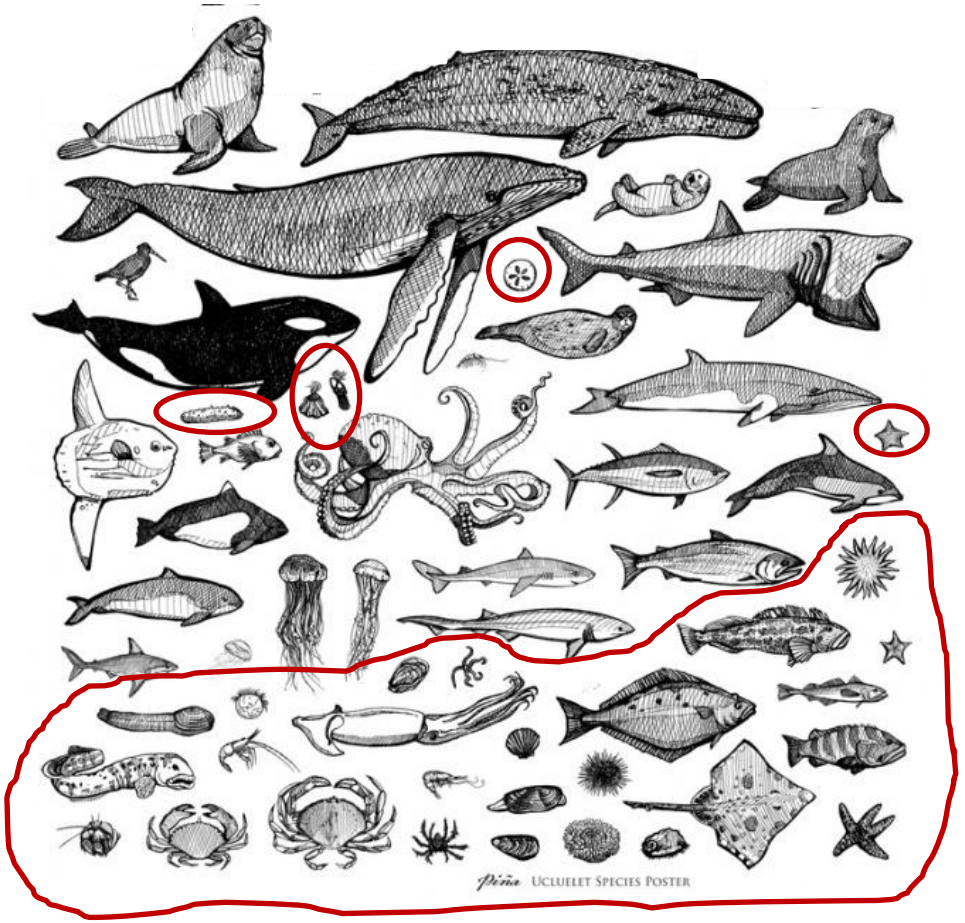
Habitat modelling workbook:
Species data – Oil vulnerability framework

- 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



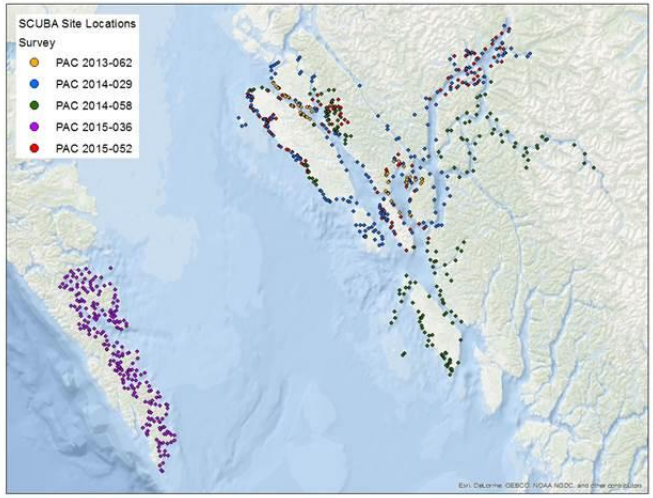
Habitat modelling workbook:
Species data

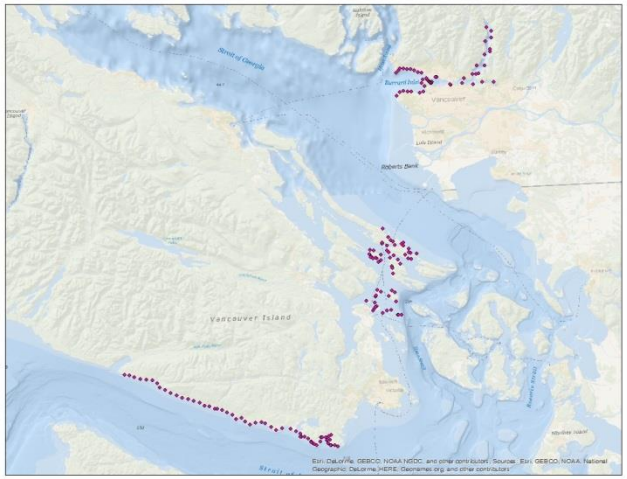
- 12 initial species
- Represent a diversity of:
  - Life history characteristics
  - Habitats
  - Data availability

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



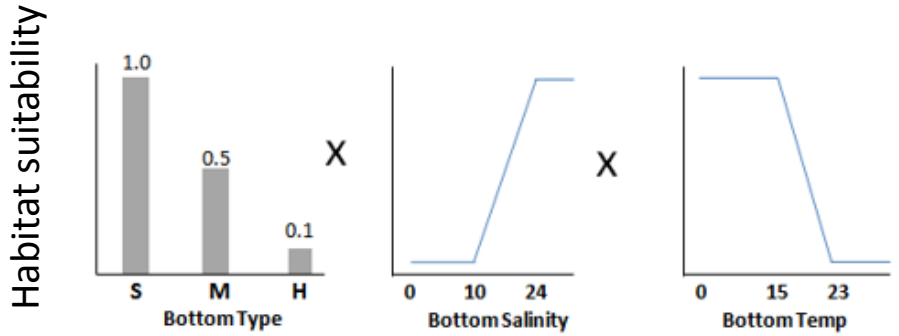


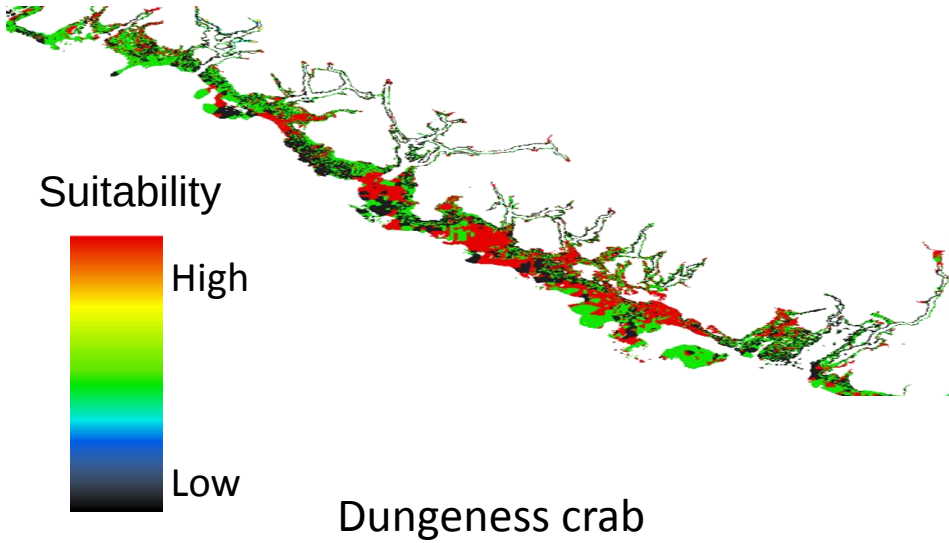
Habitat modelling workbook:
Model development

- 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