How to increase our knowledge on biodiversity in an area prone for development?

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How to increase our knowledge on biodiversity in an area prone for development?
(marine environments)

- Level of knowledge is variable,
  - Better data for commercial species, areas of easy access, times of easy access; stable areas
  - Poorer data for non-commercial species, rare and unknown species, remote areas, times with bad weather, areas that undergo changes
- Traditionally: research cruises for direct measurements and sampling, aerial surveys
- Modern: Remote/autonomous sensing, autonomous vehicles, satellite tags, data loggers

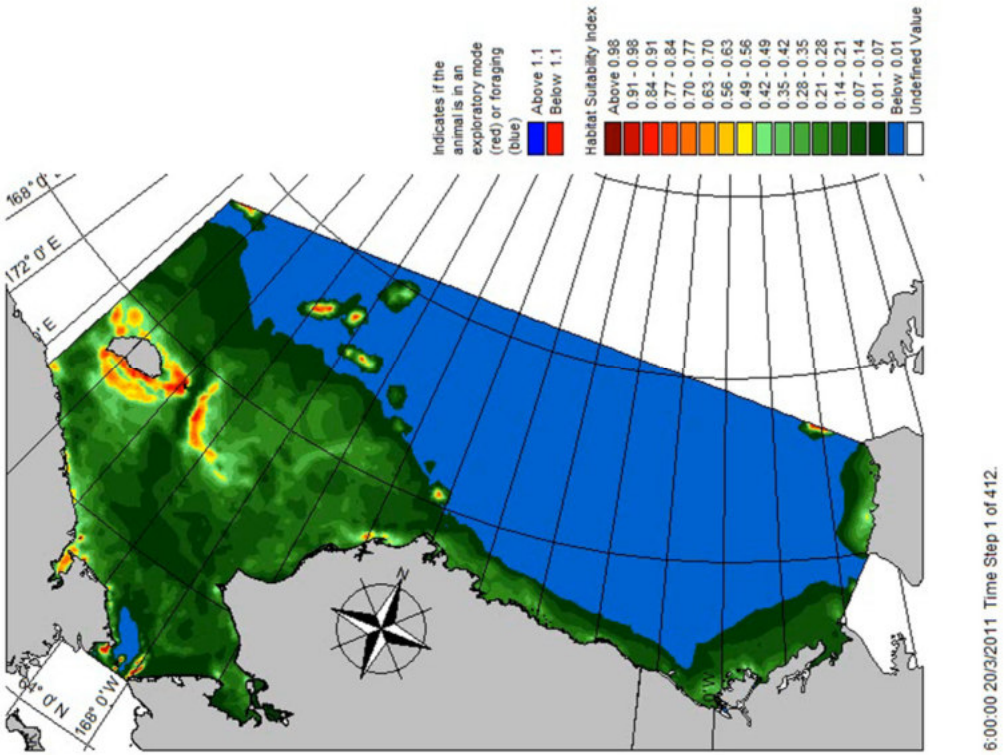
- Modelling as a tool to bridge gaps in space and time and to extrapolate for new situations
- Especially suited for animals that move freely in the environment

Marine mammals
Sea birds
Fish

Habitat modelling and agent based modelling

- Habitat modelling:
  - Looks for correlation between species presence (data from real observations) and environmental data (in the marine environment data from hydrodynamic models)
  - Is species presence related to: water temperature, water depth, salinity, distance to land, stratification, turbulence, chlorophyll a, and more
  - Habitat maps are created describing habitat suitability
- Agent based modelling:
  - Free ranging animals "decide" where there want to be:
    - Migration between breeding and feeding grounds
    - Stay longer in areas with good food availability
    - Swim/fly only in good weather conditions
    - Depending on currents (birds on water)

Example humpback whales in Cukchi Sea



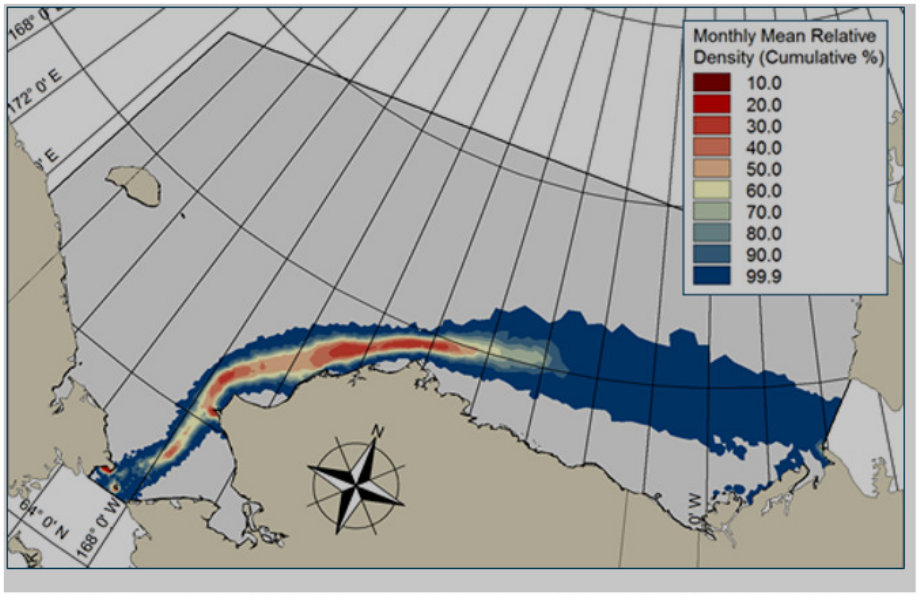


Figure 6.21 Map of the predicted monthly mean relative density in May 2009. Each colour band consists of 10% of the density and acts cumulatively, e.g. areas marked by the five red hues together make up for 50% of all animal registrations within the given month.

What makes the «animals» move in the modelled environment?

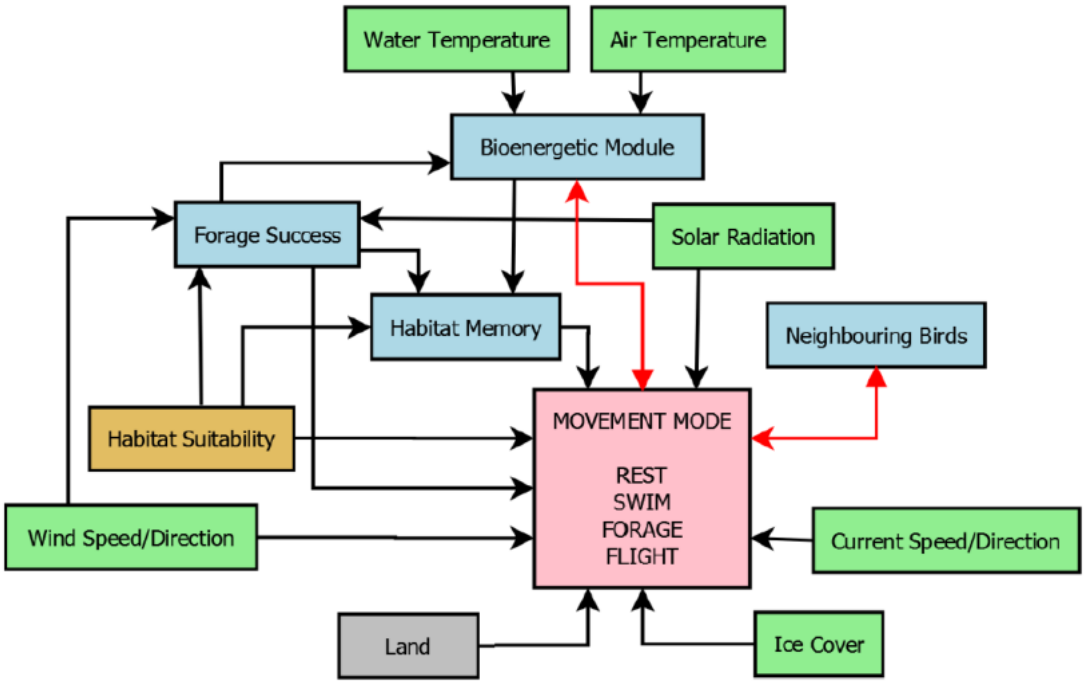
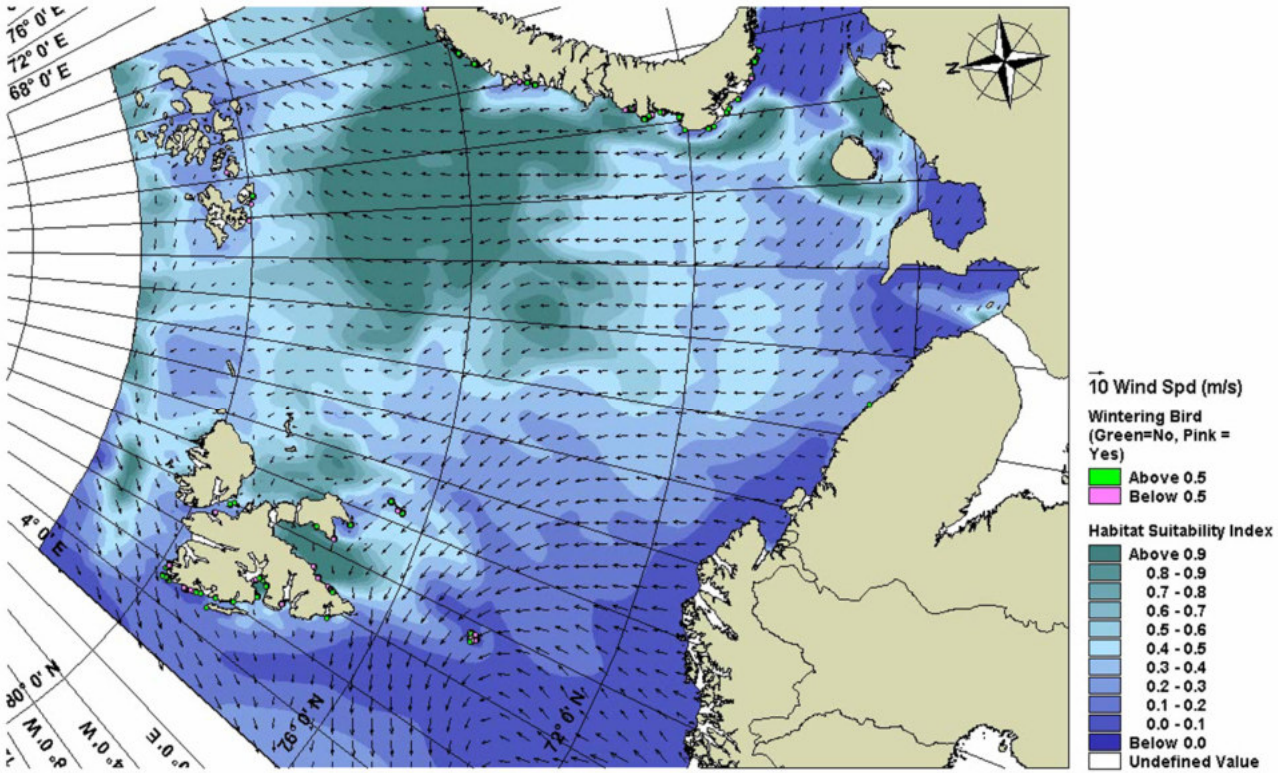
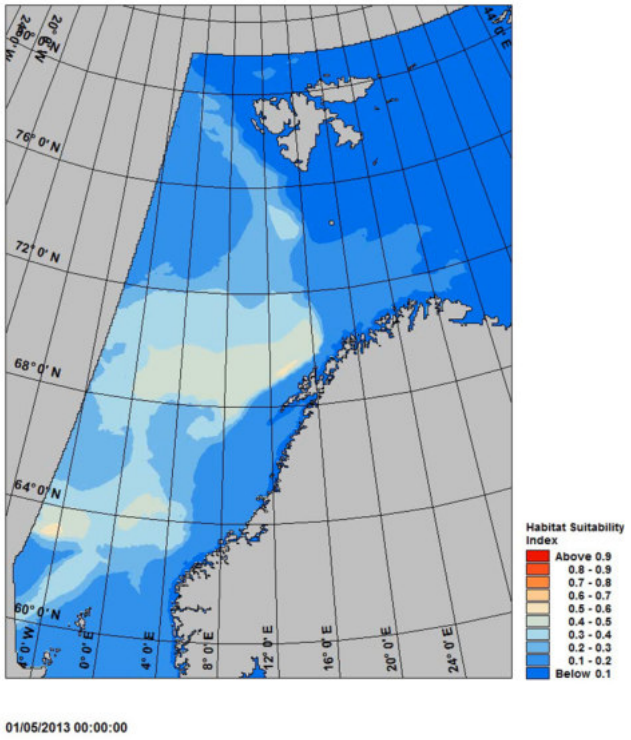


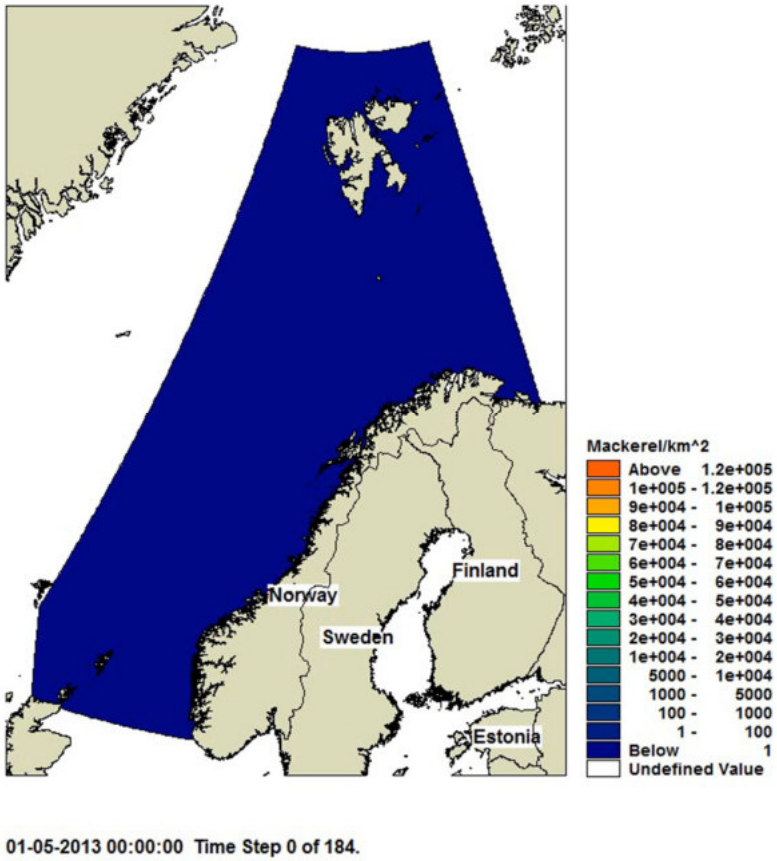
Figure 1-2 Conceptual diagram of the various parameters/sub-modules affecting movement mode decisions in the envisioned Seabird ABM (CBIRD). Green boxes variables denote Eulerian spatio-temporal model forcings, while blue boxes indicate Lagrangian variables/processes. Red arrows indicate two-way feedback mechanisms.

Sea bird Barents Sea (Brueninch's Guillemot; Polarlomvi; *Uria lomvia*)



Fish modelling: mackerel (*Scomber scrombrus*), Norwegian Sea,





Data requirement for successful modelling and verification

- Species observation with exact position and time stamp (Raw data)
  - An initial step of quality control is required for excluding wrong data (species recognition, position and time)
  - No further step of analyse is required
  - Data are used for building models and for verification of existing ones
- Hydrodynamic data with sufficient spatial and timely resolution that match time windows species observation data

Caution when using modelled data

- Good data (good spatial and timely coverage) = **good models results**
  - Existing data are sufficient
- Poor data (sporadic observations over large areas = **bad model results**
  - More data gathering/field work is required
- Verification of model results with independent datasets (not used to build the model) is required
- Expression of uncertainty in model results (animations, graphs) is a challenge (nice animations may be totally wrong)

Conclusion

- Models for are important tools to get knowledge about species presence in areas prone for development
- Advances in computer technology allow complex models (number of dependencies)
- Hydrodynamic and weather data are often sufficient good
- Models allow to make prediction into the future
- Models can be used to introduce a stressor and investigate impacts

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