Mapping of fish production habitats in the Baltic Sea to support management

Management strategies to conserve marine resources Seminar

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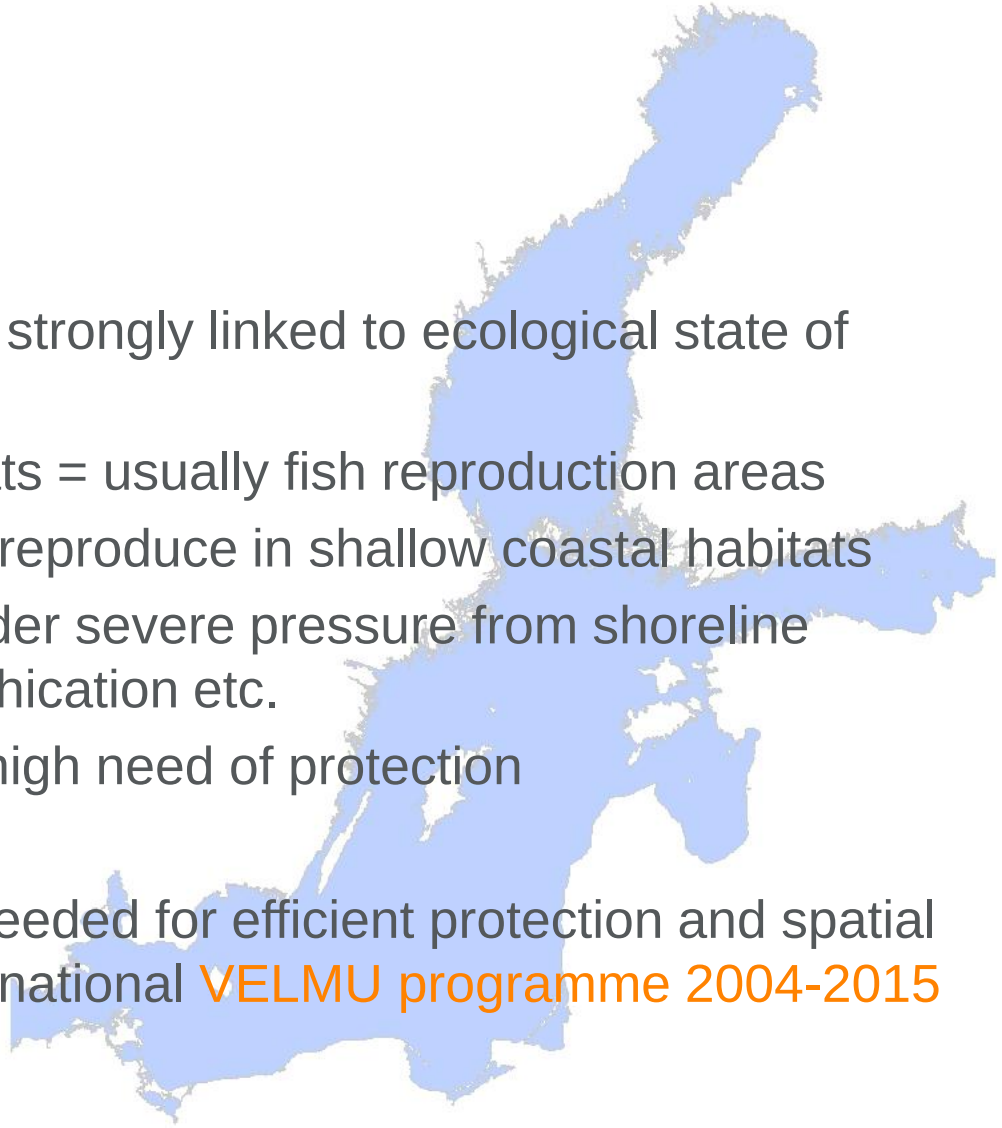
Background

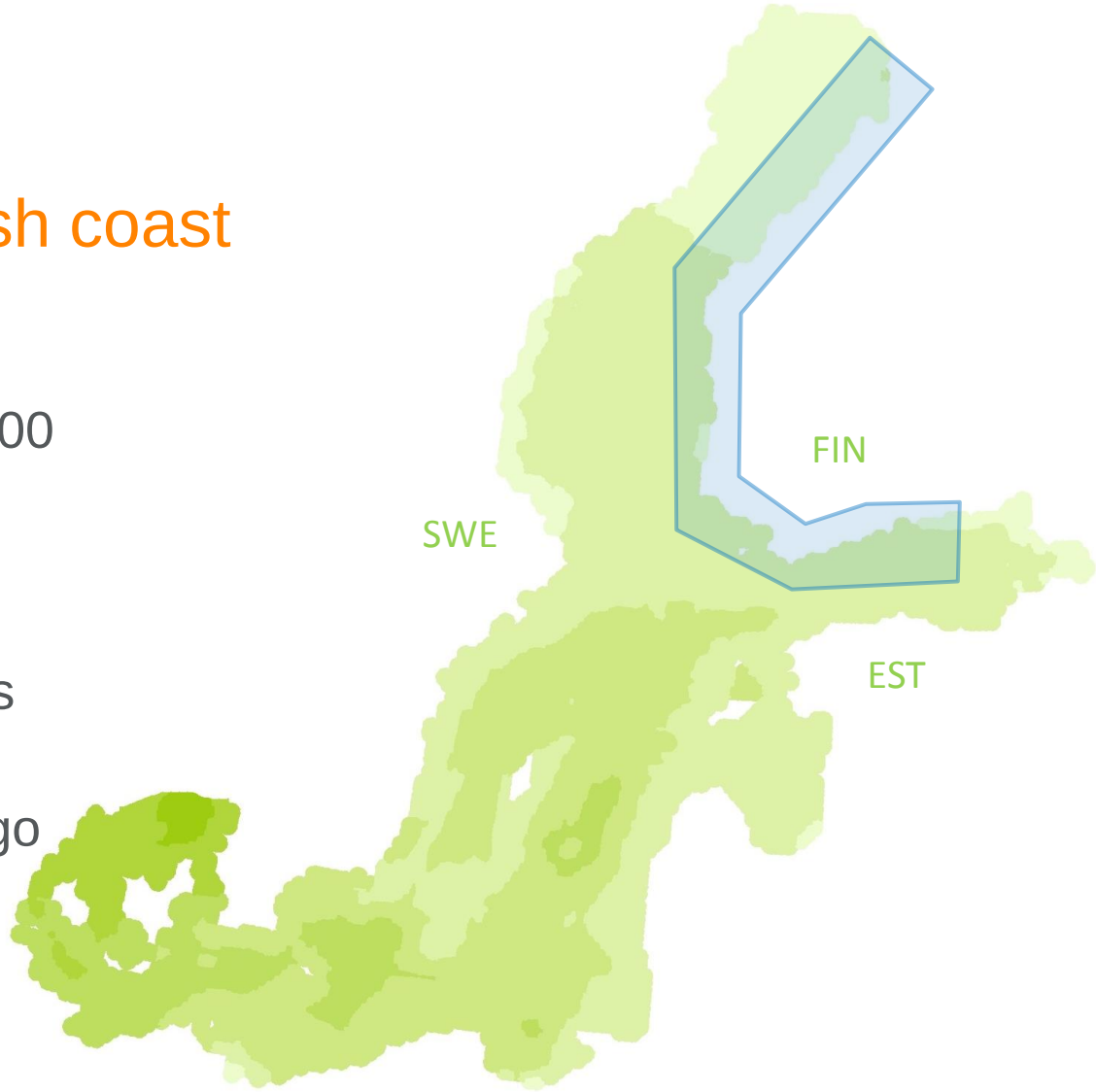


- Productive fisheries strongly linked to ecological state of essential habitats
- Essential fish habitats = usually fish reproduction areas
- Most Baltic species reproduce in shallow coastal habitats
- Coastal habitats under severe pressure from shoreline construction, eutrophication etc.
- Coastal habitats in high need of protection

- Fish habitat maps needed for efficient protection and spatial planning → Finnish national VELMU programme 2004-2015

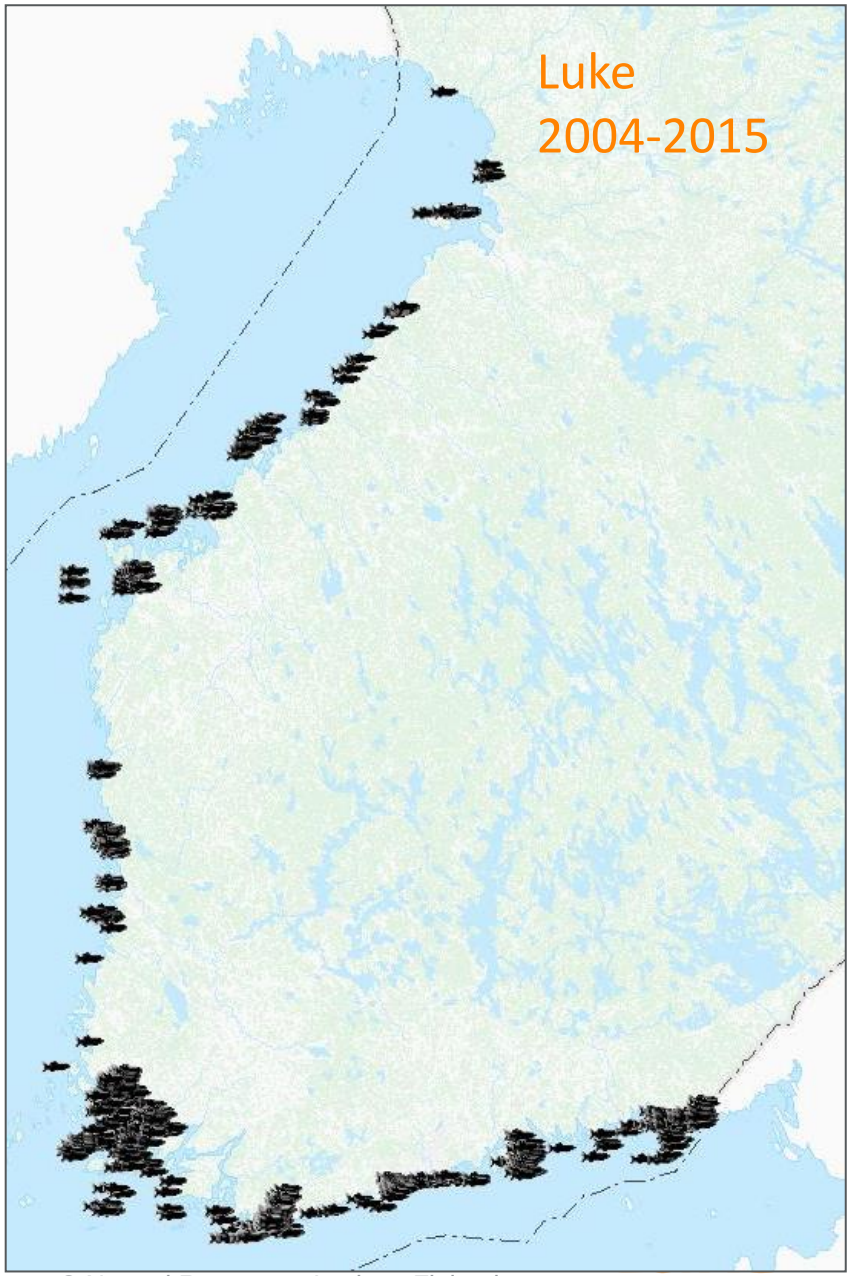
Study area: Finnish coast

- 46 000 km of shoreline, area 30 100 km^2
- Both marine and freshwater species, low species richness
- Coastal areas: extensive archipelago
- Large spatial & temporal environmental gradients

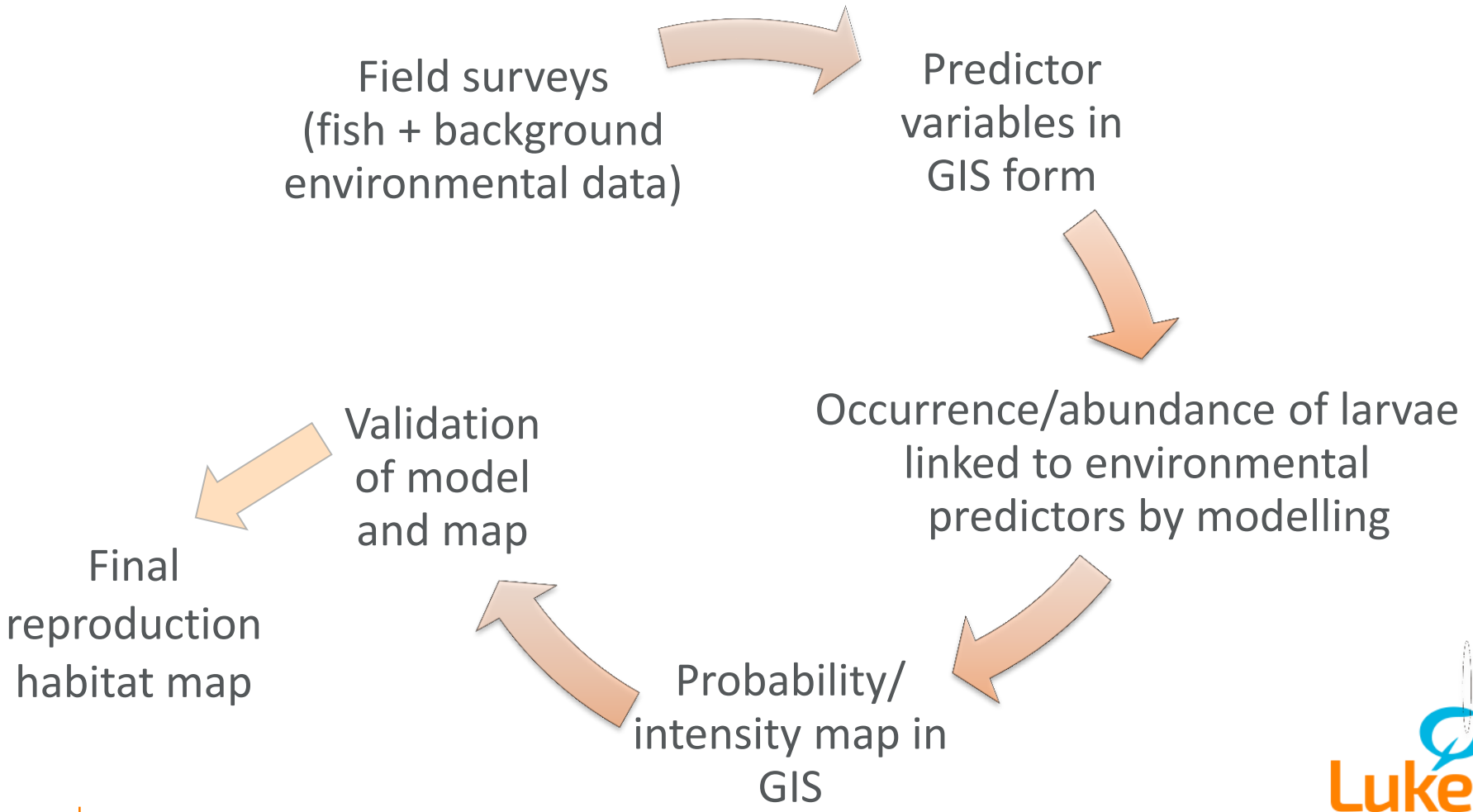


What we have achieved in VELMU?

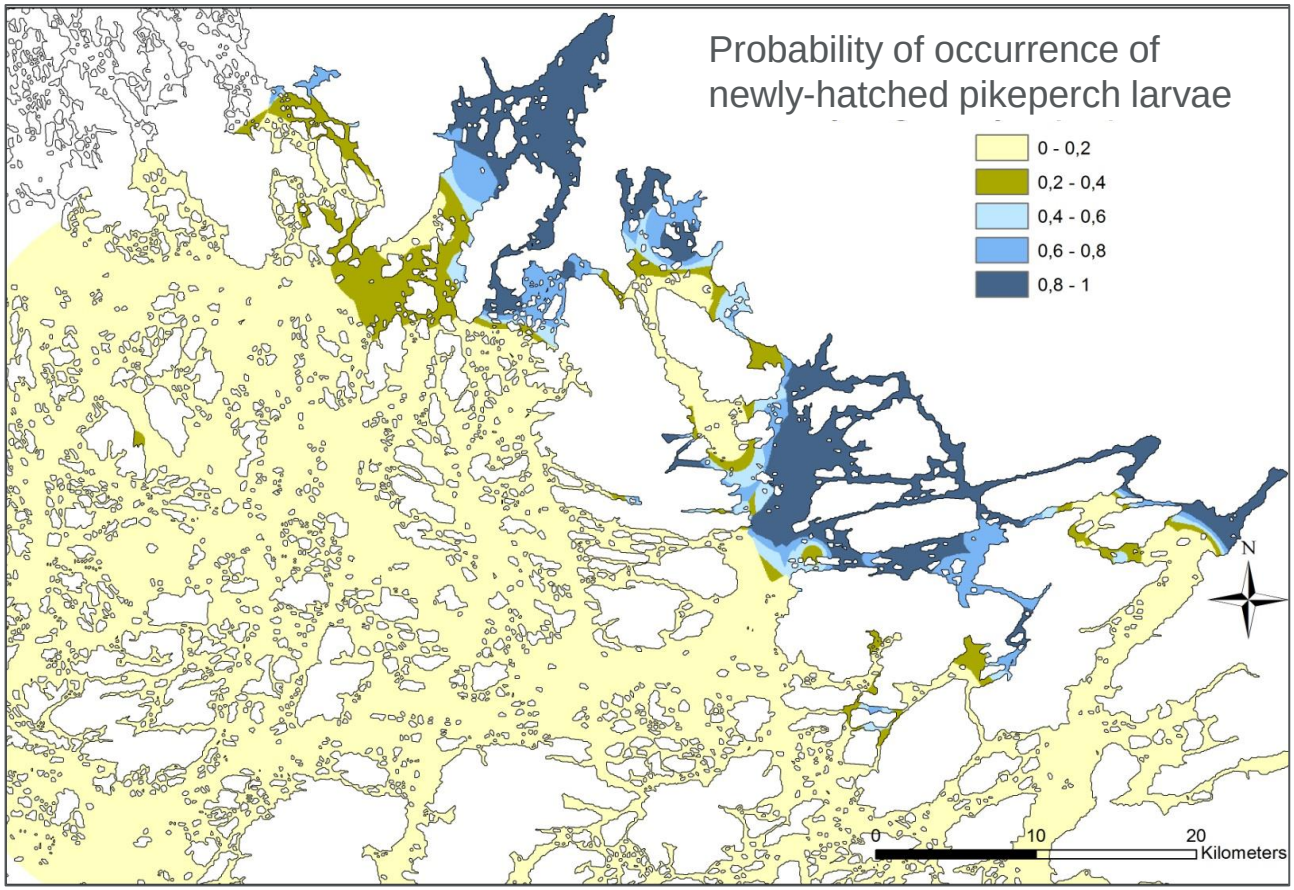
1. Developed and tested new survey and mapping methods
   - Field sampling (almost 10 000 sampling sites, several methods, >20 species)
   - Use of GIS and remote sensing
   - Species distribution modeling
2. Produced distribution maps of key reproduction habitats of coastal fish
   - Modelled reproduction habitat maps of 9 species
   - Allows visual and numerical comparison of coastal areas



Habitat mapping process



Probability maps

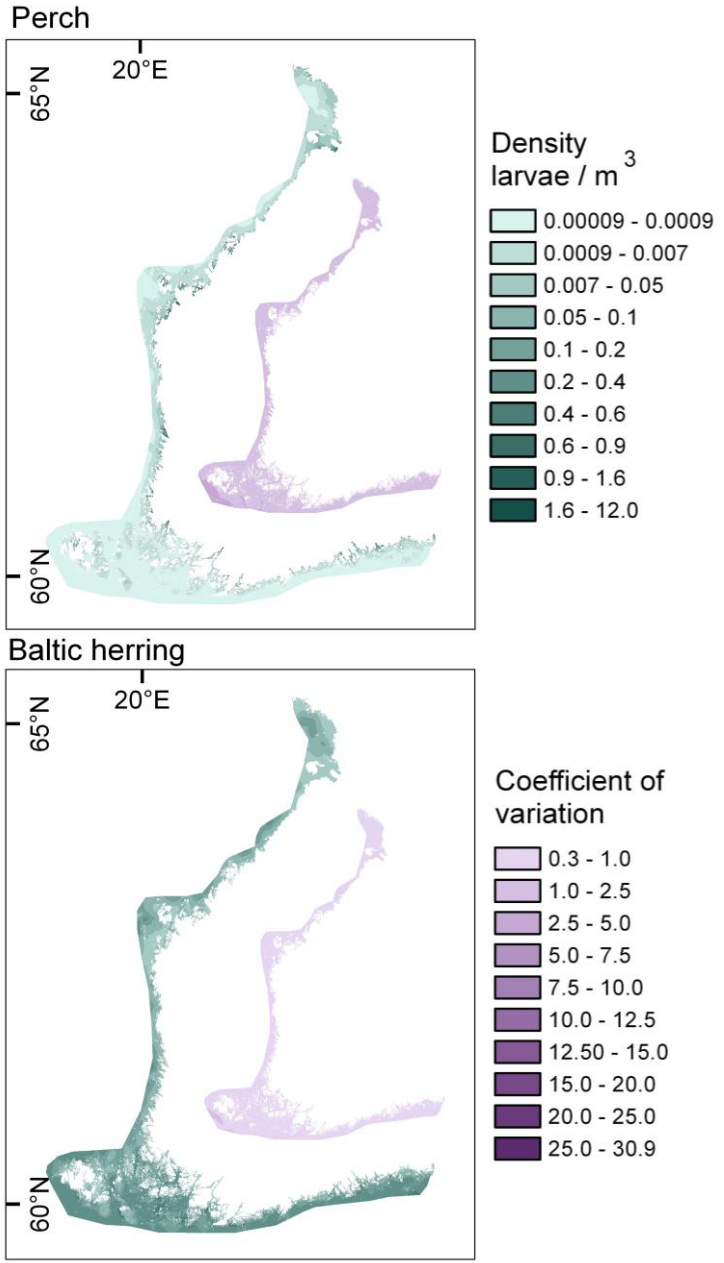


- Method: Logistic regression
- Binary (pres/abs) response variable
- Allows area-based comparison

Veneranta et al. 2011: Turbidity characterizes the reproduction areas of pikeperch (Sander lucioperca (L.)) in the northern Baltic Sea. Estuarine, Coastal and Shelf Science 95: 199-206

Density maps

- Method: Gaussian process (GP)
- Model combines a non-linear predictor with a spatio-temporal random effect
- Continuous (abundance) response variable
- Outcome: Predicted average density of larvae in 50x50 m grid cells in the study area
- Allows numerical comparisons: predicted amount of larvae per area



Kallasvuo, Veneranta, Vanhatalo 2016: Modeling the spatial distribution of larval fish abundance provides essential information for management. *Submitted to CJFAS*

Interpretation of maps

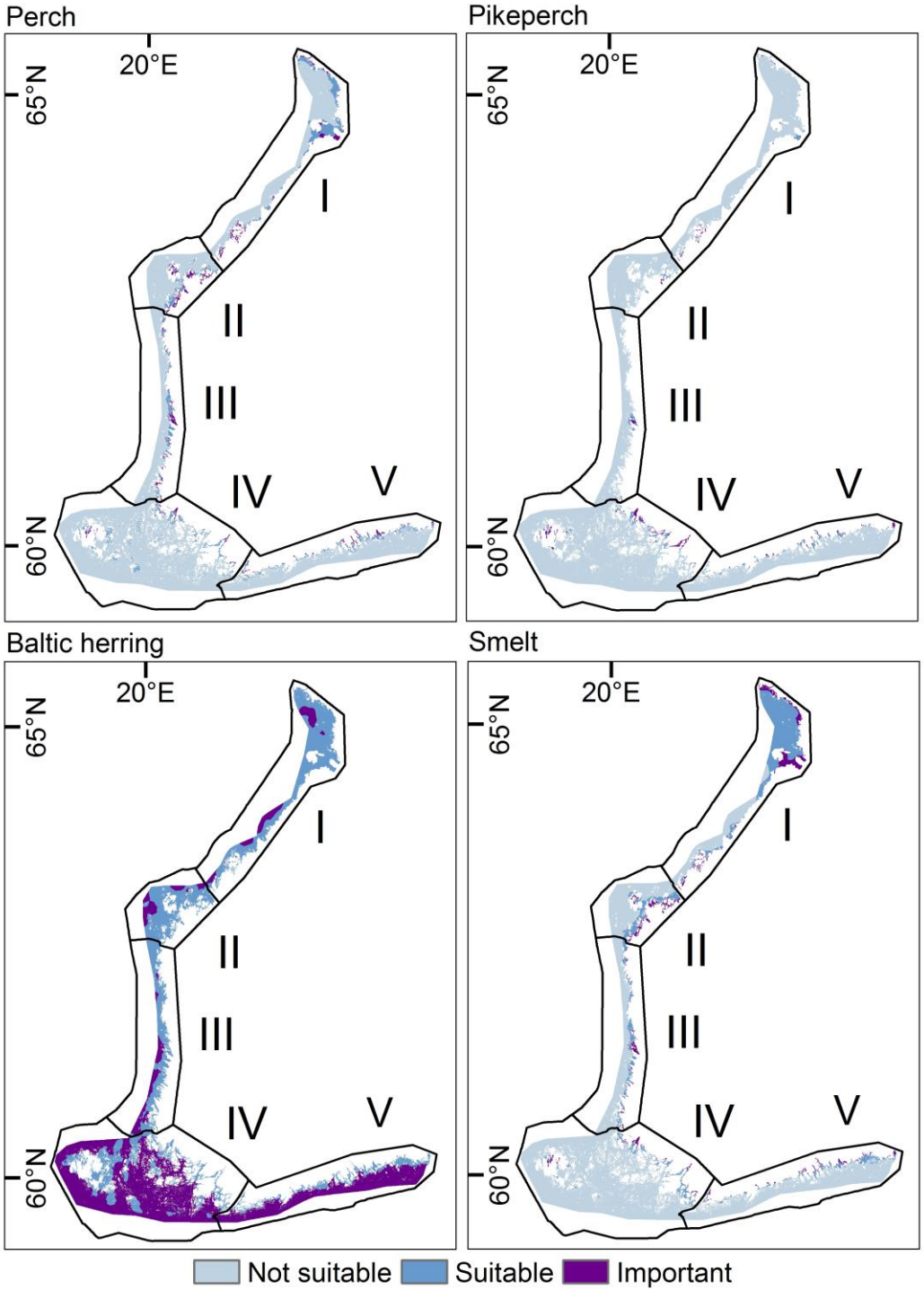
Cut-off values needed to classify the maps for end-users:

1. *Where larvae exist*

   Predicted area where larvae present within one 50x50 m cell, calculated with >50% confidence

2. *The most productive areas*

   Areas which produced in total 80% of larval production, calculated from the cumulative predicted number of larvae



Easy-to-interpret information in map-form

Allows prioritizition of areas with high production potential (abundance) over areas that are suitable for reproduction but do not significantly contribute to the larval production

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Typical reproduction areas for coastal fish species

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Conclusions

- We mapped most important coastal fish reproduction habitats in the northern Baltic Sea
- Set cut-off values that aid in quantified interpretation and comparison of larval production
- Very limited areas can be crucial for fish production
  - Total area suitable for larval production varied
  - Total area producing 80% of larval production was two to five times more limited than total area
- Variation between species and sea area was large
- Maps available: http://paikkatieto.ymparisto.fi/velmu/

How to use the results?

- Concrete support to spatial planning
  - EU Marine Spatial Planning directive → Important fish habitats noted in MSP
  - Planning of coastal areas → “Kymenlaakso regional plan”
- Concrete support to fisheries and environmental management
  - Planning of local fishing restrictions (no-take areas?) and marine protected areas (MPA)
  - New Finnish Fishing Act (enacted on January 1st 2016) → Management plans for local fisheries units
  - Local dredging permission procedure
- New cost-effective field methods

Whitefish larvae at the Bothnian Bay

Perch larvae at flad bay in Quarken area

Fucus and sticklebacks at Archipelago Sea


Underwater meadow at
Western Gulf of Finland
© Metsähallitus

Newly-hatched pikeperch larvae at Archipelago Sea

Pike larvae catching a roach larvae at Western Gulf of Finland

Thank you!

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