Ecosystem based approach: Experience from PreHab and MARMONI Project

PartiSEApate workshop
Klaipeda 2013

Martin Isæus

MARMONI

AquaBiota WATER RESEARCH

Life

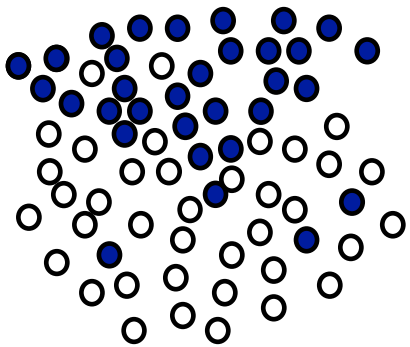
Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea

Content

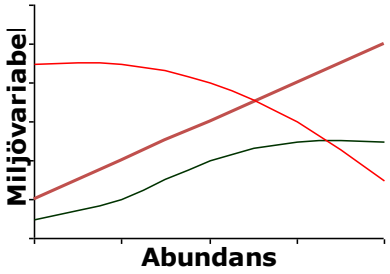
- Species distribution modeling (SDM) in practice
- How to use mapped biology for marine spatial planning (MSP)?

Species distribution modeling (SDM)

Field data



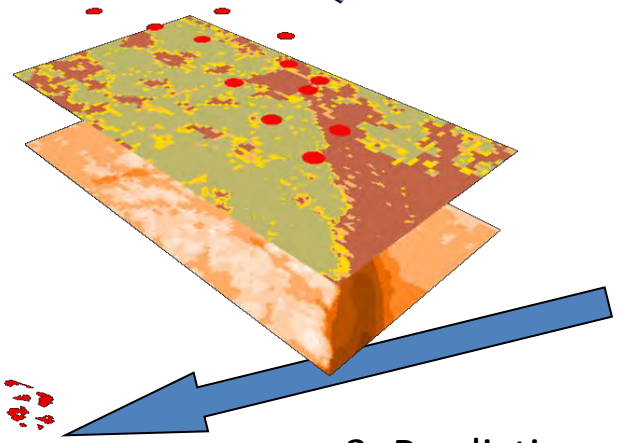
1. Statistical analysis



Model (GAM, rF, MaxEnt)

2. Cross validation

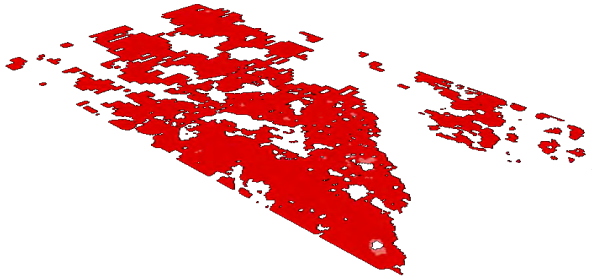
Model performance



3. Prediction

Prediction accuracy

4. External validation



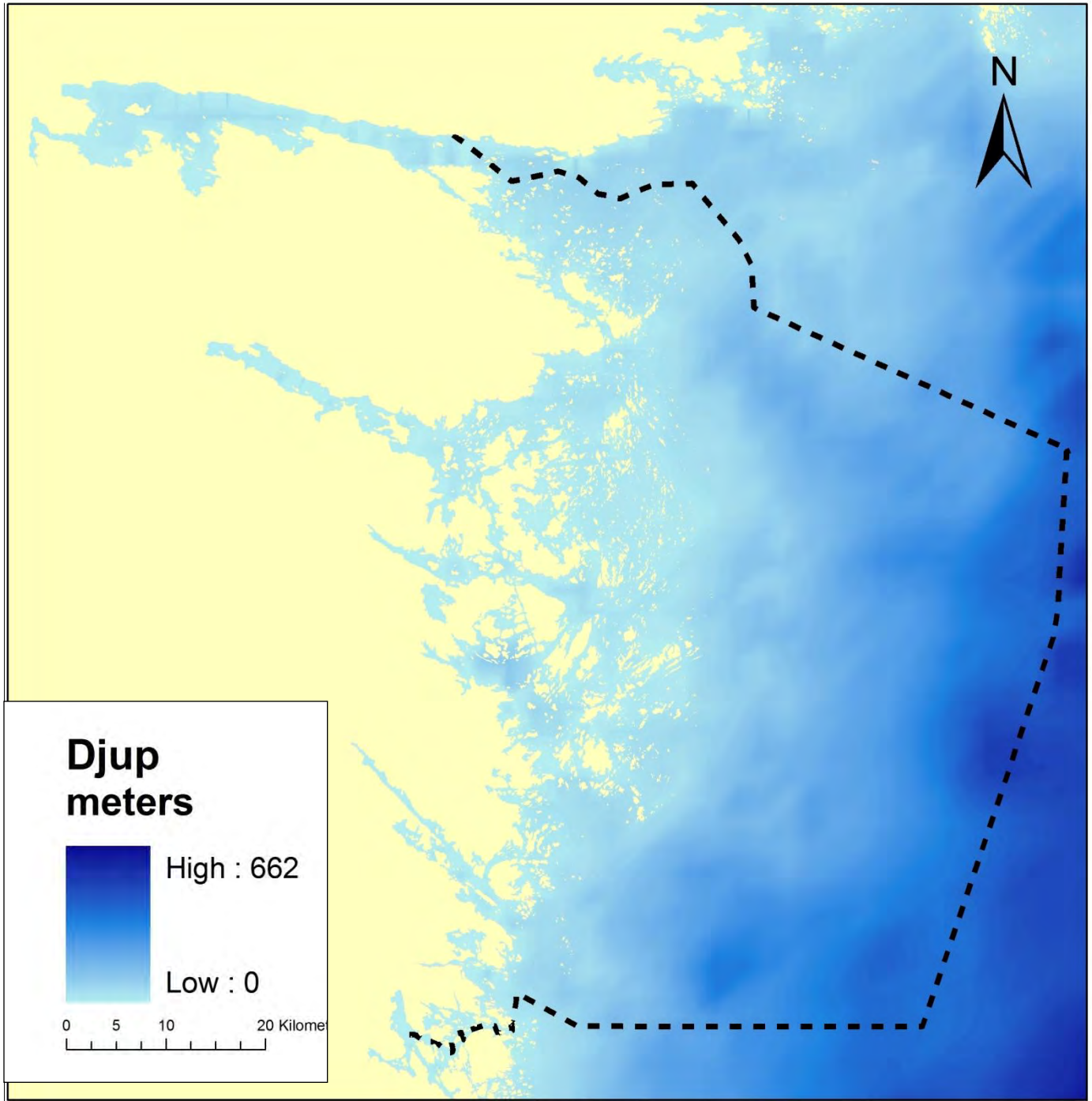
Biological sampling – Ecosystem approach? Marmoni Hanö Bight

- Benthic biota (drop-video + grab, 0-35m)
- Y-O-Y fish (small detonations, 0-6m)
- Pelagic fish (hydroacoustics)
- Seabirds coastal overwintering (observations shore)
- Seabirds coastal breeding (observations shore/boat)
- Seabirds off-shore overwintering (aerial observations)
- Available data

Drop-video + benthic grab at every station

Batymetry (m)

- Grid based on nautical charts
- 100 m



SJÖFARTSVERKET

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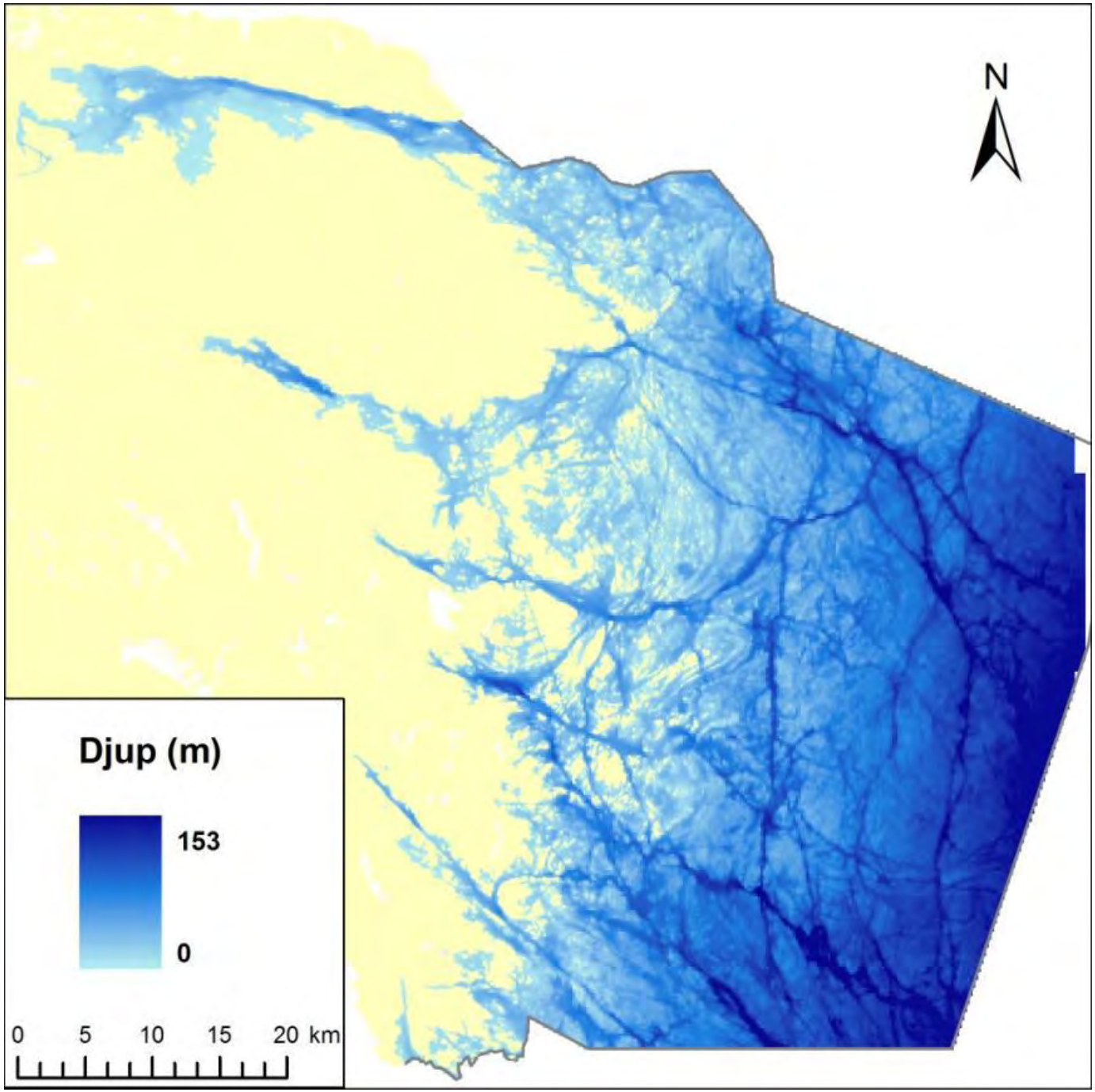
Batymetry (m)

- Grid based on digitalized measurements 200 m



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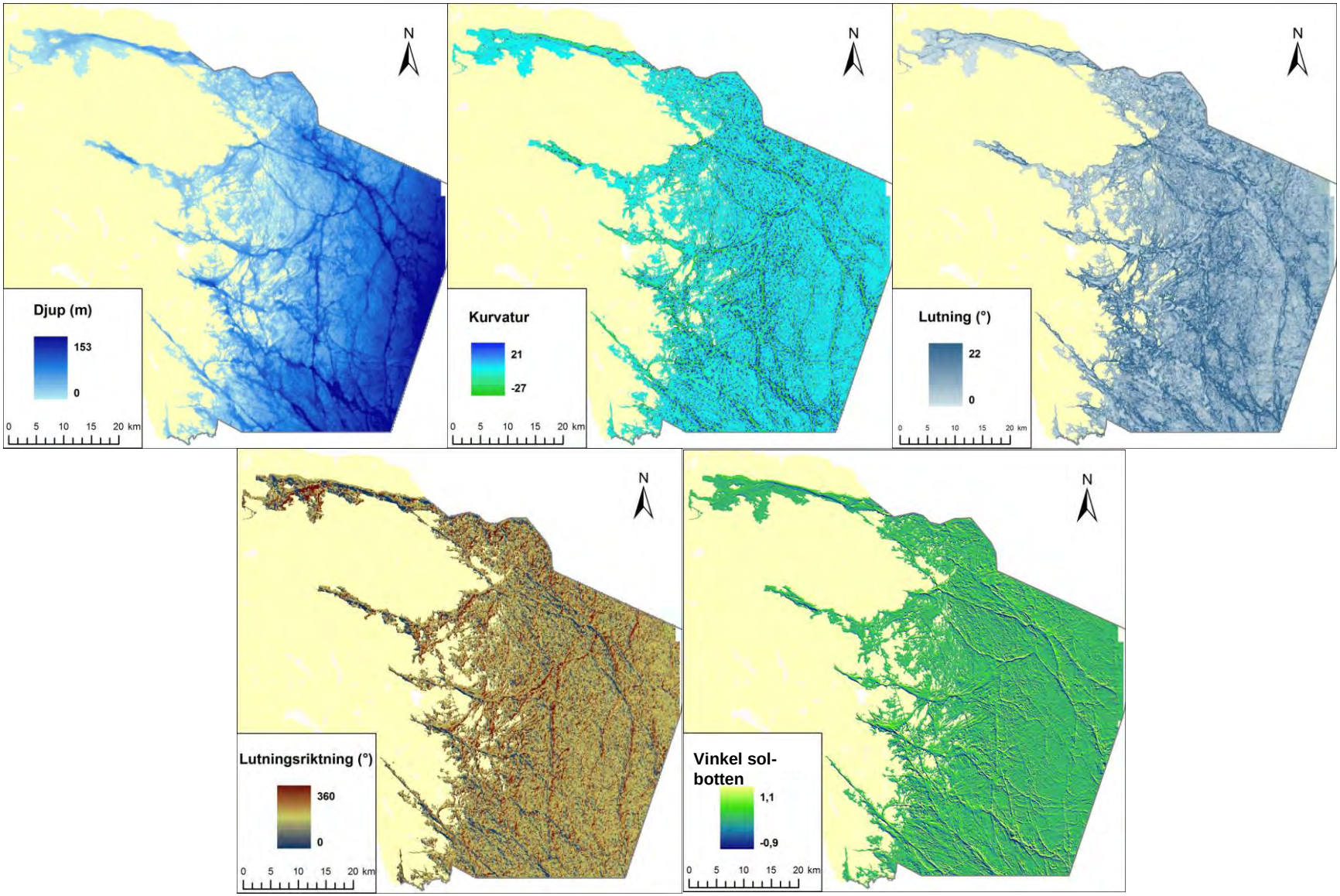
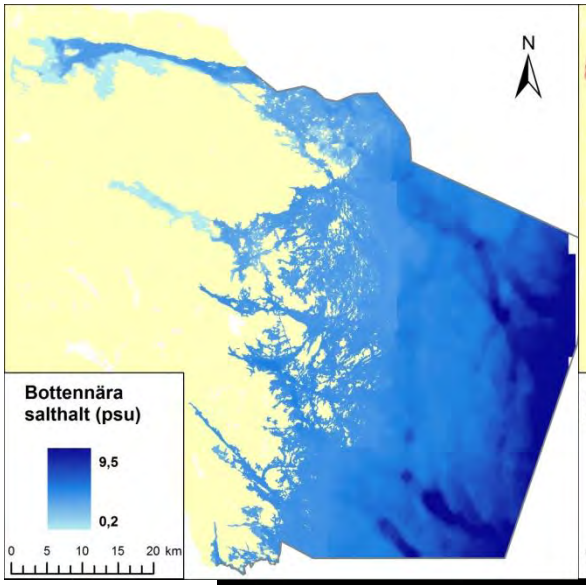
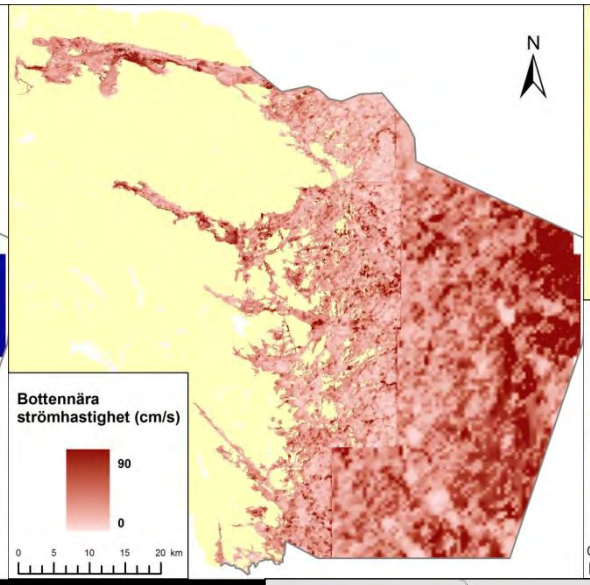
WATER RESEARCH

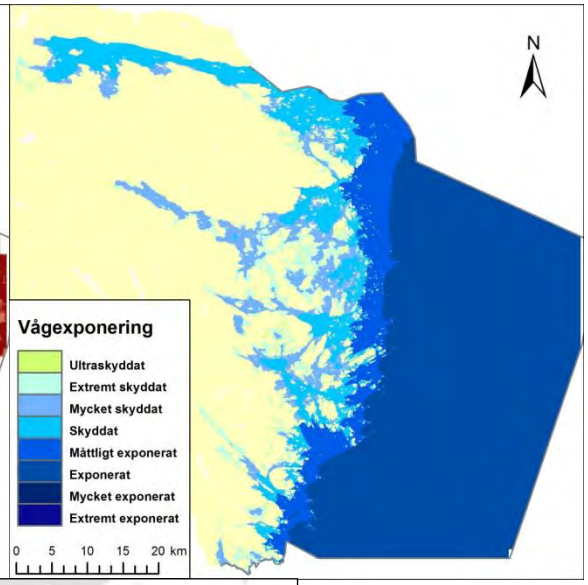
Depth with derivates

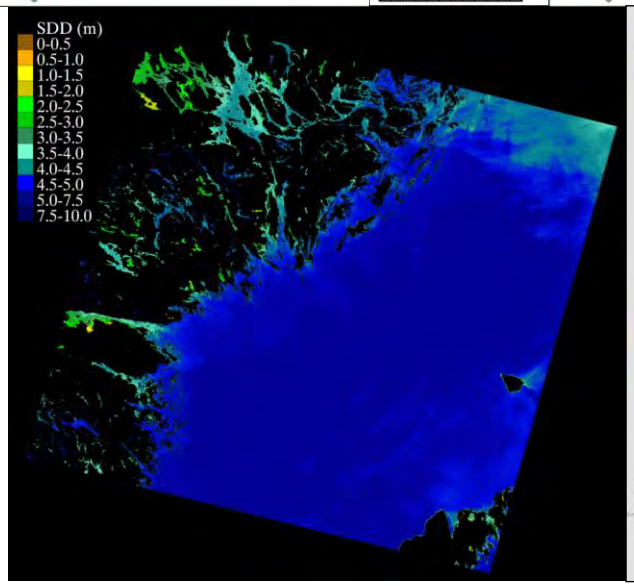


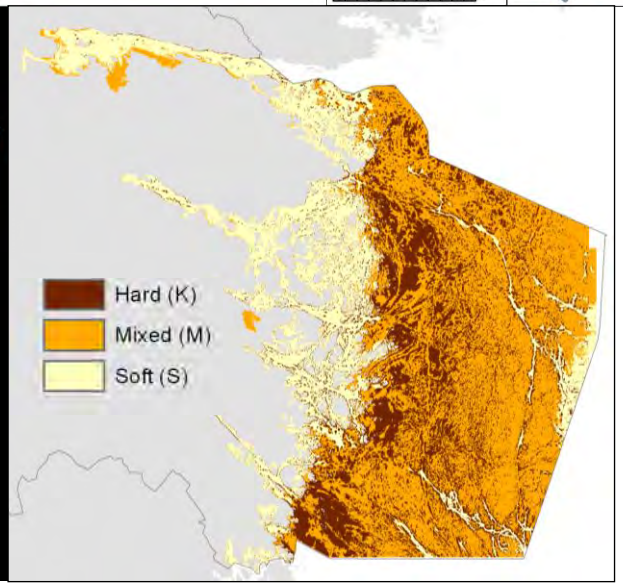
Other physical predictors



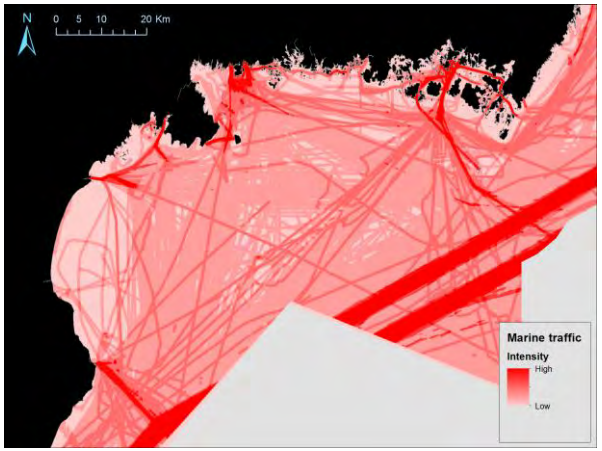


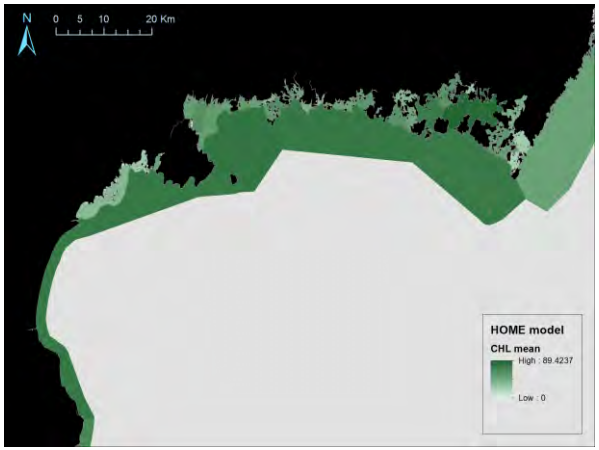


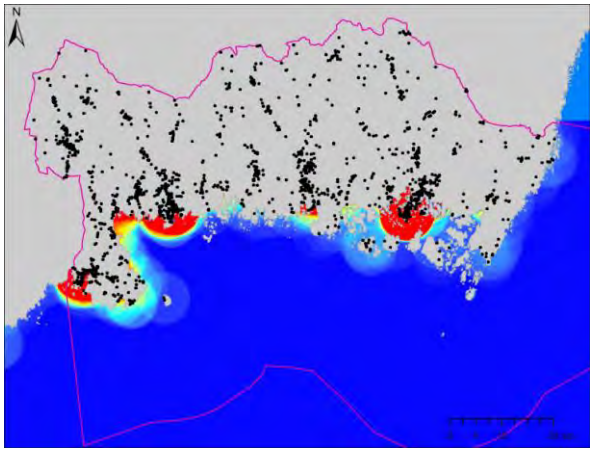




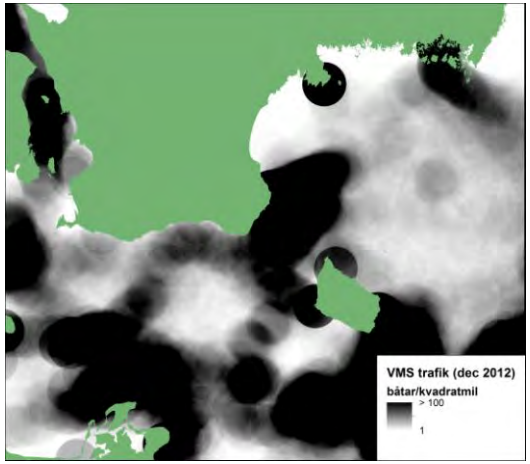
Antropogenic layers

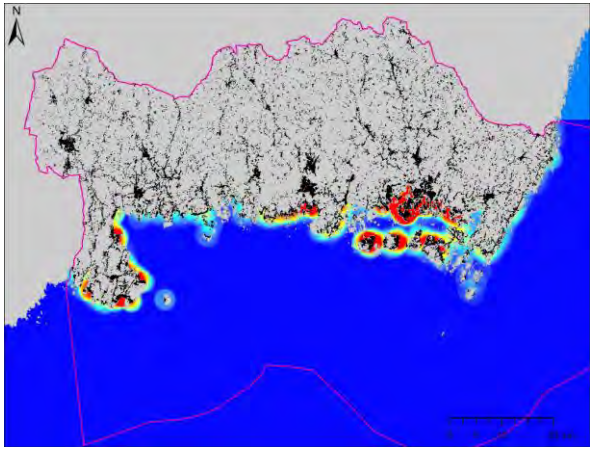






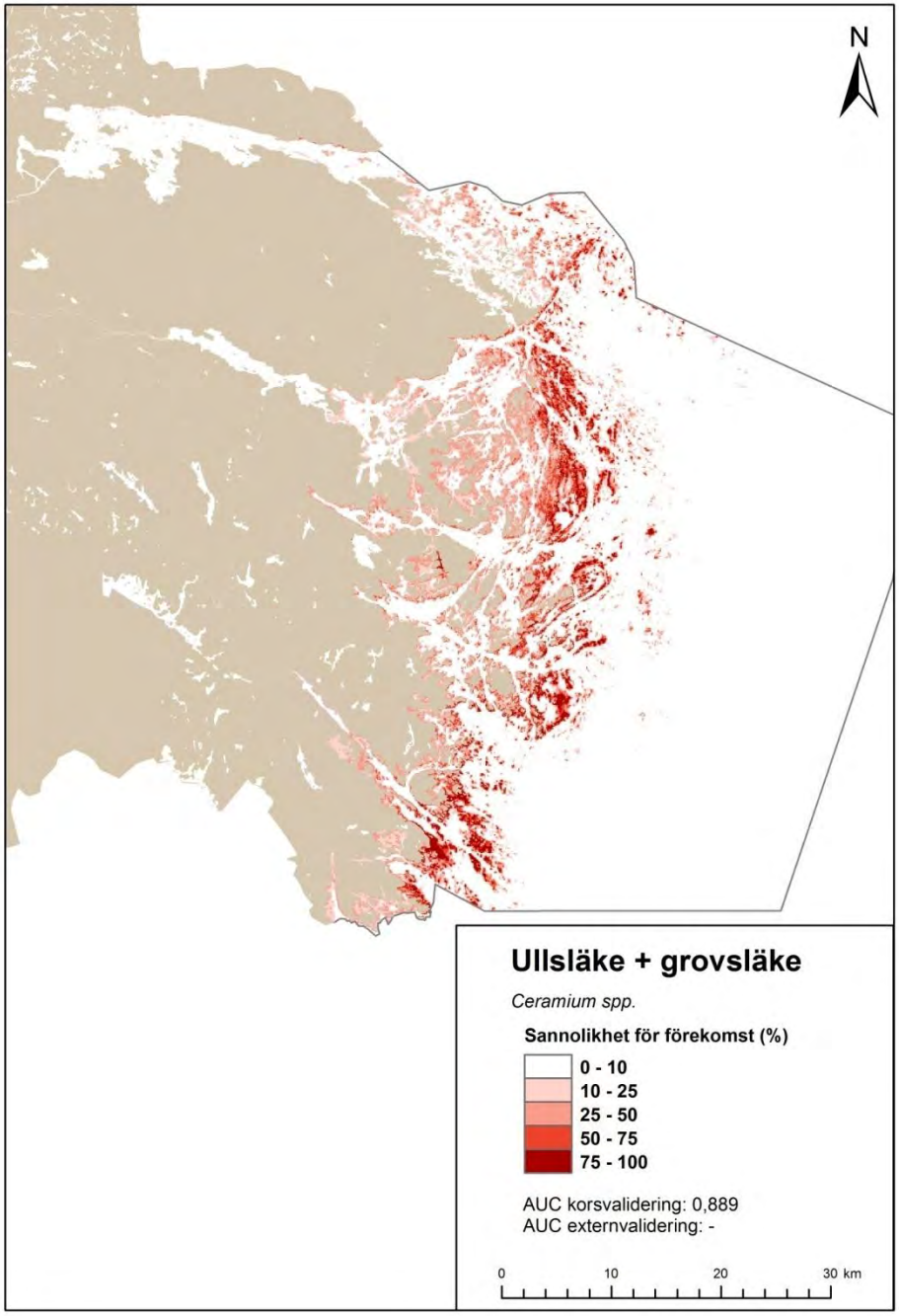
- Boat traffic density (AIS)
- Chlorophyll-a (HOME)
- Density of potentially polluted areas (MIFO)
- Fishing intensity (VMS data)
- Density of buildings





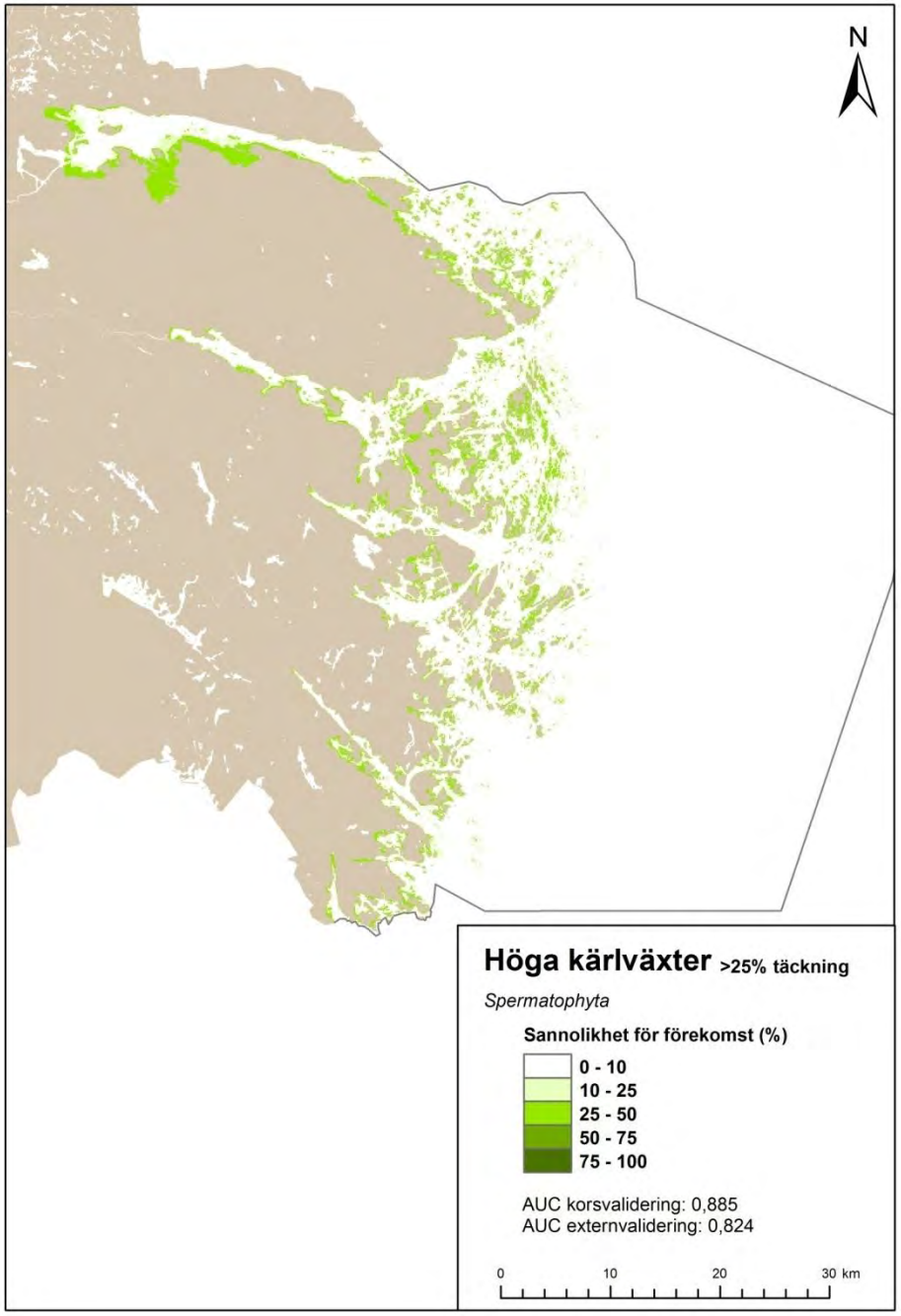
Ceramium spp.

- *Probability of presence*

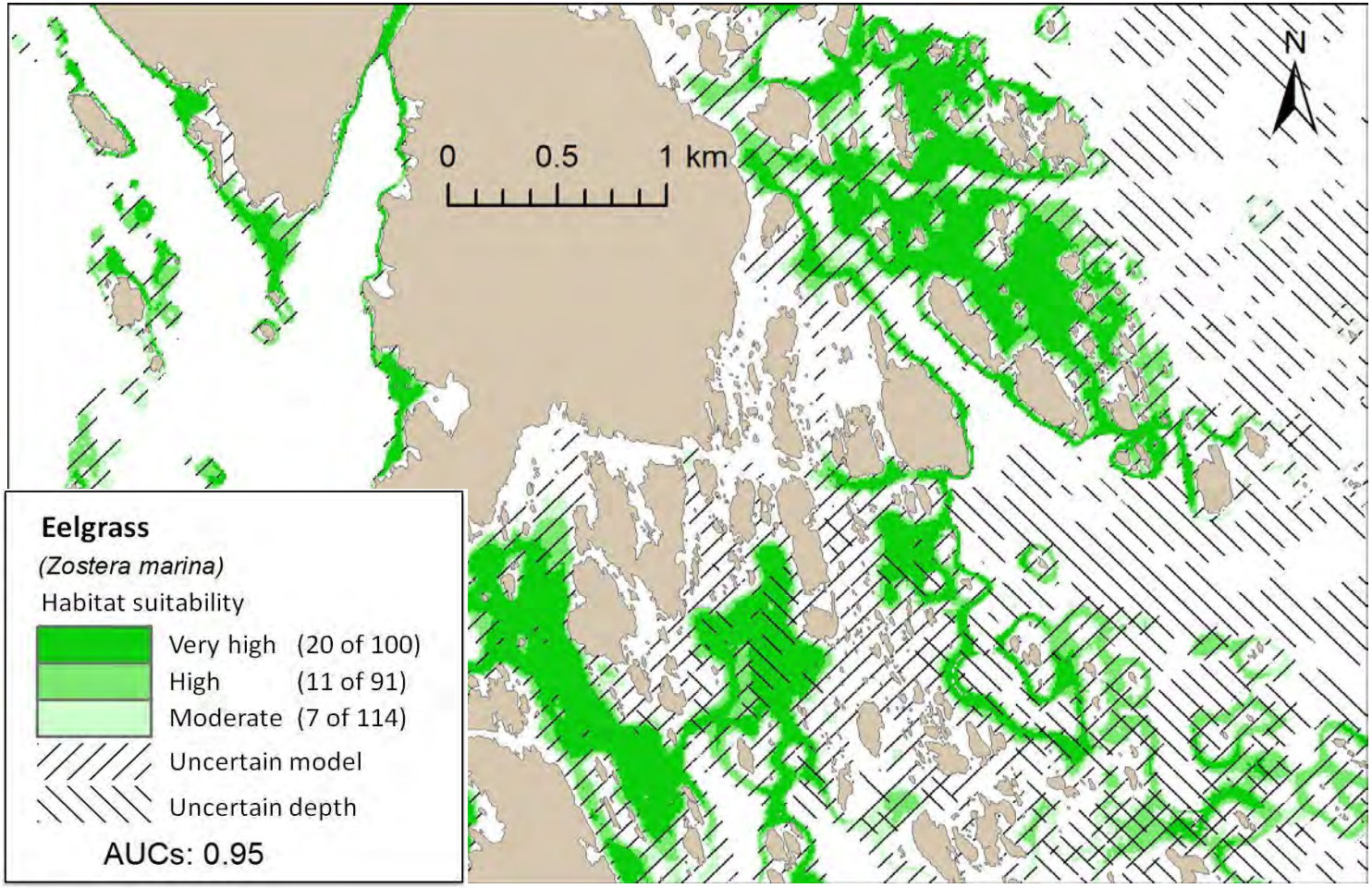


High vascular plants

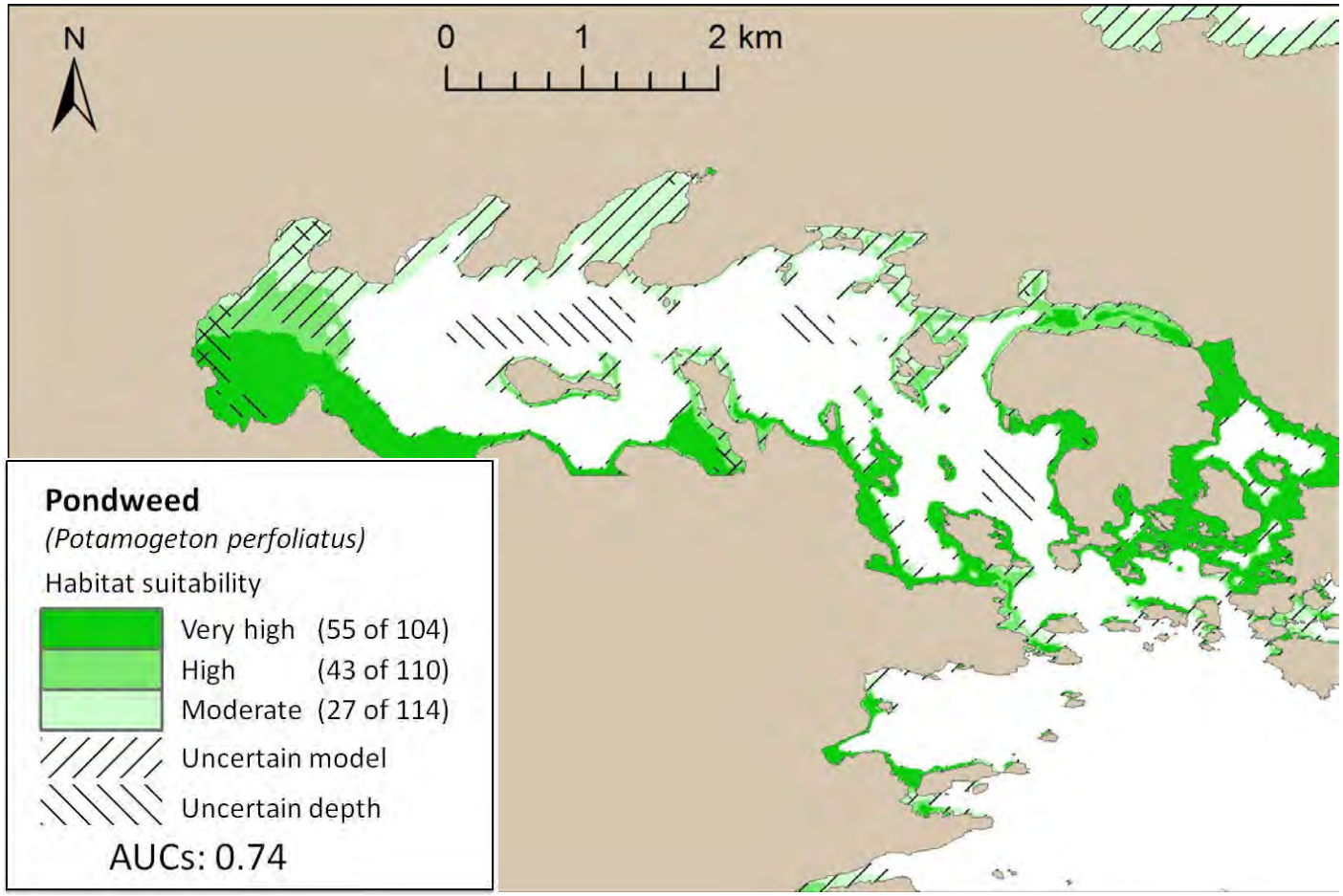
- *Probability of at least 25% cover*



Eelgrass Zostera marina – with uncertanties



Pondweed Potamogeton perfoliatus

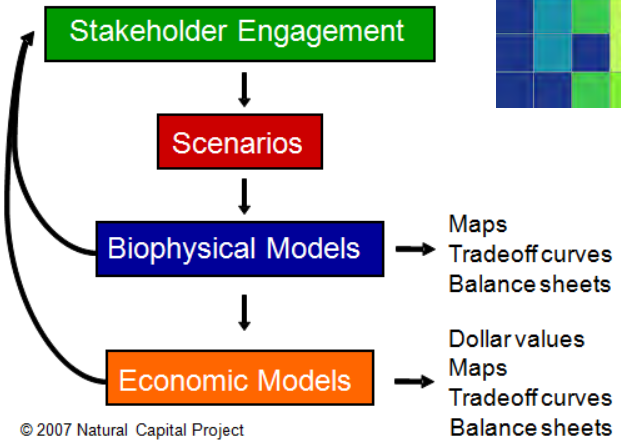


Resulting maps

- More than 50 biological maps in MARMONI
- About 10-15 improved environmental layers
- Several antropogenic layers
- Key question: How to use all this information for marine management?

Five ways of using marine biology maps for marine management

- Criteria analyses to map Natura 2000 habitats, Baltic-EUNIS
- Biological synthesis maps, i.e. conservation values or diversity clusters
- Estimation of ecosystem services (where and how much)
- Human impact analyses using scenarios
- Ocean zoning tools



Marxan
Informing Conservation Decisions Globally

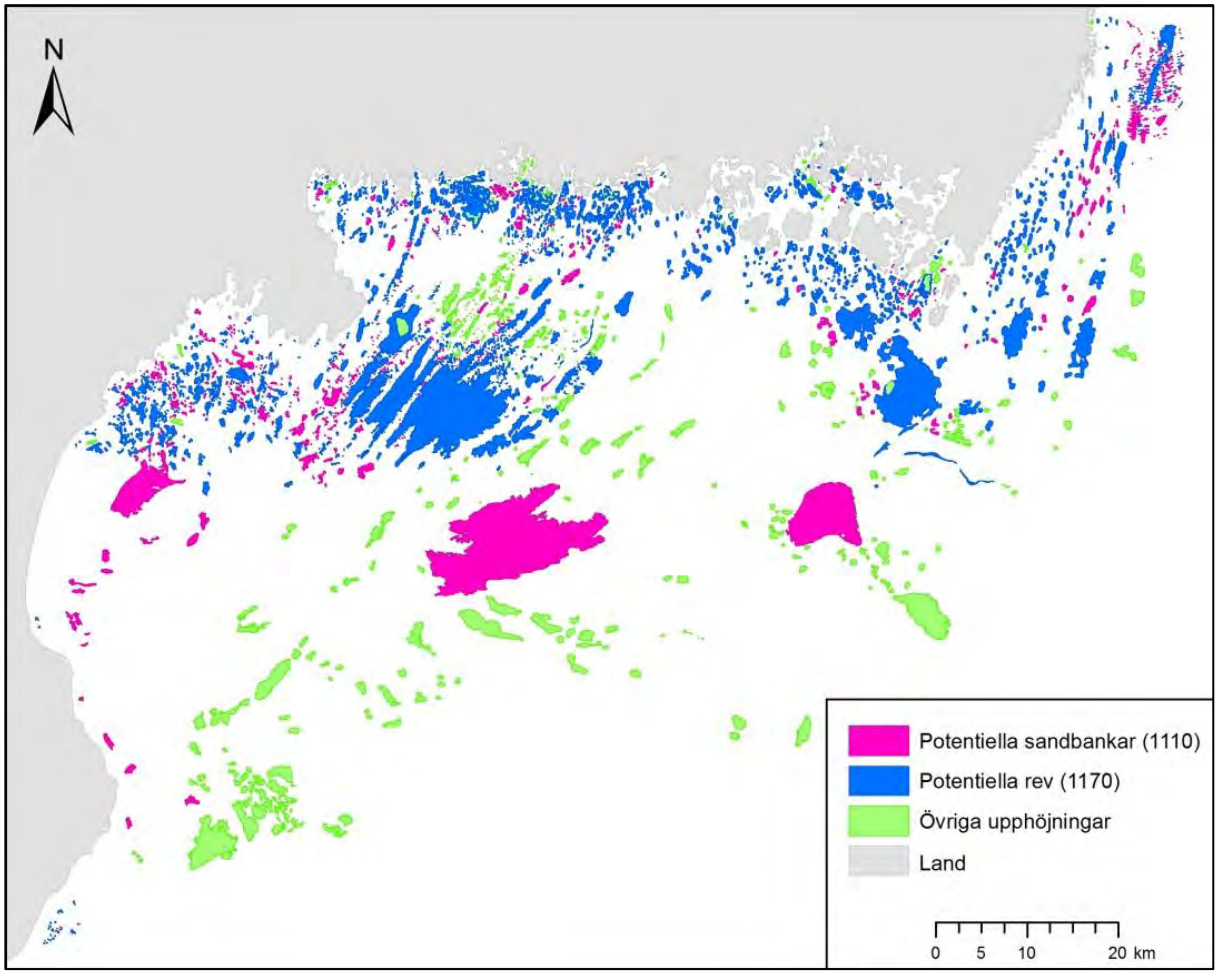
ECOSYSTEM-BASED MANAGEMENT TOOLS NETWORK

NatureServe

ZONATION
Conservation planning software

Potential Natura 2000 sandbanks and reefs (GIS-analysis)

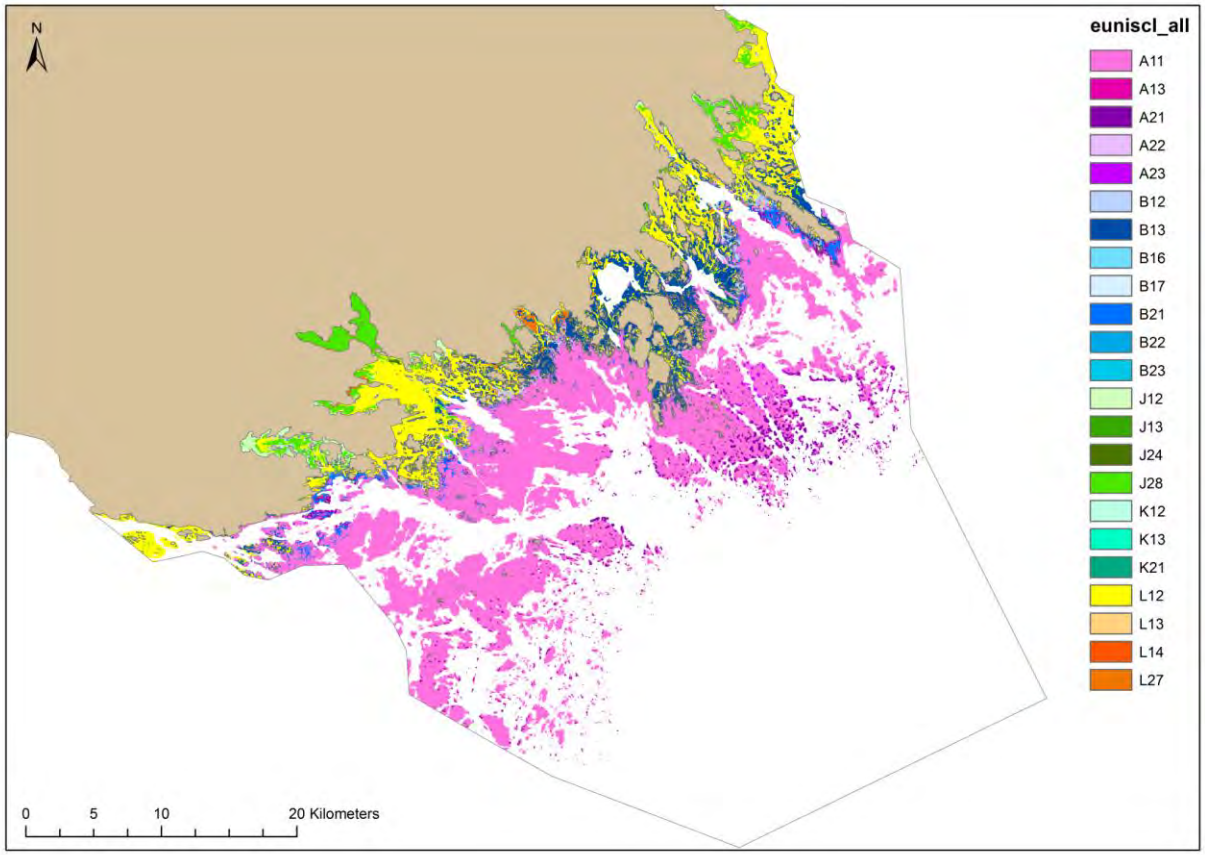
Some have later been verified using field data



HELCOM biotopes (HUB)

(Baltic EUNIS)

(modelled using random Forest)



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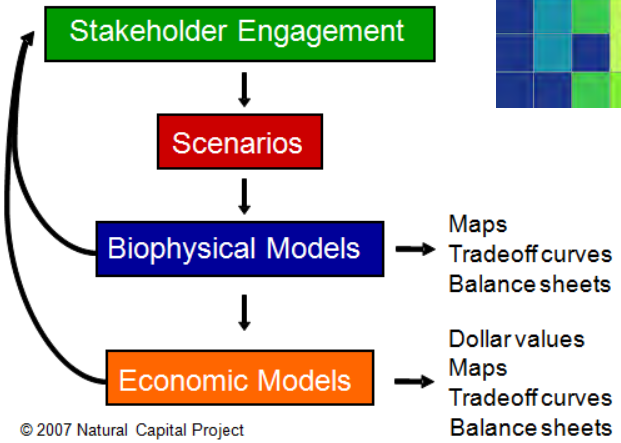

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Conservation value mapping (SUPERB)

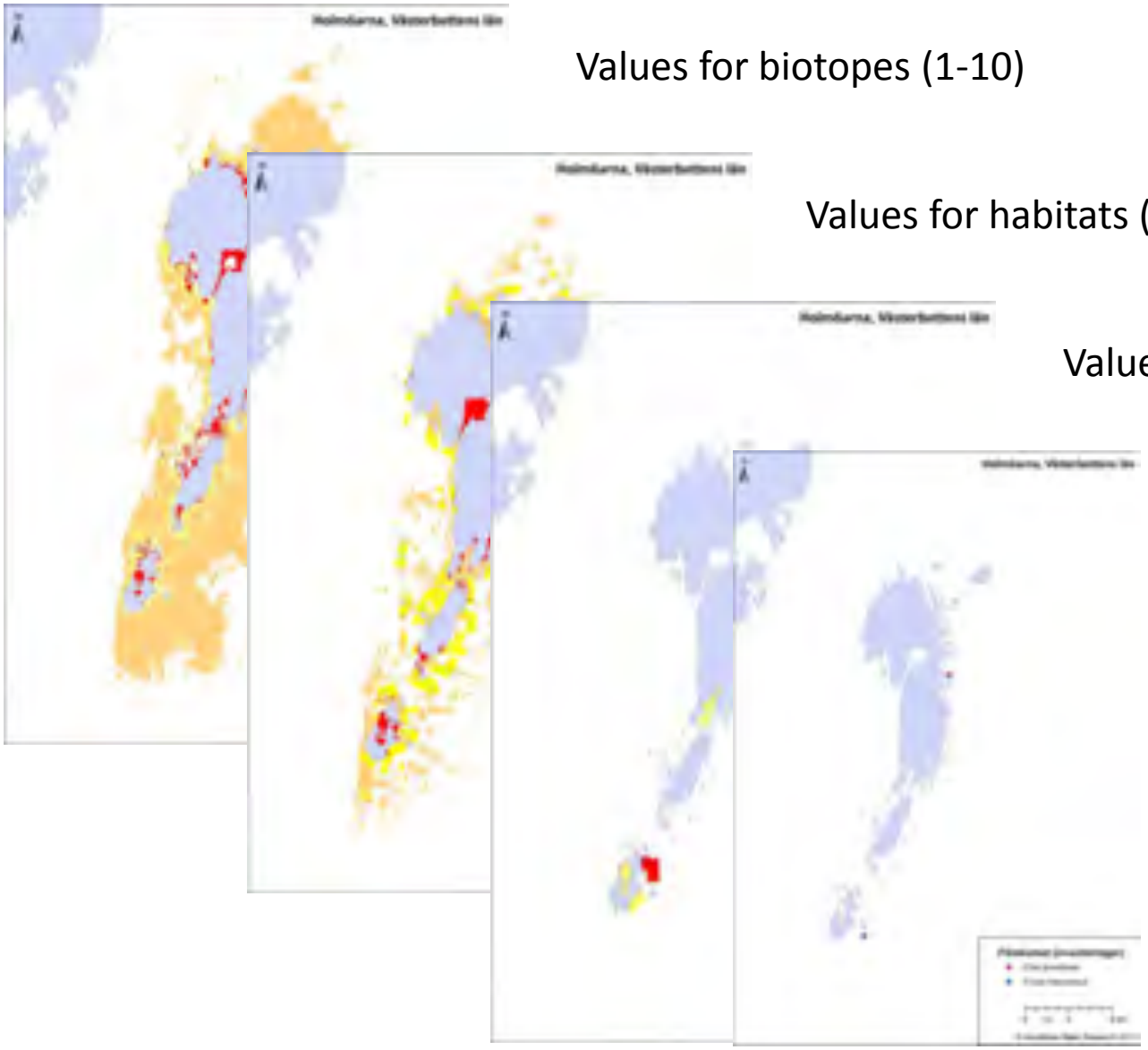
Based on

- CBD criteria
- biological maps and field data
- analyses on trophic relations
- Each biotope/habitat was assigned a value for each criterion;
  10=high value, 1=low value, 0=no value

Example: Valuation of phytobenthic biotopes

	Unique-ness	Threat	Diversity	Function		Total value
Annual algae	0	0	0	1		1
Vaucheria sp.	1	0	0	1		2
Perennial algae and moss	0	0	1	1		2
Fucus sp.	10	0	1	10		10
Perennial filamentous algae	0	0	1	1		2
Aquatic mosses (Bryophyta)	1	0	0	1		2
Submerged rooted plants	1	5	1	10		10
Pond weed (*Potamogeton perfoliatus/Stuckenia pectinata*)	1	5	1	10		10
Zannichellia spp./*Ruppia* spp.	1	5	1	1		8
Watermilfoil (*Myriophyllum* sp.)	1	5	1	10		10
Charales	1	5	1	10		10
Epibenthic fauna = Sponges (Porifera)	1	0	1	1		3

Compiling data to map of biological values



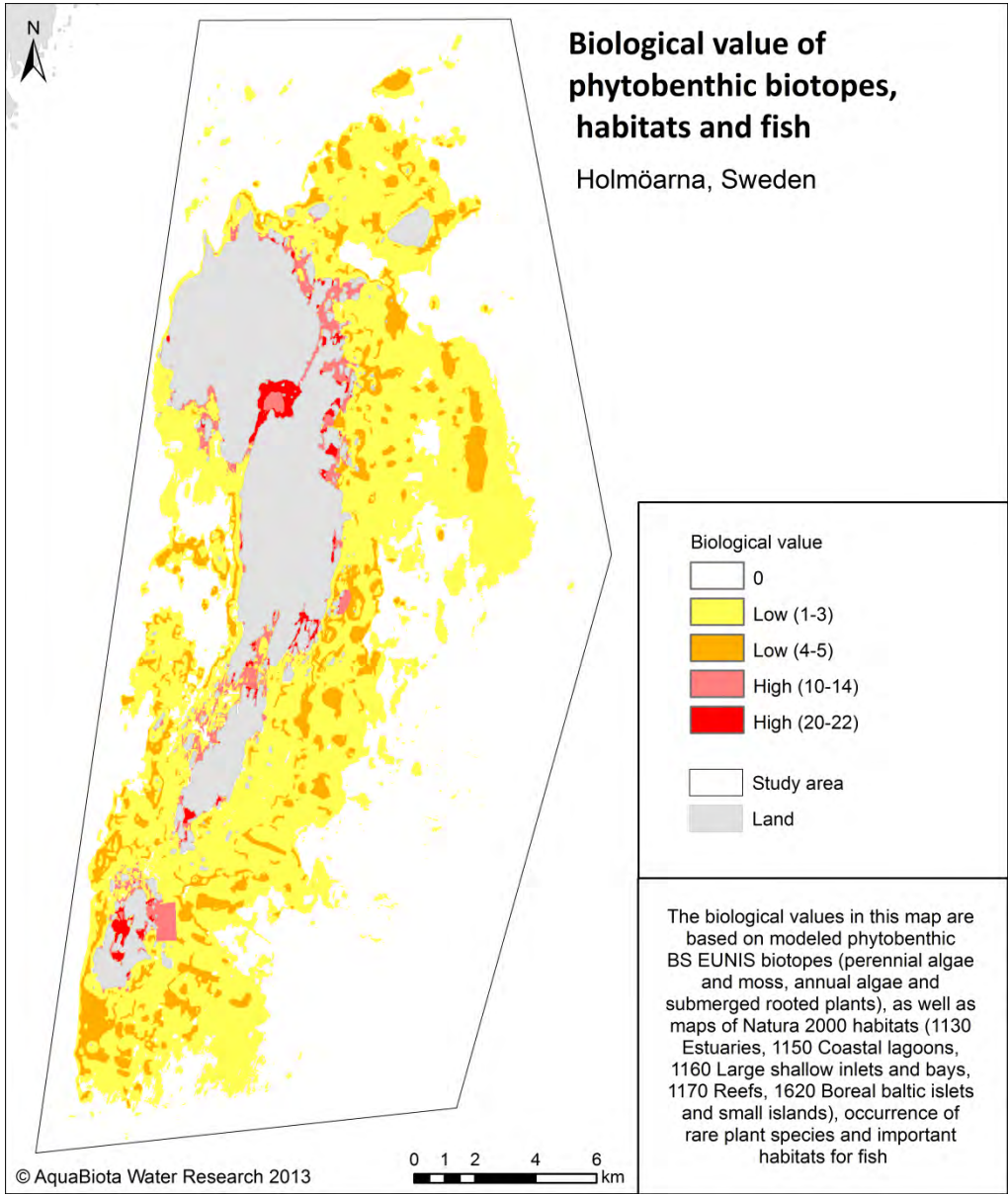
Values for biotopes (1-10)

Values for habitats (1-10)

Values for fish (1-10)

Rare plants (10)

Compiling data to map of biological values



Note: No maps for zoobenthic biotopes

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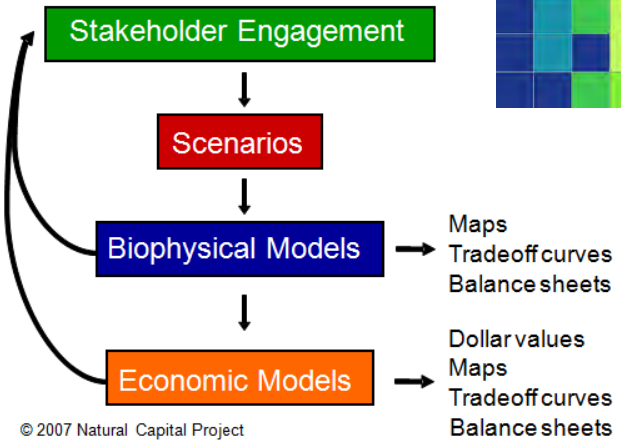

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ECOSYSTEM-BASED MANAGEMENT TOOLS NETWORK

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ZONATION
Conservation planning software

- Quantitative connection between amount of habitats and large fish population sizes (Sundblad et al 2013)
- **Identification of ecological structures (fine scale) and provision of multiple ecosystem services (fine and large scale)**
  - **Ie shallow, vegetated areas generate large fish that perform top-down control of eutrophication symptoms and human benefits such as fish(eries)**

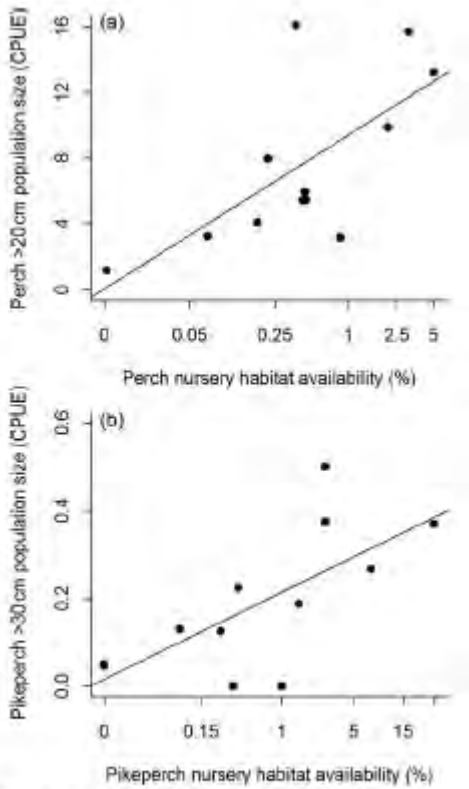
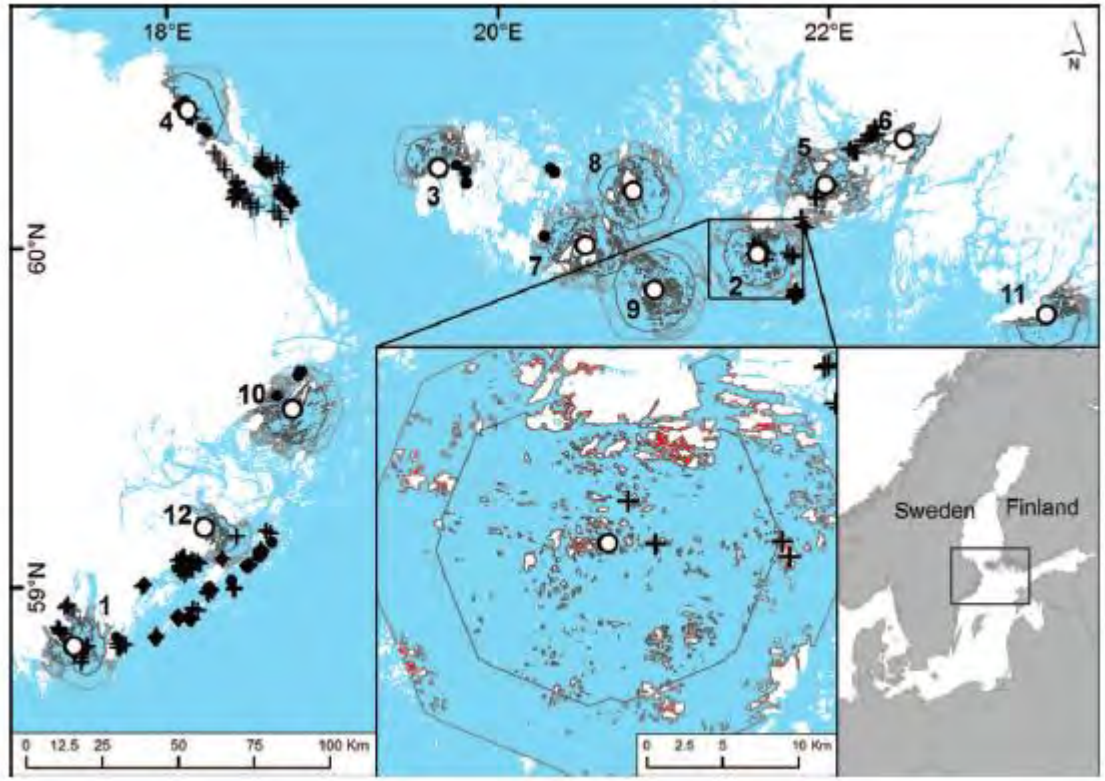
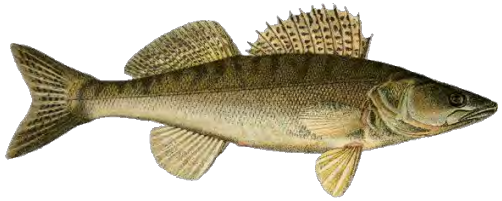


Figure 3. Adult fish population size as a function of nursery habitat availability for 12 populations of (a) perch ($r^2 = 0.46$) and (b) pikeperch ($r^2 = 0.48$) in the Baltic Sea. cpue and habitat availability were measured within the average migration distance of the 12 populations. The y-axes are presented on a ln scale.





Sundblad, G., Bergström, U., Sandström, A., Eklöv, P., 2013. Nursery habitat availability limits adult stock sizes of predatory coastal fish. ICES Journal of Marine Science: Journal du Conseil.

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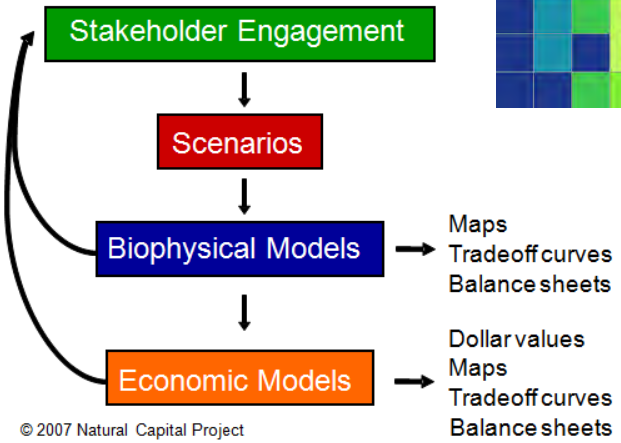

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Conservation planning software

Evaluating eutrophication management scenarios in the Baltic Sea using species distribution modelling. PREHAB

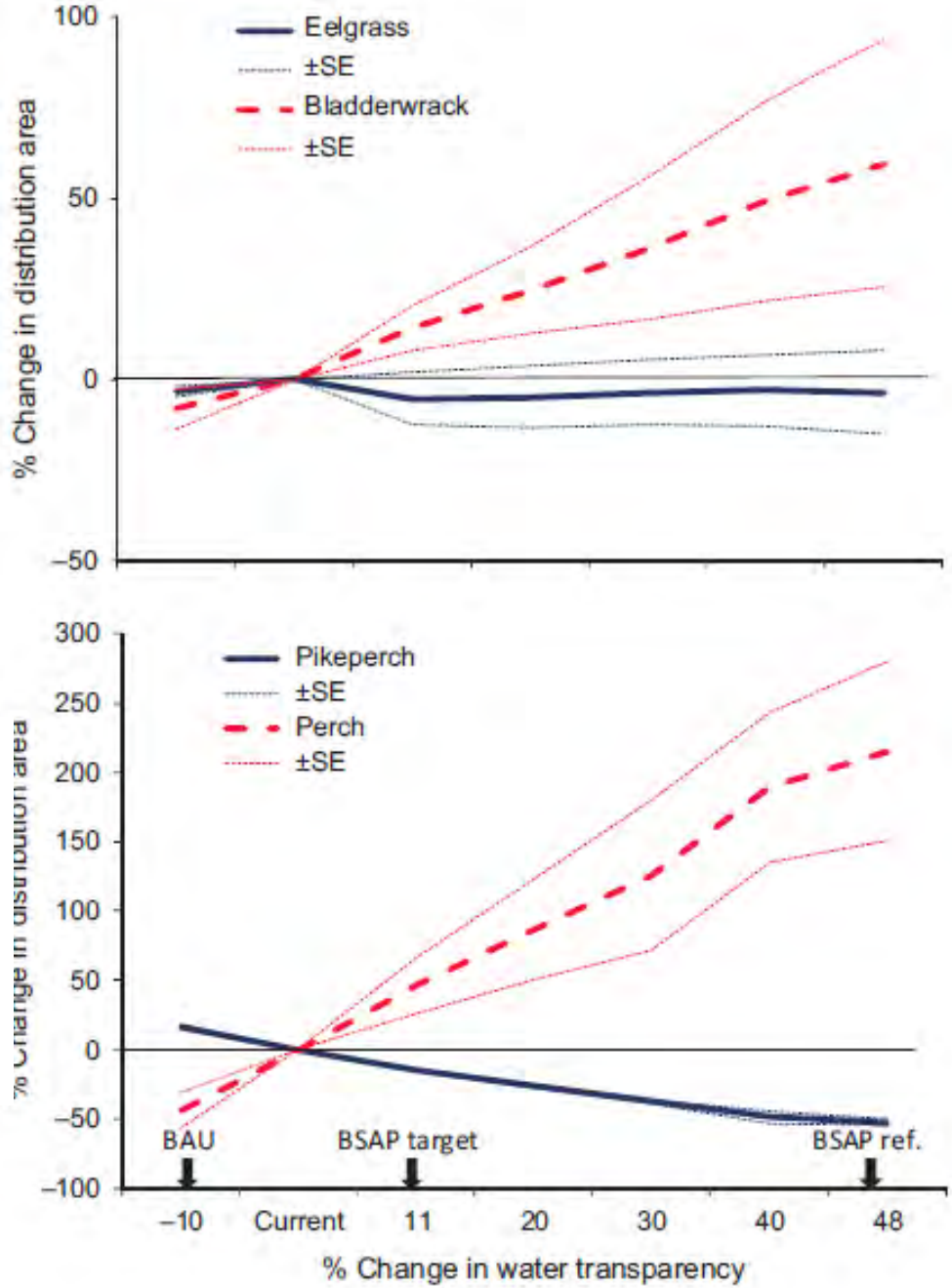

Fig. 3. Predicted effects on the distribution of bladderwrack, eelgrass and recruitment areas of perch and pikeperch as a response to changes in water transparency according to a set of eutrophication scenarios. Curves show percentage change in areal cover with changes in Secchi depth, where numbers on *x*-axis denote % deviation from current Secchi depth level. Dotted lines show standard errors of predictions from three separate modelling methods. The arrows indicate, from left to right, the Secchi depth changes according to the scenarios business-as-usual (BAU), Baltic Sea Action Plan (BSAP) target and reference levels.

Bergström, U., Sundblad, G., Downie, A.-L., Snickars, M., Boström, C., Lindegarth, M., 2013. Evaluating eutrophication management scenarios in the Baltic Sea using species distribution modelling. J. Appl. Ecol., n/a-n/a.

Conclusions from the scenarios study

- Eutrophication management (BSAP) will have species-specific effects (Bergström et al 2013)
  - Increase perch and decrease pikeperch – or vice versa
- Spatial modelling and scenarios useful for assessing alternative management decisions
- General comment on using SDM for scenarios: Causuality is expected for making scenarois. In SDM you can't assume causal relationships unless that is known from earlier studies.

Bergström, U., Sundblad, G., Downie, A.-L., Snickars, M., Boström, C., Lindegarth, M., 2013. Evaluating eutrophication management scenarios in the Baltic Sea using species distribution modelling. J. Appl. Ecol., n/a-n/a.

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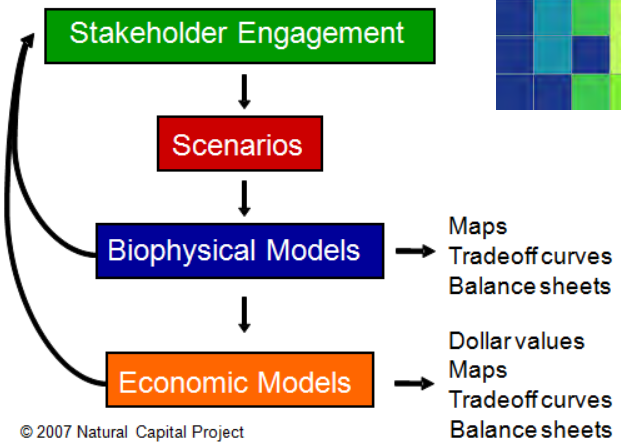

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NatureServe

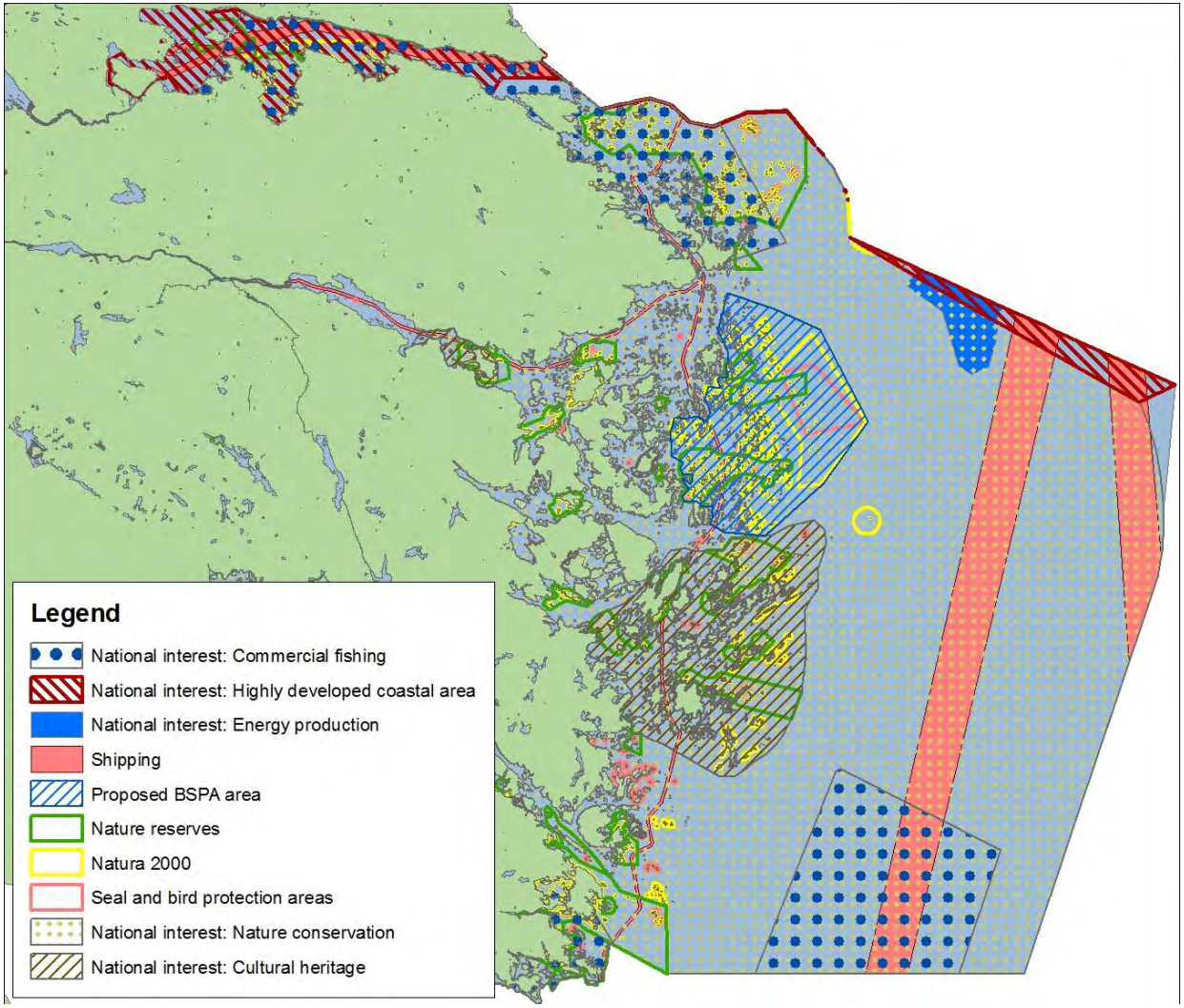
ZONATION
Conservation planning software

Ocean Zooning tools

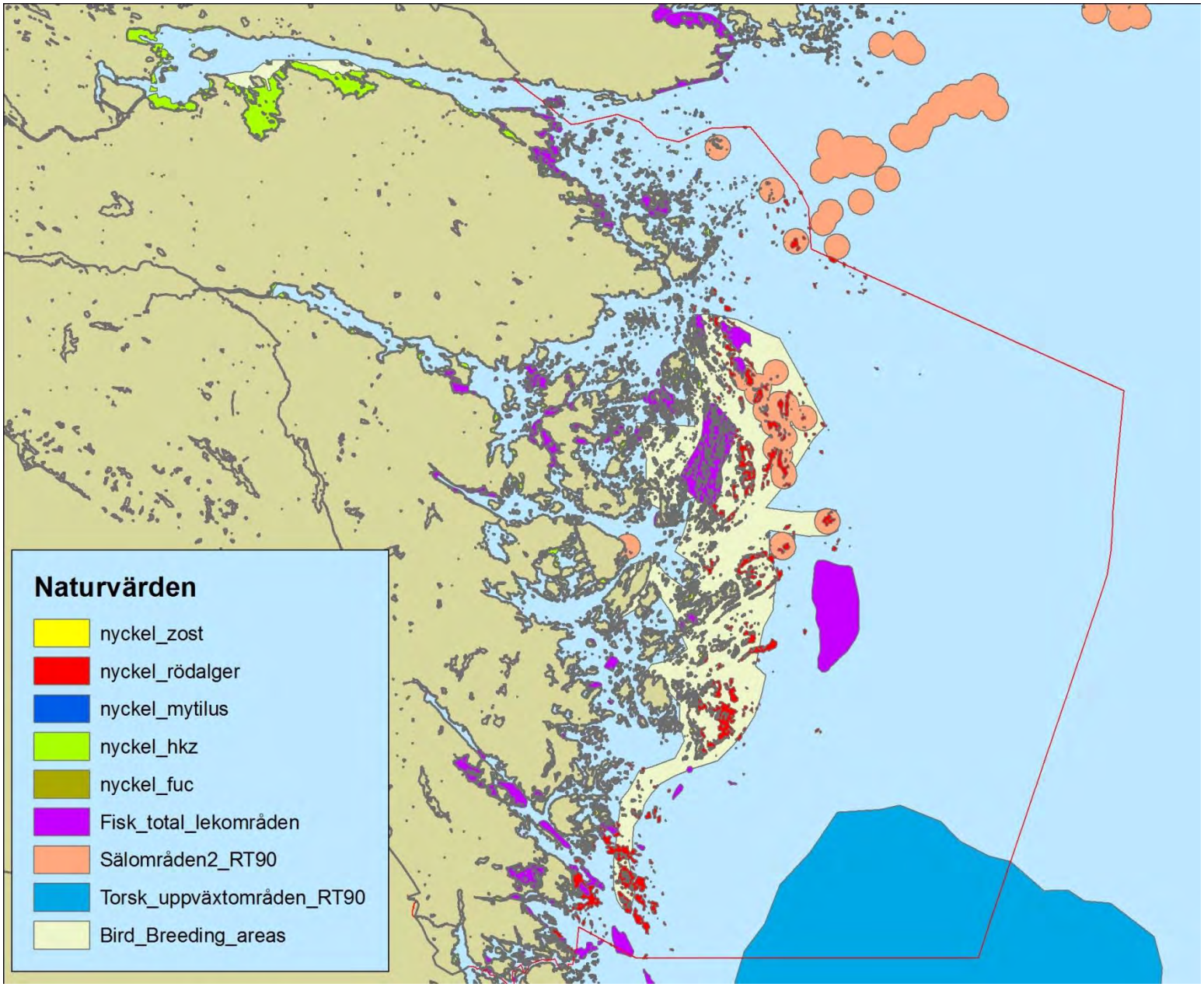
- NatureServe Vista
- Marxan & Marxan with zones
- Cumulative Impact Assessment Tool
- Zonation
- InVest
- Atlantis
- MarineMap

Marxan with zones

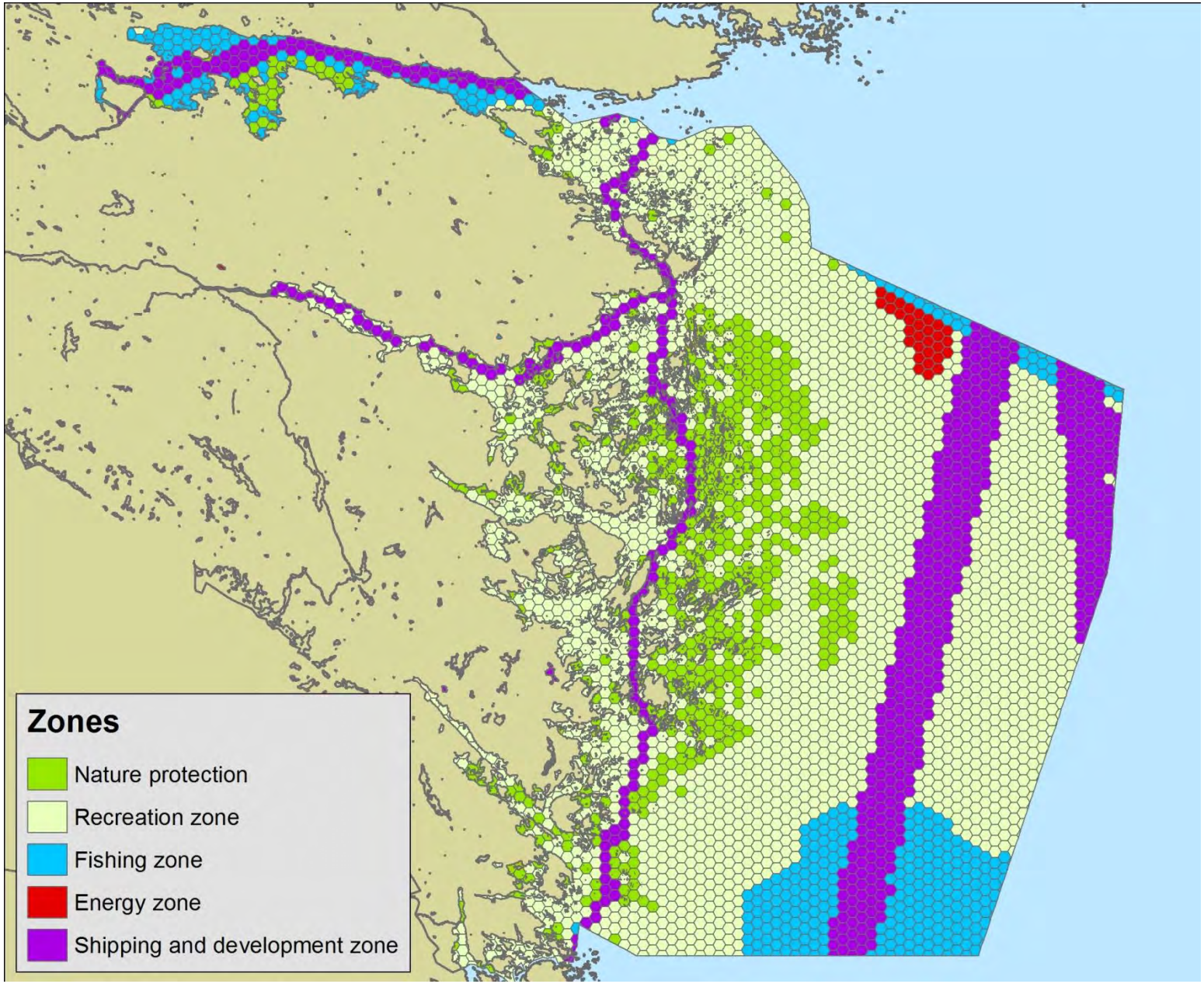
Complexity map, Östergötland , Sweden (MESMA)



Conservation values Östergötland



Example on resulting zones from Marxan analysis



Key messages

- Modeling is a possible way to produce useful ecosystem input for MSP
- Once biological maps are available, there is a variety of relevant methods and tools to aid MSP based on those maps

Acknowledgement - Links

Marmoni

www.marmoni.balticseaportal.net

PreHab

www.prehab.gu.se

SUPERB

http://www.ultra-superb.eu/

MESMA

http://www.mesma.org/

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