Data-intensive surveys provide background for maritime spatial planning
VELMU and SmartSea projects

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Markku Viitasalo / SYKE

Example of a situation where thorough inventories would have been useful:
Establishment of a national park in the Bothnian Sea

1 §
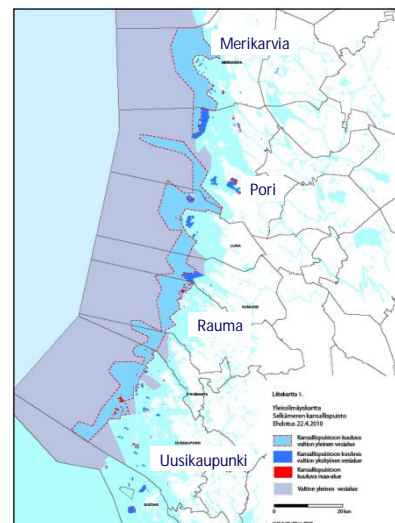"To protect the underwater nature of the open sea of the Bothnian Sea…"

"…to secure lively professional fishing…"

4 § "Fishing is allowed…"

5 § "…hunting of gray seal is allowed…
autumn hunt of waterfowl is allowed…
…possible to take measures to control the cormorant population…"

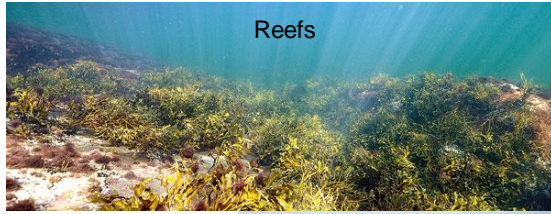http://www.finlex.fi/fi/laki/alkup/2011/20110326
Translations by M. Viitasalo

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91 200 ha, length 125 km, width 1-10 km

How to locate the most valuable habitats?

Reefs

Lagoons

M. Westerbom

Parks & Wildlife Finland

Estuaries

Underwater
sandbanks

Stony beaches

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M. Viitasalo

How to locate habitat forming and rare species?

Parks & Wildlife Finland

Bladderwrack
Fucus vesiculosus

Eelgrass *Zostera marina*

Pekka Tuuri

Blue
mussel
*Mytilus
trossulus*

*Hippuris
tetraphylla*

- Within the EU occurs only
in Finland

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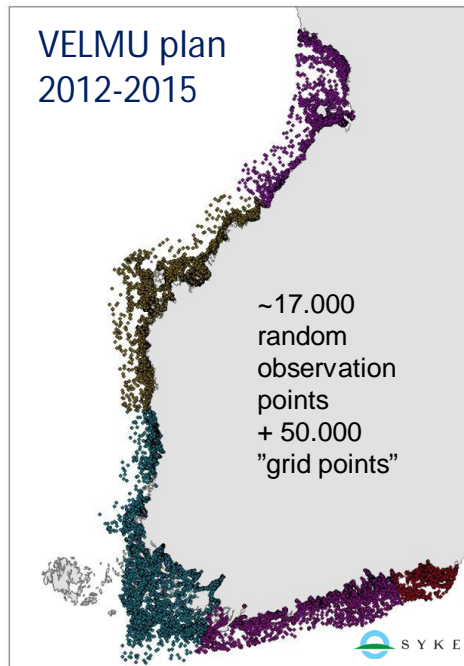
Parks & Wildlife Finland / H. Arponen

Solution

1) Make a sampling scheme that
   - has sufficient spatial coverage
   - covers the environmental gradients affecting the species
2) Use quick methods (video) complement with dives
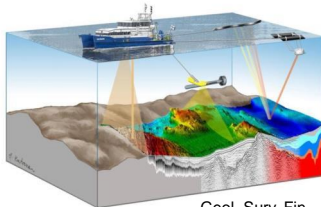3) Use species and habitat modelling

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VELMU plan 2012-2015

~17.000 random observation points
+ 50.000 "grid points"

SYKE

How were the data collected?
Geological and biological inventories

- Bottom topography, geology
- Habitats
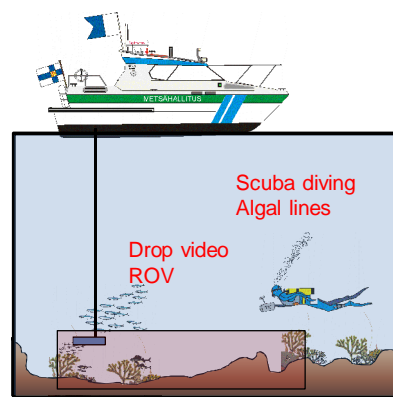- Algae and water plants
- Invertebrates
- Fish spawning areas

Geological echosounding methods

Geol. Surv. Fin. / H. Kutvonen

SYKE

Scuba diving
Algal lines

Drop video
ROV

Parks & Wildlife Finland

Benthic sampling
Sampling of fish larvae

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VELMU

VELMU partners

- Ministry of the Environment (funding and steering)
- Finnish Environment Institute (coordination)
- Coastal Centres for Economic Development, Transport and the Environment
- Parks & Wildlife Finland
- Natural Resources Institute
- Geological Survey of Finland
- Naval Research Insitute (Finnish Navy)
- Åbo Akademi University

Funding

- Ministry of the Environment: ca 1,3 M€ /year in 2011-2015

Larger EU-funded projects:
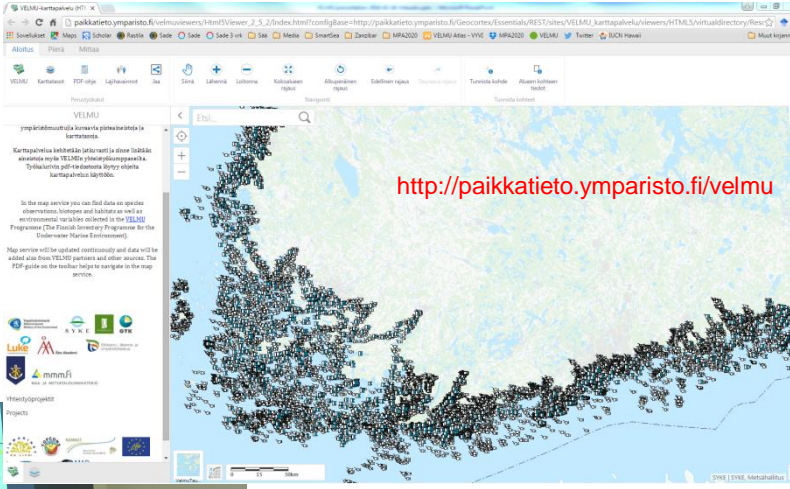

VELMU statistics

February 2016

- 122 640 observation points:
  - 95 600 video points (mainly drop-videos & ROV)
  - 23 200 dive line points, in approx 2000 dive lines
  - 1000+ benthos samples
  - 1800 Gulf-lines for fish larvae
  - 700 beach seine areas for fish larvae
  - 340 white board points for fish larvae
- 20 000 km echosounding / 784 sediment samples
- 100 000+ underwater photos

VELMU Map Portal

http://paikkatieto.ymparisto.fi/velmu

Minister Tiilikainen speaks in the opening
of the VELMU Map Portal 28.1.2016

Sukeltajaliiton ensimmäinen ympäristöpalkinto meriluonnon monimuotoisuuden kartoitukselle

Suomen ympäristökeskuksen tiedote 10.10.2016

Sukeltajaliitto on myöntänyt ensimmäistä kertaa jaetun Sukeltajaliiton ympäristöpalkinnon Vedenalaisen meriluonnon monimuotoisuuden inventointiohjelmalle (VELMU). Ohjelma kerää tietoa vedenalaisten luontotyyppien, lajien ja niiden muodostamien yhteisöjen esiintymisestä Suomen merialueilla.

Ohjelman päätavoitteena on edistää Itämeren lajien ja merialueiden suojelua sekä tukea meren ja sen luonnonvarojen kestävää käyttöä. Hankkeessa ovat mukana mm. ympäristöministeriö, Suomen ympäristökeskus SYKE sekä Metsähallituksen luontopalvelut.

Palkintojenjakotilaisuudessa, Sukeltajaliiton 60-vuotisjuhlaseminaarissa, liiton toiminnanjohtaja Sari Nuotio sanoi VELMU-hankkeen poikkeuksellisen laajan tiedonkeruun olleen keskeinen palkitsemisperuste.

Lue koko tiedote (www.ymparisto.fi)

Palkintoa vastaanottamassa Metsähallituksen luontopalvelujen Jan Ekebom, Mats Westerbom, Heidi Arponen ja Maiju Lankinen, SYKEn Wilma Viljanmaa ja ympäristöministeriön Penina Blankett. Kuva © Kristiina Karila.

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"VELMU Atlas"

- An encyclopedia, atlas and photo book of the Finnish underwater marine environment; to be published in 2017
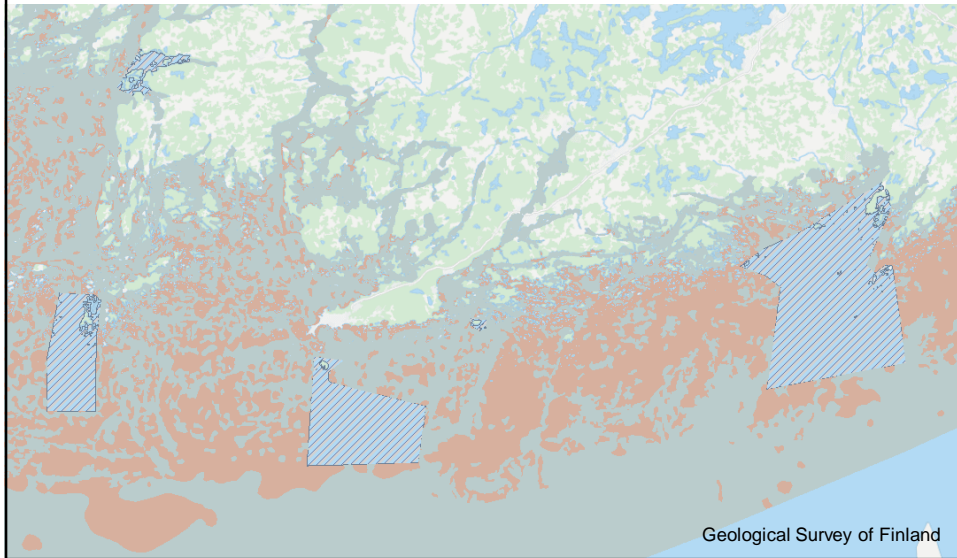

Juuso Haapaniemi

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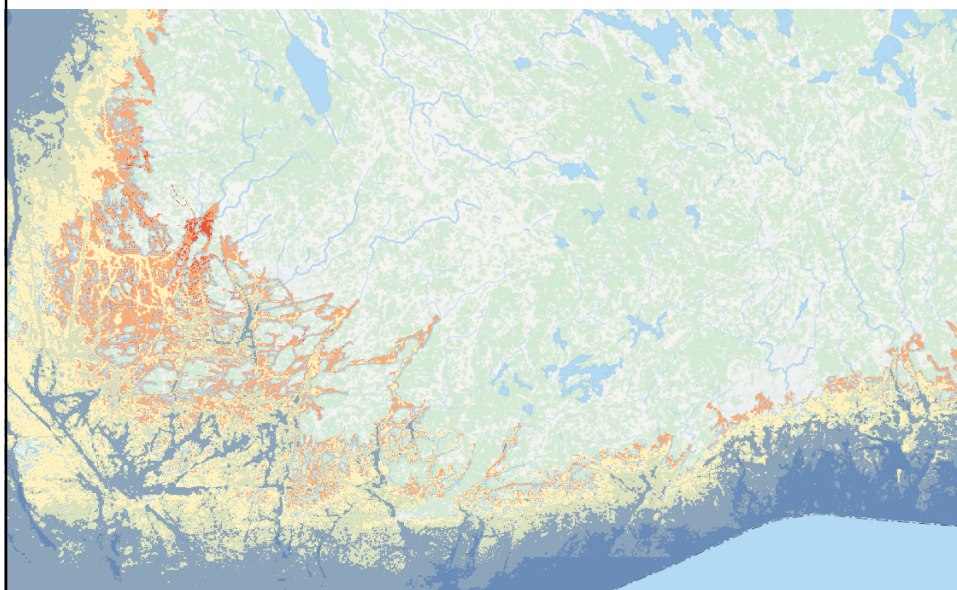
Examples of end products of VELMU

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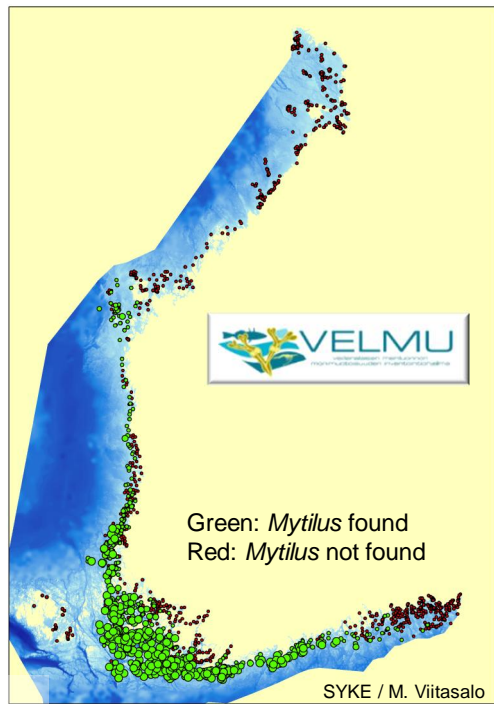Geological maps
Hard (red) and soft (blue) bottoms

Geological Survey of Finland

Environmental variables
Water temperature at bottom

Geographical distribution maps
Blue mussel *Mytilus trossulus*

Parks & Wildlife Finland / H. Arponen
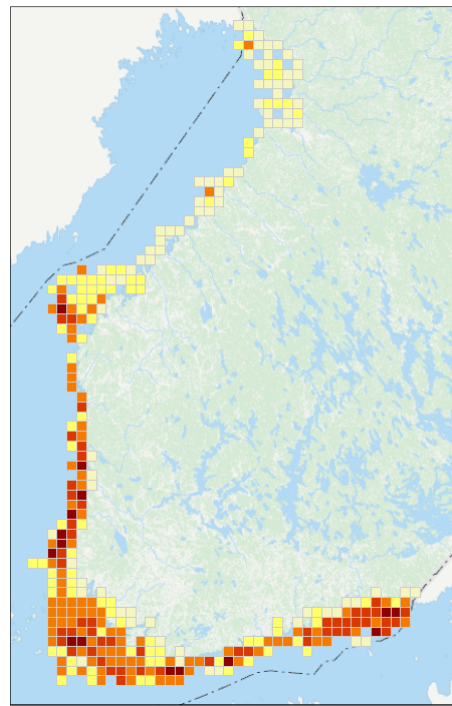

Green: *Mytilus* found
Red: *Mytilus* not found

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Biodiversity maps
Number of algal genera

Parks & Wildlife Finland / L. Kurvinen

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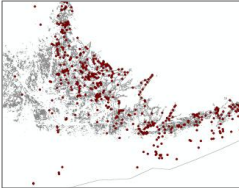
Species Distribution Models (SDM's)

Eelgrass *Zostera marina*
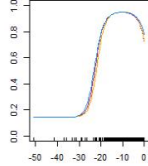
18

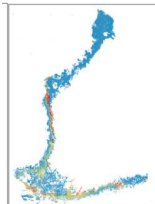Species Distribution Models (SDM's)

Species observations

- Point data; 82 000 points used
- Randomized to two datasets

Data matrix

A	B	C
Mytilus	yc	xc
0	59,8110	23,7658
0	59,8432	23,7745
0	59,8432	23,7746
0	59,8431	23,7746

Model fits & evaluation

- 39 raster layers (10-20 used)
- Depth, exposure to wind, nutrients, slope, light…
- Resolution 20 m
- 900 millions cells; 140 GB

Environmental (predictor) variables

Distribution maps of predictions

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Creating SDMs with R on Taito

- Serial computation
  - Batch jobs
  - Simple code; reasonably short runs (5-10 hours)

- R packages
  - Raster; Gbm & dismo; PresenceAbsence

- Workflow
  - Read species data from tables; Read rasters and stack them
  - Fit the model using species observations and environmental variables
  - Predict species' probability of occurrence for each cell of the grid
  - Intensive computing – all raster layers used
  - Calculate Presence-Absence raster (1/0) using classification statistics
  - Write the model as raster
  - Validate the model using a separate observation dataset
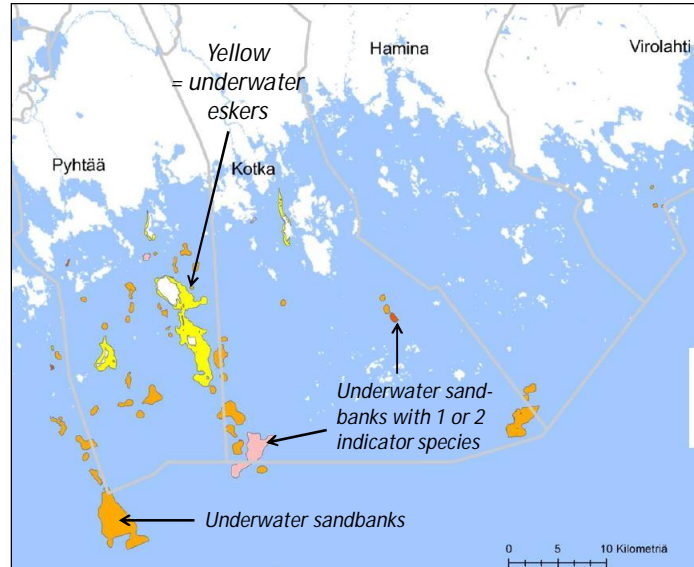
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Usage of VELMU data in maritime spatial planning

Example:
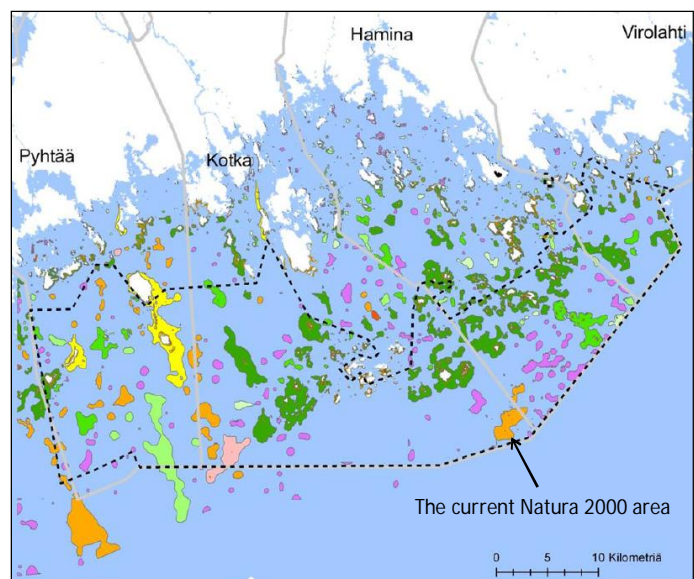Kymenlaakso Regional Plan

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Underwater eskers and sandbanks,
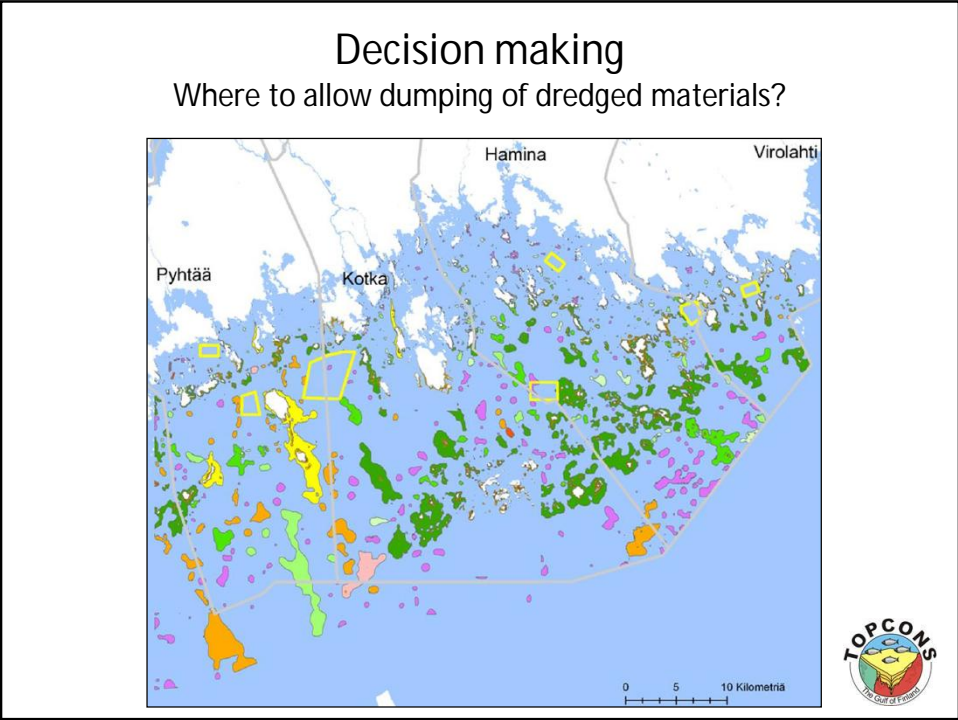and their indicator species

Yellow = underwater eskers

Hamina

Virolahti

Pyhtää

Kotka

Underwater sandbanks with 1 or 2 indicator species

Underwater sandbanks

0 5 10 Kilometriä

Kymenlaakso Spatial Plan

Summary graph
Eskers, sandbanks, reefs, algae and indicator species

Hamina

Virolahti

Pyhtää

Kotka

The current Natura 2000 area

0 5 10 Kilometriä

Decision making
Where to allow dumping of dredged materials?

Gulf of Bothnia as Resource for Sustainable Growth

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- Academy of Finland - Strategic Research Council
- 2015-2020; 8.5 milj. €
- Coordinator Jari Haapala, Finnish Meteorology Institute
- Smartsea.fmi.fi

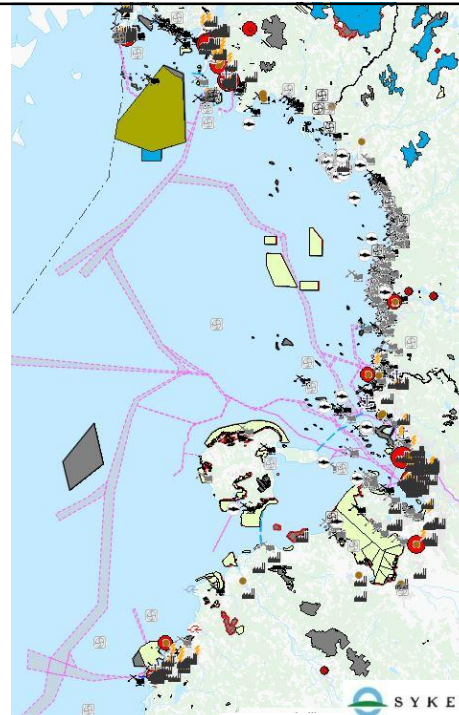- "Blue Growth is the long term strategy to support sustainable growth in the marine and maritime sectors."
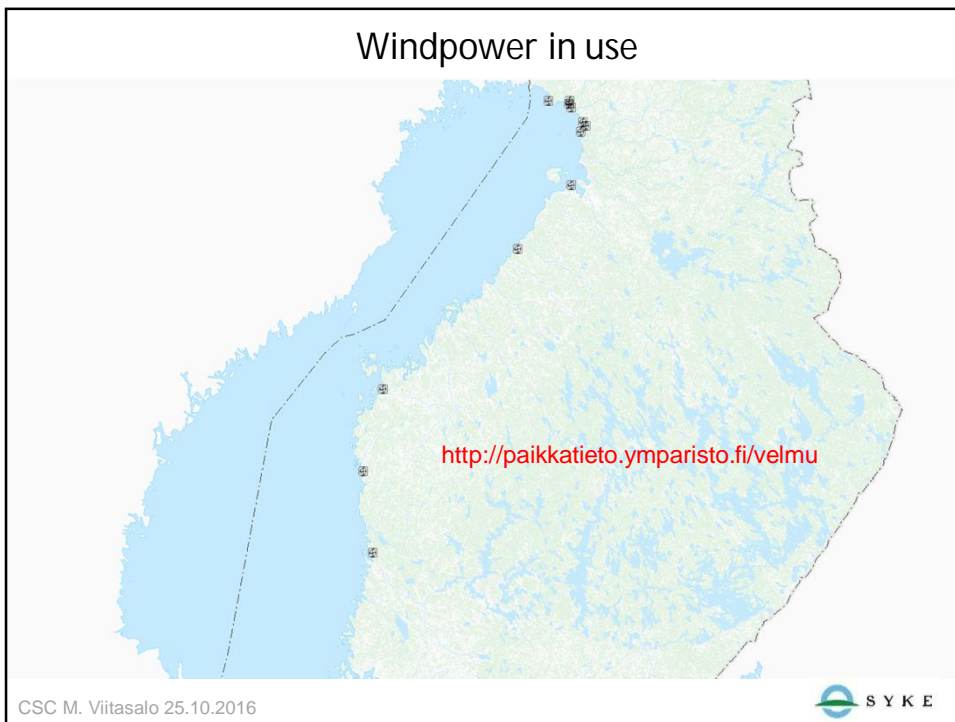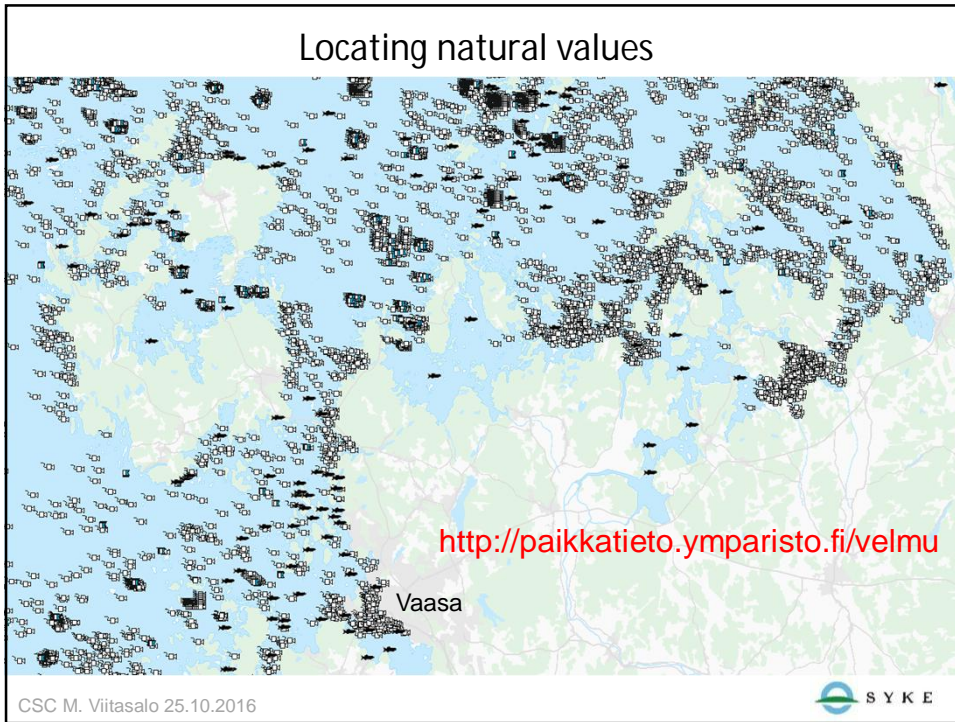 - http://ec.europa.eu/maritimeaffairs/policy/blue_growth/index_en.htm

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Identifying and locating human activities

Example: Bothnian Bay

http://paikkatieto.ymparisto.fi/velmu

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Locating natural values

http://paikkatieto.ymparisto.fi/velmu

Vaasa

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Windpower in use

http://paikkatieto.ymparisto.fi/velmu

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S Y K E

Windpower under planning

http://paikkatieto.ymparisto.fi/velmu

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SYKE
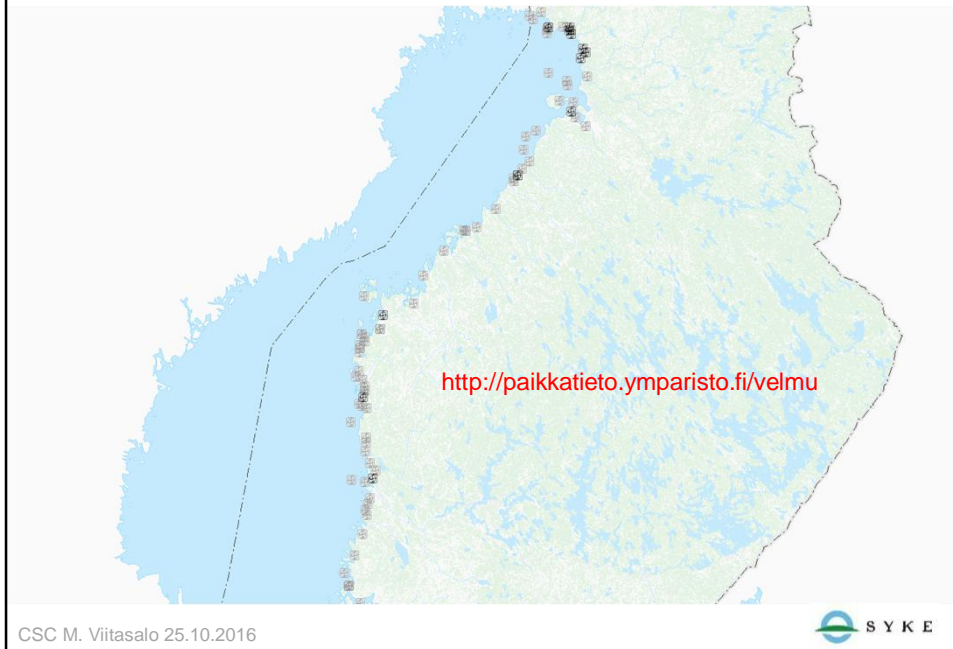
"Multi-use of ocean's space"

Green and Blue concept http://www.troposplatform.eu/
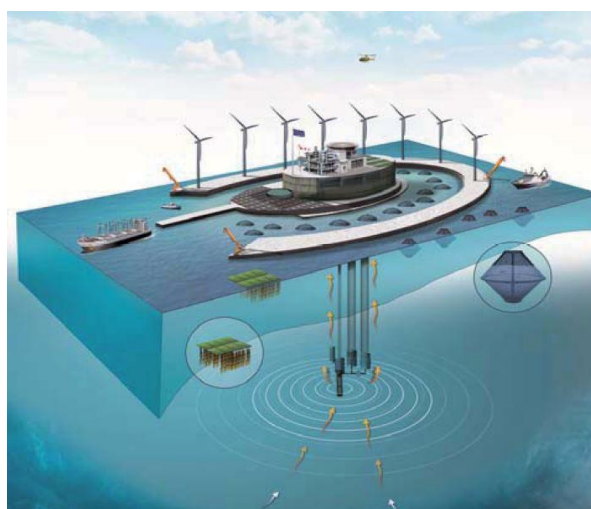
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"Multi-use of ocean's space"

Leisure Island concept   http://www.troposplatform.eu/

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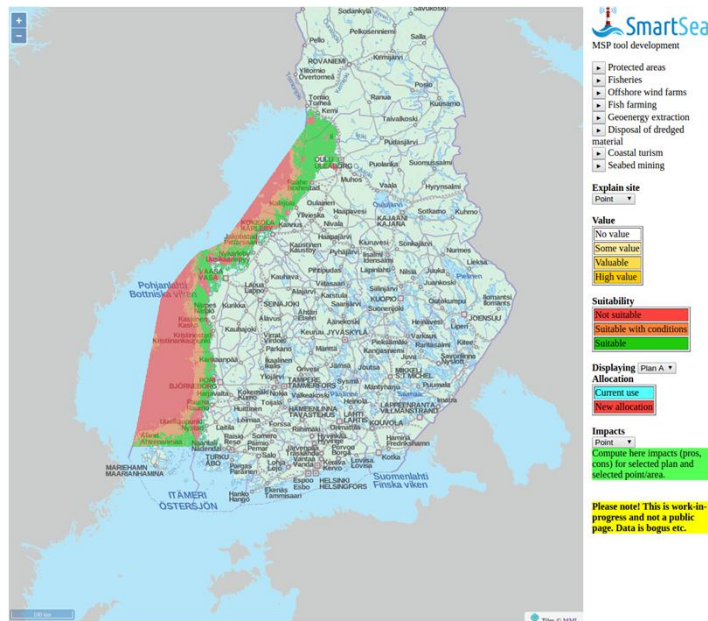
"Multi-use of ocean's space" - SmartSea

- Can wind power and fish farming be combined?
- Where should such "Blue Growth Oases" be located

VTT / Jaakko Heinonen

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SmartSea Marine Spatial Planning tool

Summary

1. VELMU: A lot of new observations on geology, habitats and species

2. Information can be used in conservation and sustainable use of the marine ecosystem, and in maritime spatial planning (e.g. SmartSea)

3. Large amounts of spatial data => CSC needed
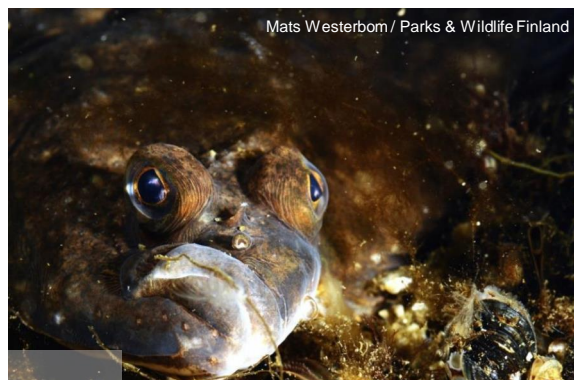
Mats Westerbom / Parks & Wildlife Finland

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