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## Environmental vulnerability and cumulative risk spatial profiles – Gulf of Finland project area

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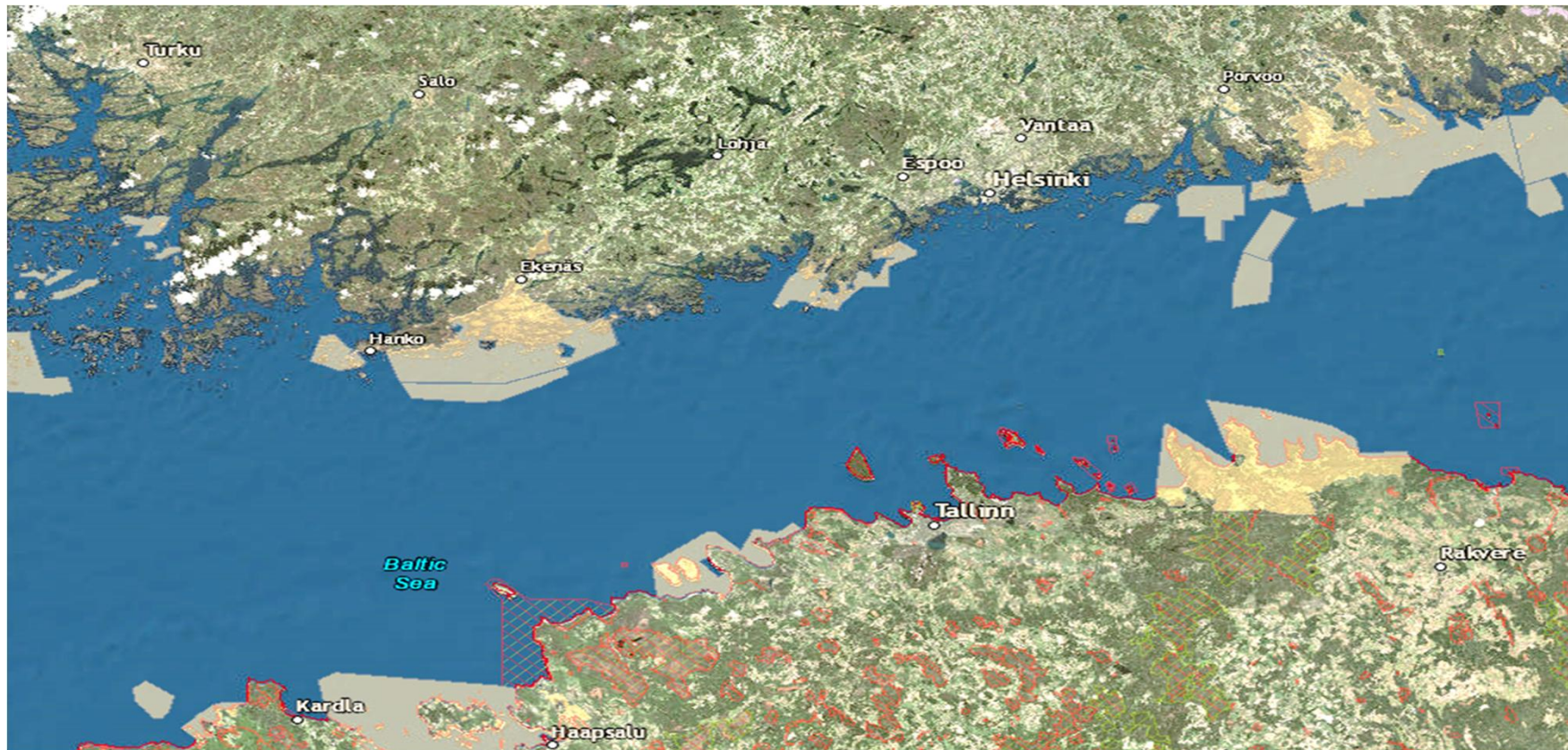
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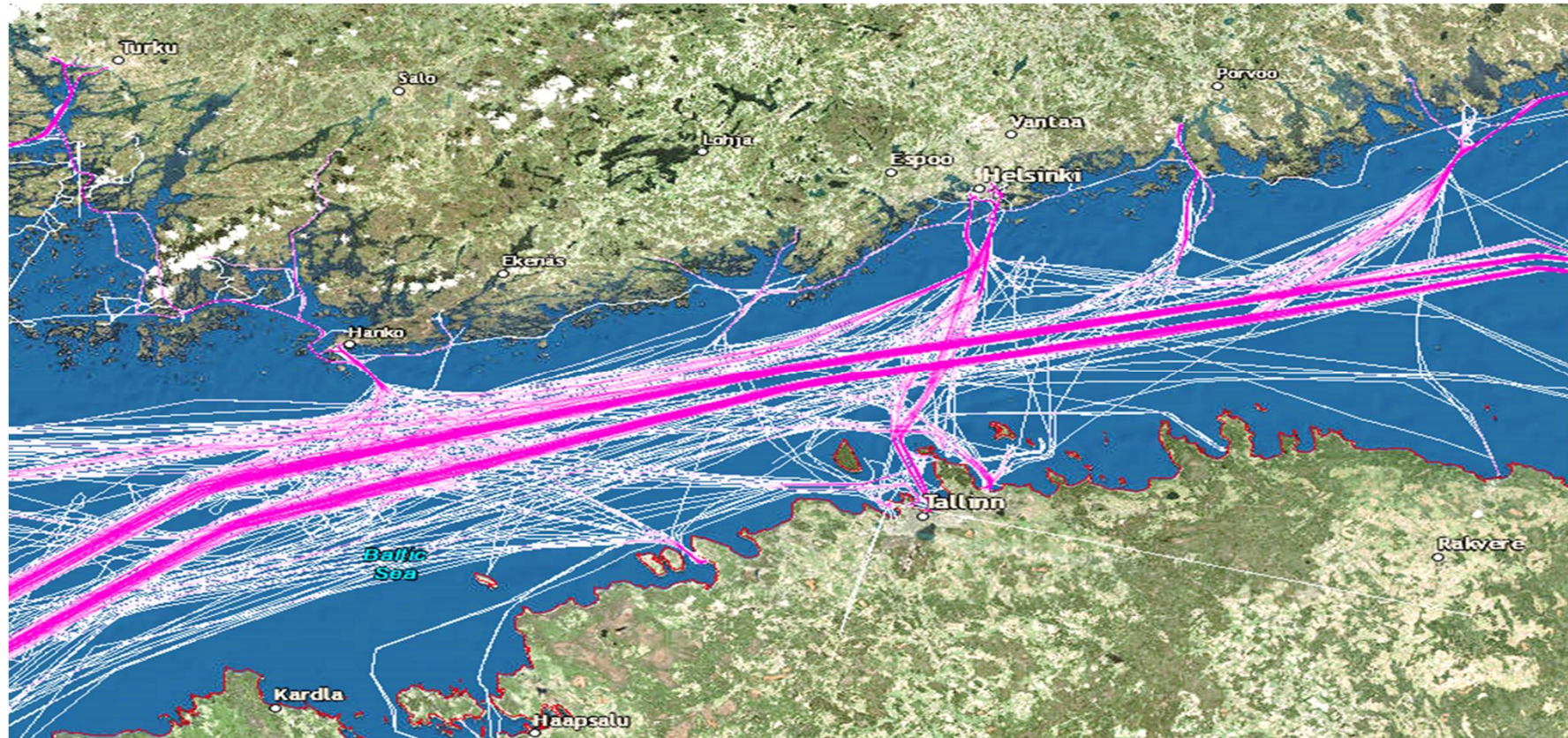




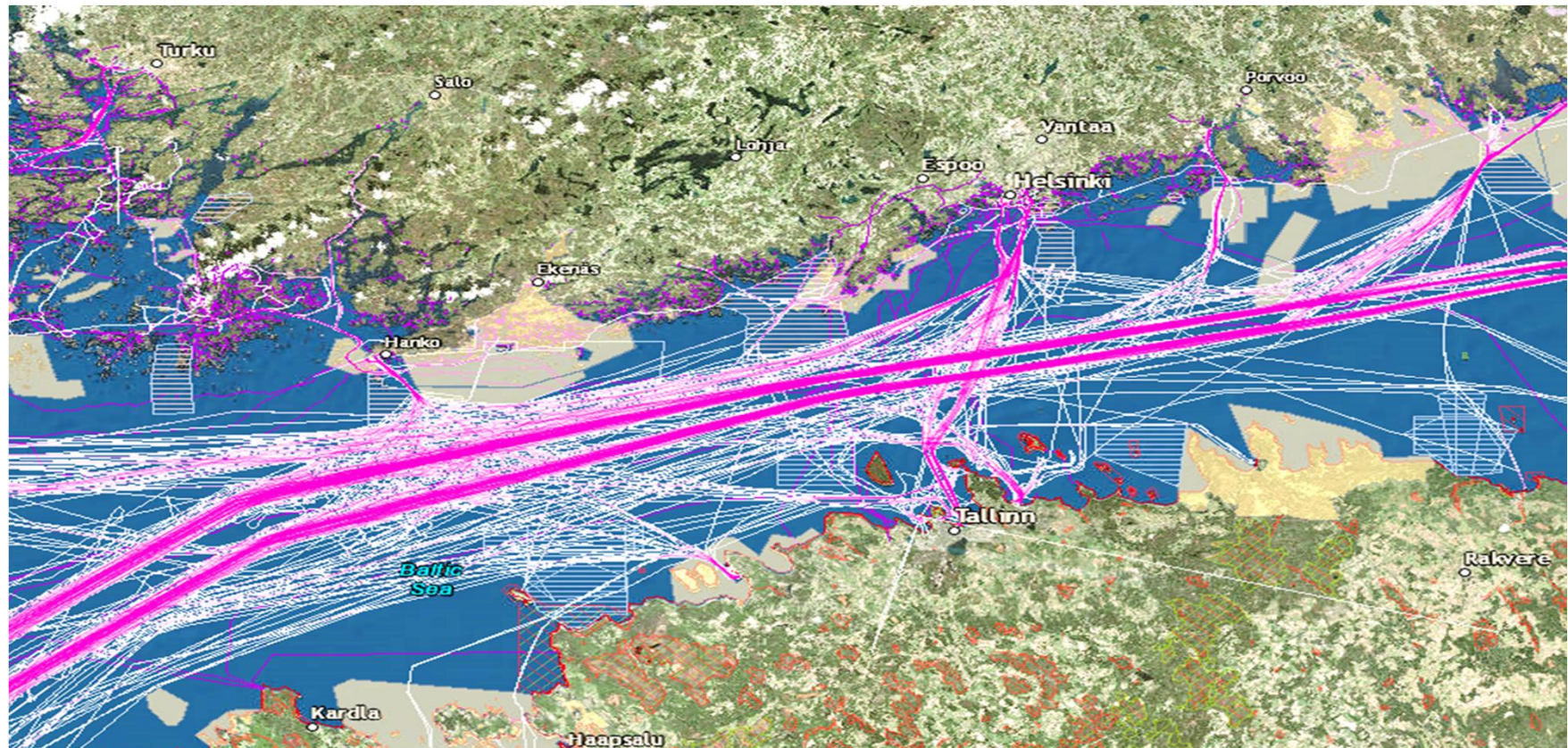
# Sensitive environment



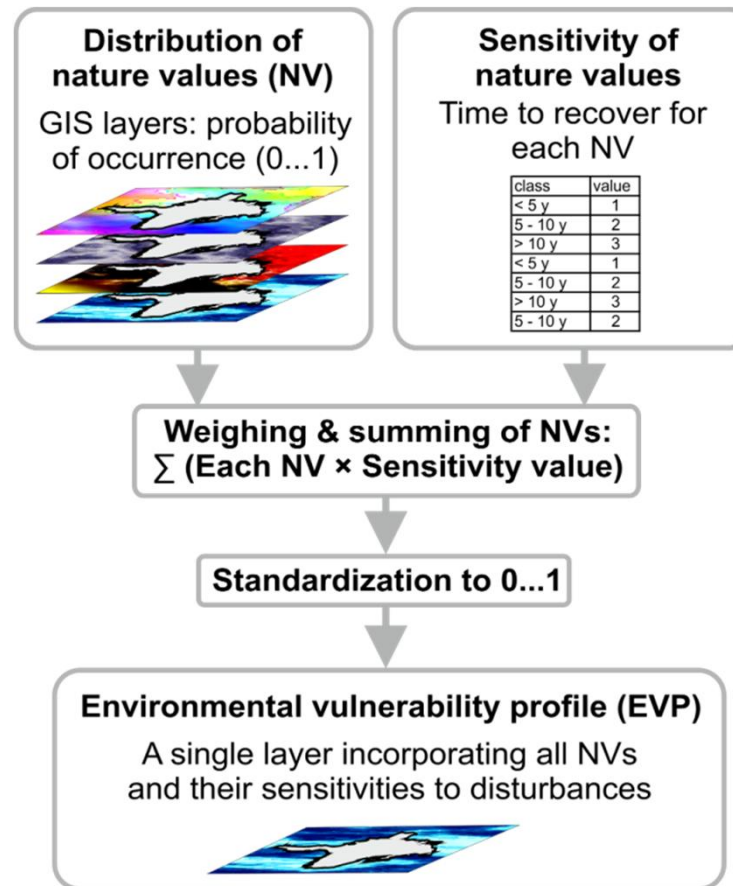
# Heavy maritime traffic



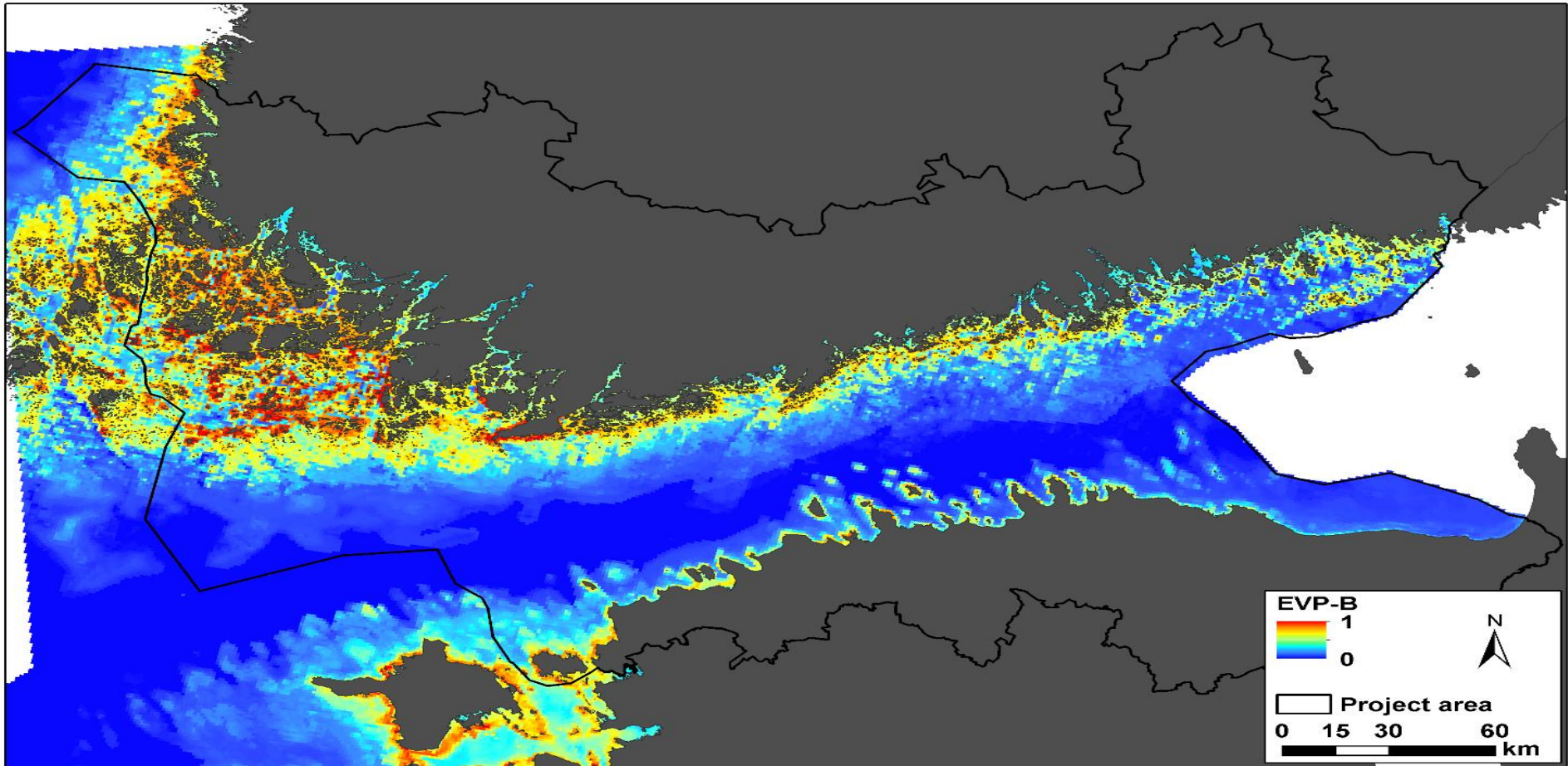
# Multi-use of marine space



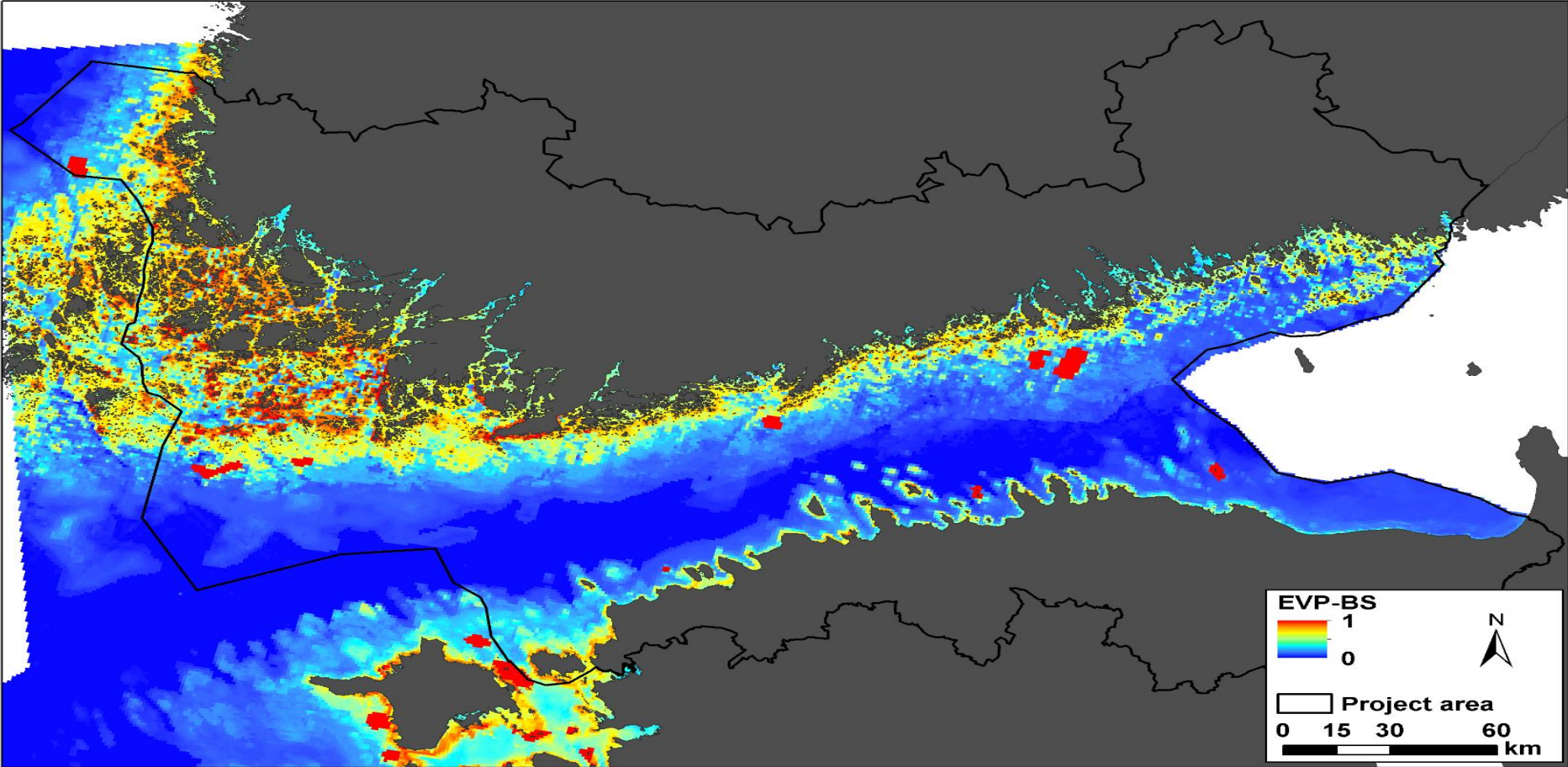
# Environmental Vulnerability Spatial Profile



# Environmental Vulnerability Profile - Benthic Nature Values

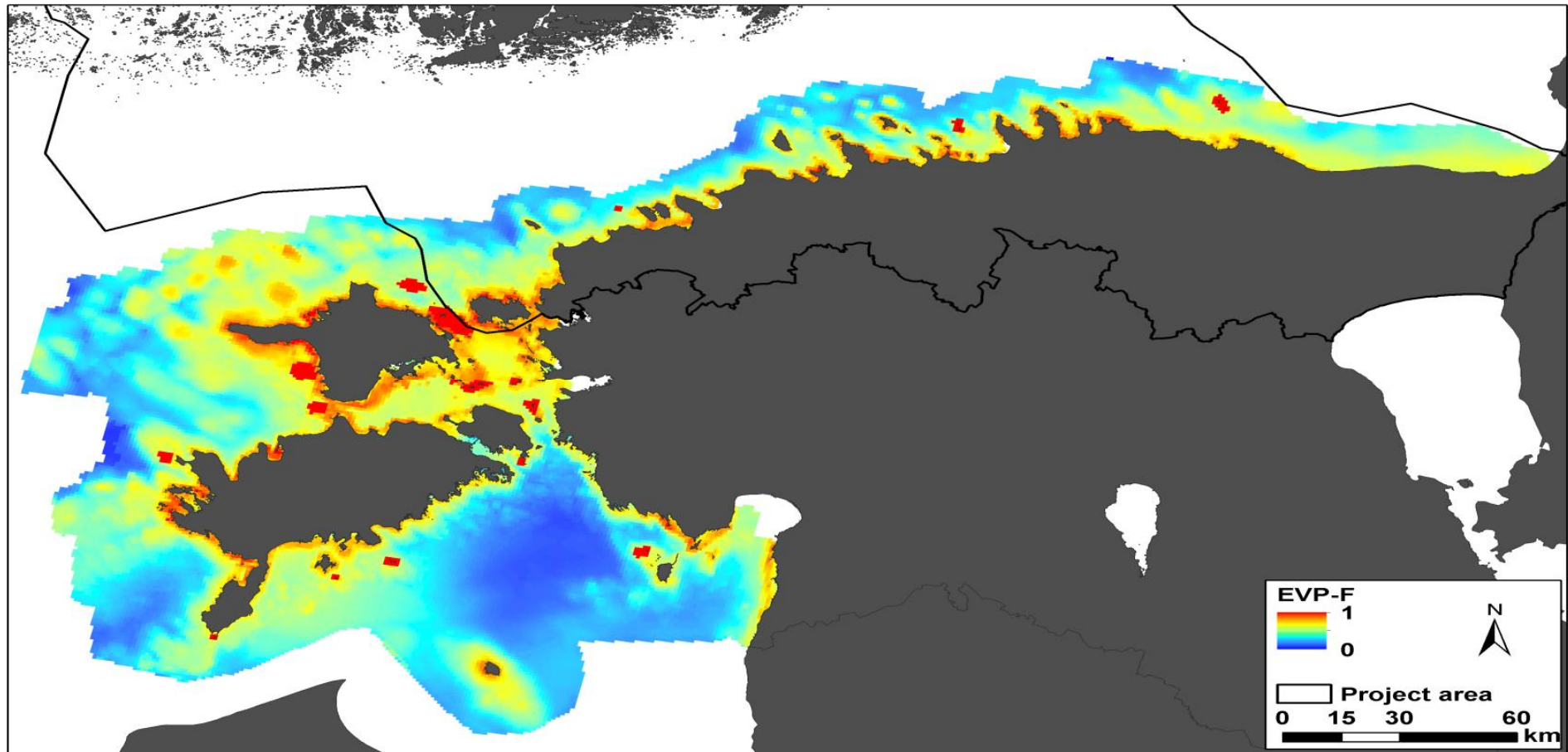


# Environmental Vulnerability Profile – Benthic Nature Values + Seals





## Environmental Vulnerability Spatial Profile – Benthic Nature Values + Seals + Birds



**Baltic Sea Environment Proceedings No. 125**

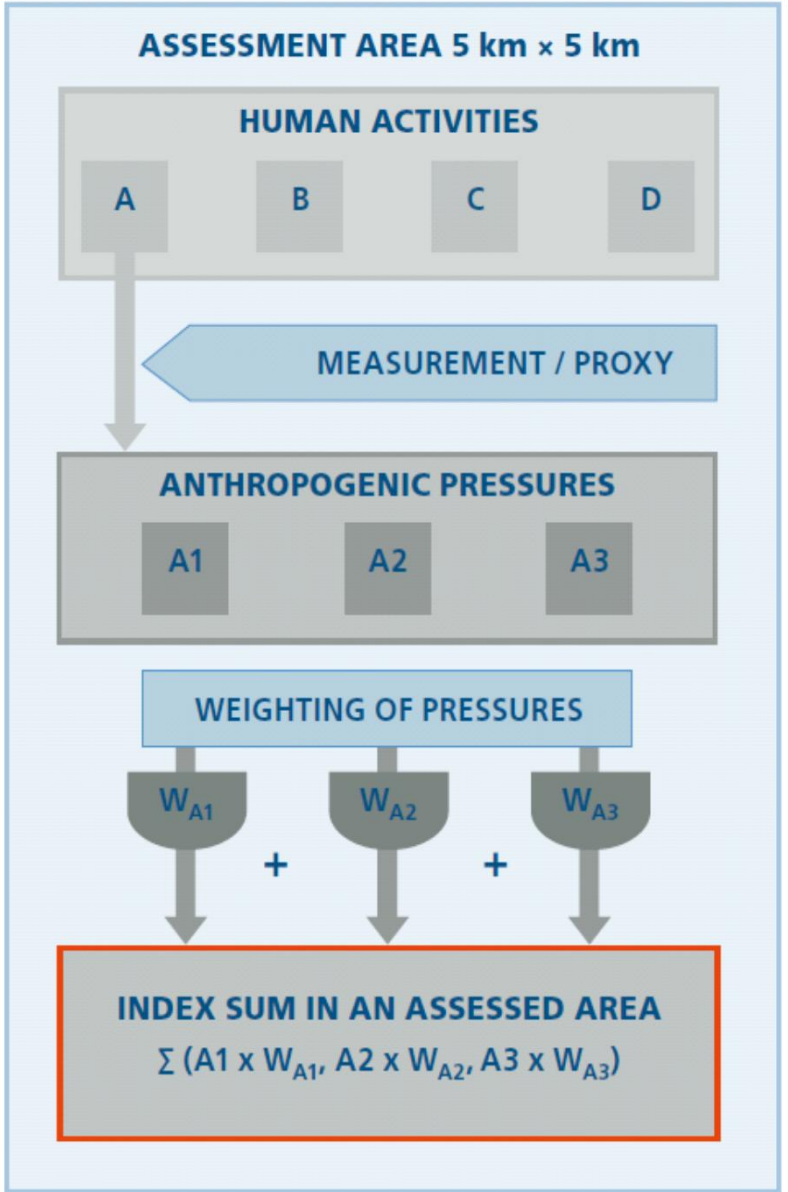
# **Towards a tool for quantifying anthropogenic pressures and potential impacts on the Baltic Sea marine environment**

A background document on the method, data and testing of the Baltic Sea Pressure and Impact Indices



## Baltic Sea Pressure Index (BSPI)

- Published by HELCOM (2010) the Baltic Sea Pressure Index (BSPI) is defined as the “straightforward measure of the geographical distribution and intensity of anthropogenic pressures on the Baltic Sea marine environment”
- In this study the HELCOM BSPI as the measure of the spatial distribution and intensity of anthropogenic pressures all over the Gulf of Finland project area is used to develop the environmental cumulative risk profile
- HOLAS II to be published by June 2017



### **Smothering**

Disposal of dredged spoils  
Wind farms, bridges, oil platforms (construction)  
Cables and pipelines (construction)

### **Sealing**

Harbours  
Coastal defense structures  
Bridges

### **Changes in siltation**

Riverine runoff of organic matter  
Dredging + Sand/gravel/boulder extraction  
Bathing sites, beaches and beach replenishment  
Shipping (coastal)

### **Abrasion**

Commercial fishery -bottom trawling  
Dredging + Sand/gravel/boulder extraction

### **Selective extraction**

Dredging + Sand/gravel/boulder extraction (habitat loss)

### **Underwater noise**

Shipping (coastal and offshore)  
Recreational boating + sport  
Wind farms (operational)  
Wind farms, bridges, oil platforms (construction)  
Cables and pipelines (construction)  
Oil platforms

### **Marine litter**

Population density  
Harbours

### **Changes in thermal regime**

Power plants (warm water outflow)

### **Changes in salinity regime**

Bridges and coastal dams  
Coastal waste water treatment plants

### **Introduction of synthetic compounds**

Atmospheric deposition of dioxins  
Polluting ship accidents  
Oil slicks / spills  
Coastal industry, oil terminals, refineries, oil platforms  
Harbours  
Population density (e.g. hormones)

### **Introduction of non-synthetic substances and compounds**

Waterborne load of heavy metals  
Atmospheric deposition of metals

### **Introduction of radio-nuclides**

Discharges of radioactive substances

### **Introduction of other substances**

### **Inputs of fertilisers**

Aquaculture  
Atmospheric deposition of nitrogen  
Waterborne discharges of nitrogen  
Waterborne discharges of phosphorus

### **Inputs of organic matter**

Aquaculture  
Riverine runoff of organic matter

### **Introduction of microbial pathogens**

Aquaculture  
Coastal waste water treatment plants

### **Introduction of non-indigenous species**

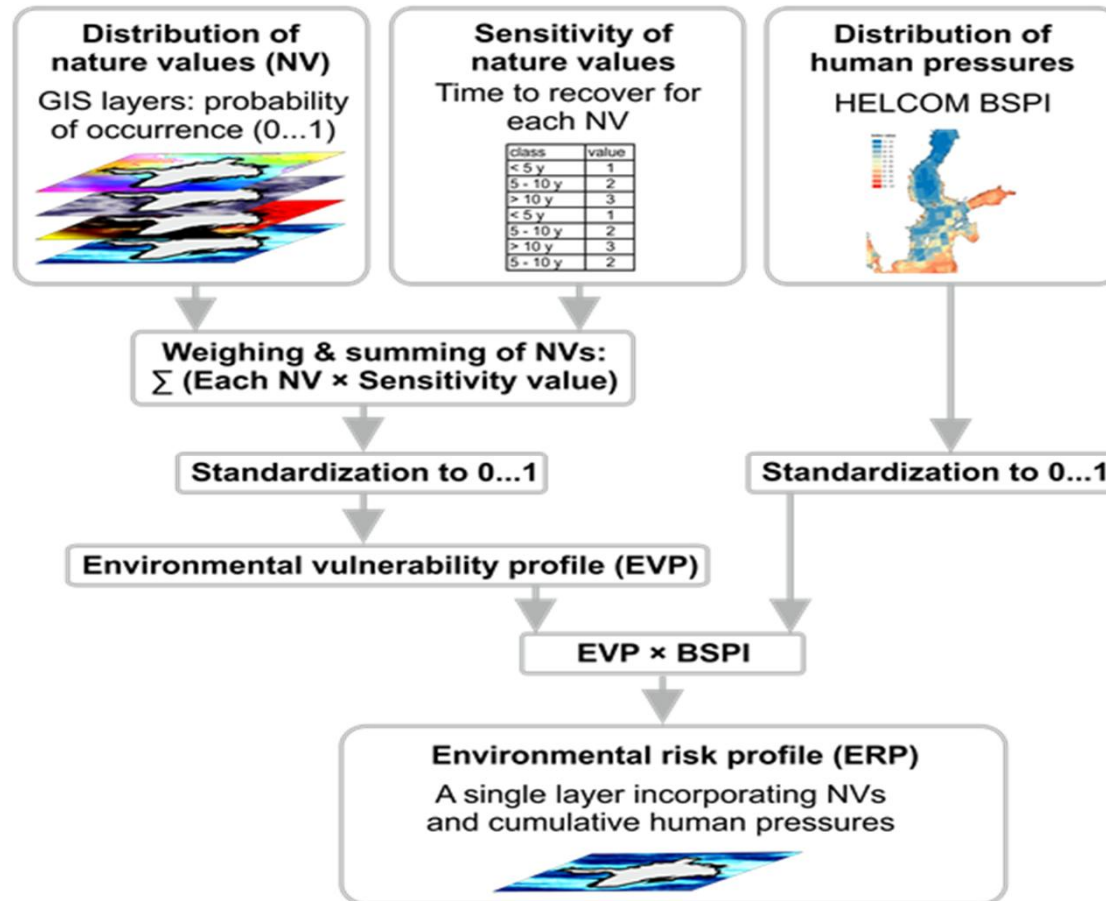
### **Selective extraction of species**

Hunting of birds  
Hunting of seals  
Commercial fishery -surface and mid-water  
Commercial fishery -bottom trawling  
Commercial fishery -coastal stationary  
Commercial fishery - gillnets

## Environmental Cumulative Risk Spatial Profile

- Referring to US National Research Council (2009) the “cumulative risk is formally defined as the combination of risks posed by aggregate exposure to multiple agents or stressors in which aggregate exposures exposure by all routes and pathways and from all sources of each given agent or stressor”
- In our case this means the aggregate exposure of ecosystem components in the Gulf of Finland project area to multiple anthropogenic pressures agents or stressors (BSPI) by all routes and pathways and from all sources of each given agent or stressor of anthropogenic pressures concerned

# Environmental Vulnerability and Cumulative Risk Spatial Profiles



## DAPSI(W)R(M)

Drivers- Activities-Pressures-State changes-Impacts (on Welfare)-Responses  
(Management)

(Elliott et al., 2017)

**DAPSI(W)R(M)** (*pronounced dap-see-worm*) is linking the natural and social systems to deliver the **Ecosystem Approach**, i.e. to protect and maintain the natural system while supporting ecosystem services which then can help to deliver societal goods and benefits (Elliott, 2014)



## DAPSI(W)R(M)

- **Drivers** – basic human needs (satisfaction of human wants usually in the form of consumer products/services)
- **Activities** - identify individual Activities as they are more specific with respect to their resulting Pressures, State changes and Impacts (on Welfare) and thus can be subject to more specific management Responses (as Measures)
- **Activities** do not necessarily automatically lead to Pressures on the system if prevention, mitigation or compensation mechanisms are put in place, as reflected by management Responses (as Measures)

(Elliott et al., 2017)

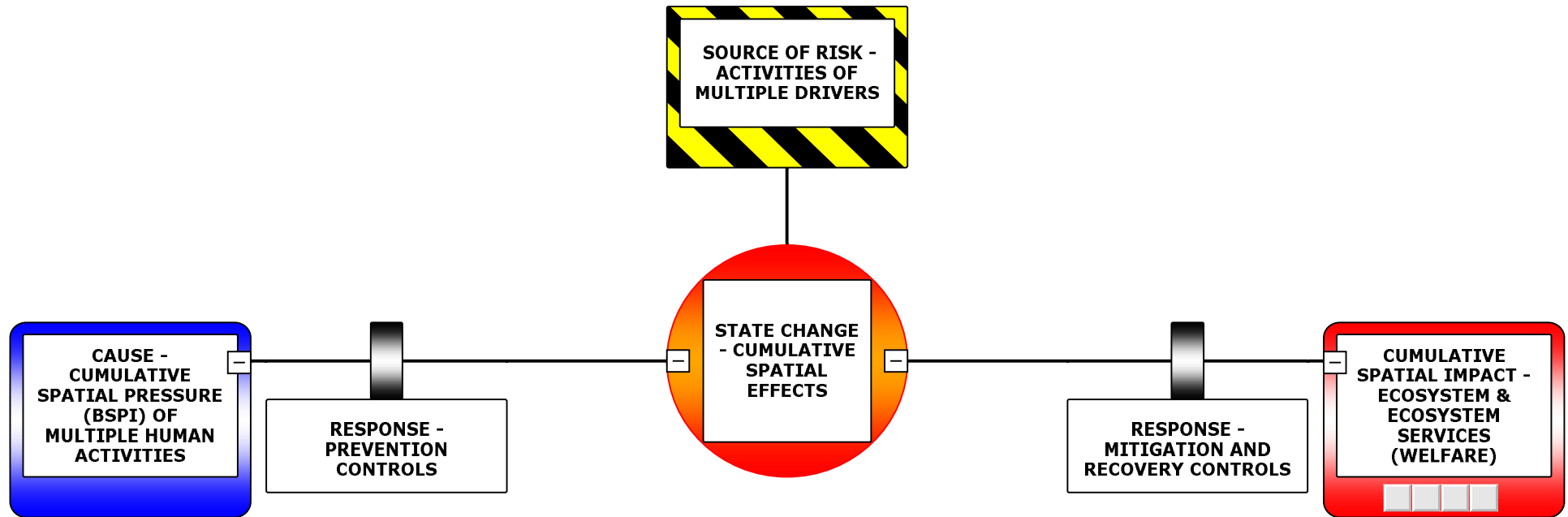
## DAPSI(W)R(M)

- **Pressures**, as a result of one or more **Activities**, reflect the mechanisms of change and can result in changes to the natural system (State changes) and subsequently the social system (Impacts on human Welfare)
- **Impacts** result from changes in the natural system, but which have consequences for societal Welfare
- **Response** - marine management responses emanate from a governance background which relates to the political landscape and marine policies and administration

(Elliott et al., 2017)

DAPSI(W)R(M) to inform risk assessment and  
risk management

# Bow-tie representation of the DPSIR/DPSWR framework for spatial cumulative risk assessment (adapted from Cormier *et al.* 2013)

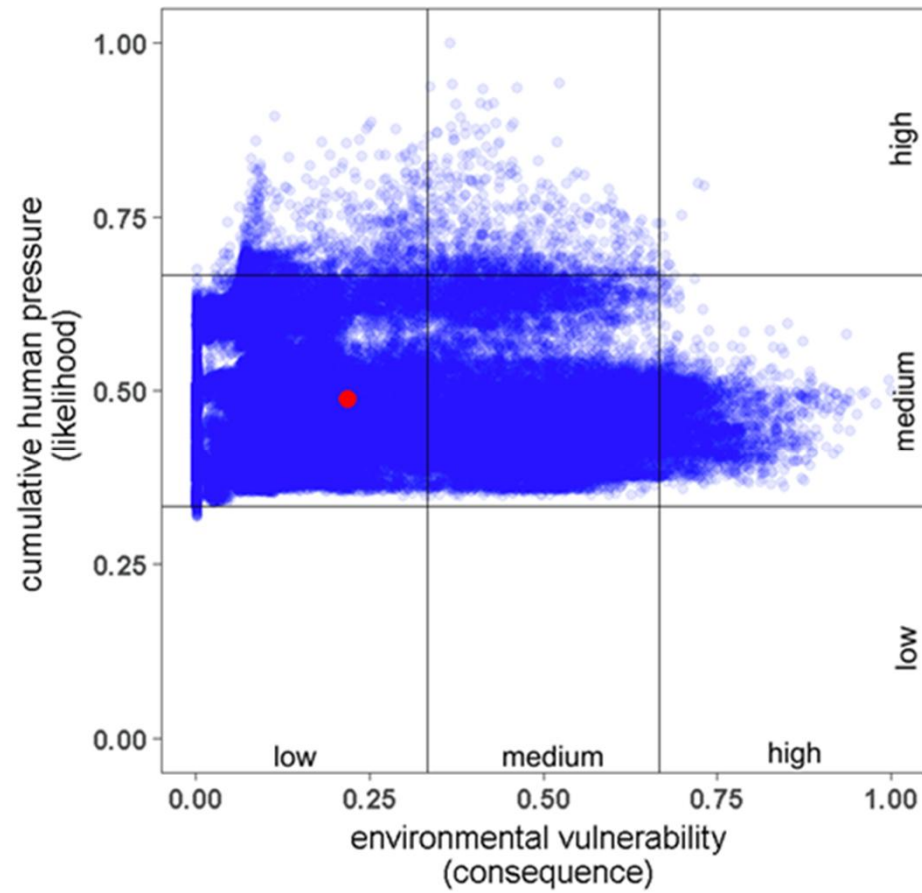


## Basic assumptions

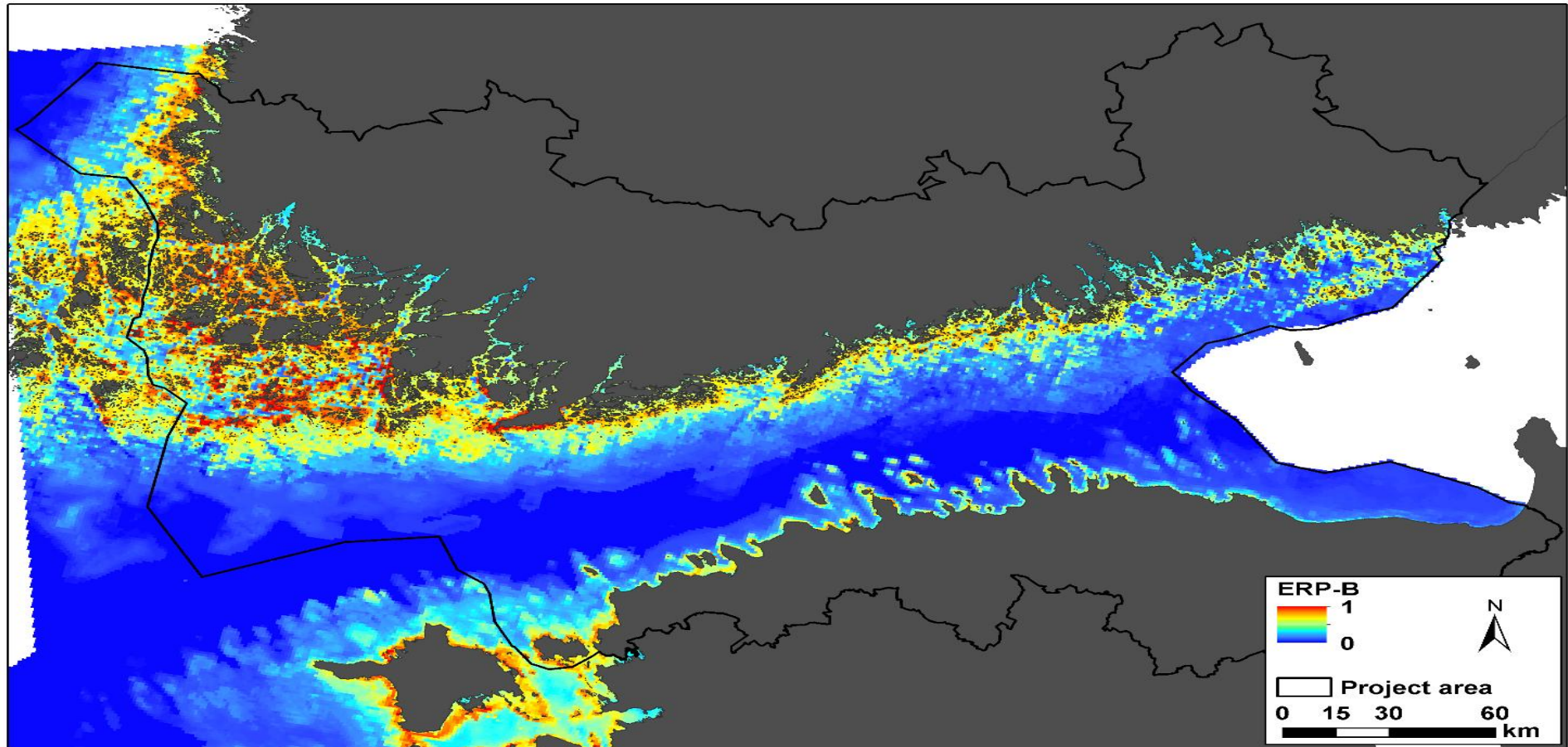
The level of cumulative human spatial pressure is proportional to the likelihood level of potential cumulative spatial effects and impacts on ecosystem and the ecosystem services (welfare)

The level of environmental vulnerability is proportional to the level of potential cumulative environmental effects and impacts / consequences

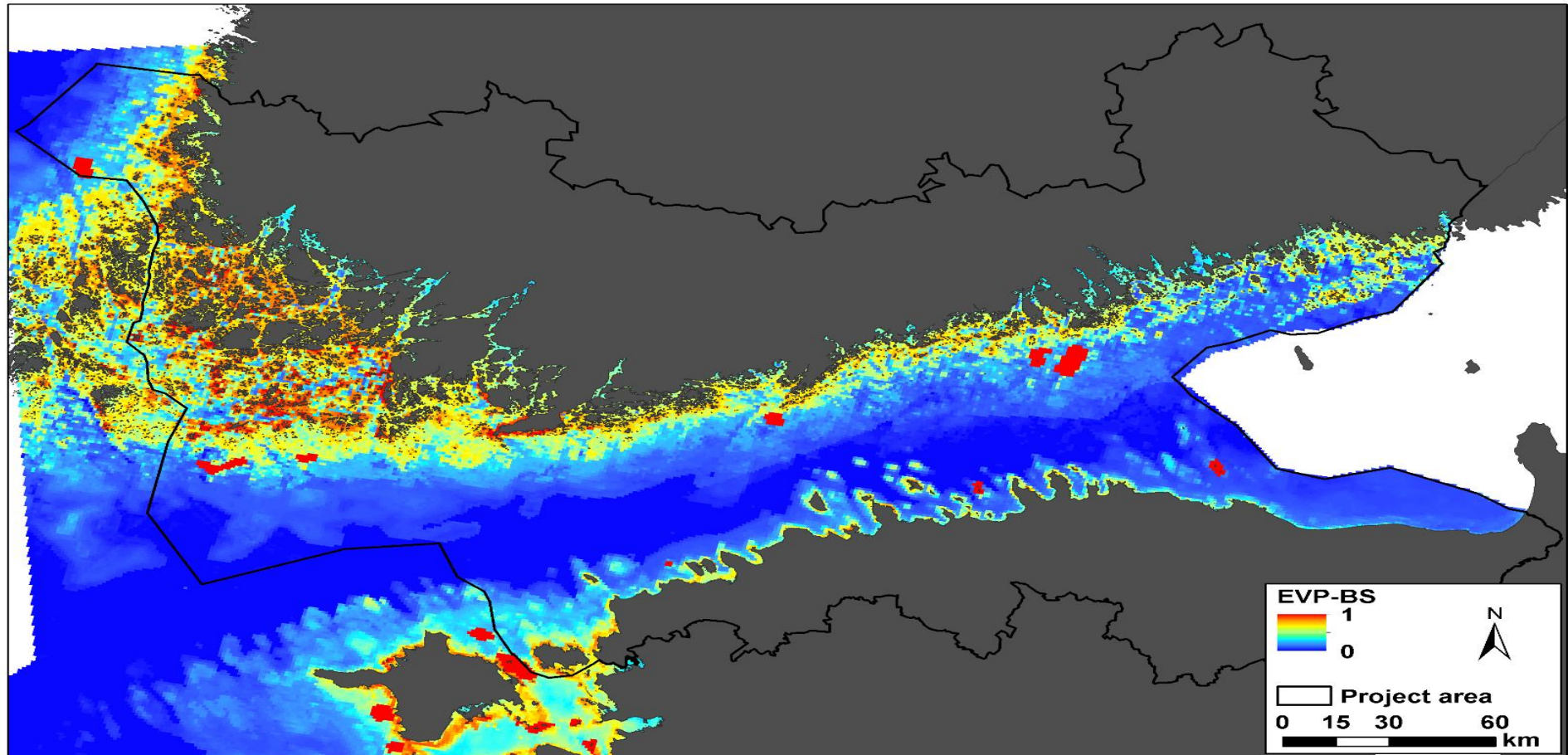
# Environmental Spatial Cumulative Risk Matrix



# Environmental Spatial Cumulative Risk Profile - Benthic Nature Values

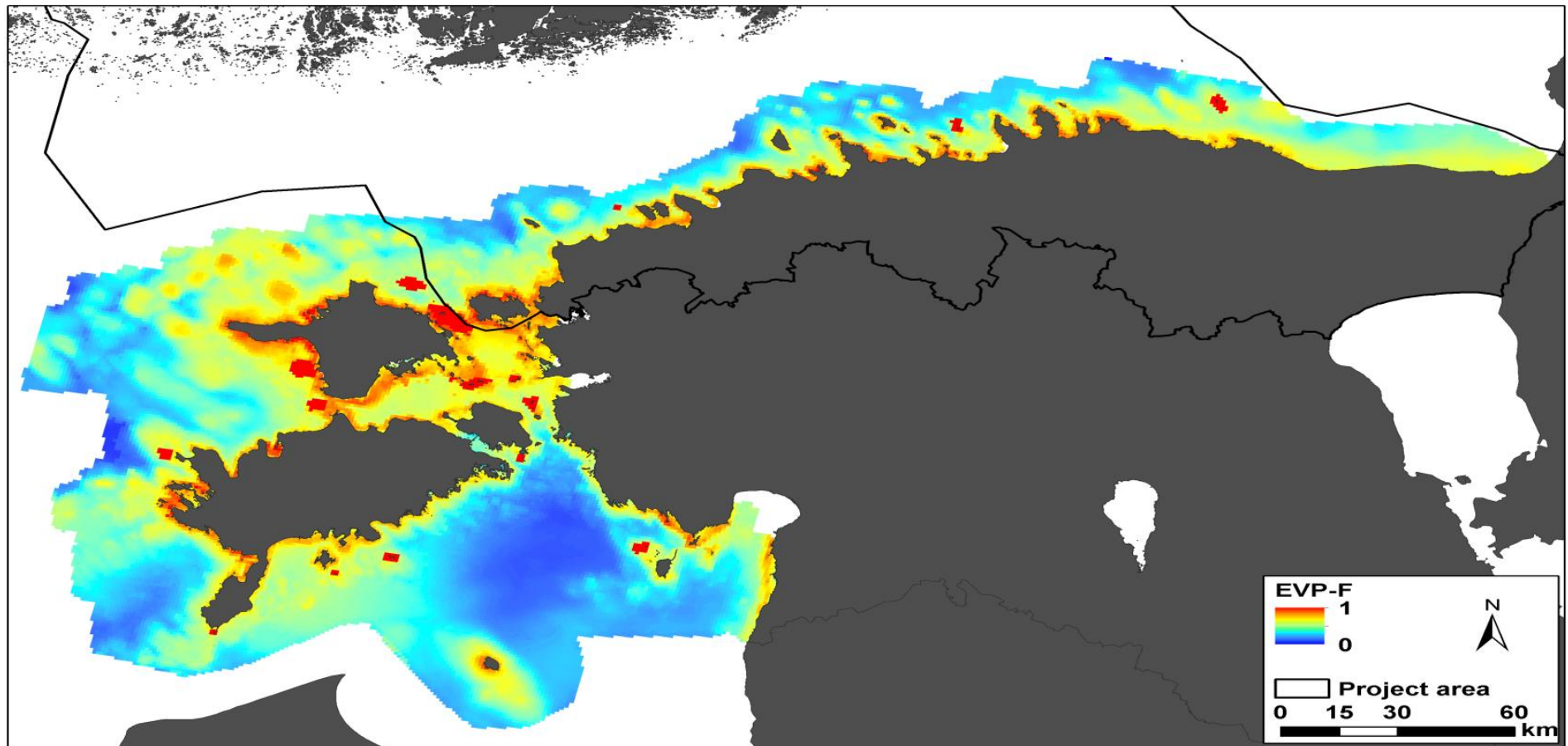


## Environmental Spatial Cumulative Risk Profile – Benthic Nature Values + Seals

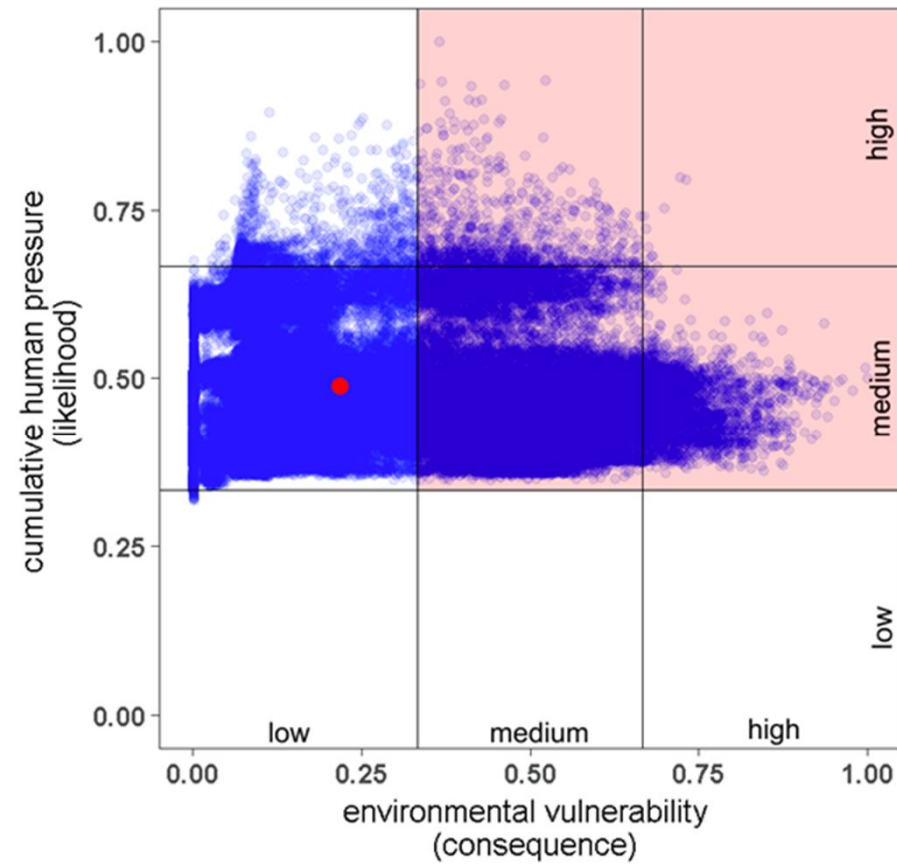




# Environmental Spatial Cumulative Risk Profile – Benthic Nature Values + Seals + Birds



# Environmental Spatial Cumulative Risk Management Matrix



Treat Risk	
Monitor Risk	

## Environmental Spatial Cumulative Risk Management

“Given that a scientific assessment is objective and is based on facts, it would simply reflect likelihood and magnitude leaving the severity, tolerability or values to the governance decision-making processes and stakeholder constituency”

ICES. 2014. Report of the Joint Rijkswaterstaat/DFO/ICES Workshop

# The Vision



# Acknowledgements

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*Thank you very much for your attention!*