Assessing cumulative effects to support ecosystem-based management (bridging the gap)

CNR – ISMAR Marine Science Institute - Venice| Stefano Menegon

CEA's relevance to the sustainability

Authorities / Governments

Plan / program

MSP
Maritime Spatial Planning

Process by which the relevant Member State's authorities **analyse and organise human activities in marine areas** to achieve **ecological, economic and social** objectives
(MSP Directive: 2014/89/EU)

SEA
Strategic Environmental Assessment

Project / activity

Oil & Gas installation

Offshore wind farm

….

EIA
Environmental Impact Assessment

Developers

- Define current conditions
- Identify issues
- Evaluate alternative management actions

Transboundary, Spatially-explicit, Aggregated indicators

CEA
Cumulative Effects Assessment

Bridging the gap between **science and decision-making** in ecosystem-based management

High — Level of uncertainty — Low

Qualitative — Type of assessment — Quantitative

Low — Level of detail — High

CEA gradients

Supporting MSP processes: Adriatic Sea exploratory CEA

Management aim
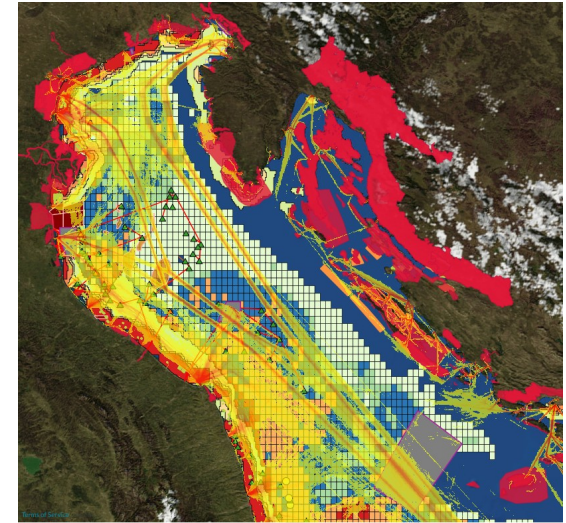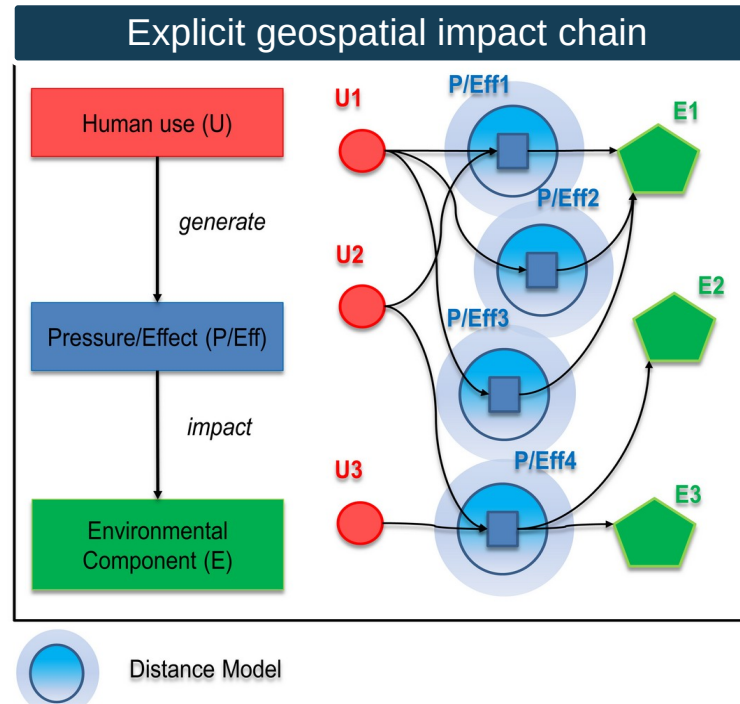define current conditions and identify issues

CEA aim
Transboundary cumulative effects of multiple human uses (**multi-sectoral**) on multiple environmental receptors (seabed habitats, fish nursery, marine mammals and turtles).

Maritime transport
Oil & gas extraction
Coastal & maritime tourism
Small scale fishery
....

Marine litter
Underwater noise
Inputs of organic matter
Abrasion
......

Seabed habitats
Nursery habitats
Marine mammals
Turtles
......

Explicit geospatial impact chain

Human use (U)

generate

Pressure/Effect (P/Eff)

impact

Environmental Component (E)

U1 P/Eff1 E1
U2 P/Eff2
    P/Eff3 E2
U3 P/Eff4 E3

Distance Model

- 5 countries
- 18 human uses
- 15 MSFD pressures (**MSFD alignment**)
- 28 environmental receptors
- Hydrodynamic modeling of the Adriatic Sea to improve pressure assessments
- **Land-Sea interactions** (78 rivers, 40 coastal cities). Nutrient dispersion (organic matter, nitrogen and phosphorus) and salinity
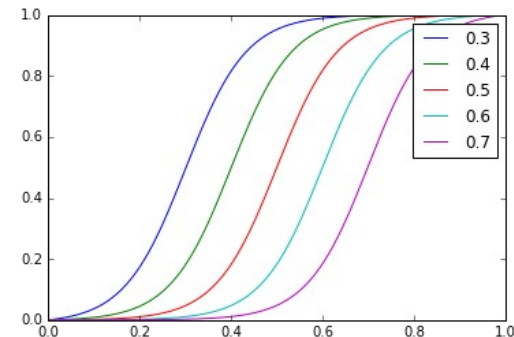- Grid-based analysis (resolution 500 m)

Supporting MSP processes: Adriatic Sea exploratory CEA

Spatial distribution of MSFD pressures

Abrasion

Contaminants

Underwater noise

Coastal tourism

LSI Nutrients dispersion: Nitrogen and Phosphorus
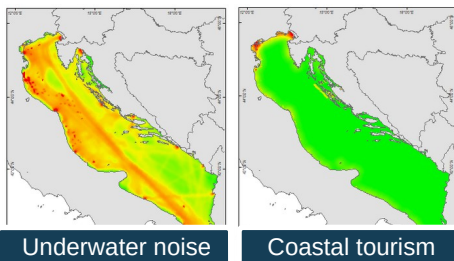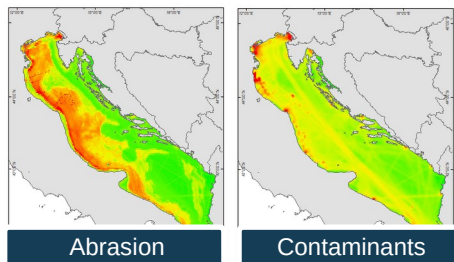
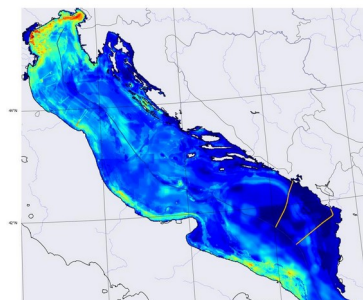**Sensitivities-based modelling of the cumulative ecological effects**
- Expert-based survey, interviews, literature review
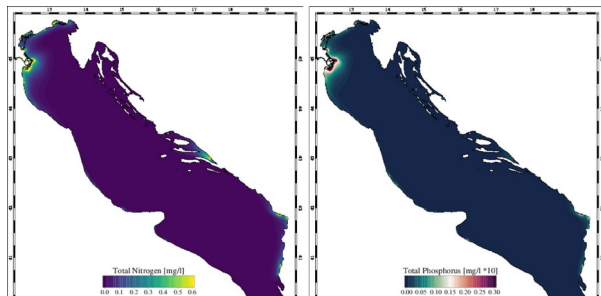- Impact extent, impact level, recovery time

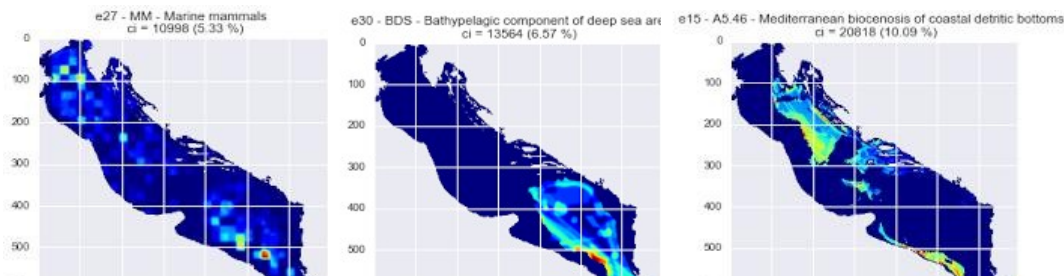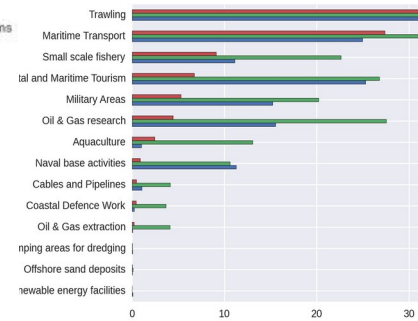**Spatial distribution of Cumulative impact**

Maritime Transport · Coastal and Maritime Tourism · Trawling

Cumulative impacts from specific sea uses

e27 - MM - Marine mammals $ci = 10998$ (5.33 %) · e30 - BDS - Bathypelagic component of deep sea are $ci = 13564$ (6.57 %) · e15 - A5.46 - Mediterranean biocenosis of coastal detritic bottoms $ci = 20818$ (10.09 %)

Cumulative impacts on specific environmental receptors

Overall CEA

MSP proposal: Emilia-Romagna Case Study

5.300 km^2
14 municipalities
526.000 residents
38.000.000 annual overnight stays

Expected Trends

Identify issues
- Conflicts and synergies
- **Cumulative Impacts**
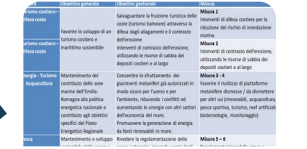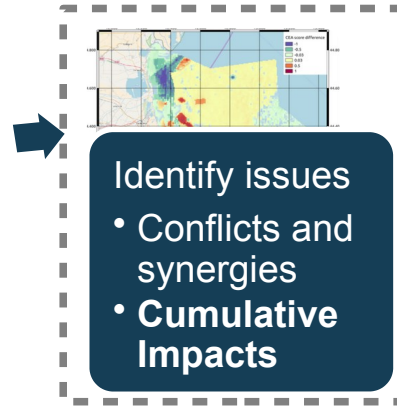
Vision and Management Objectives

Portfolio of Measures

Scenario analysis
- Conflicts and synergies
- **Cumulative Impacts**

Human activities

Intensive aquaculture

Maritime transport

60 extraction platforms & terminals

Fishery

Portfolio of planning measures

Coastal defense and erosion

O&G decomm.

Offshore wind farms

Fishery and aquaculture

Environmental protection

Scenario analysis
How impacts would change

Barbanti et al. 2018

CEA & Marine Ecosystem Services

Integrating socio-ecological dimension into the CEA procedure
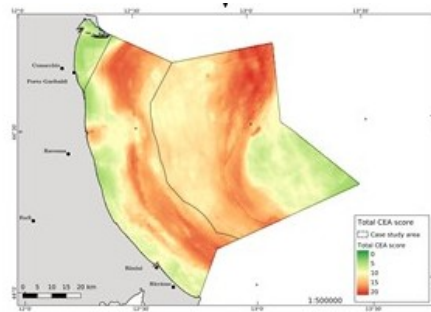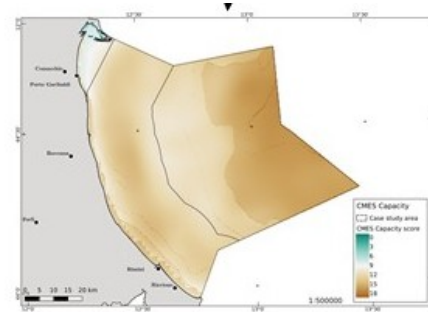
Cumulative effects assessment   **Marine Ecosystem services (MES)**   **MES Threat**
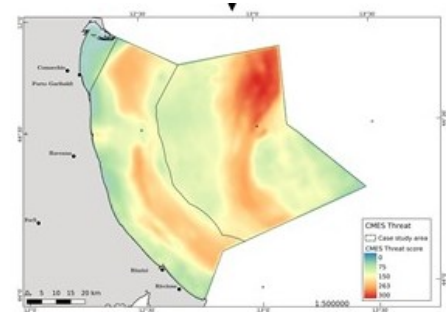
Conservation objectives

A) Preservation of the integrity of Essential Fish Habitats (EFHs) of fish species of high commercial value

B) Protection of high-conservation value species (mammals and turtles), currently severely threatened by human activities
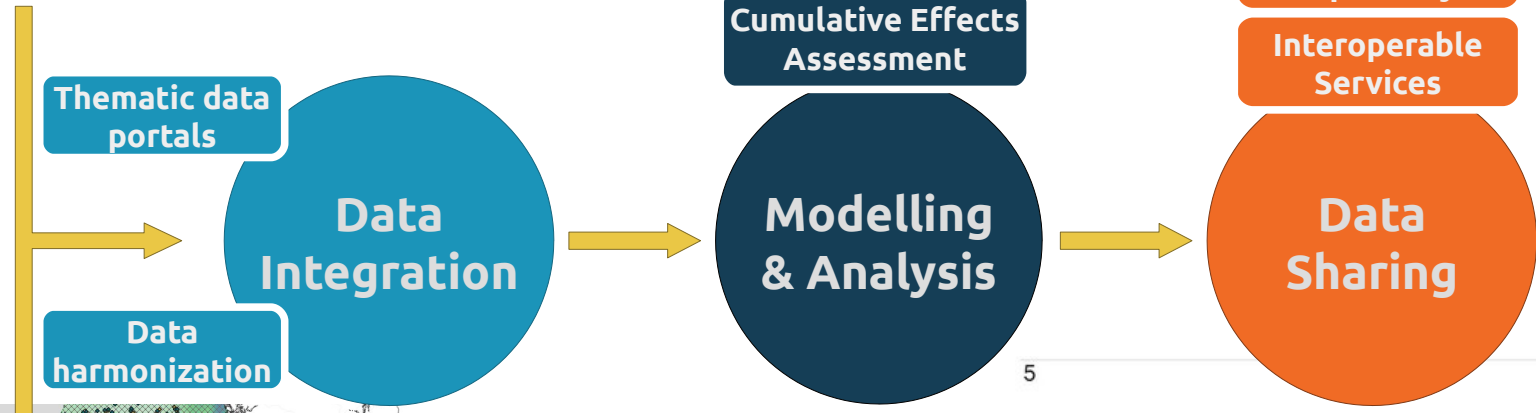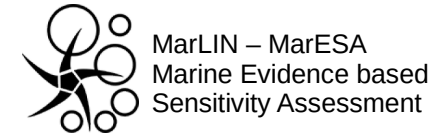
Conservation proposal

1 Biological Protection Area (BPA)

2 priority areas for the protection of sea turtles and bottlenose dolphins
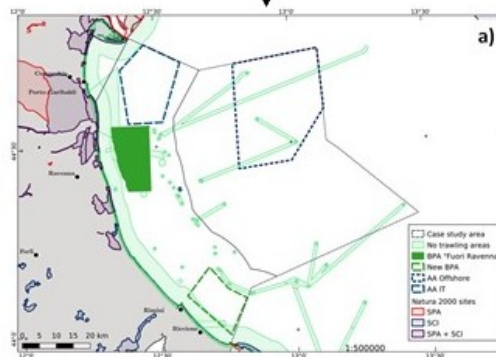
Farella et al. 2020 (Under review)

Data & information needs

EMODnet
European Marine
Observation and
Data Network

Copernicus
Europe's eyes on Earth

Marine Environment Monitoring Service
Climate Change Service

OBIS
OCEAN BIOGEOGRAPHIC
INFORMATION SYSTEM

MarLIN – MarESA
Marine Evidence based
Sensitivity Assessment

Thematic data portals

Data harmonization

Data Integration

Cumulative Effects Assessment

Modelling & Analysis

Open data repository

Interoperable Services

Data Sharing

Ocean modeling
Species distribution modeling
Hydrodynamic modeling
Marine connectivity modeling
Ecological modeling
(e.g. Ecospace)

EMODnet Human activities
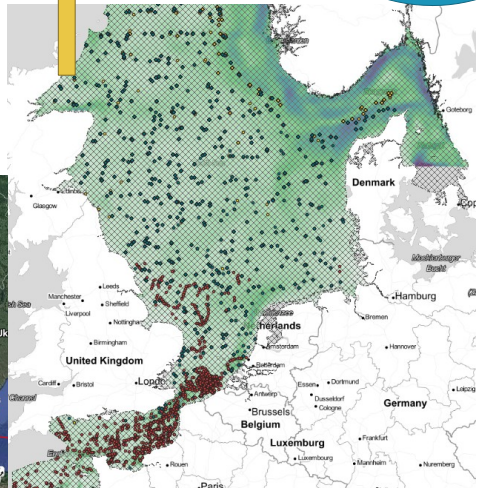
OBIS – occurrences
Copernicus – sea water velocity
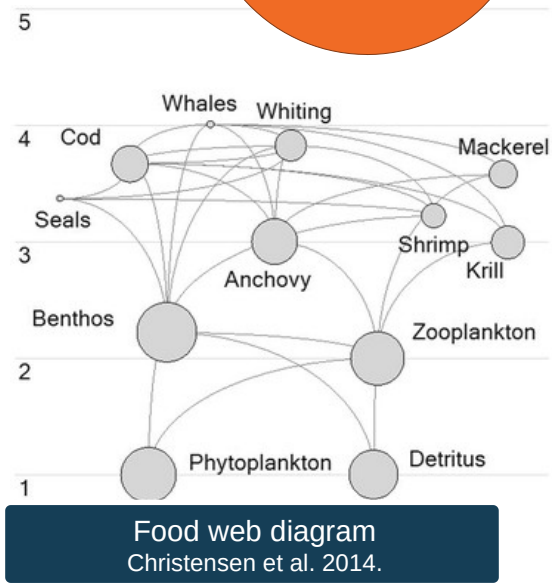
Food web diagram
Christensen et al. 2014.

Geoplatform: data repositories and tools

Key challenges

Global distribution within the water column of recorded marine biodiversity
(Webb, Vanden Berghe, O'Dor, 2010. Source: OBIS)

The global distribution of marine biological records reveals chronic under-exploration of the deep pelagic ocean

- Strengthen overall knowledge on deep pelagic ocean.

- Improve access to marine data, including economic, social and environmental information
- Encourage the deposition of sample/data in **open data** and interoperable repositories
- Improve effects and impact assessment (**ecological response**)
  - Overcome weakness on expert judgments to model Pressure-Environmental receptors relationships
  - Improve evaluation of indirect interactions and effects (especially at broader scales)
  - Three-dimensional and multi-temporal (e.g. seasonality) aspects (time-series)
- **Climate change issues**
- Need for methods to better take into **account Marine Natural Capital** and its direct and indirect benefits to maritime commercial and non-commercial activities