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www.marineebm.org

Zach Ferdaña and Michael W. Beck
Global Marine Initiative

advancing Ecosystem-Based Management
a decision support toolkit for marine managers

Ecosystem-Based Management | Decision Support | Multi-Objective Case Studies | Resources

Ecosystem-Based Management
An overview of marine ecosystem-based management from new approaches.

Decision Support
A description of too assessing marine ecosystems, gaps protection, and opp to enhance their management.

Multi-Objective Ca Studies
Approaches to com management objec conservation, fishe hazard mitigation.

marine diversity and human benefits

The world's coasts and oceans support an enormous amount of marine biodiversity and provide substantial services to

The aim of this toolkit is to guide managers and practitioners in the use of common tools for regional planning and to illustrate through case studies approaches to advance ecosystem-based management by jointly addressing multiple objectives in conservation, fisheries and coastal hazards.

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NOAA

Sea Around Us Project

The University Of Queensland AUSTRALIA

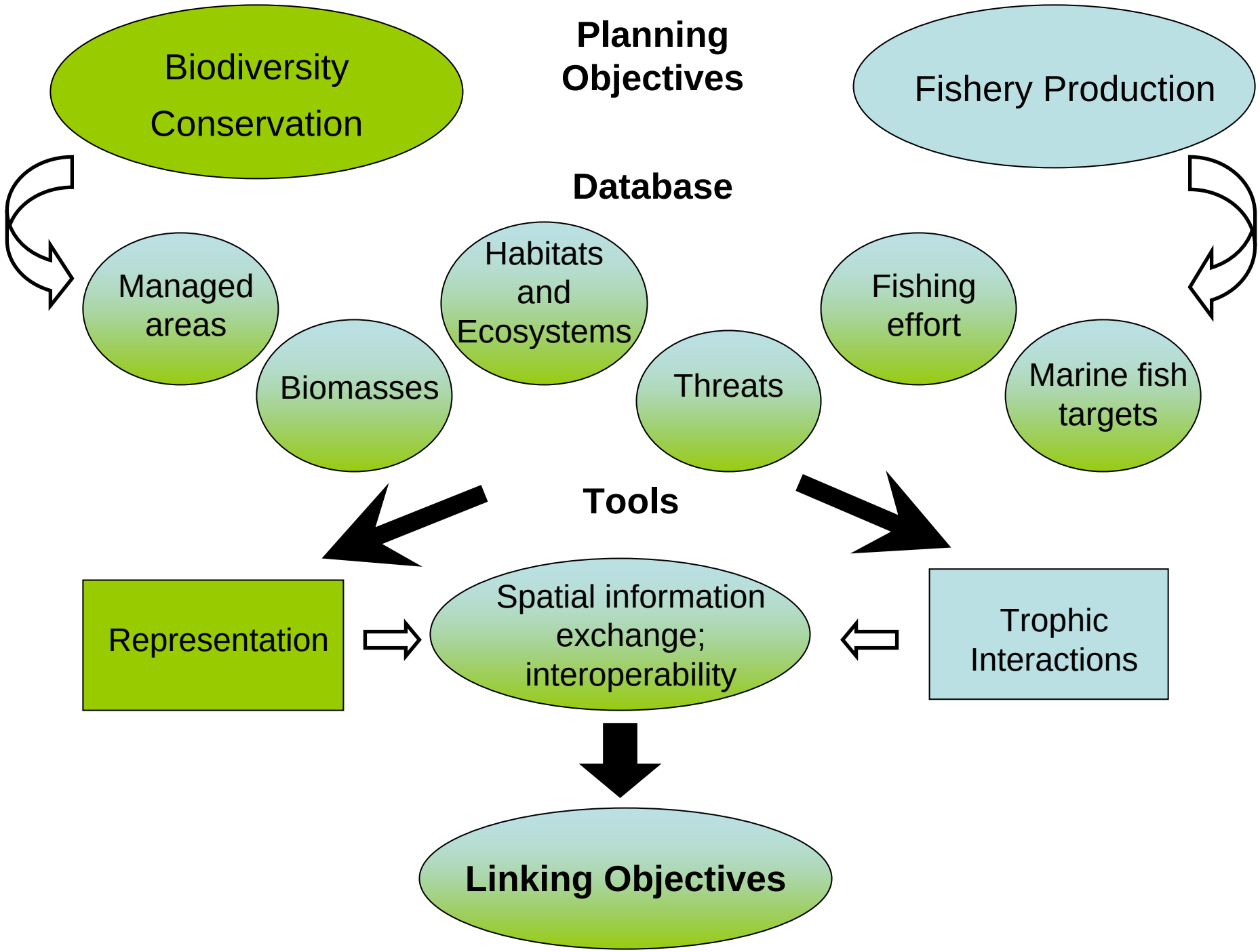
EBM TOOLS NETWORK

I. Background: conservation and fisheries-related planning approaches and tools

II. Case 1: incorporating fisheries-related information in regional planning

III. Case 2: linking decision support tools to account for multiple objectives

IV. Key messages moving forward


Planning Objectives
Biodiversity Conservation
Fishery Production
Database
Managed areas
Biomasses
Habitats and Ecosystems
Threats
Fishing effort
Marine fish targets
Tools
Representation
Spatial information exchange; interoperability
Trophic Interactions
Linking Objectives

Ecoregional Planning and E-BM

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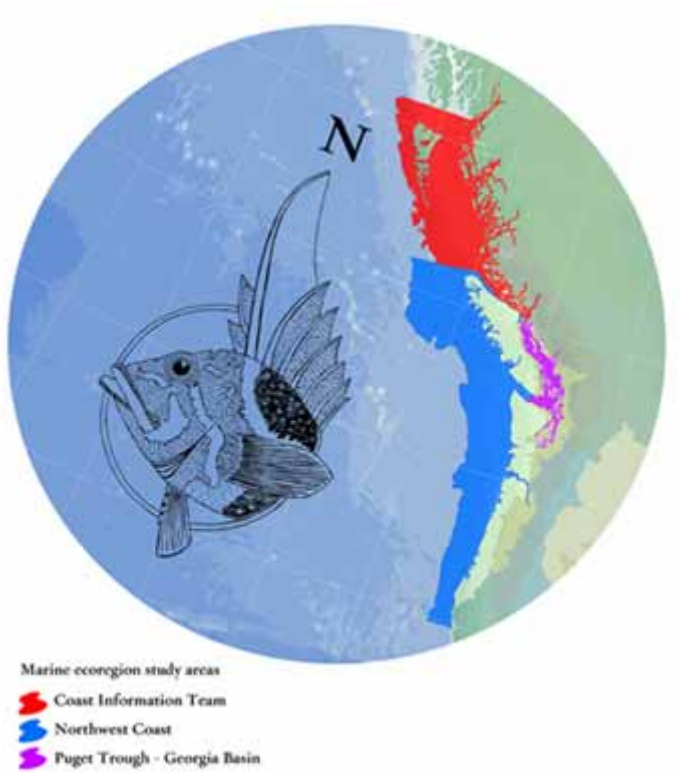
terms of reference

Marine Ecoregional Planning -- to identify a set of high priority areas which, if conserved and effectively managed, will protect a representative subset of the marine biodiversity in an ecoregion

Marine Ecosystem-Based Management – an integrated approach to management that considers the entire ecosystem, including humans…it considers the cumulative impacts of different sectors (e.g., multiple species, multiple objectives) *



* McLeod et al. 2005

Pacific Northwest Coast ecoregion

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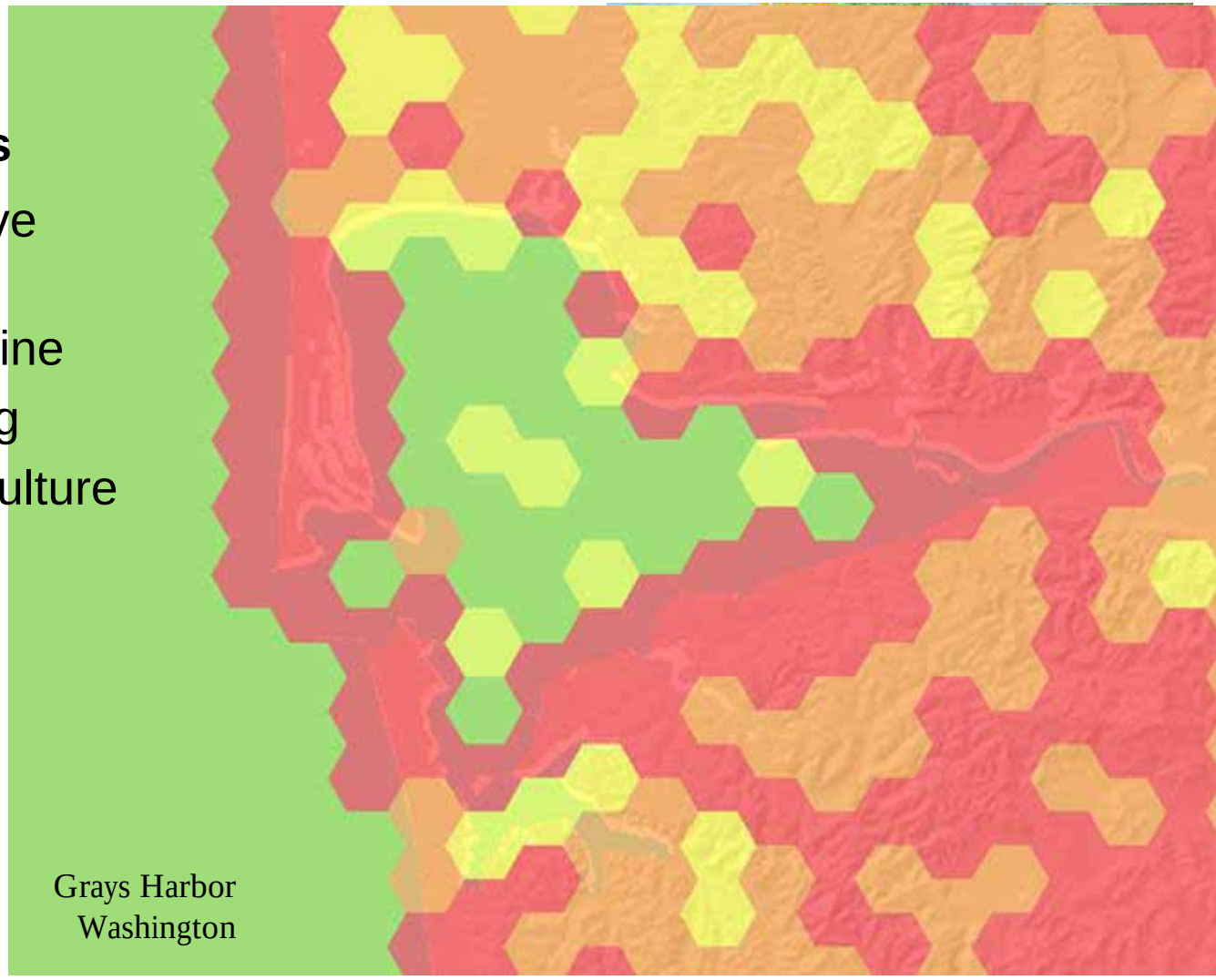
marine ecoregional assessment process

Terrestrial Impacts

- Logging
- Agriculture
- Urban density
- Road density

Marine Impacts

- Invasive species
- Shoreline armoring
- Aquaculture leases



Grays Harbor
Washington

Credible, transparent, flexible: building a decision support system

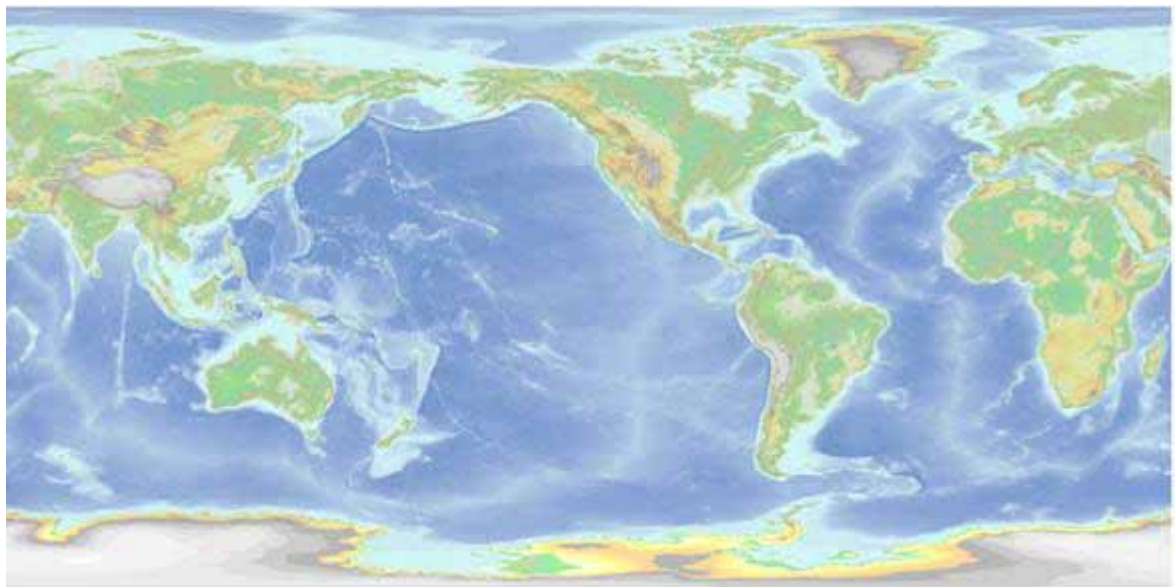
tools

Marxan:

Site selection algorithm
University of Queensland
(**www.ecology.uq.edu.au**)

The algorithm attempts to minimize the total cost of an alternative scenario determined by cumulative impacts, representative goals, and spatial configuration

- optimized scenarios
- irreplaceability analyses
- combined spatial databases
- interoperability

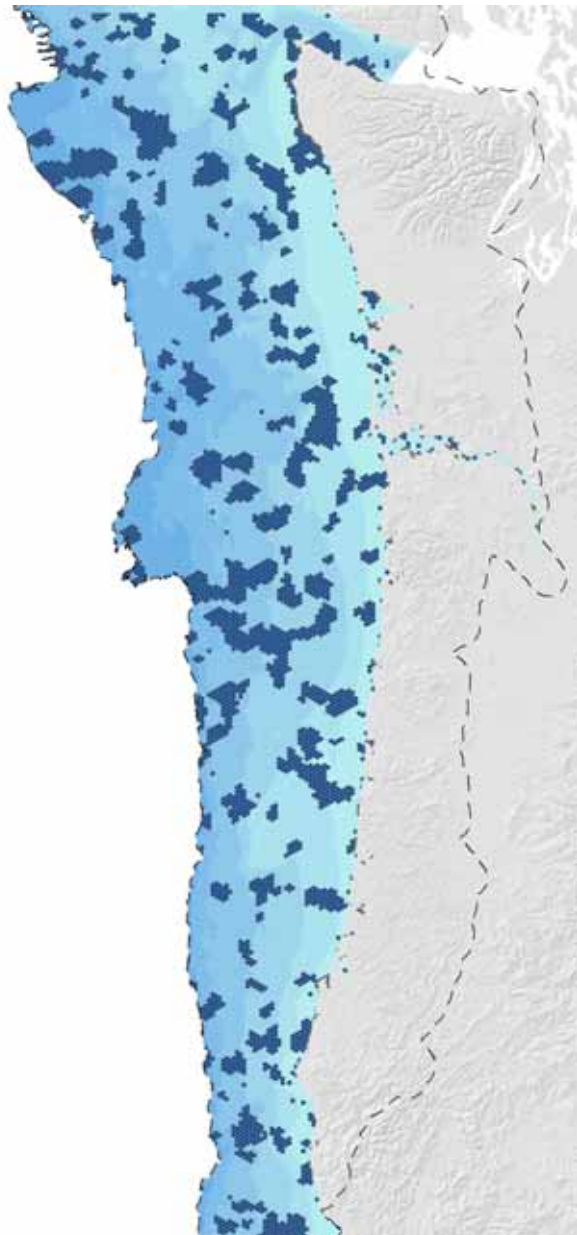


Marxan selection tool: without fisheries information

Pacific Northwest Coast

Without marine fish targets
or fishing effort

- 588 targets
- 98% goals met



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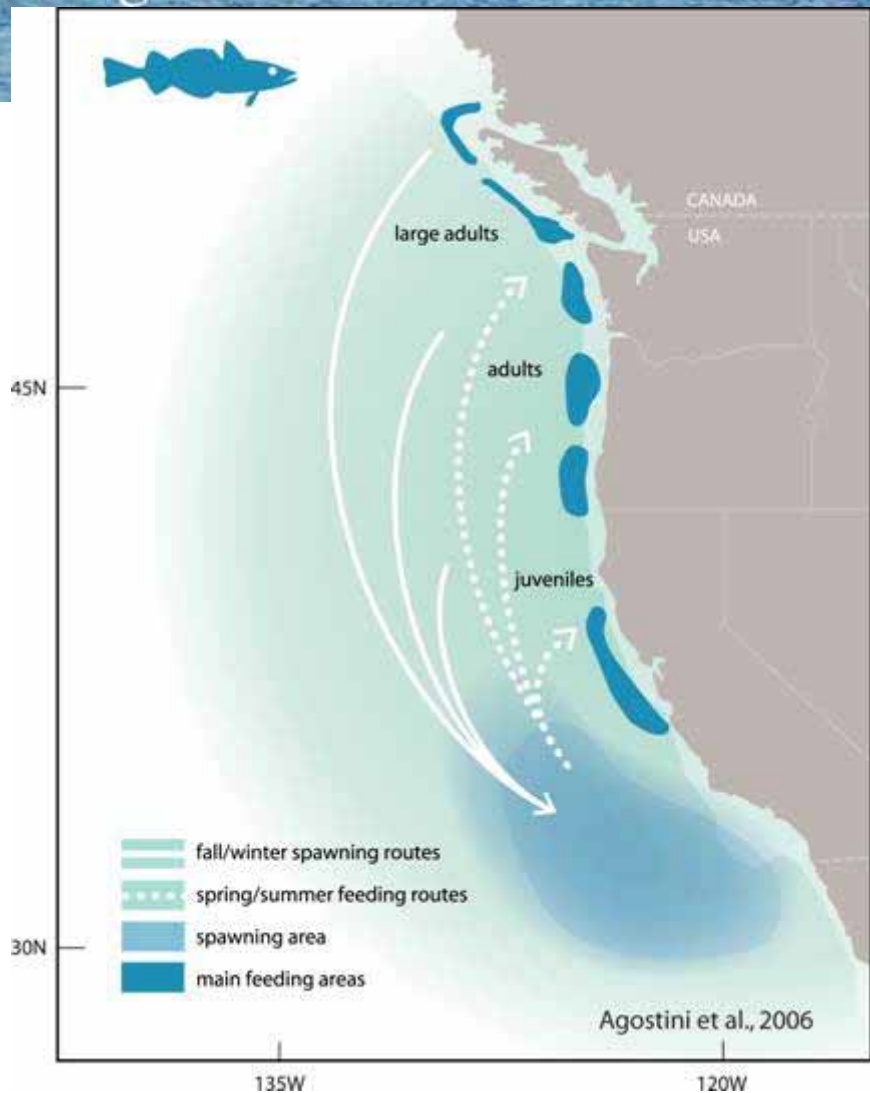
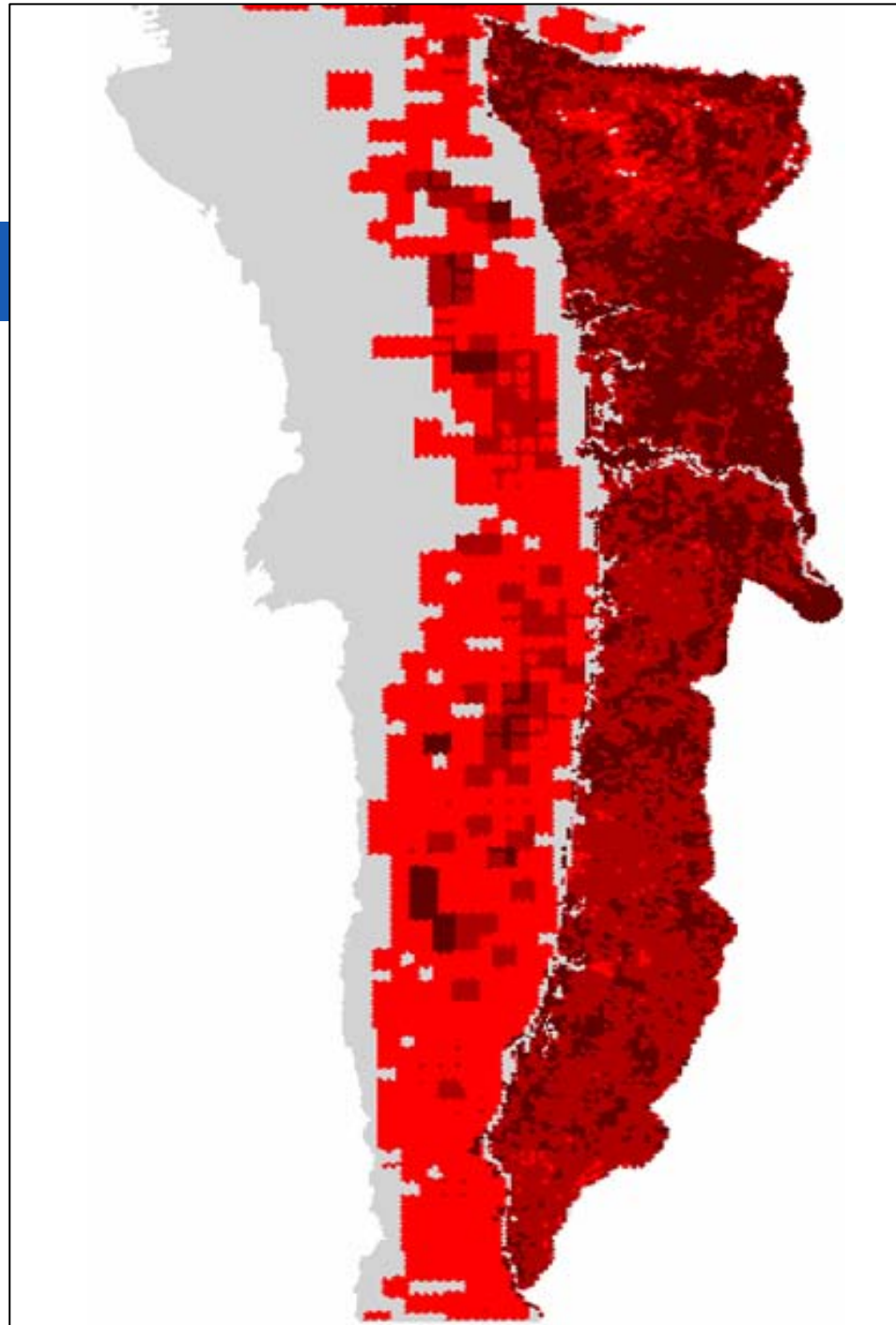


NMFS' Trawl Surveys

Fish and fishing

- Total Hauls (WA/OR): 5,489
- Years: 1977 – 2004
- Depths: 50 m – 1280 m
- 47 of TNC's 58 target species
- Only species represented in >10% of hauls
- Catch Per Unit Effort (CPUE) = weight (kg) / trawl area swept (ha)
- Mean CPUE / 100 km2 for each of 17 species



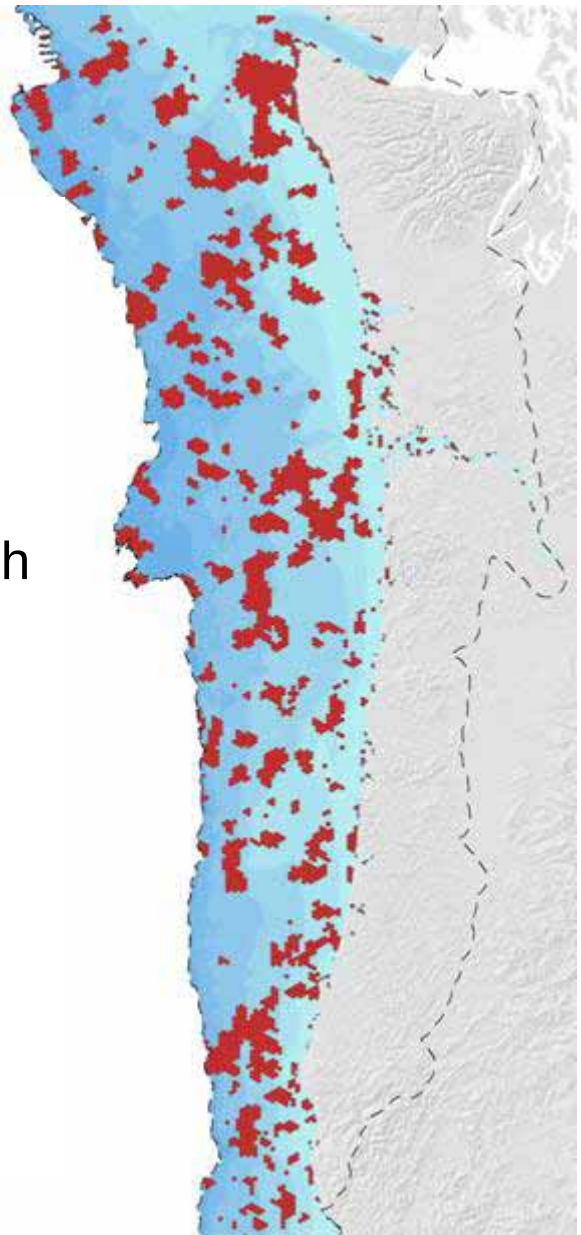
Marxan: with and without fisheries information

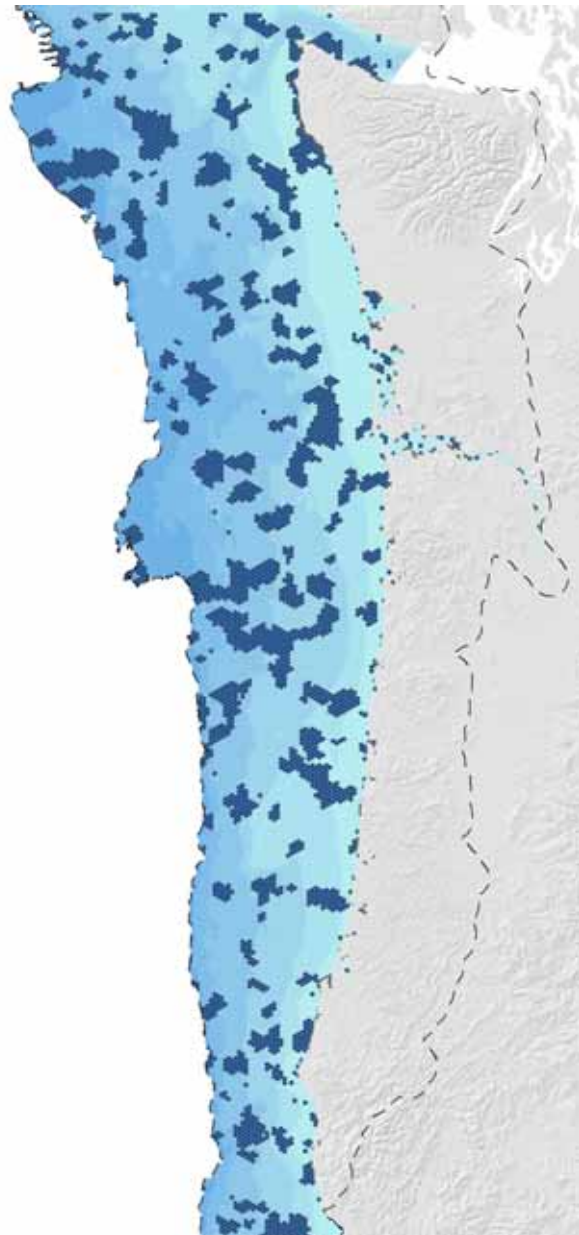
Implications

- Olympic peninsula contains high biodiversity value

- Olympic Coast National Marine Sanctuary contains high marine fish diversity and lower fishing effort

- Need for appropriate management in OCNMS





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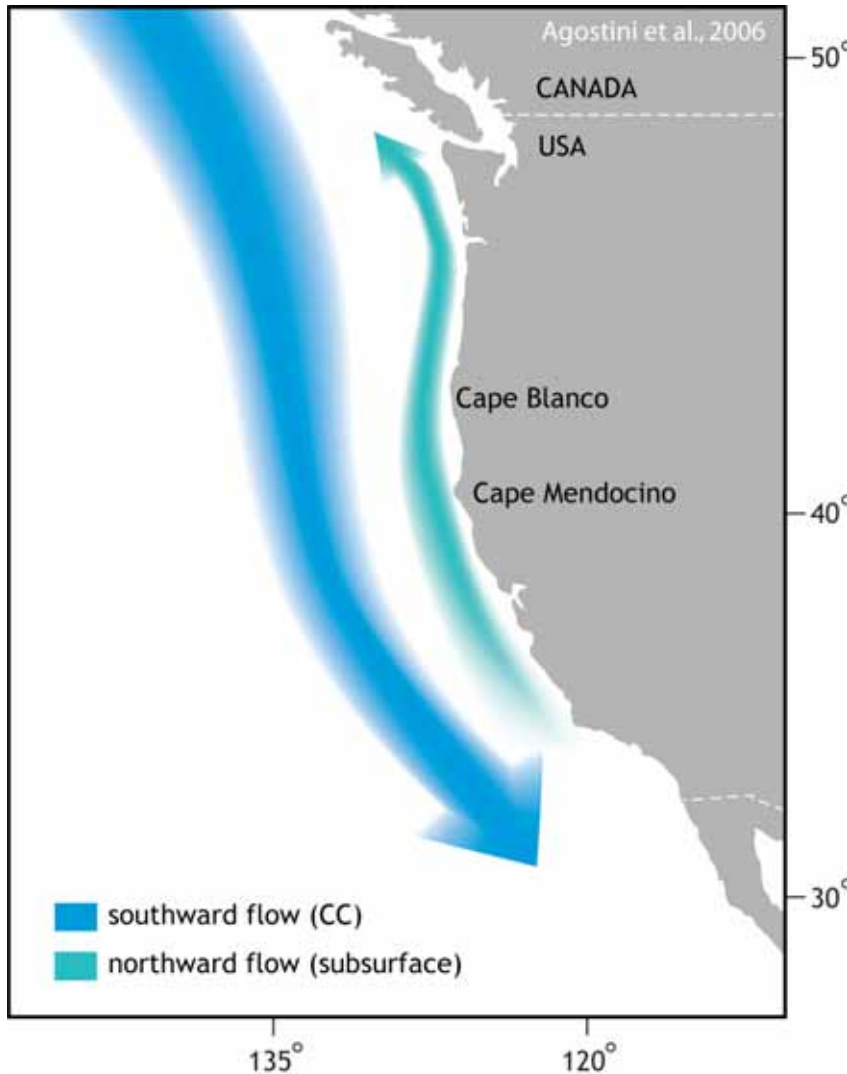

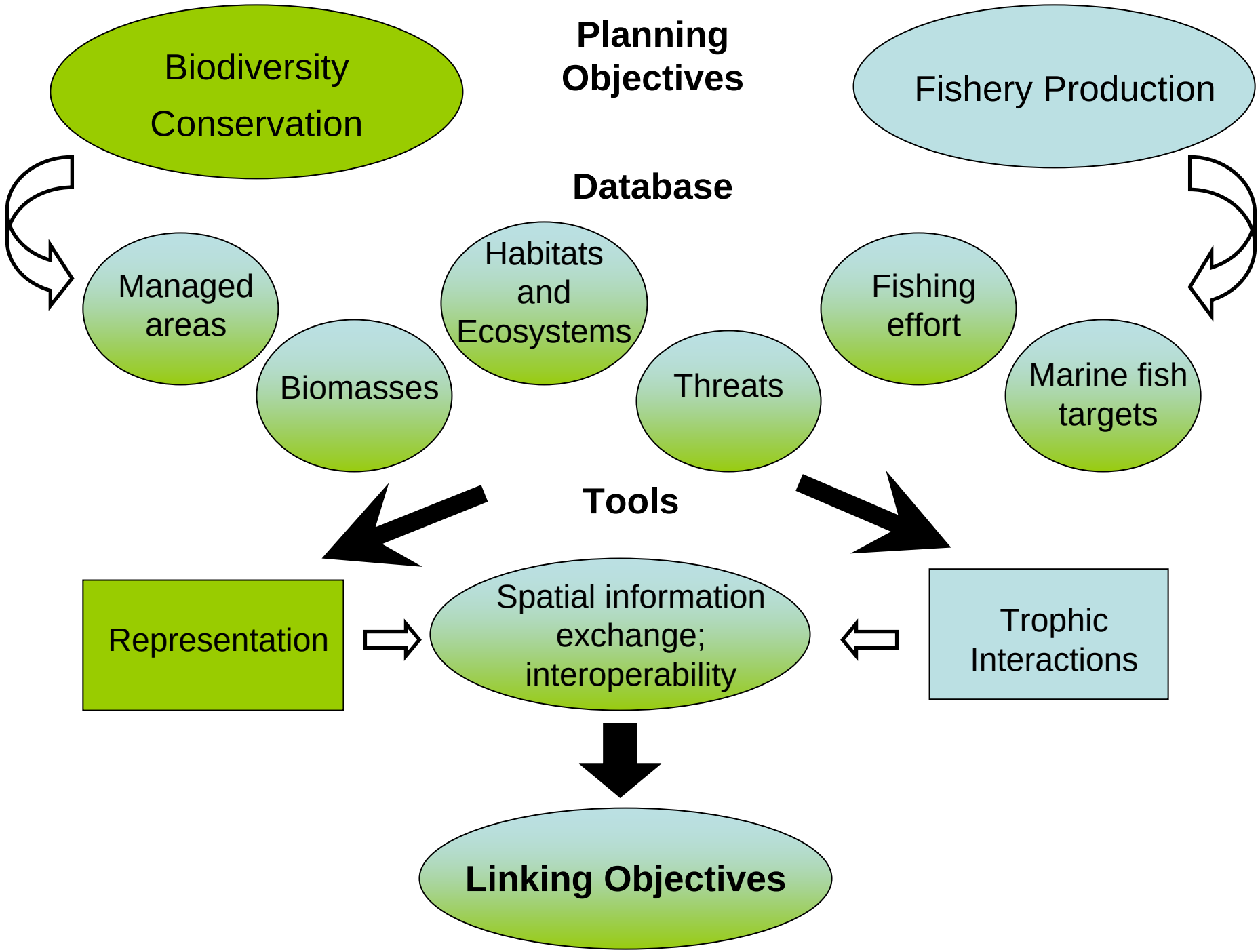
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Whose eating whom, when, where?

Ecopath with Ecosim

UBC fisheries (Pauly, Christensen, Walters)

A. Ecosystem trophic mass balance analysis (ecopath)

$$B_i\left(\frac{P}{B}\right)_i \mathrm{EE}_i + \mathrm{IM}_i + \mathrm{BA}_i = \sum_j \left(B_j \frac{Q}{B} \mathrm{DC}_{ij}\right)_j + \mathrm{EM}_i + C_i$$

- Biomasses, production/biomass and consumption/biomass ratios

B. Dynamic modeling of past and future biomasses and catch (ecosim)

$$\frac{\mathrm{d}B_i}{\mathrm{d}t} = g_i \sum_j Q_{ji} - \sum_j Q_{ij} + I_i - (M0_i + F_i + e_i)B_i$$

- Fishing impacts and environmental disturbances

C. Ecosim models replicated over a spatial grid (ecospace)

$$f_i = \frac{g_i \sum_i C_{ij} - \sum_j C_{ji}}{P_i}$$

- Exploration of policies, spatial dispersal, advection, migration

Modeling the ecosystem

Ecopath model of the Northern California Current

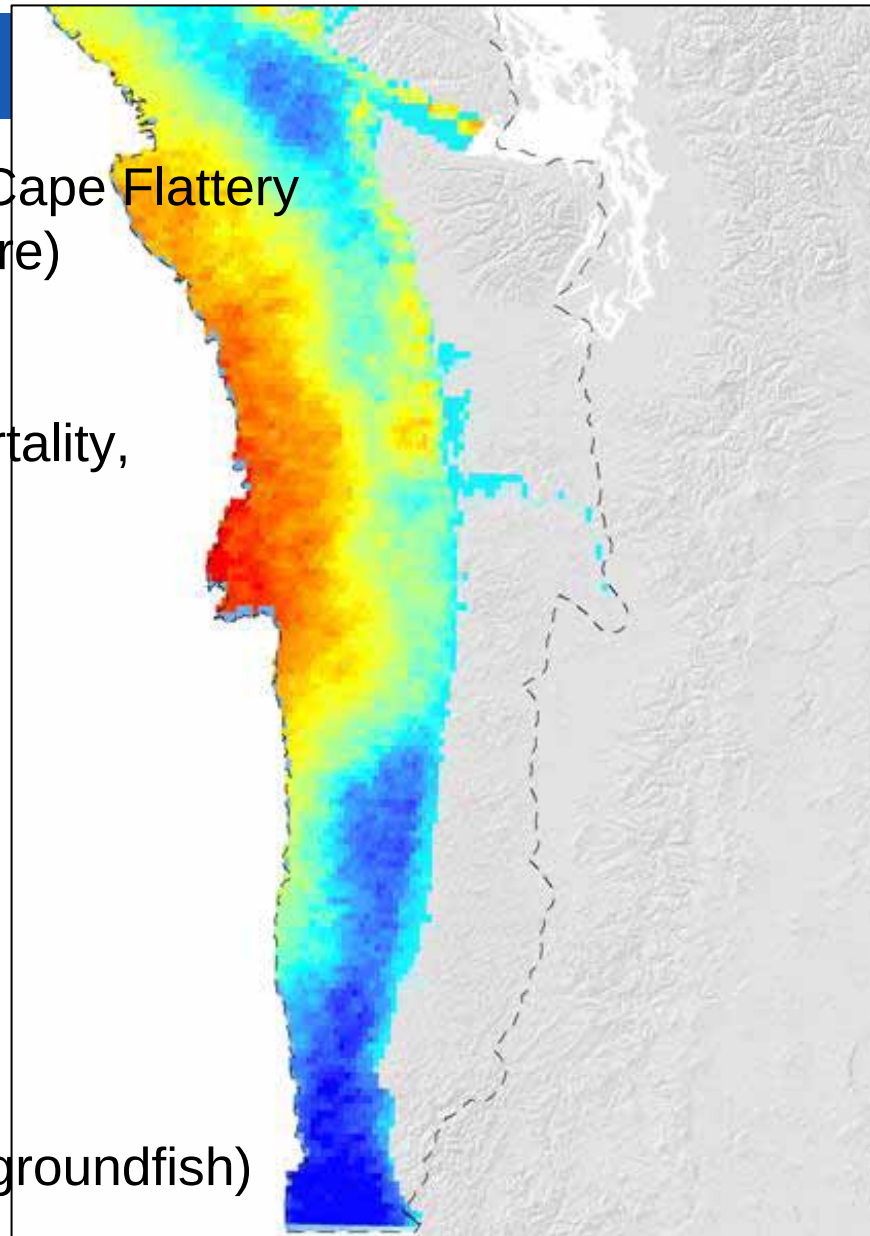
Model extends from Cape Mendocino to Cape Flattery
(1,280 meters depth or 20 – 80 km offshore)

Based on historic estimates of fishing mortality, relative fishing effort, and climate forcing

63 components:

- 21 species of fish or shellfish
- 8 aggregations (i.e., genus)
- 11 functional groups (i.e., seabirds)
- 4 producers (i.e., phytoplankton)
- 19 broad aggregates (i.e., zooplankton)

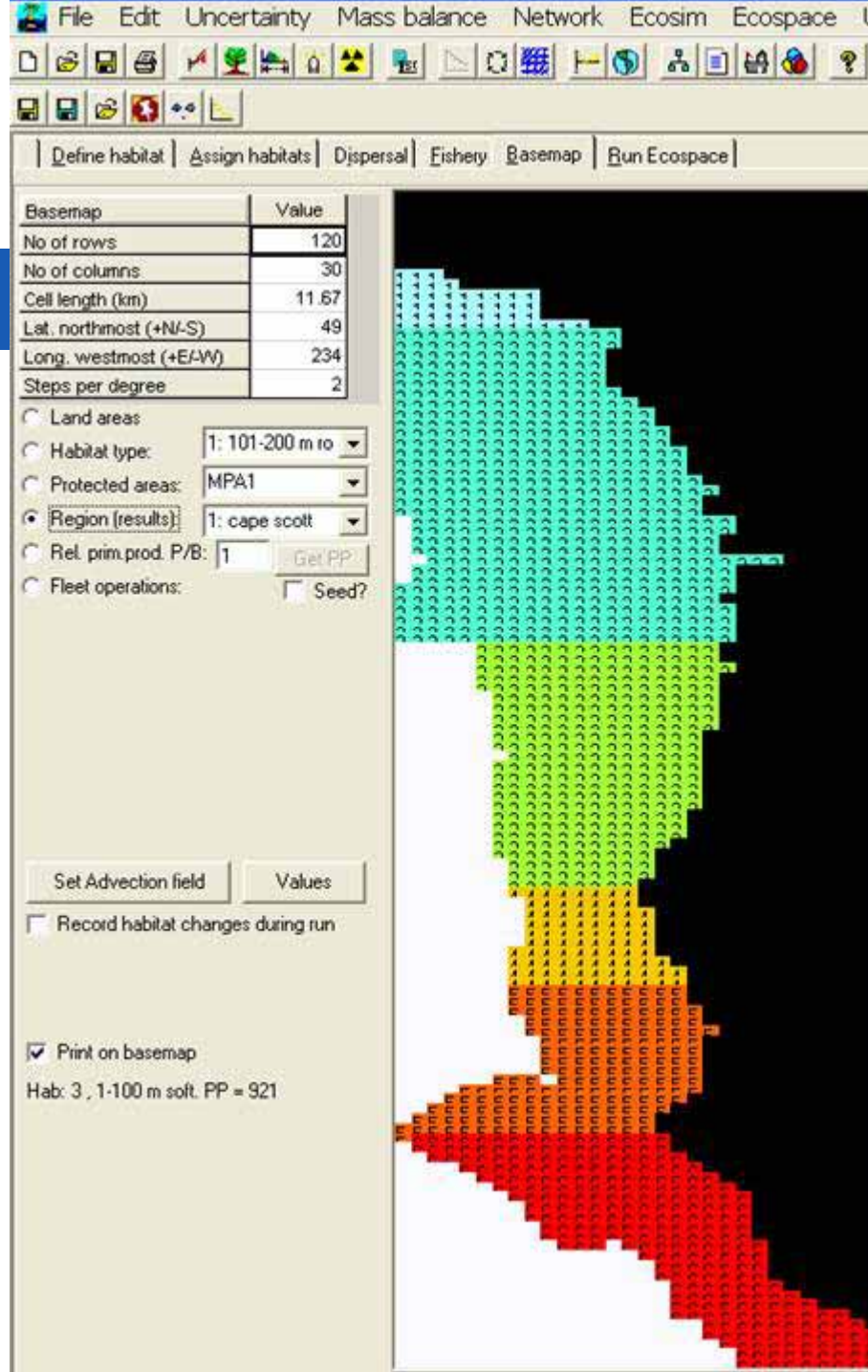
Emphasizes mid-trophic level predators (groundfish)



Ecospace model

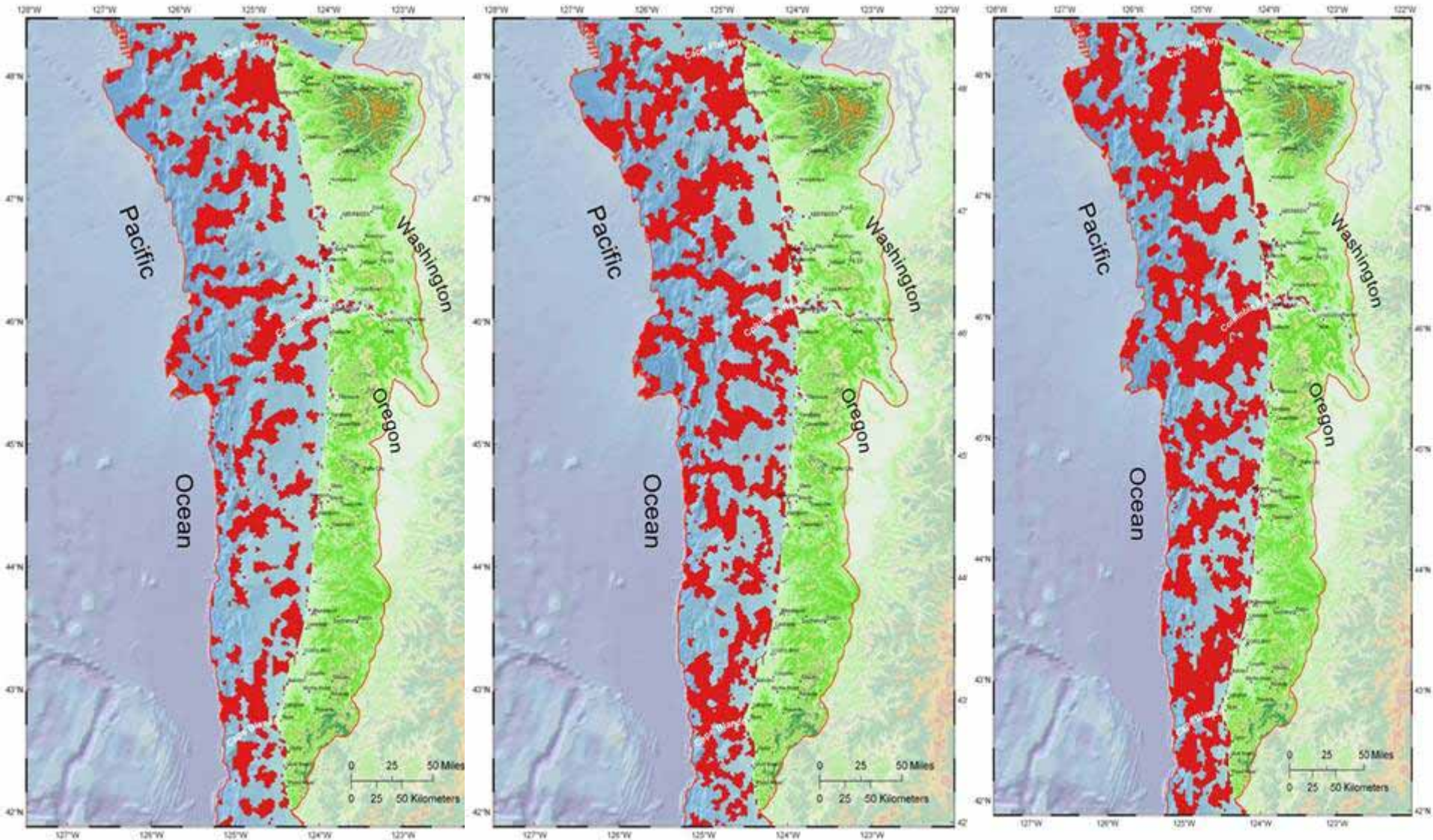
a spatial, mesoscale version of Ecosim

- Spatial grid of homogeneous cells
- Assigns species-habitat preferences and allocation of fishing effort
- Movement of species through cells driven by rates of dispersal, feeding and predation
- Allows for placement of different marine management scenarios



Designing effective decision support systems:
transparent, flexible, credible

37% of total area | 40% | 44%



Linking tools linking objectives

Marxan solutions importedin Ecospace

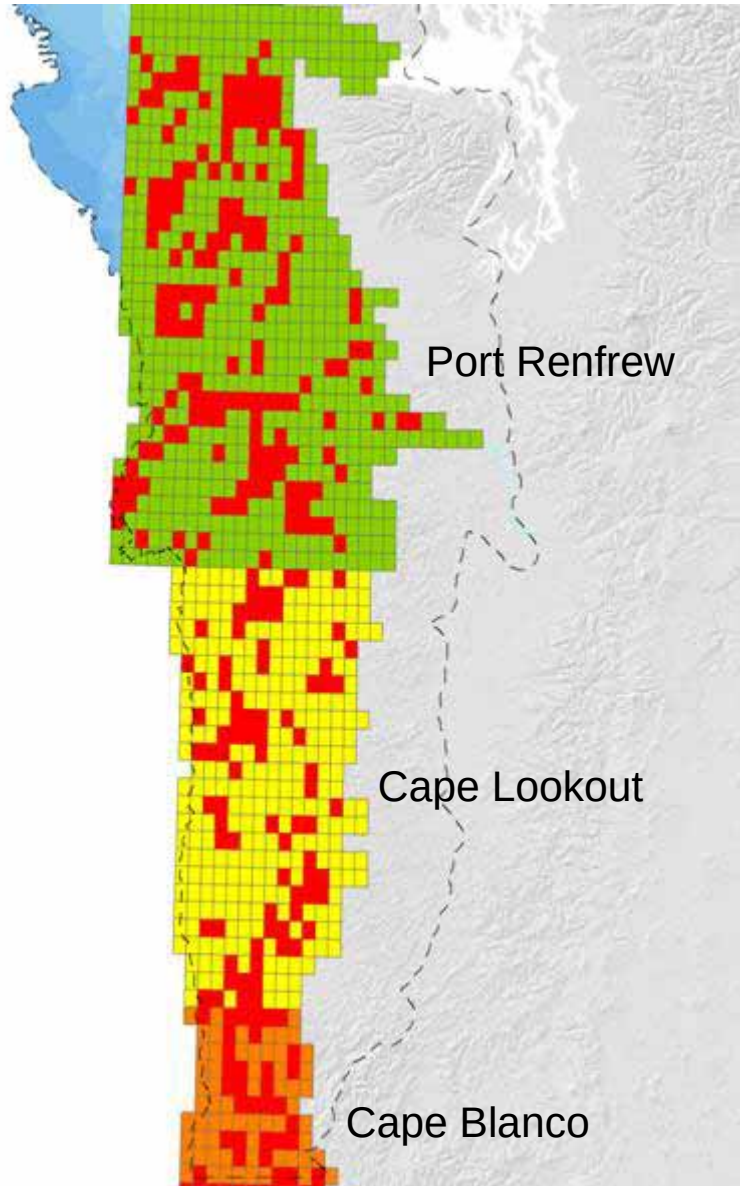
indicators and implications

- Importing solutions implies representative spatial efficiency

- Lingcod and Dover Sole show more production inside priority areas than outside in most cases

- Why did fishery production for English Sole decline after 25% total conservation area in the Cape Blanco subregion?

- Accounts for species-habitat preferences and fishery production in and outside of priority conservation areas



IV. Key messages moving forward

- Ecoregional planning framework
  - Ecosystem approach
  - Accommodates multiple objectives

- Accounting for marine fish species
  - Conservation and fisheries-related planning

- Enhancements
  - Better exchange of information between planning tools

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