A Risk Analysis Approach to Bringing Stock Status Estimates Closer to Reality

E N Armelloni

Institute for Biological Resources and Marine Biotechnology (IRBIM), National Research Council of Italy (CNR), Ancona, Italy

enrico.armelloni@irbim.cnr.it

CNR IRBIM
ISTITUTO PER LE RISORSE BIOLOGICHE E LE BIOTECNOLOGIE MARINE

MEDAC
MEDITERRANEAN ADVISORY COUNCIL

Split (Croatia)
16-17 October 2024

Structure

Mechanism: a brief overview of environmental and ecological effects

Why do we need to change: main criticism of actual Mediterranean Stock assessment framework

Risk Analysis: a way foreword to face the unpredictable

Multiple pressures

Environmental drivers and human pressures contributes to shape the ecological status of marine systems

A stock assessment ignoring the present and future ecological status can lead to imprecise results

Imprecise results used for fisheries management can either means overexploitation OR missing catch opportunities

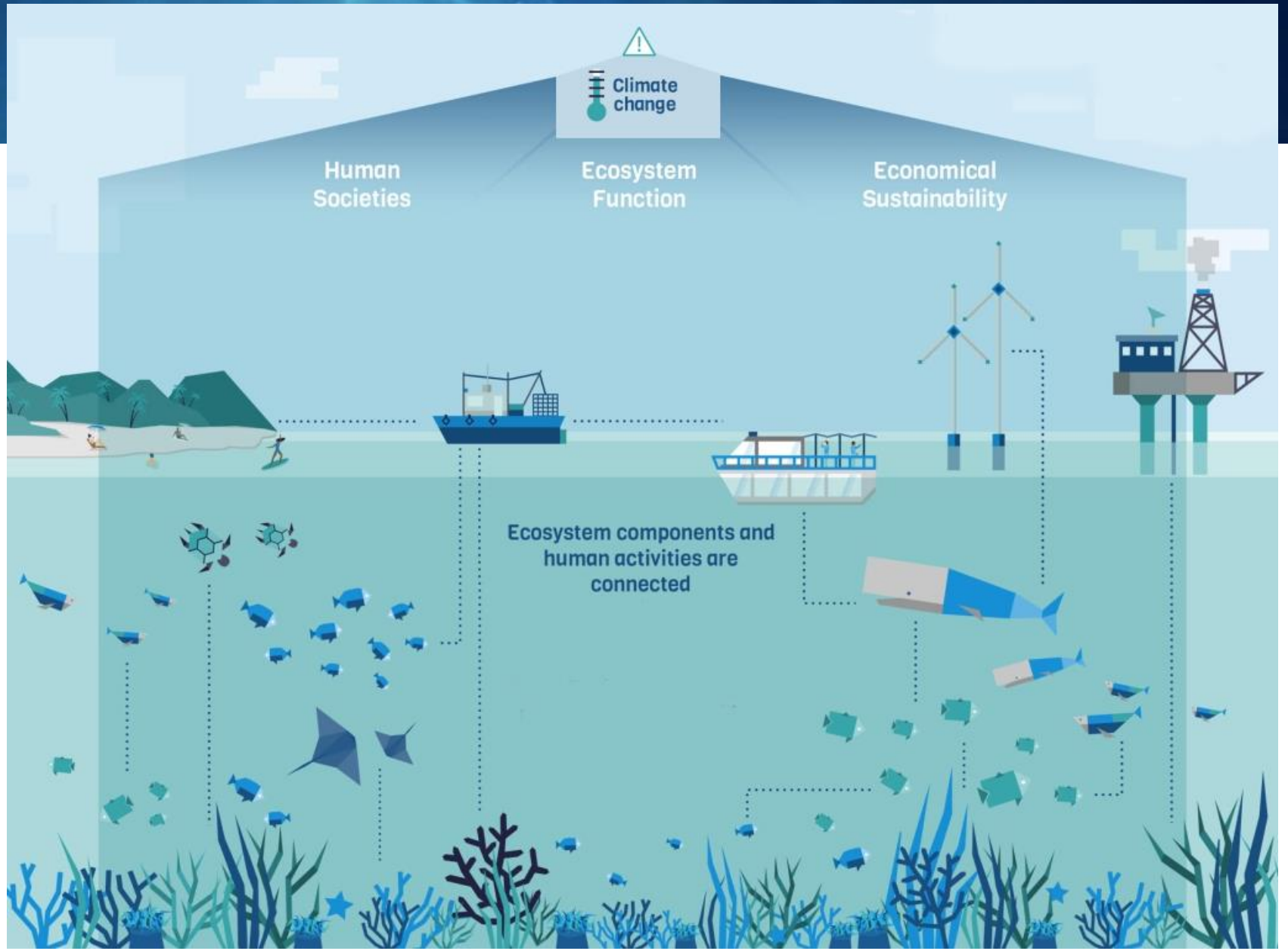


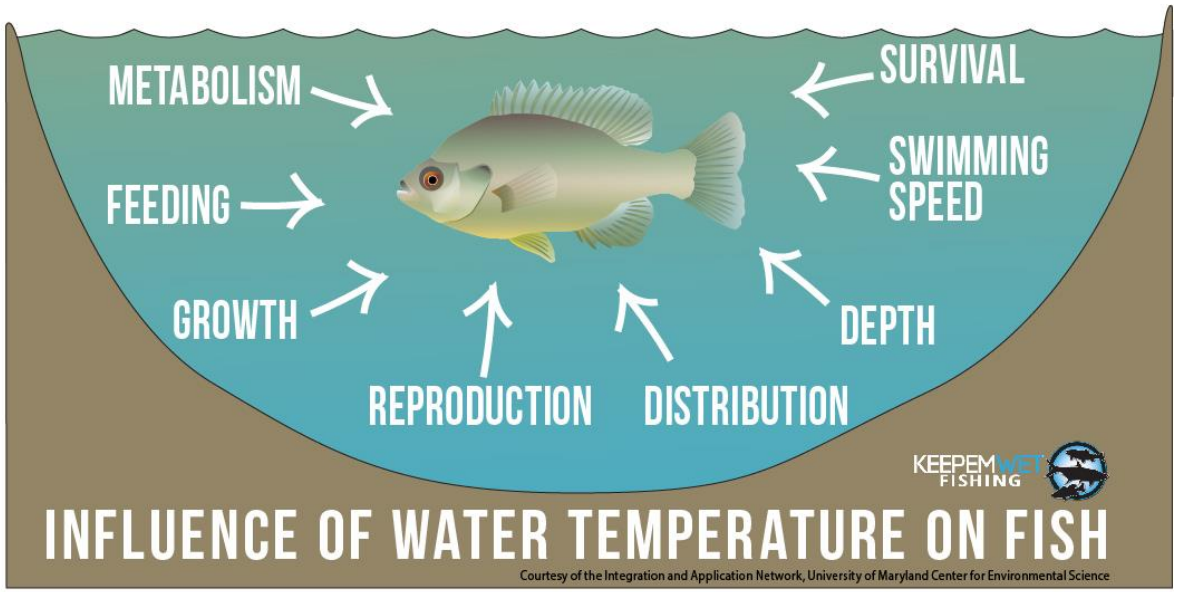
Image modified from GES4SEAS H2020 project

Environmental pressures

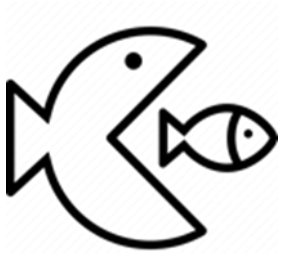
Environment is source of variability that we can scarcely control

A classic example: temperature

An ideal stock assessment world would use prediction of future temperature to inform recruitment, survival and change in distribution



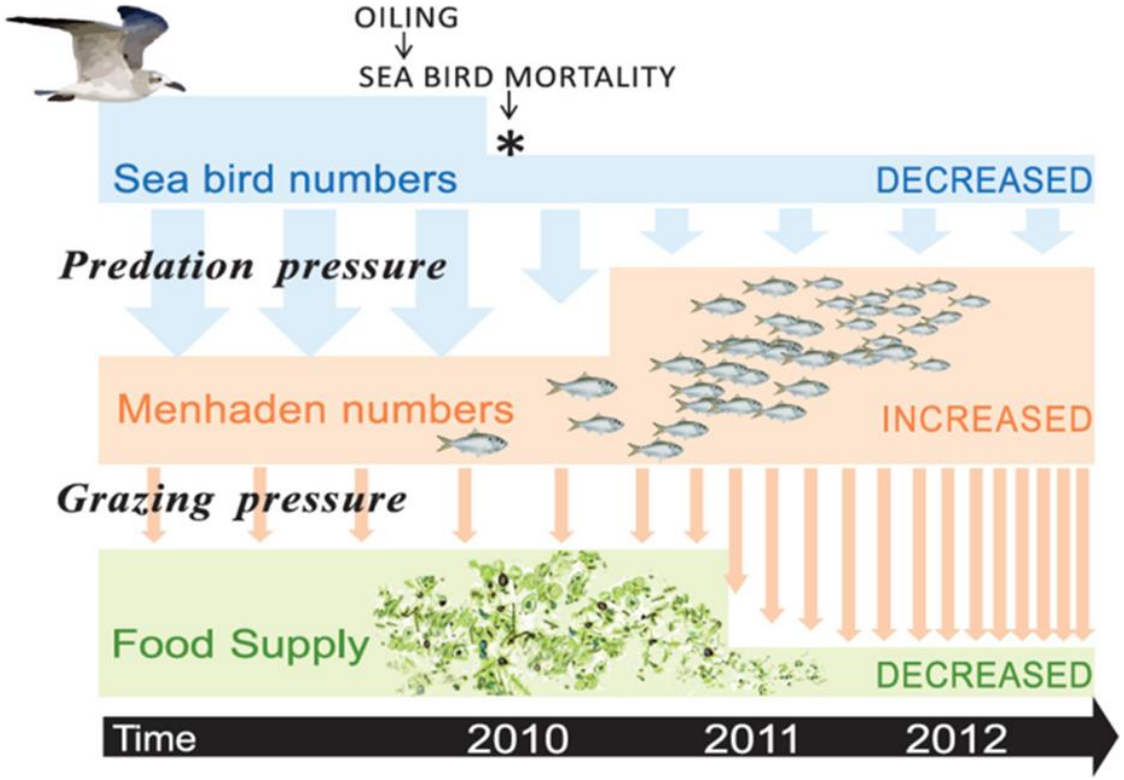
Ecological pressures



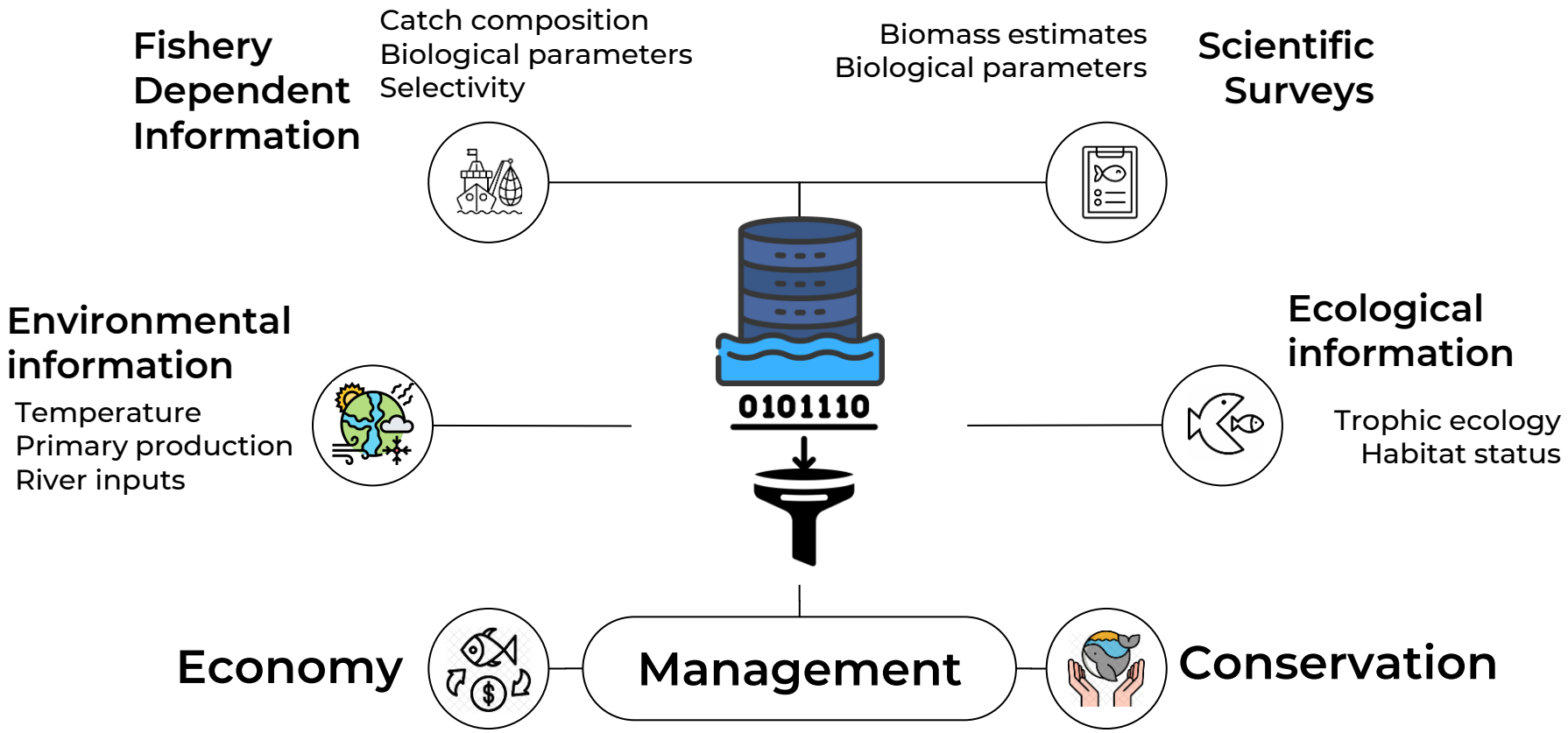
Food web status depends on environmental drivers AND on human pressure: management actions can have an effect

A classic example: trophic cascades

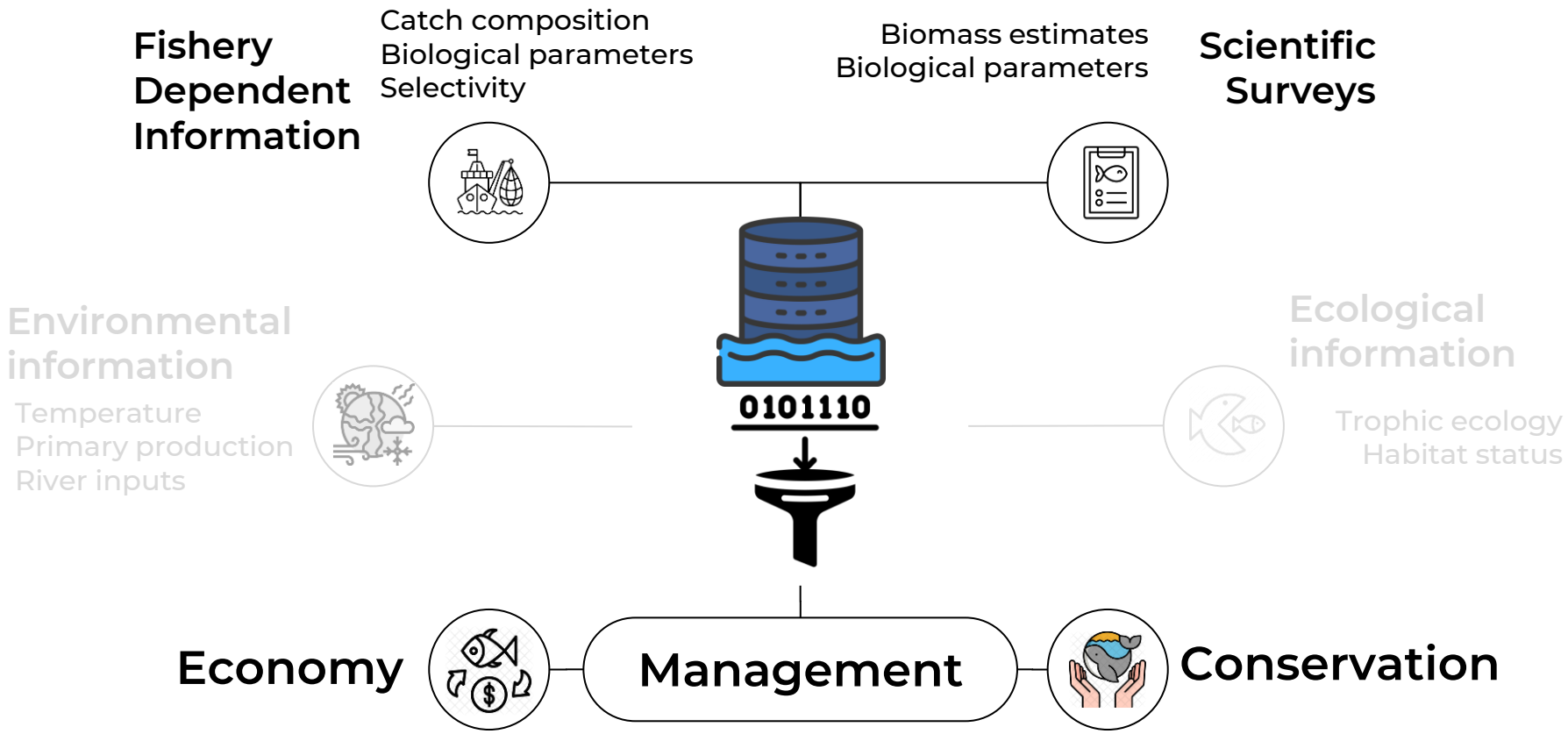
An ideal stock assessment world would use food web information to inform somatic growth and survival (predation mortality). Applying closed loops simulations allows for testing how food web react to management strategies



What information do we have



What information do we use



What is no longer working

Large amount of information is available

Environment is changing fast

The future is scarcely predictable

Lack of methods to deal with this complexity

Stock assessment models base on static biological parameters

Uncertainty ranges are scarcely used

How to change for the better?

Understanding of climatic drivers AND ecological connections

Inclusion of explicit socio-economic consideration in the definition of management objectives

Account for future scenarios

Uncertainty is likely to be very large

Needs to reason in terms of what if scenario

Expand the strategies to provide advice

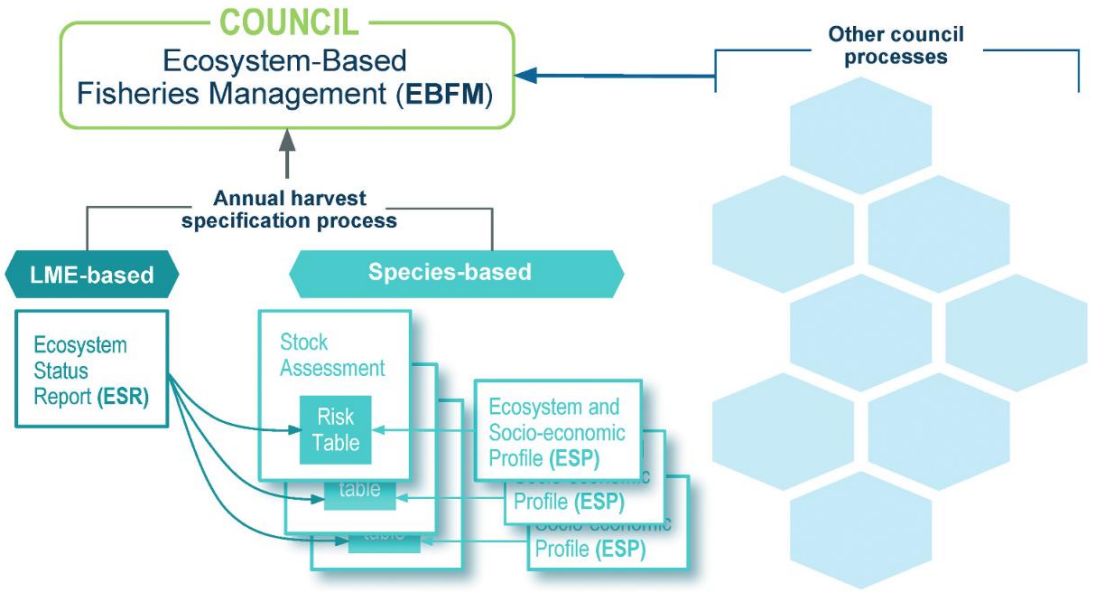
An example of risk analysis

Ecosystem Approach to Fishery Management for Alaskan fisheries: coupling a qualitative risk assessment to default single species evaluation

Reports describing environmental and ecological drivers given to stock assessment meetings

Concerns that
cannot be address within single-species stock assessments are summarized with qualitative risk analysis

Risk levels are used by managers to decide how to interpret stock assessment results (*e.g.*: do we need to apply a precautionary buffer?)



Dorn and Zador, 2020

An example of risk analysis

Ecosystem Approach to Fishery Management for Alaskan fisheries: coupling a qualitative risk assessment to default single species evaluation

Reports describing environmental and ecological drivers given to stock assessment meetings

Concerns that cannot be address within single-species stock assessments are summarized with qualitative risk analysis

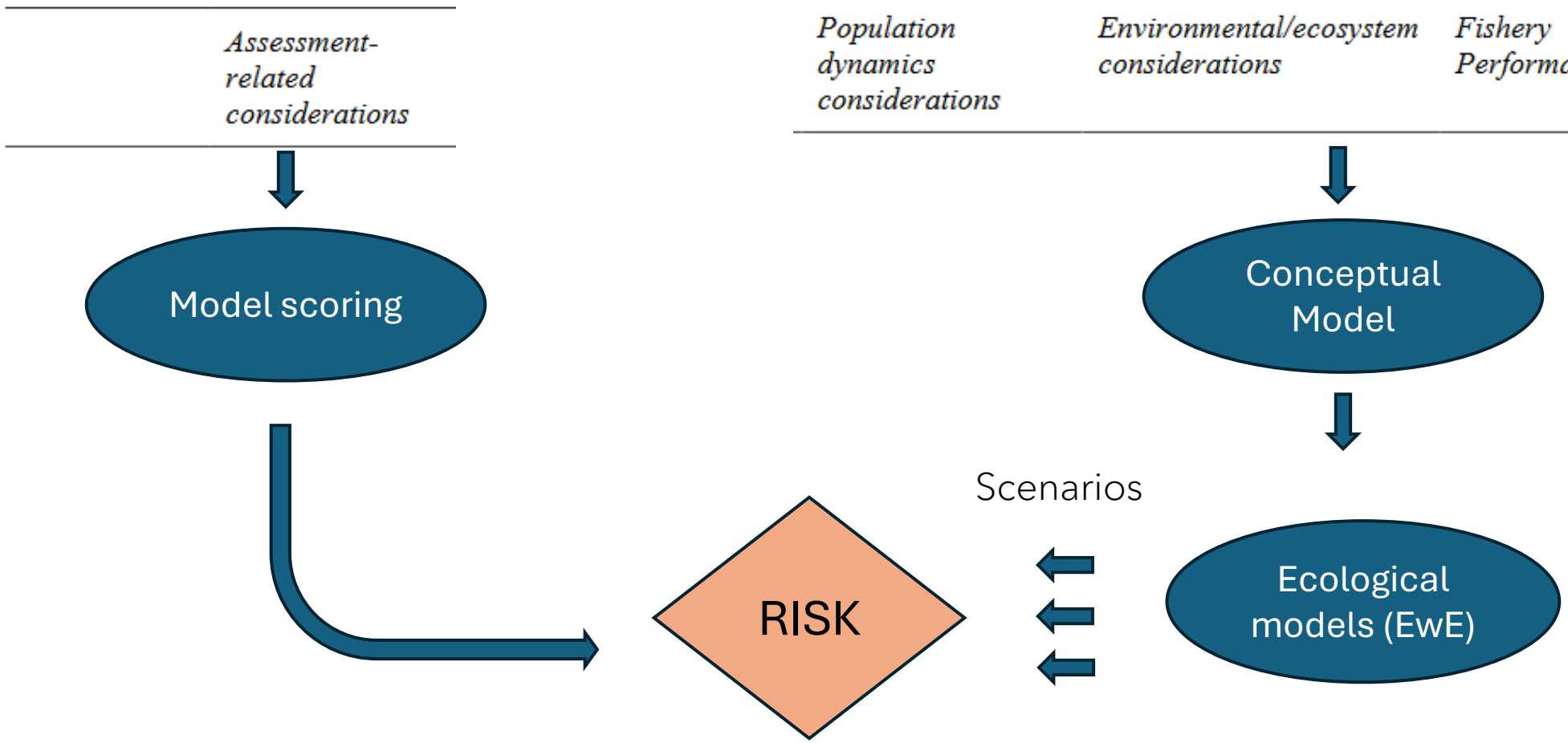
Risk levels are used by managers to decide how to interpret stock assessment results (*e.g.*: do we need to apply a precautionary buffer?)

	Assessment-related considerations	*Population dynamics considerations*	*Environmental/ecosystem considerations*	*Fishery Performance*
Level 1: Normal	Typical to moderately increased uncertainty/minor unresolved issues in assessment.	Stock trends are typical for the stock; recent recruitment is within normal range.	No apparent environmental/ecosystem concerns	No apparent fishery/resource-use performance and/or behavior concerns
Level 2: Substantially increased concerns	Substantially increased assessment uncertainty/ unresolved issues.	Stock trends are unusual; abundance increasing or decreasing faster than has been seen recently, or recruitment pattern is atypical.	Some indicators showing an adverse signals relevant to the stock but the pattern is not consistent across all indicators.	Some indicators showing adverse signals but the pattern is not consistent across all indicators
Level 3: Major Concern	Major problems with the stock assessment; very poor fits to data; high level of uncertainty; strong retrospective bias.	Stock trends are highly unusual; very rapid changes in stock abundance, or highly atypical recruitment patterns.	Multiple indicators showing consistent adverse signals a) across the same trophic level as the stock, and/or b) up or down trophic levels (i.e., predators and prey of the stock)	Multiple indicators showing consistent adverse signals a) across different sectors, and/or b) different gear types
Level 4: Extreme concern	Severe problems with the stock assessment; severe retrospective bias. Assessment considered unreliable.	Stock trends are unprecedented; More rapid changes in stock abundance than have ever been seen previously, or a very long stretch of poor recruitment compared to previous patterns.	Extreme anomalies in multiple ecosystem indicators that are highly likely to impact the stock; Potential for cascading effects on other ecosystem components	Extreme anomalies in multiple performance indicators that are highly likely to impact the stock

Extended risk analysis

Use objective methods to assign a trustworthiness score to stock assessment results

Use of data and models to describe the status of the system under alternative states of nature in terms of probabilities



An example of results

Example of Risk analysis results that we can couple to standard single species stock assessment output

Risk Table

	Assessment	Pop. dynamic	Environment/ecosystem	Fishery performance
Risk	2	2	3	1

Extended Risk Analysis

Assessment scoring

	Model	Data
Risk (1-score)	0.2	0.25

Environmental and ecological Risk

Temperature (T°)	Constant		+1°	
Int. Competition (IC)	0	1	0	1
Management Plan (MP)	0.53 (± 0.06)	0.73 (±0.04)	0.35 (±0.05)	0.58 (±0.04)
Further Effort Reduction (FER)	0.6 (±0.04)	0.79 (±0.04)	0.39 (±0.05)	0.67 (±0.04)
Zooplankton increase (RCP85)	0.51 (±0.04)	0.79 (±0.05)	0.33 (±0.05)	0.59 (±0.05)

Conclusions

Summarising the Risk

Do we have any indication that future environmental state of the system is likely to affect productivity?

How does our stock might react to (multispecies) management scenarios?

Interpreting the Risk

Ecosystem consequences of management strategies matters: food web components does not react at the same pace to fishing effort reduction

Unexplained patterns in stock assessment models can be due to environmental trends

Using the risk approach to implement advice

Apply a more (or less) precautionary approach based on broad evidences and considering the potential future state of the system

To recommend alternative management instruments (i.e.: if the benefit of lowering bottom trawl are compensated by increasing predation)

Thank you

MEDAC
MEDITERRANEAN
ADVISORY
COUNCIL

Split (Croatia)
16-17 October 2024