

# MareFrame

NORTH WESTERN  
WATERS  
ADVISORY COUNCIL



NWWAC WG1: MareFrame:  
West of Scotland Case study  
Kåre Nolde Nielsen and Alan Baudron  
Paris 03.02.2016



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 613571

# Outline

- MareFrame
- Cooperation with NWW/WG1
- Outcomes so far
- Discuss & decide next steps

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## The MareFrame project

- Ecosystem Approach to Fisheries - how?
- Tools, processes
- Case studies - ICES VIa
- Half way – 2 years left



## Multiannual plans as EAF instrument

- A first step to EAF in EU
- Wide areas; more species; consider MSFD (D3+)
- Regionalisation
- Baltic template?
- NWW demersal MAP: consultation 01.09
- Can MareFrame VIa case be relevant here?



## The Baltic plan - a template?

### Process:

- Lead by Commission
- Interactions: STECF, BSAC, Baltfish...
- Decision making standoff



### Content:

- Predator and prey species
- Fmsy ranges: target or max?
- Min. SSB levels
- Empower regional measures
- Review clause





**MareFrame**

## The cooperation process

- ✓ Management problem(s)
- ✓ Objectives and indicators
- ✓ Alternatives and evaluation structure
- ✓ Ecosystem model (EwE)
  - Simulate alternatives
  - Evaluate and select best approach
  - Draft 'management proposal' (01.01.17)

[Dublin, 22.05.14]

[Skype, 18.11.14]

[Aberdeen, 30.09.15]



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# Decision support as in?

## Damara

- User-defined scenarios
- Mixed fisheries; high detail

## MareFrame (in VIa)

- Collective alternative definition & evaluation
- Foodweb model; broad picture



## Case study problems - summary

- **Cod and whiting recovery?**
- **Impact of seal predation?**
- **Multispecies MEY?**





## Management alternatives

- «Current path»: LO and MSY constraints
- «Mixed MEY»: Economic optimization; relaxed MSY constraints
- «Different cod stock definition» – *on hold*
- «Gadoid recovery» «



# Modelling the West of Scotland case study



- Ecosystem Approach to Fisheries = Ecosystem model
- Mixed fishery = multi species/multi fleet
- Trophic interactions
- Ecosystem health = ecosystem indicators
- Impact of environmental forcing
- Variety of modelling tools available



West of Scotland



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# Modelling the West of Scotland case study

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ICES Journal of  
**Marine Science**



## Investigating the recent decline in gadoid stocks in the west of Scotland shelf ecosystem using a foodweb model

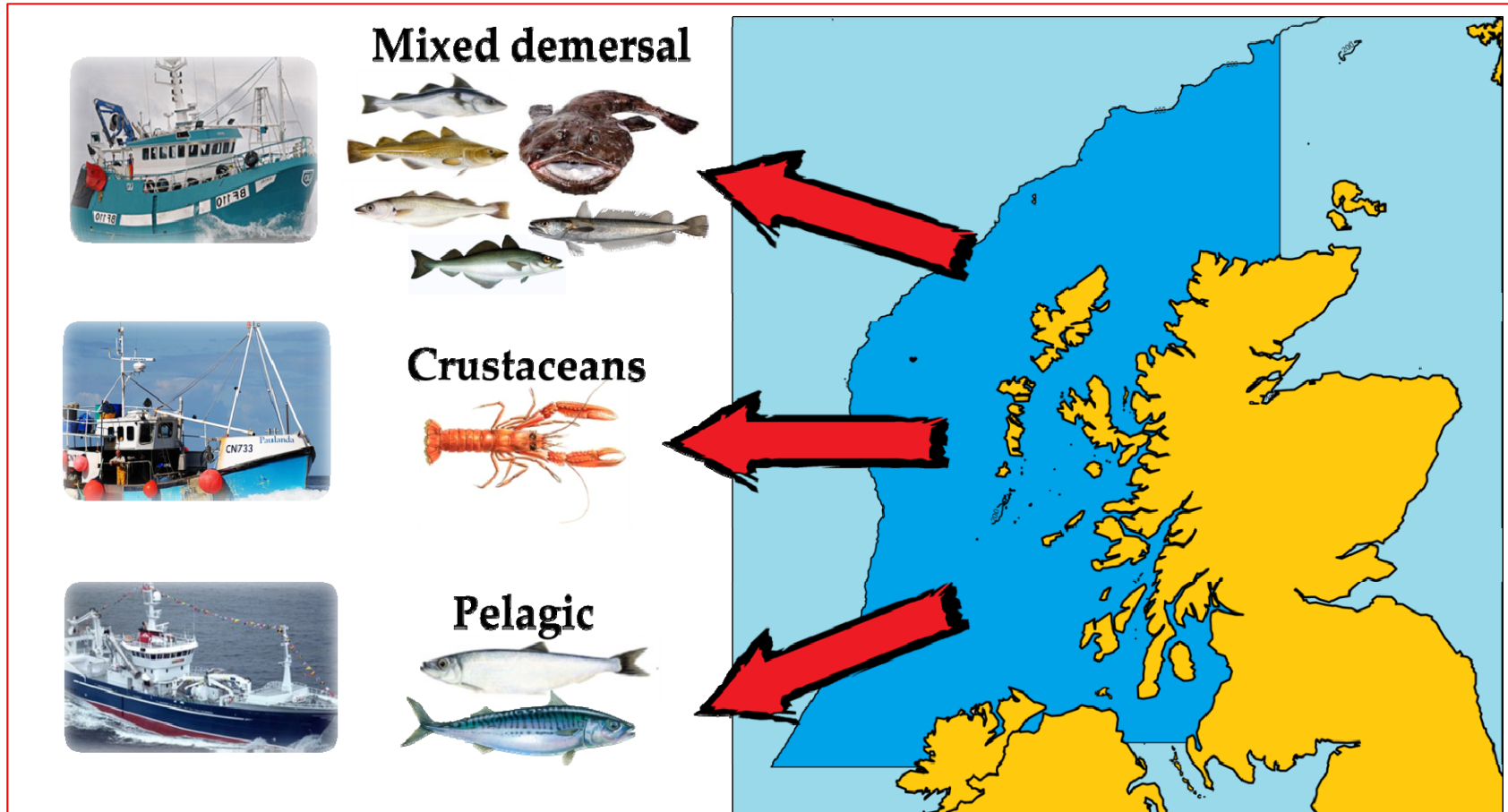
Karen A. Alexander<sup>1\*</sup>, Johanna J. Heymans<sup>1</sup>, Shona Magill<sup>1</sup>, Maciej T. Tomczak<sup>2</sup>, Steven J. Holmes<sup>3,4</sup>, and Thomas A. Wilding<sup>1</sup>

- **End-to-End, foodweb model**
- **Shelf area (<200 m) of VIa = 3 main fisheries**
- **41 functional groups = includes commercial species**
- **Includes top predators**
- **5 fishing fleets = demersal trawl, Nephrops trawl, pelagic trawl, potting, other trawl**
- **Parameterised for 1985-2008**



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# Modelling the West of Scotland case study



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ICES  
CIEM

International Council for  
the Exploration of the Sea  
Conseil International pour  
l'Exploration de la Mer

## Investigating the recent decline in gadoid stocks in the west of Scotland shelf ecosystem using a foodweb model

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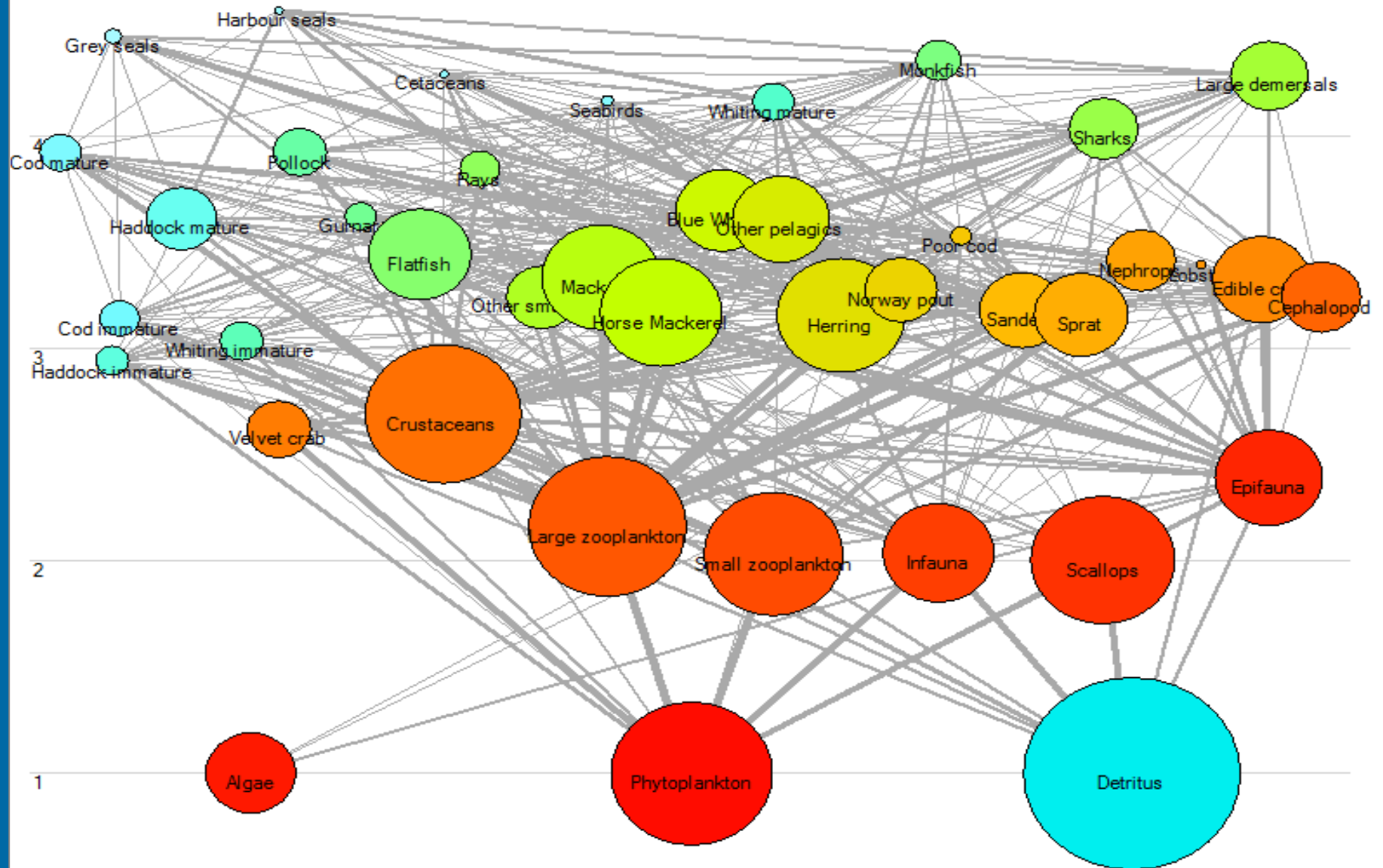
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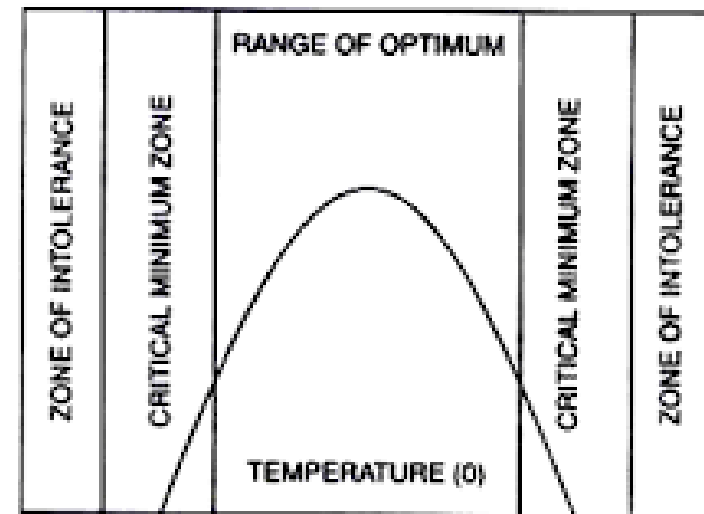


# Modelling the West of Scotland case study

- Update the parameterisation = 1985 to 2013
- Latest assessment and survey data available
- Latest catch and discards estimates
- Including temperature effect
- For each group:

Temperature impact on search rate for food

- Better parameterisation

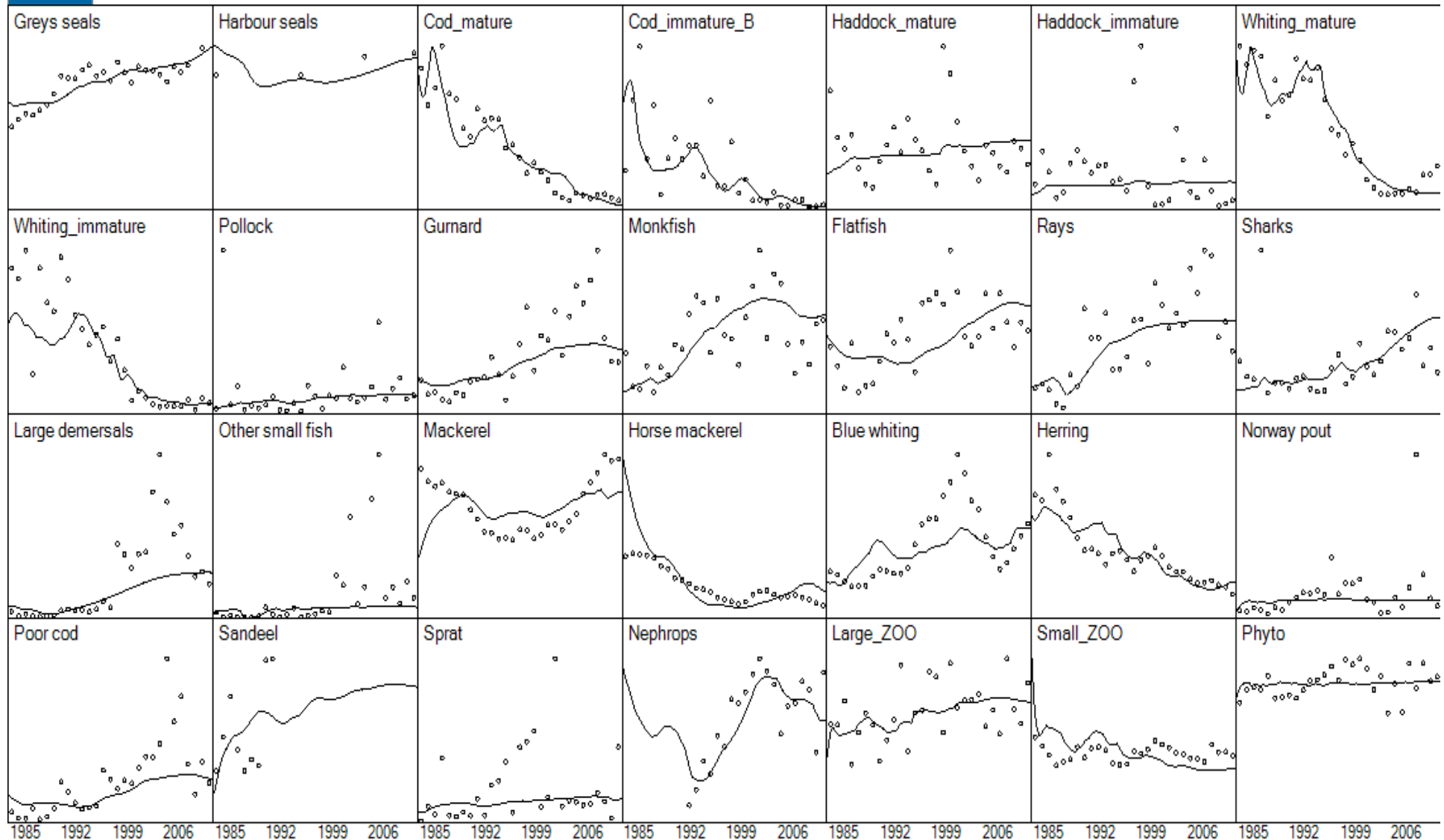


RANGE OF TEMPERATURE TOLERANCE



# Modelling the West of Scotland case study

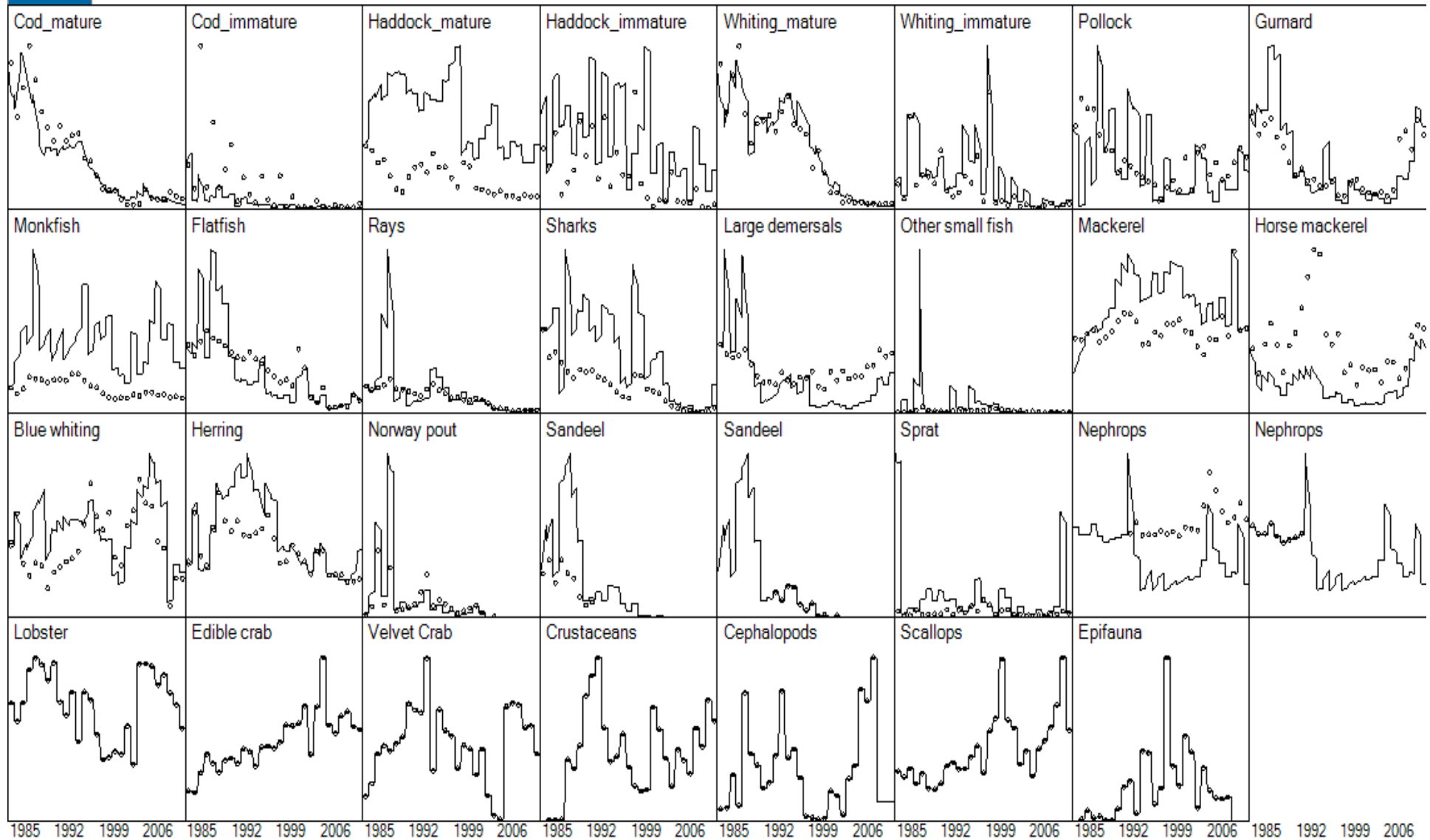
MareFrame





# Modelling the West of Scotland case study

MareFrame



# Modelling the West of Scotland case study

### *Strengths and weaknesses*



Ecopath with Ecosim

*No fish is an island*



- End-to-end model = whole ecosystem
- Foodweb model = trophic interaction
- Ability to model large number of species
- Encapsulate complex processes
- Impact of environment



- Not (initially) designed to simulate fisheries
- Careful when simulating mixed fishery
- Catches = discards not modelled (no landings obligation...)
- Model  $\neq$  reality, can we simulate decades in the future?  
(Planque, 2016)

- Capture main processes
- Simualte management alternative, everything else being equal



# Modelling the West of Scotland case study

# MareFrame

Ecopath with Ecosim  
*No fish is an island*

- What we can simulate: F and effort scenarios
- What the model returns:



- What we can calculate:

Shannon's  
diversity index  
(SI),

mean maximum  
length (MML)

mean trophic  
index (MTI)

pelagic to  
demersal  
ratio (P/D)

GES indicators from  
biomass and landings

(Gascuel *et al.* 2014)



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# Modelling the West of Scotland case study



## Scenarios

- **Status quo (baseline): F set at the last historical value**
- **Current path: stocks with reference points in VIa harvested at  $F_{MSY}$**

Stock	$F_{MSY}$	Notes
Cod	0.19	
Haddock	0.37	Value for areas IV and VI
Whiting	Undefined	Should be as low as possible
Nephrops	0.116	Averaged between FU 11 and FU12



# Modelling the West of Scotland case study



## Scenarios

- **Maximum Economic Yield = Current path +:**
  - **Increasing Nephrops and pelagic trawl effort increase overall revenue**
  - **Nephrops trawl do catch demersal fish species**
  - **MEY = increase NTR by 20%, PTR by 30%**



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# Modelling the West of Scotland case study

MareFrame

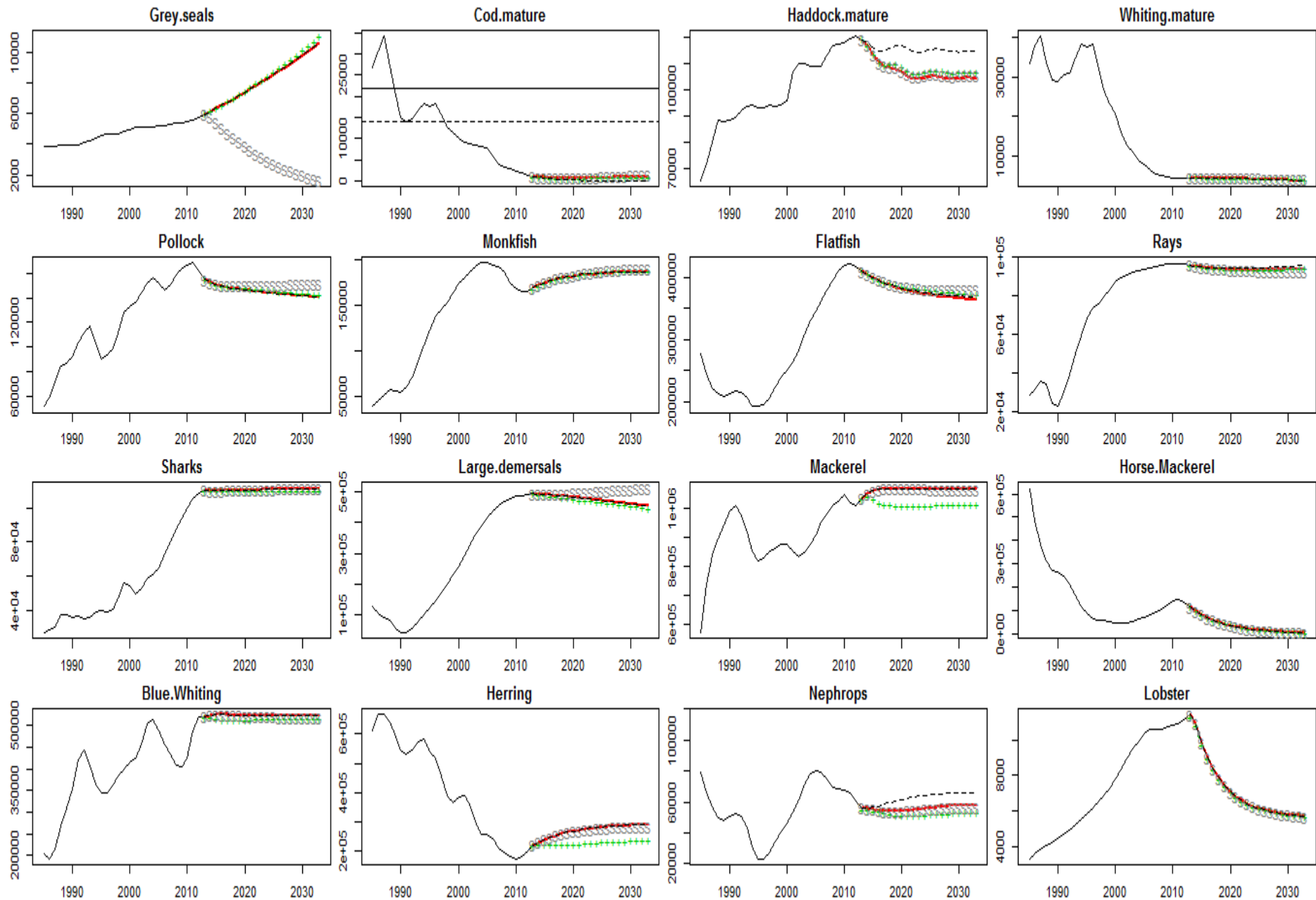
## Scenarios

- Gadoid recovery = Current path +
  - Culling 10% of the grey seal population each year

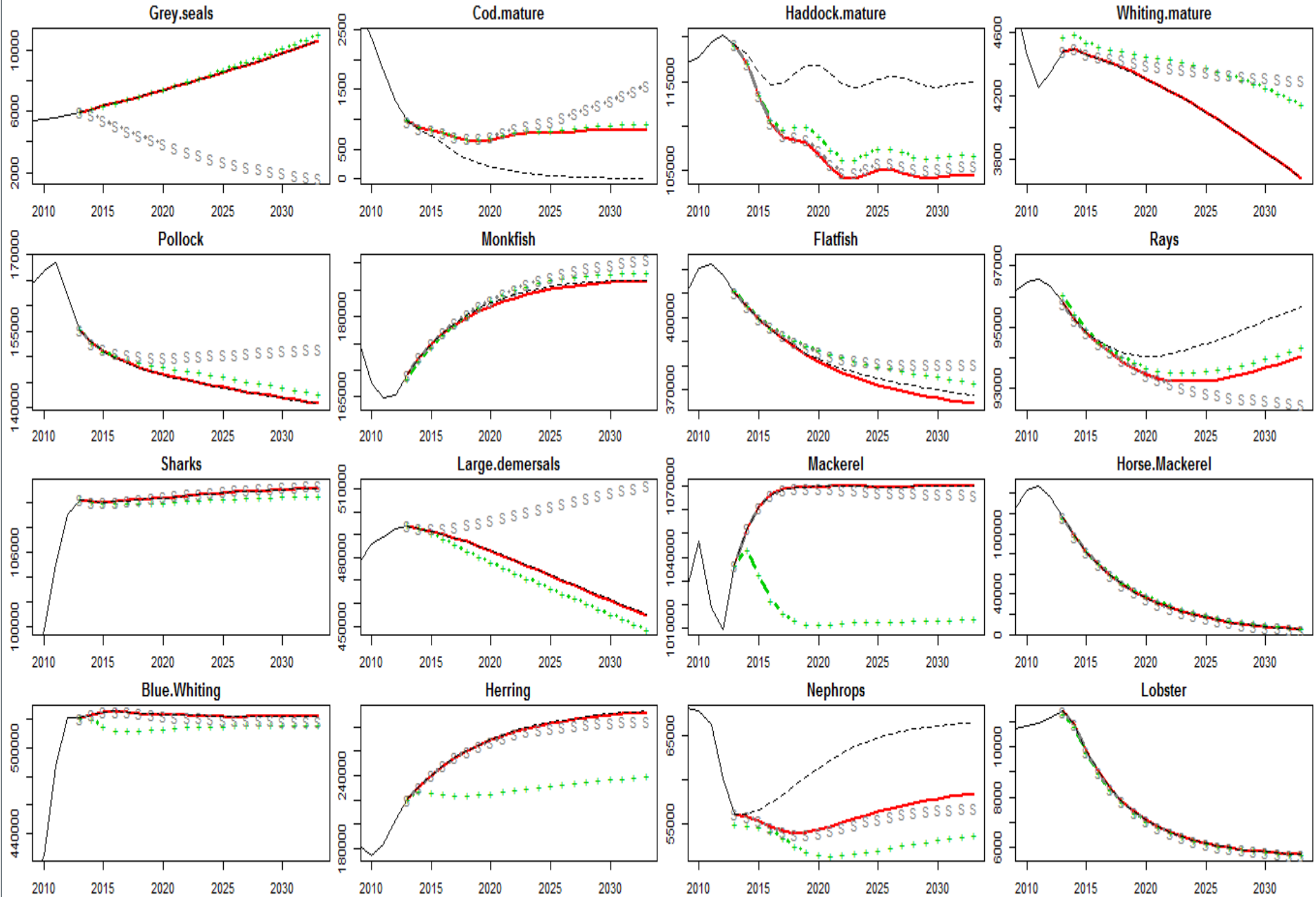


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# Biomass (tonnes)

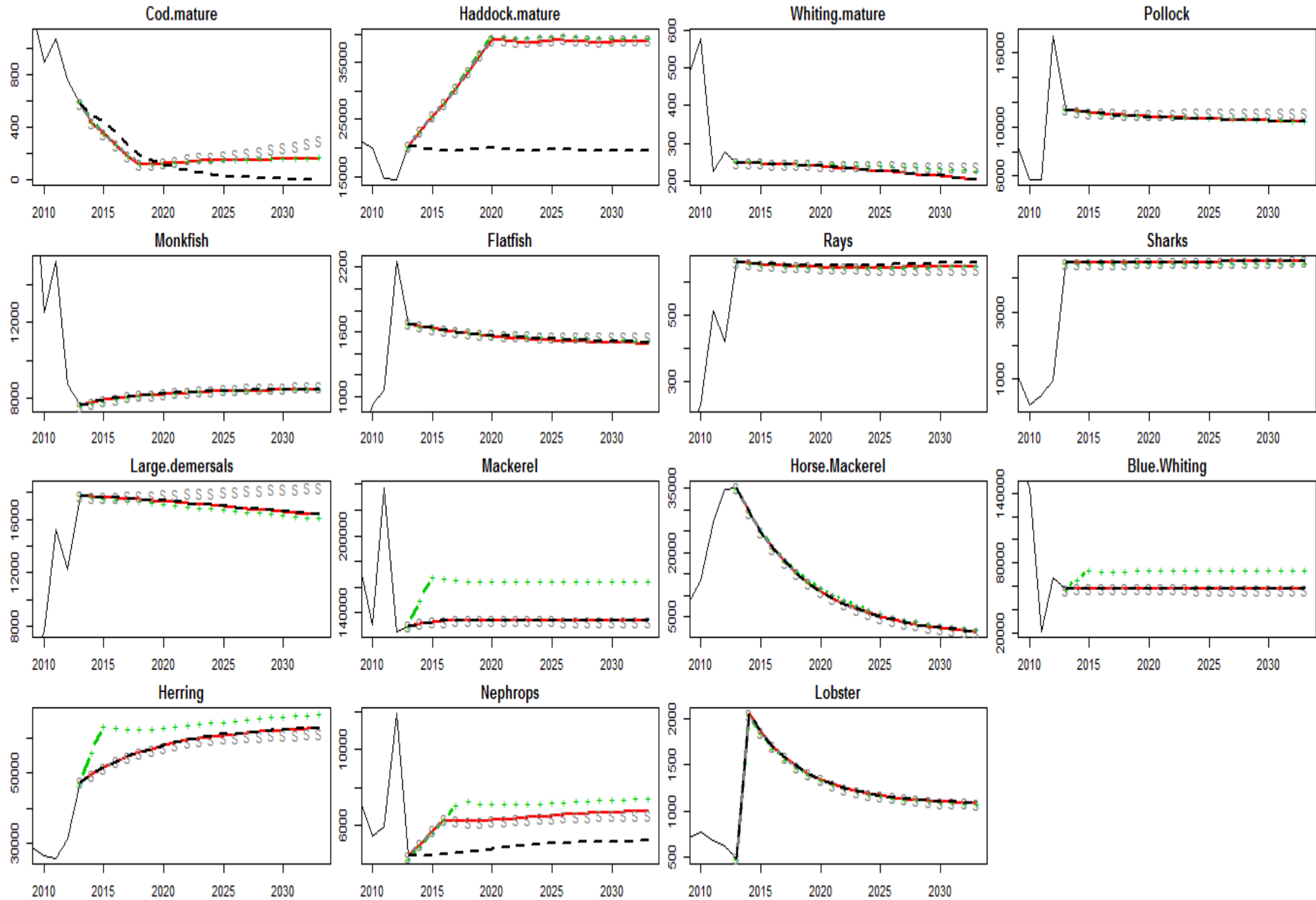


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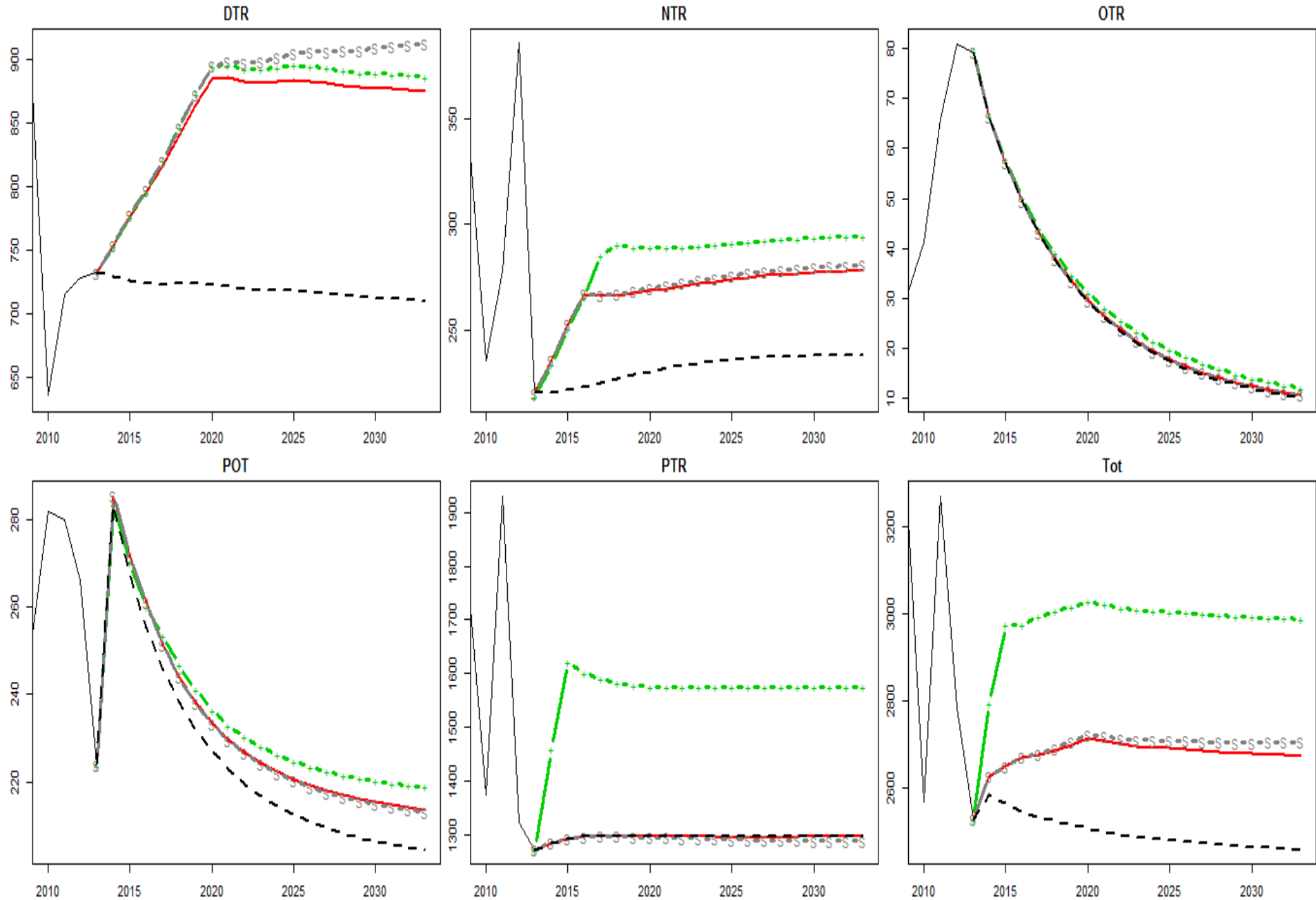




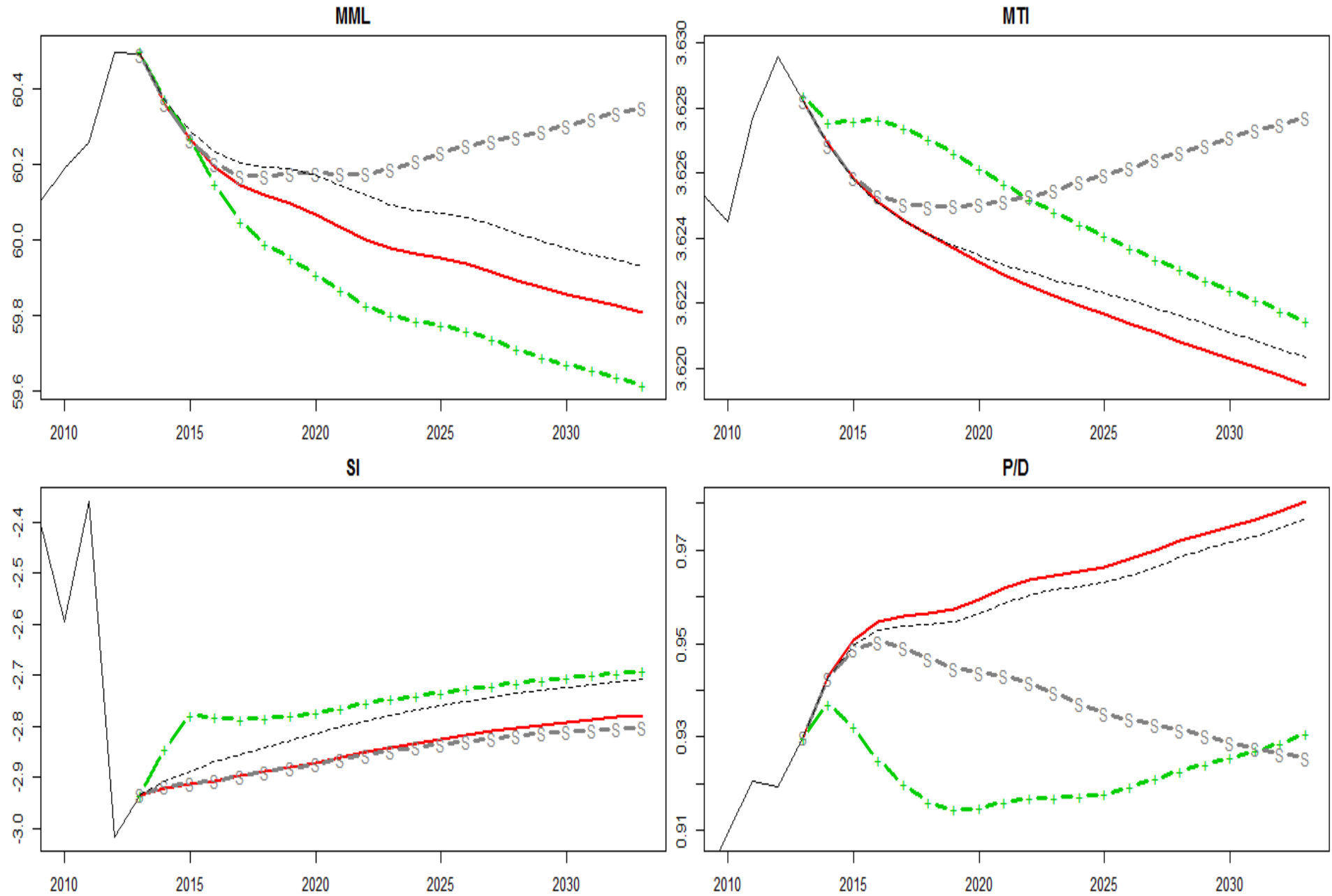
# Landings (tonnes)



# Revenue ('000s of £)



# GES indicators



# Modelling the West of Scotland case study



- Culling seals: slight increase in cod biomass, but limited impact towards recovery
- What to do to recover cod and whiting?



## Investigating the recent decline in gadoid stocks in the west of Scotland shelf ecosystem using a foodweb model

Karen A. Alexander<sup>1\*</sup>, Johanna J. Heymans<sup>1</sup>, Shona Magill<sup>1</sup>, Maciej T. Tomczak<sup>2</sup>, Steven J. Holmes<sup>3,4</sup>, and Thomas A. Wilding<sup>1</sup>

➤ F too high



*Journal of Applied Ecology* 2015

doi: 10.1111/1365-2664.12439

## Grey seal predation impairs recovery of an over-exploited fish stock

Robin M. Cook<sup>1\*</sup>, Steven J. Holmes<sup>2,3</sup> and Robert J. Fryer<sup>3</sup>

➤ Seal mortality underestimated



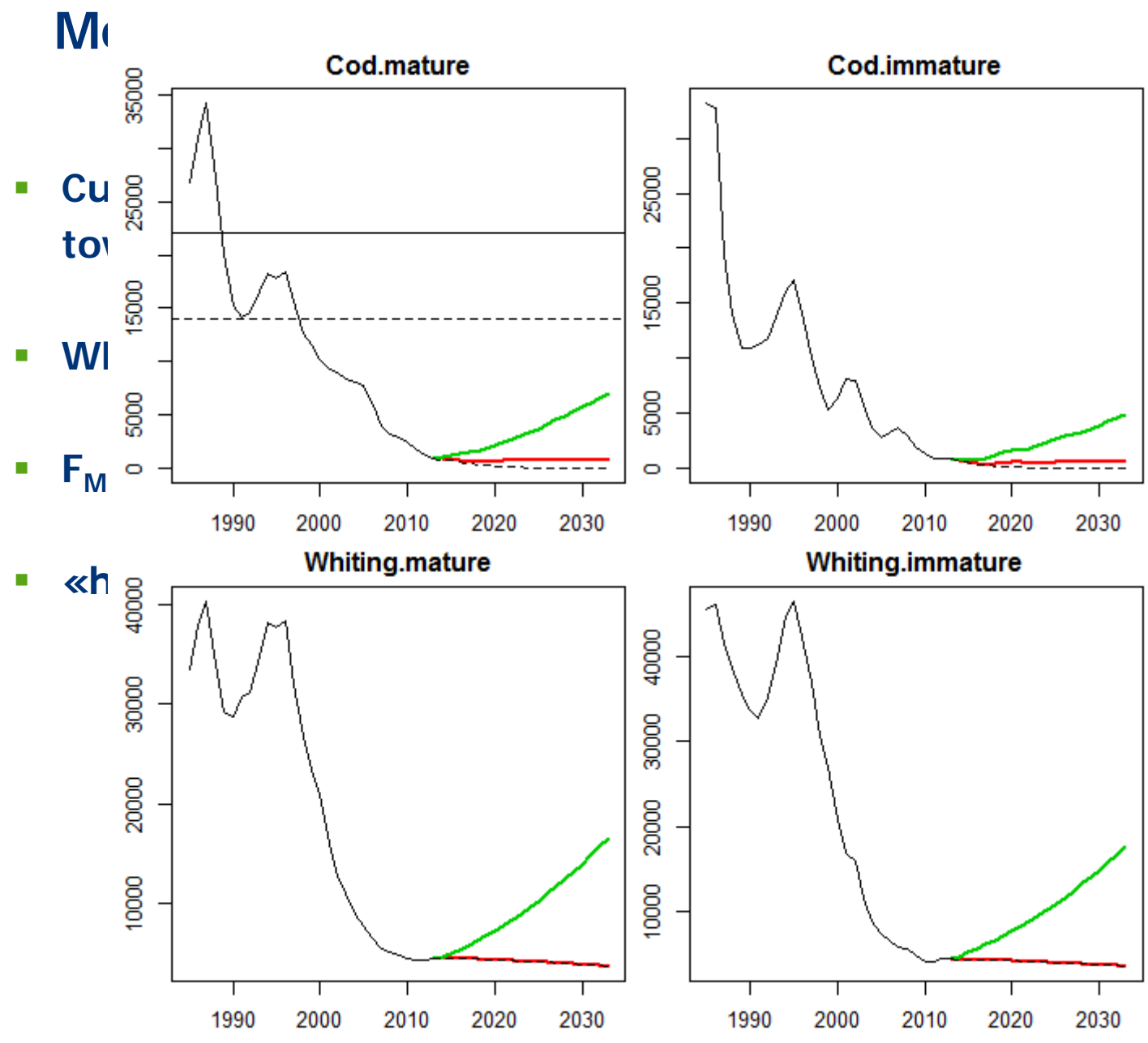
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# Modelling the West of Scotland case study



- **Culling seals: slight increase in cod biomass, but limited impact towards recovery**
- **What to do to recover cod and whiting?**
- **$F_{MSY}$  too high? Reduce cod  $F$  to 0.05**
- **«high»  $F$  on whiting immature = Reduce  $F$  to 0.05**





# Modelling the West of Scotland case study



- **Culling seals: slight increase in cod biomass, but limited impact towards recovery**
- **What to do to recover cod and whiting?**
- **$F_{MSY}$  too high? Reduce cod  $F$  to 0.05**
- **«high»  $F$  on whiting immature = Reduce  $F$  to 0.05**
- **What if cull seals and reduce  $F$  to 0.05???**





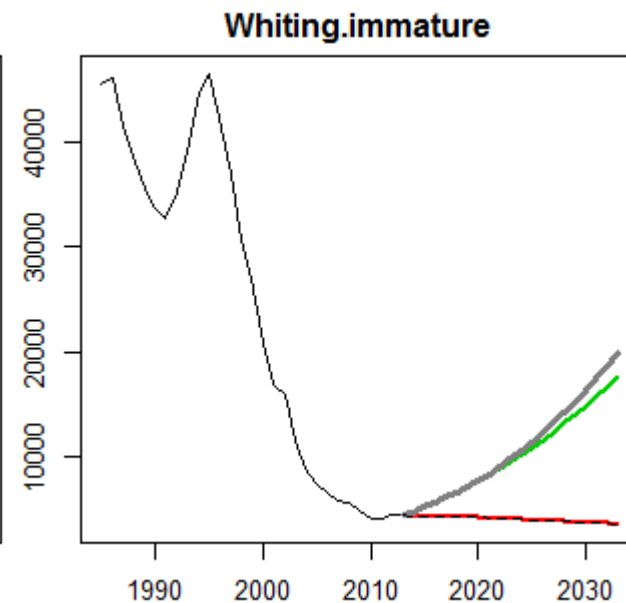
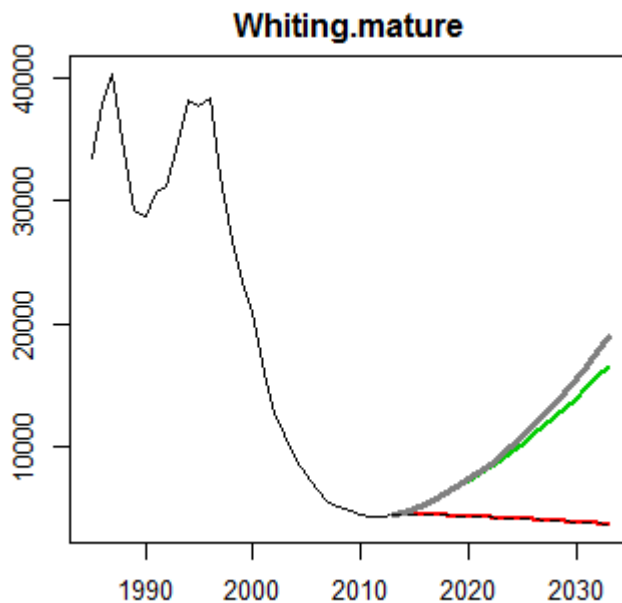
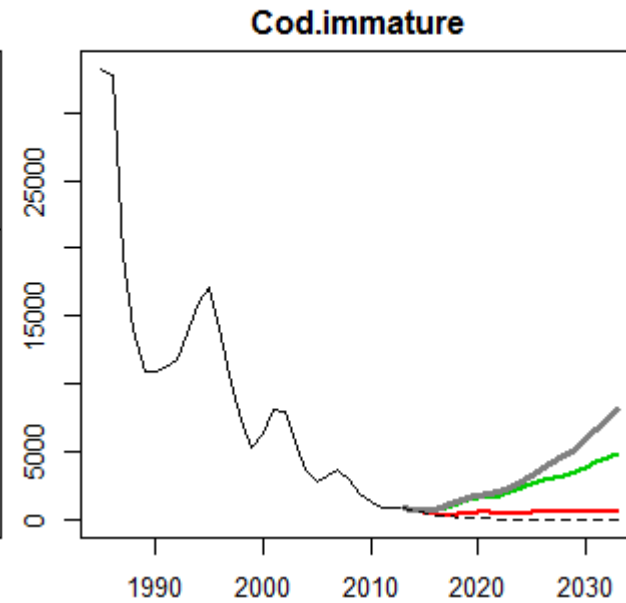
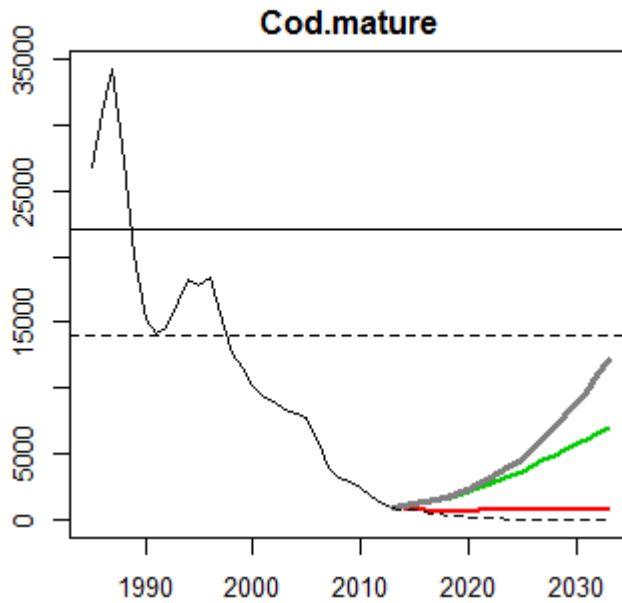
Me

- Cu
- to
- WI
- $F_M$

- «h
- WI



impact



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## Model results:



- Current path = unlikely to achieve gadoids recovery (F still too high)
- MEY: increasing Nephrops (moderately) and Pelagic trawl effort does increase overall revenue, but is it a viable option?
- Reducing seal predation alone leads to little improvement
- Combining a seal cull and drastic reduction in F = most likely option to recover cod and whiting, but no «miracle» solution
- Mixed fishery: how likely are we to reduce F for cod and whiting whilst exploiting other demersal stocks?



# Decision support with Multicriteria Analysis

- **Structured approach to compare / evaluate alternatives**
- **Facilitate communication about choices and reasons**
- **Understand (potentially resolve) conflicts of interest**



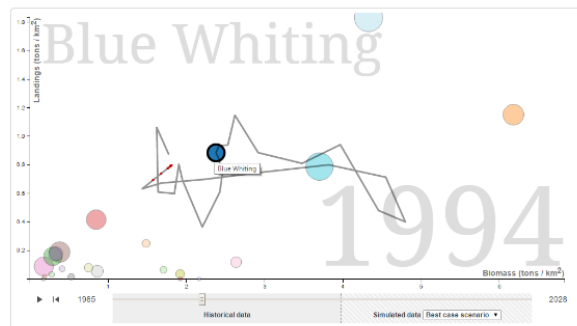
## The case study online

### MareFrame Decision Support Framework

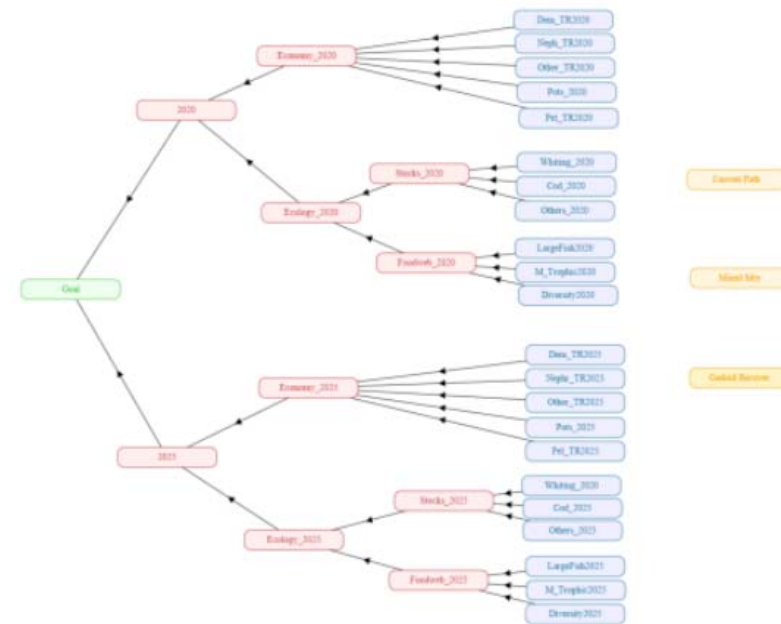
The MareFrame Decision Support Framework is a pragmatic planning process for moving towards an Ecosystem Approach to Fisheries Management. Please select from the case studies below to review the available information and decision support tools.



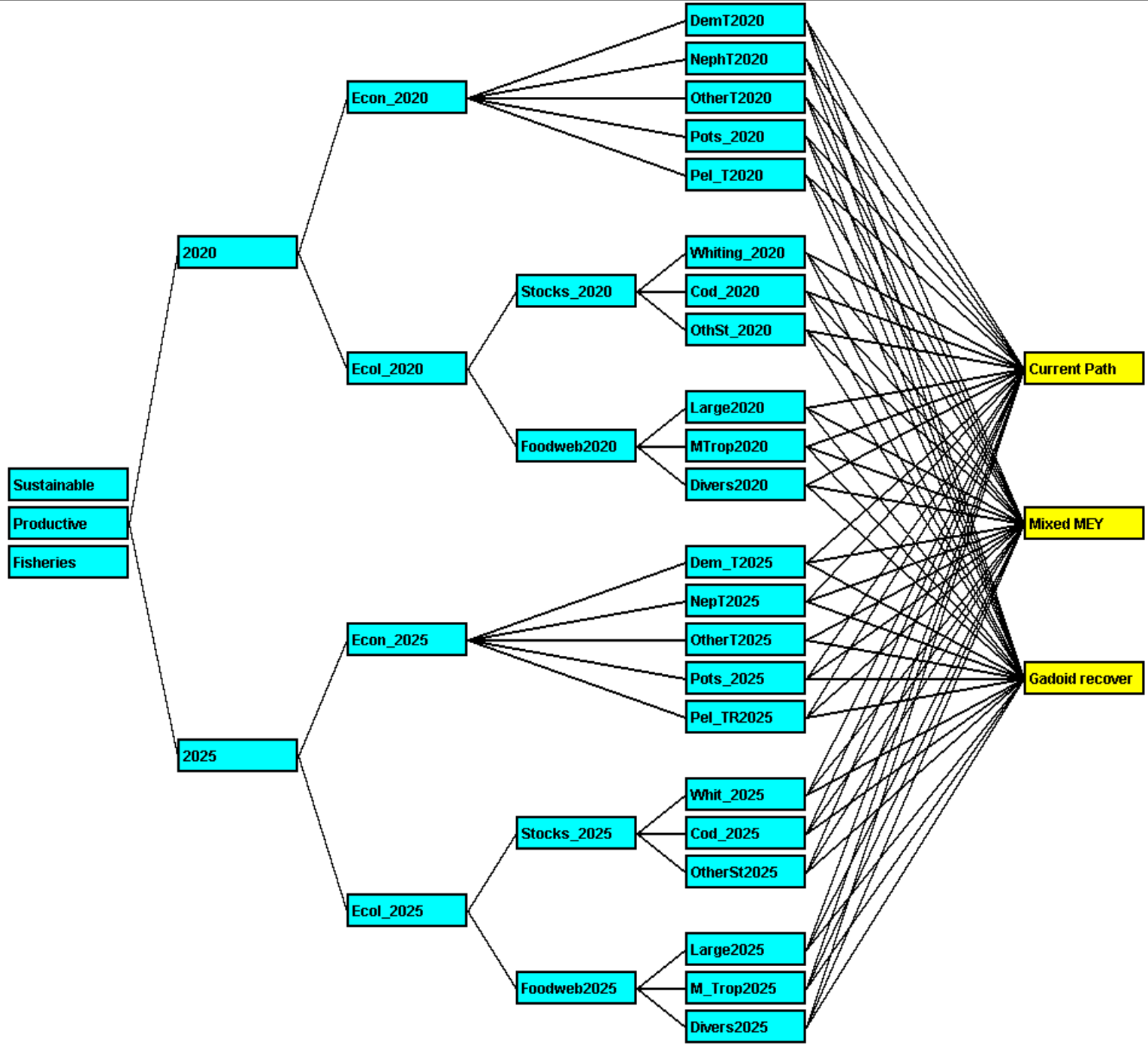
### Scenario Model output



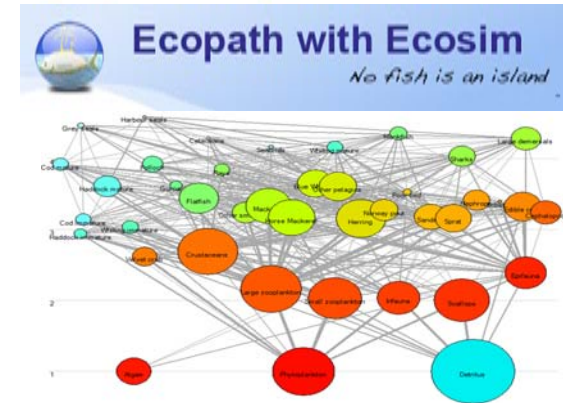
<http://mareframe-fp7.org/>  
<http://mareframe.mapix.com/west-coast-of-scotland.html>



Goal	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Alternatives
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# Input data from the ecosystem model



	Cod_2020	OtherT2020	Whit_2025	OtherT2025
<b>Min Rating</b>	<b>345.0</b>	<b>15.0</b>	<b>2139.0</b>	<b>9.0</b>
<b>Current Path</b>	<b>622.0</b>	<b>17.7</b>	<b>4100.0</b>	<b>17.7</b>
<b>Mixed MEY</b>	<b>692.0</b>	<b>19.6</b>	<b>4382.0</b>	<b>19.6</b>
<b>Gadoid recov</b>	<b>719.0</b>	<b>17.6</b>	<b>4351.0</b>	<b>17.6</b>
<b>Max Rating</b>	<b>1036.0</b>	<b>45.0</b>	<b>6417.0</b>	<b>27.0</b>
<b>Unit</b>	<b>Tonnes SSB</b>	<b>1000€</b>	<b>Tonnes SSB</b>	<b>1000€</b>



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## Using the MCA tool

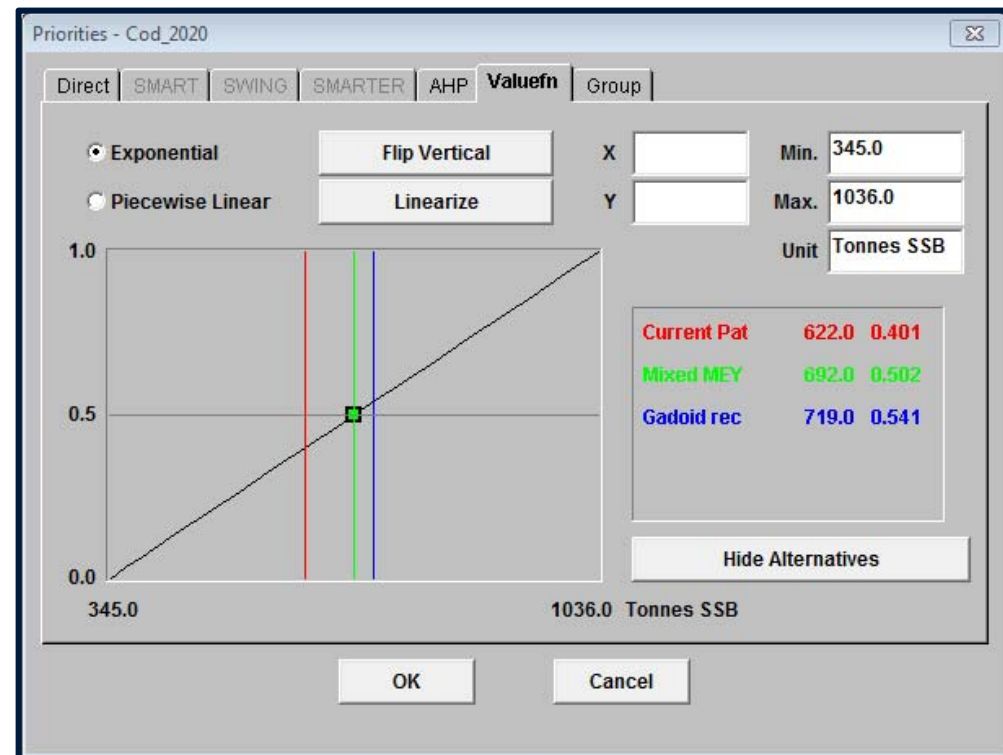
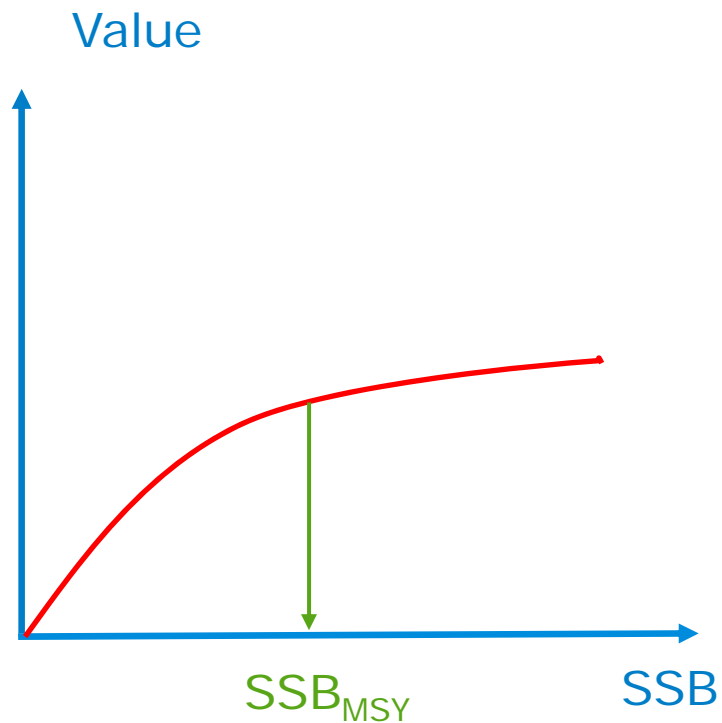
1. Decide relative importance of criteria



2. How does changes in a variable relate to preferences?



## Value function – e.g. spawning stock biomass

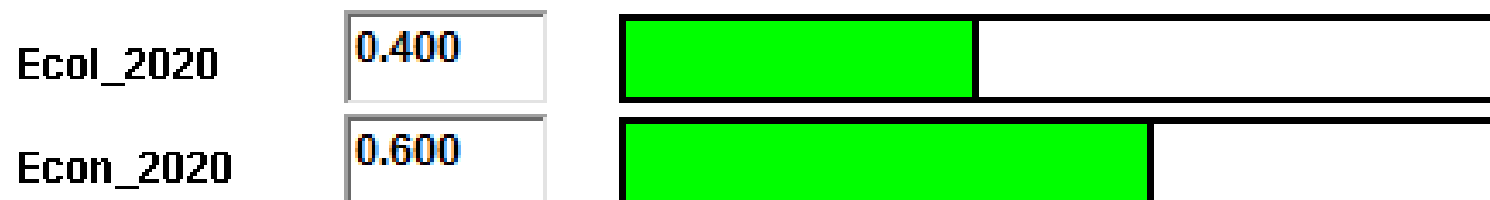


## Example of weighting

### Short vs. longer term:

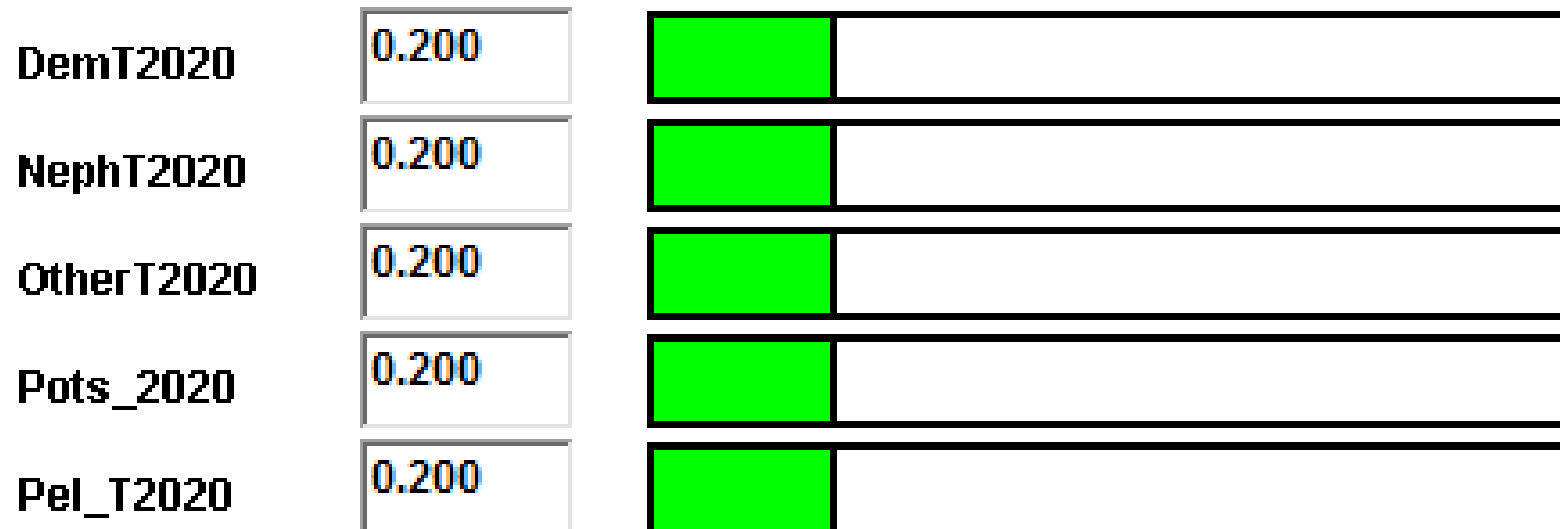


### Ecology vs. economy:





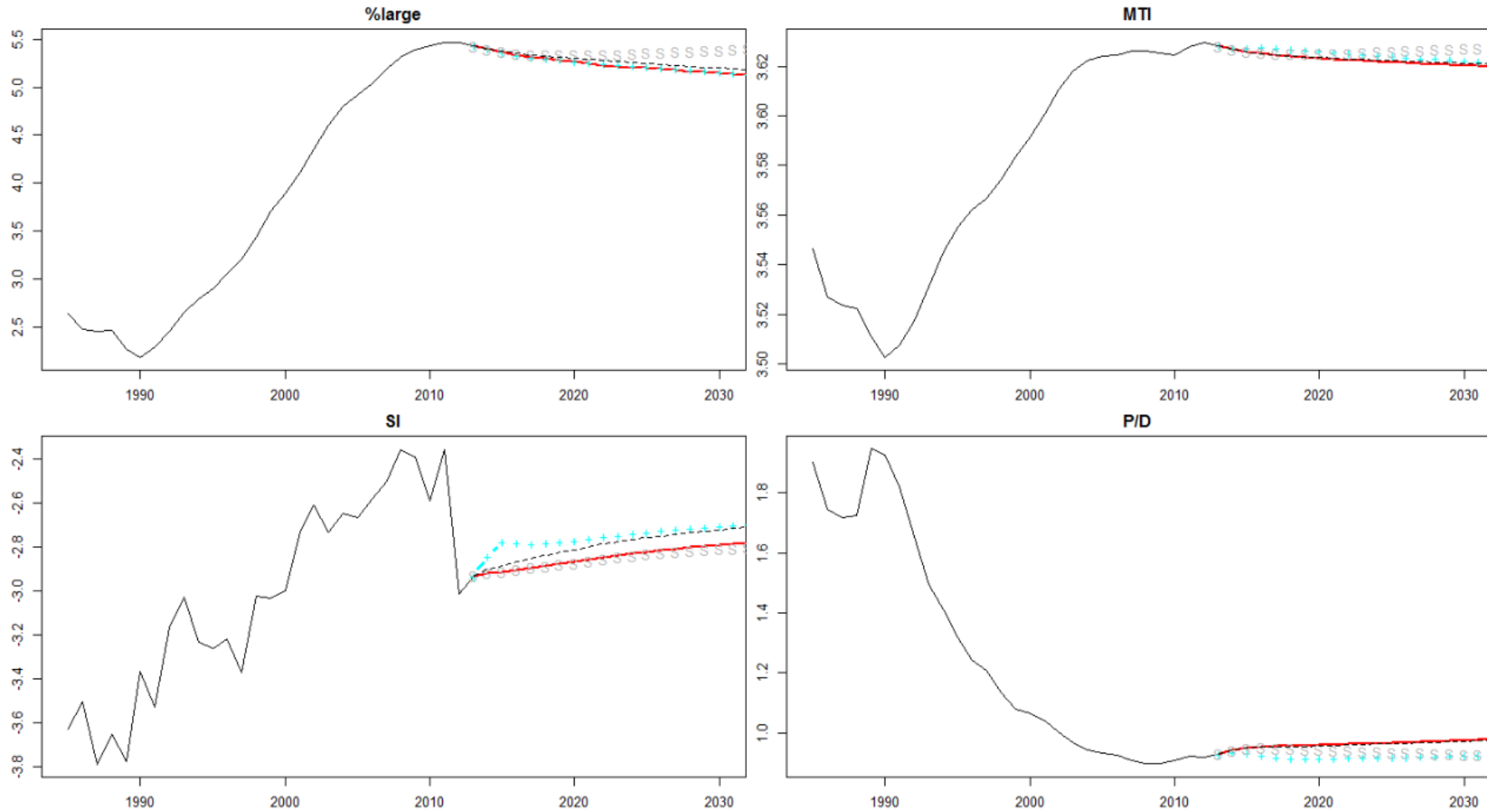
## Fleets



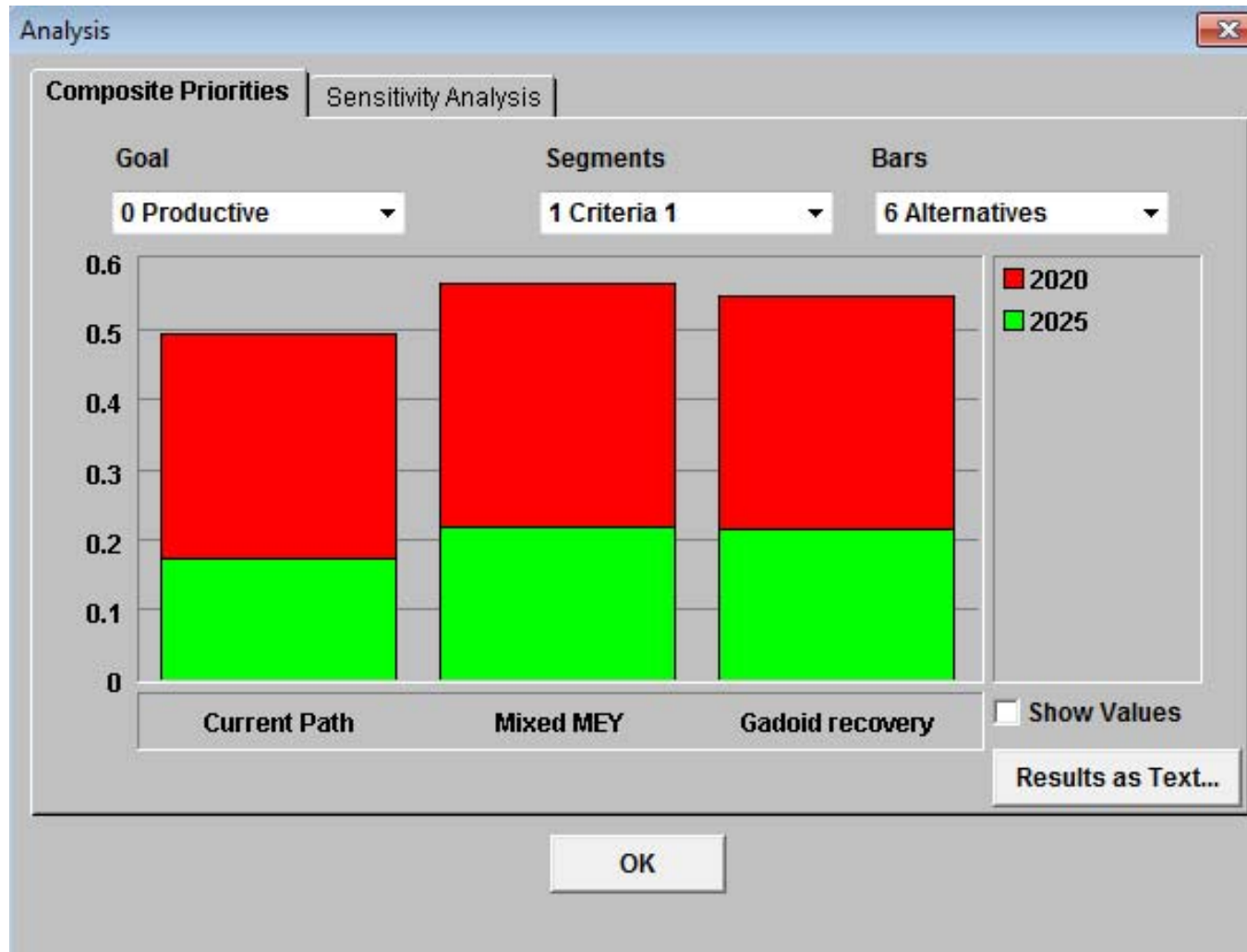
## Ecosystem indicators



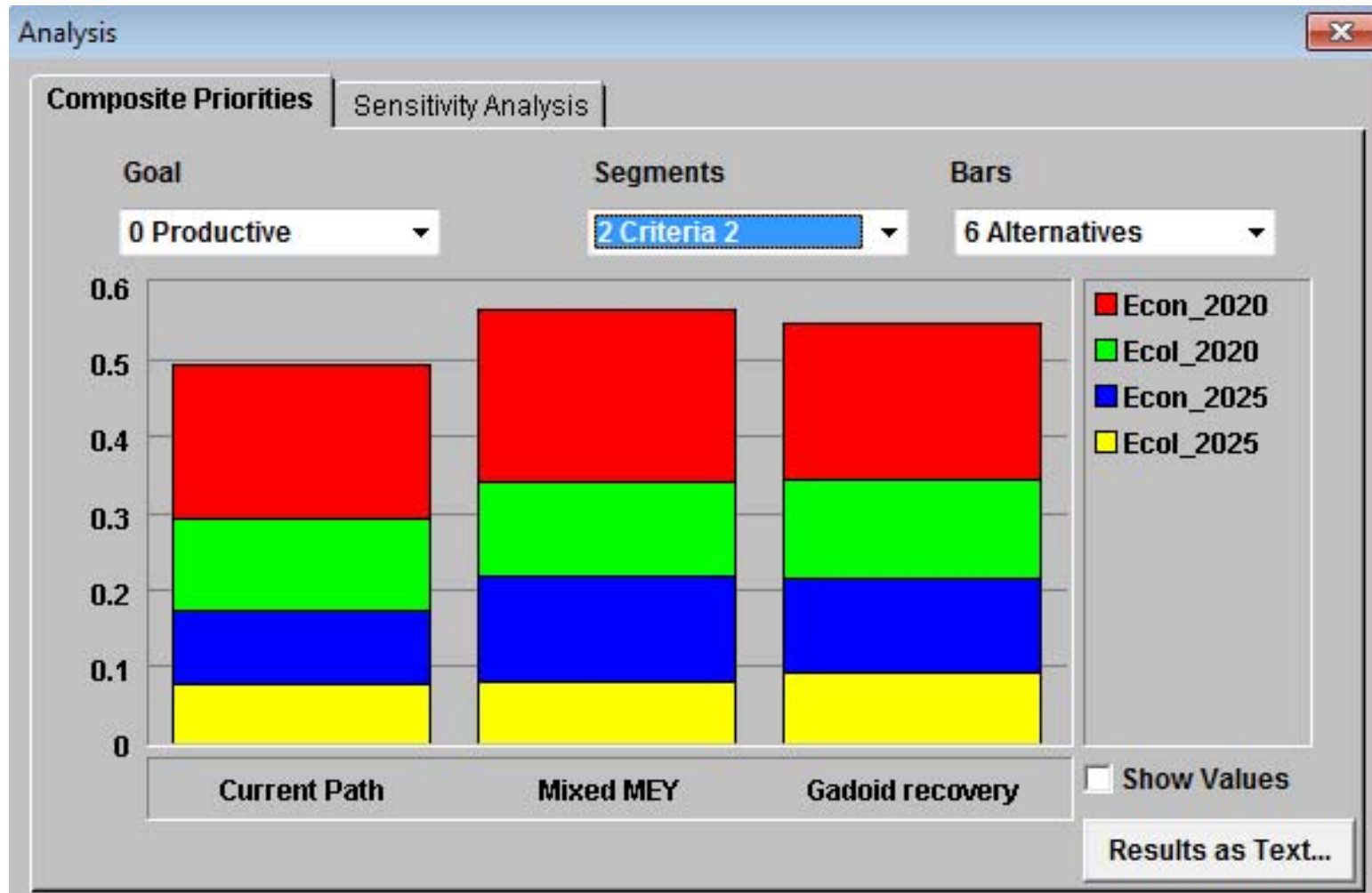
# Ecology: stocks and foodweb indicators



# Composite analysis - overview



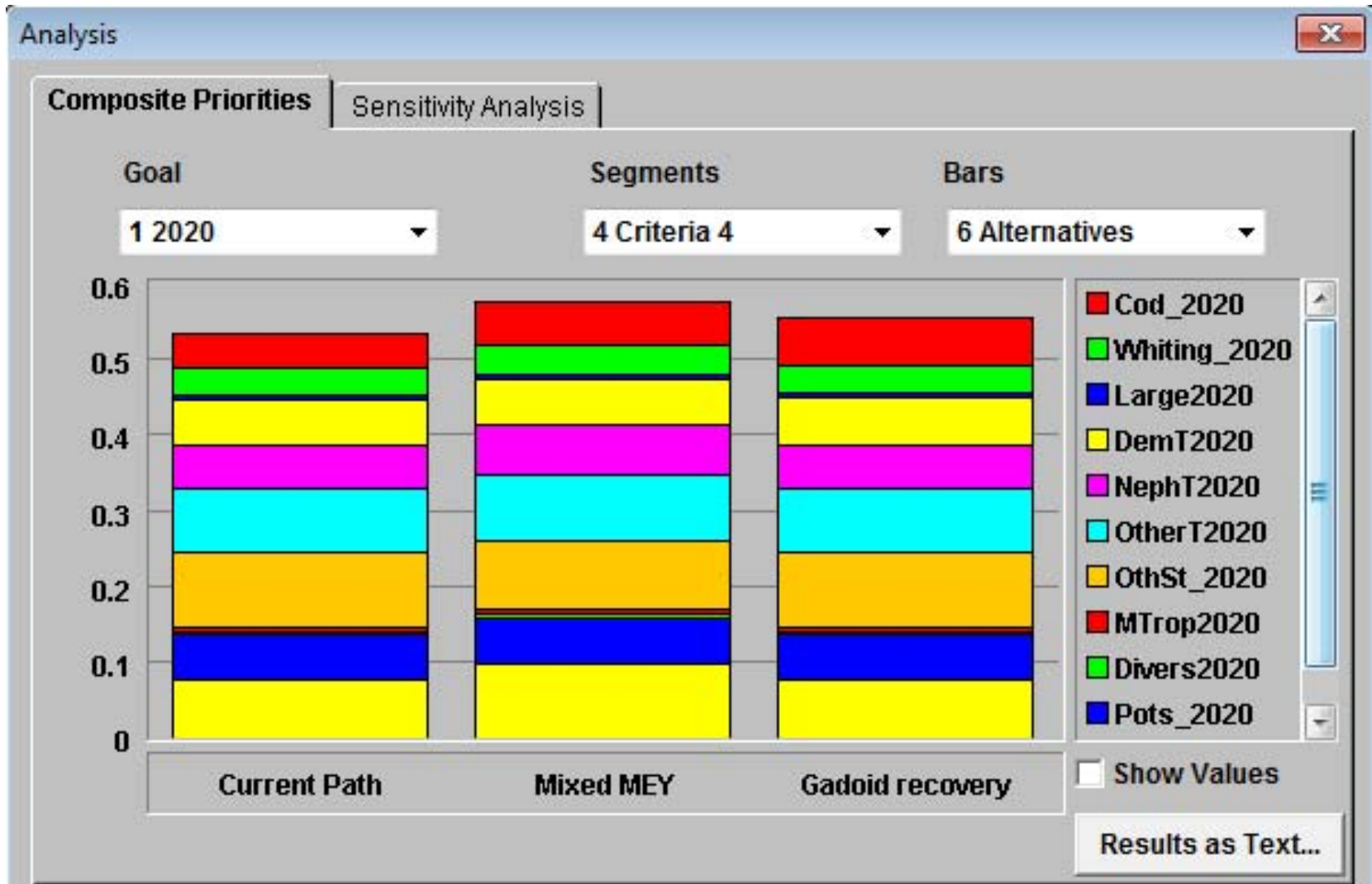
# Composite analysis – more detail



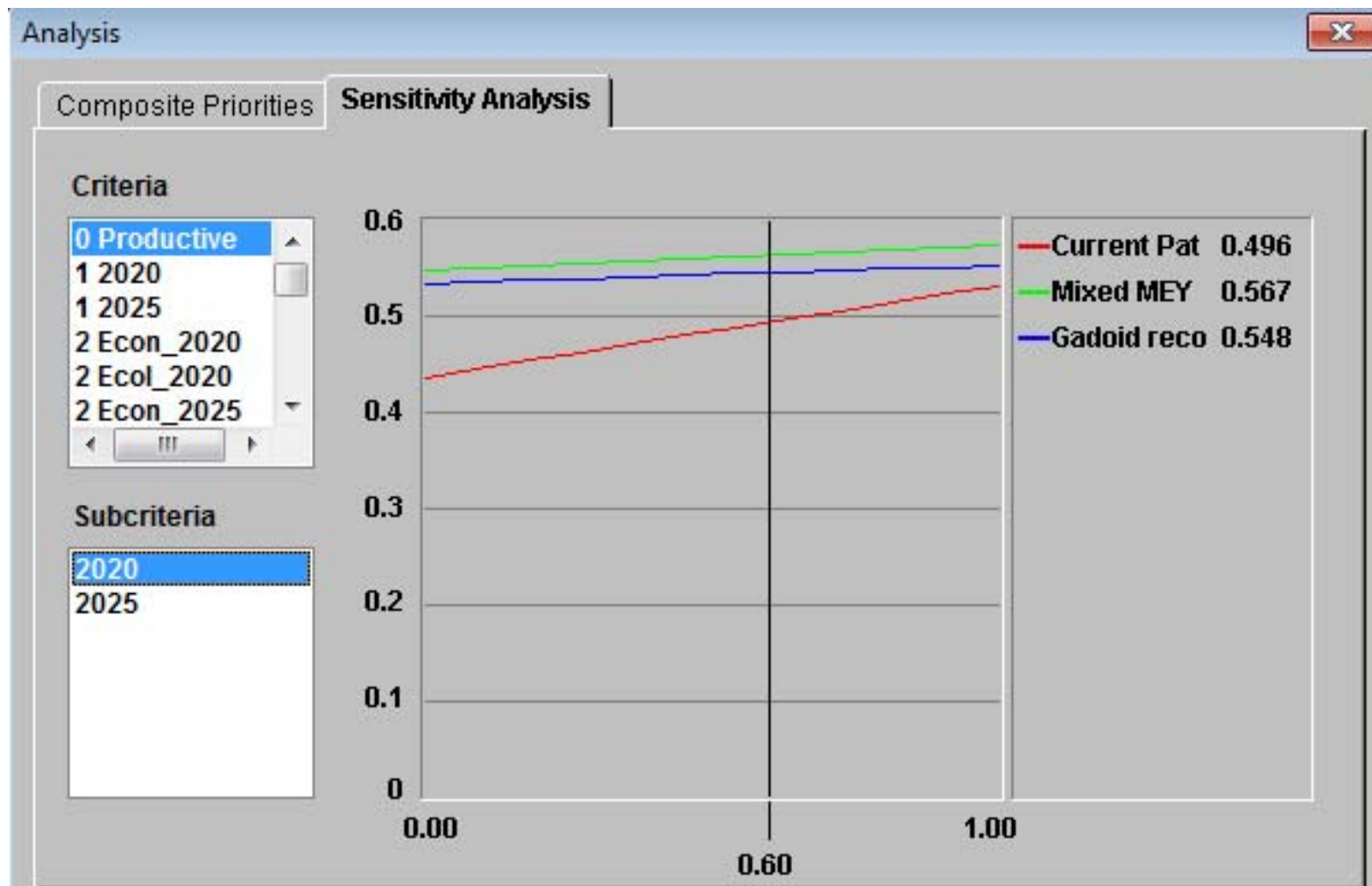
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# Composite analysis:

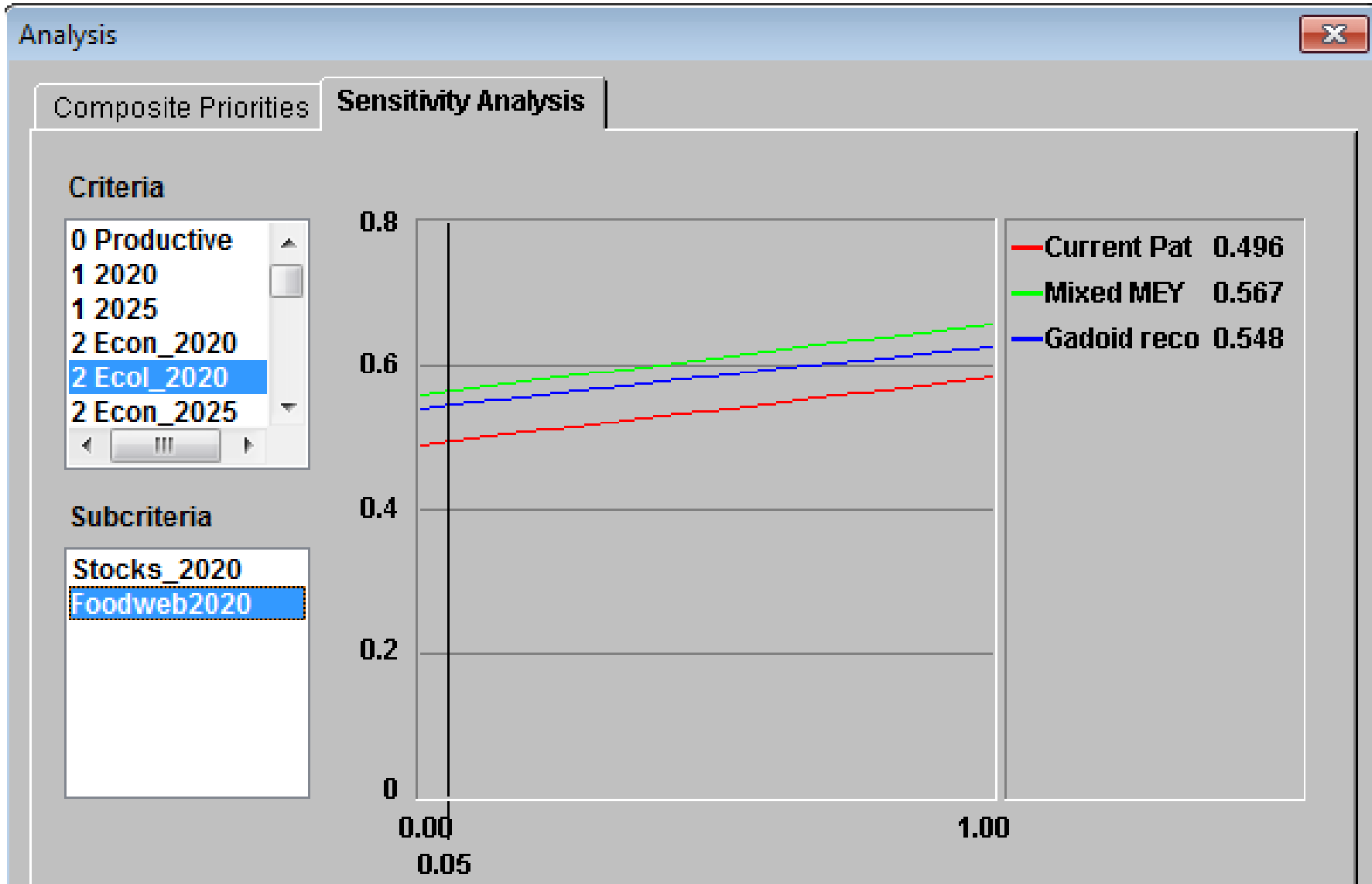
- how elements contribute to the goal



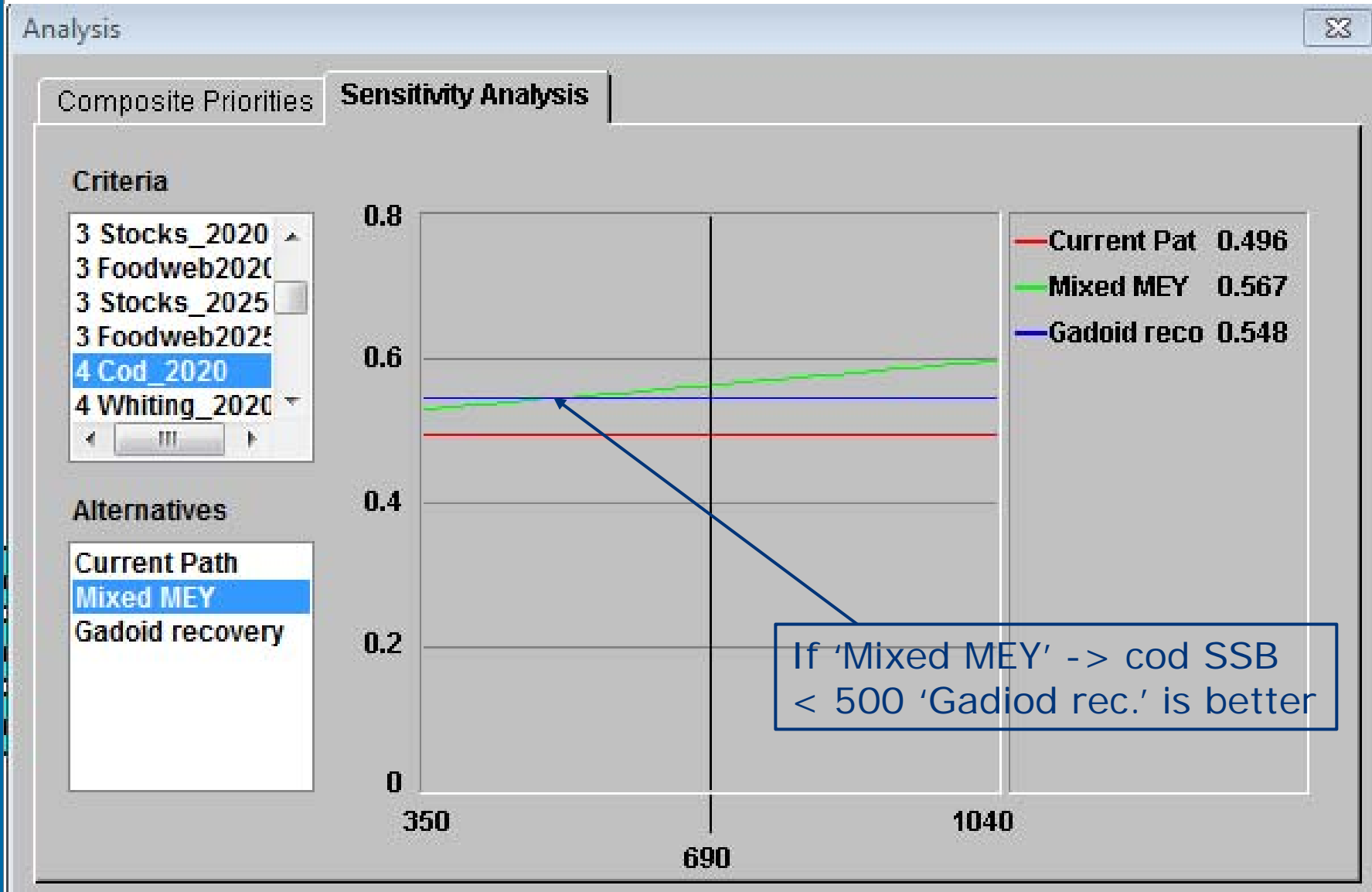
## Sensitivity – influence of weighting



# Outcome is independent of weighting of foodweb indicators



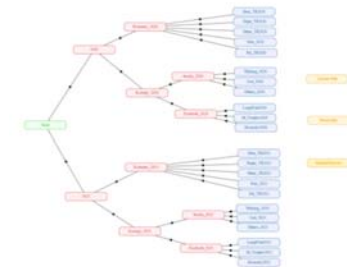
# Sensitivity of evaluation to model estimates





## How achieve a good planning outcome?

- Good alternatives!
- Relevant problem structure
- Clear objectives, criteria and indicators
- Relevant and reliable data
- Time to use MCA and discuss



## Summing up

- **'Mixed MEY' and 'Gadoid Recovery' seem preferred to 'Current Path'**
- **'NWW invited to perform its own analysis!'**



## Further model and MCA work

- **Min. and max. indicator levels (01.03.16?)**
- **Ecosystem indicators with better guidance for evaluation**
- **Make «other stocks» indicator more relevant (01.03.16?)**
- **Different cod stock definition**





## Next steps?

- Invitation to NWWAC: use MCA to decide approach; improve alternative
- MareFrame draft recommendation: 01.01.17.
- Fisheries model (GADGET) by Dec. 2016

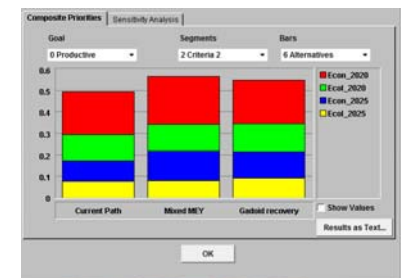
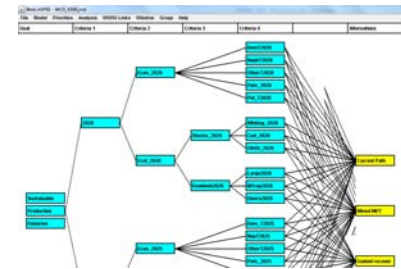
### Practical issues:

- When and how to continue?
- MCA: Small team?



## MCA analysis with Web-Hipre

- <http://hipre.aalto.fi/>
  - Follow installation procedure (enable java)
  - User name: NWWAC
  - Password: ICES6A
  - Kåre's example: WOS.KNN.jmd
- 
- Open the file: WOS.jmd
  - Analyse using your own weights and value functions
  - Save as: WOS.XXX.jmd
  - Contact: Kare.nolde.nielsen@uit.no



## Contact information

Alan Baudron:

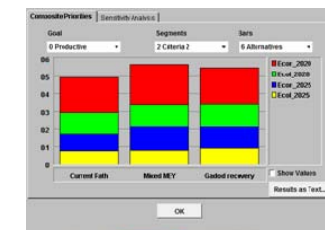
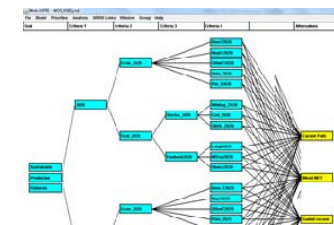
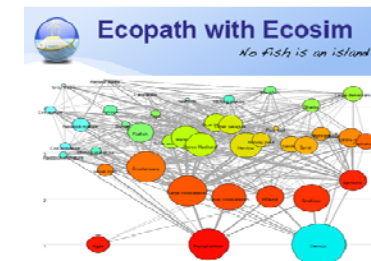
[alan.baudron@abdn.ac.uk](mailto:alan.baudron@abdn.ac.uk)

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[kare.nolde.nielsen@uit.no](mailto:kare.nolde.nielsen@uit.no)

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