MISSION ATLANTIC

Towards the Sustainable Development of the Atlantic Ocean

Celtic Sea Case Study

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MISSION ATLANTIC At A Glance

PROGRAMME:	European Union Horizon 2020	**TOPIC:**	All Atlantic Ocean Research Alliance Flagship
TYPE OF ACTION:	Research & Innovation Action (RIA)	**DURATION:**	September 2020 – August 2025
CONSORTIUM:	13 partners in 14 countries	**COORDINATOR:**	Danmarks Tekniske Universitet, Denmark
TOTAL BUDGET:	€11.5 million		

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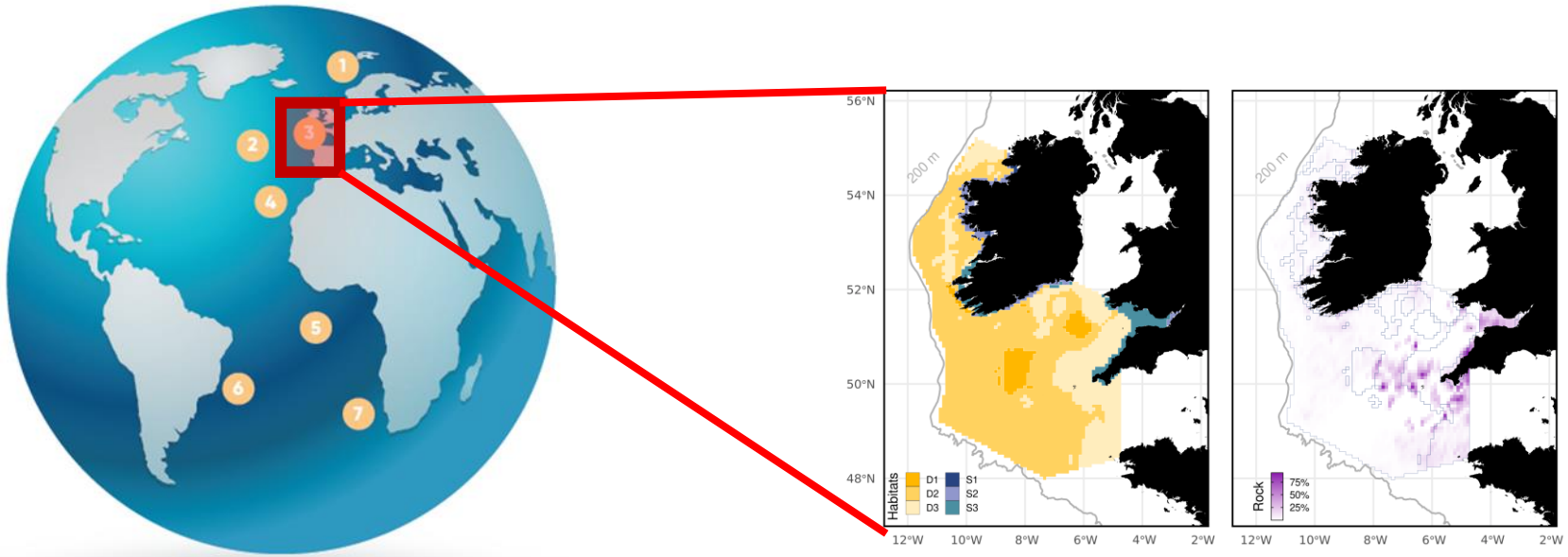
Case Studies

MISSION ATLANTIC will develop and systematically apply IEA at seven regional Case Studies, with contrasting biogeography in sub-Arctic and Tropical regions of the Atlantic Ocean, ranging from shelf seas to the mid-Atlantic Ridge.

The project will also develop an operational IEA for the entire Atlantic basin.

Case Studies
1. Norwegian Sea
2. North Mid Atlantic Ridge
3. Celtic Sea
4. Canary Current
5. South Mid Atlantic Ridge
6. South Brazilian Shelf
7. Benguela Current



Project Concept

- **MISSION ATLANTIC** is;
  - Combining all available data from different sectors and pressures
  - Consulting with stakeholders to identify issues and ground-truth outputs
  - Applying a flexible Integrated Ecosystem Assessment process

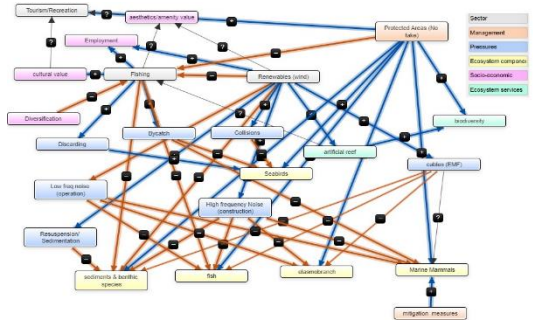
  The results will provide a comprehensive view of the case study systems and identify the most important factors influencing or affecting sustainable development.

- Integrated Ecosystems Assessment (IEA) involves;
  - **Scoping** to determine key management objectives, human activities, and the parts of the ecosystem they affect
  - **Indicator Development** to assess status, drivers and resilience of ecosystems
  - **Risk Analyses:** to assess risks and vulnerabilities of ecosystems to present impacts and future changes
  - **Scenario testing** to simulate ecosystem state and dynamics under various scenarios of climate change, resource exploitation and social development

MISSION ATLANTIC will synthesise the necessary knowledge and provide tools to support marine resource managers and policy makers to move towards a positive future for the Atlantic Ocean.

17 Sectors, 20 pressures, 26 ecological components

3 stakeholder meetings



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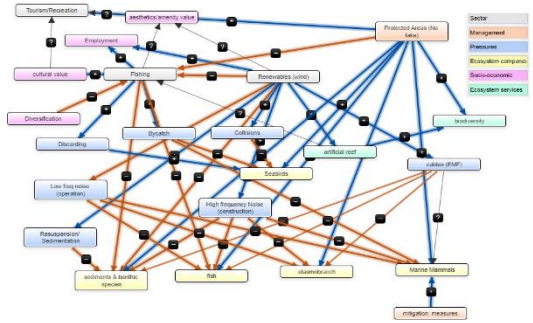

Integrated Trend Analysis

Early Warning Analysis

Breakpoints Analysis

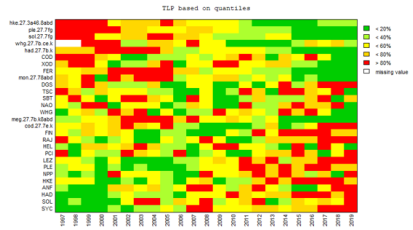

Figure 5: Traffic light plot of pressures and CPUE series in the Celtic Sea from 1997 to 2019.

Primary driver = fishing, not environment

Temperature and Primary production have remained relatively stable

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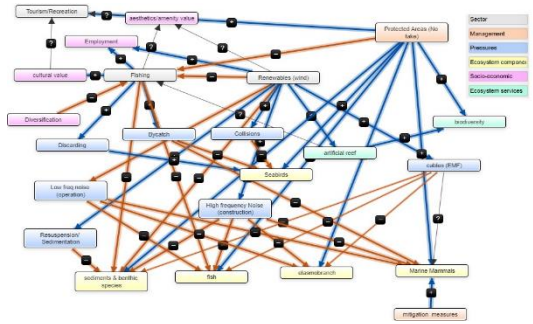

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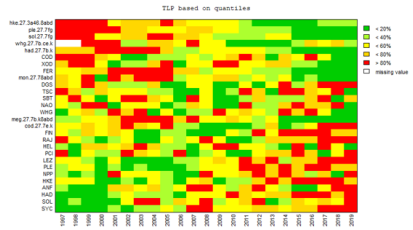
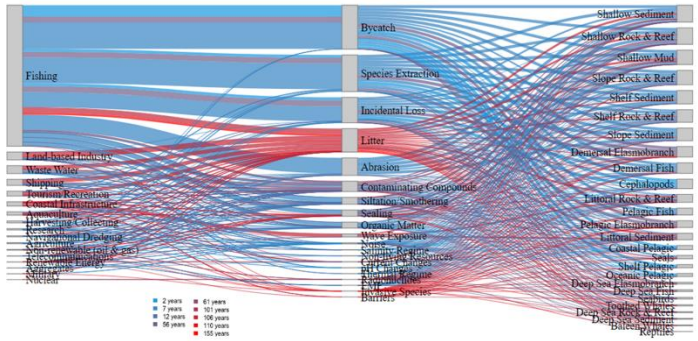


Figure 5: Traffic light plot of pressures and CPUE series in the Celtic Sea from 1997 to 2019.

Sector	Pressure
Fishing (78%)	Bycatch (25%)
Land-based Industry (4%)	Species Extraction (21%)
Waste Water (4%)	Incidental Loss (13.6%)
Shipping (3.2%)	Litter (12.4%)
Tourism/Recreation (2.5%)	Abrasion (9.4%)
TOTAL: 91.7%	TOTAL: 81.4%



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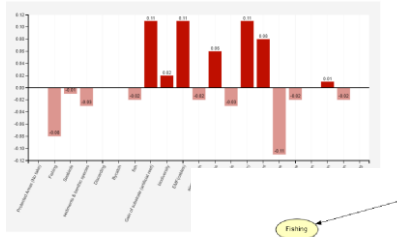
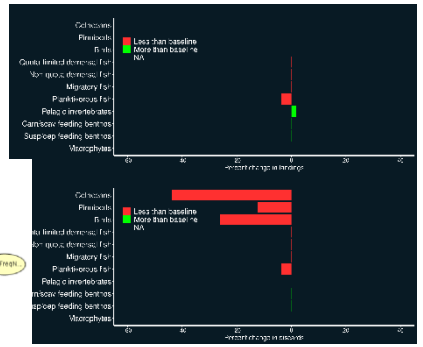
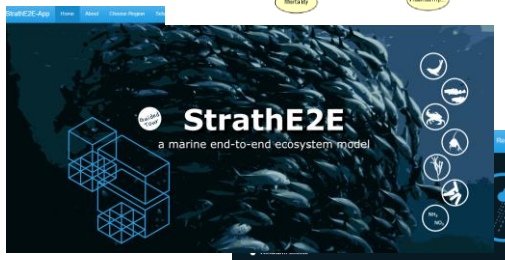
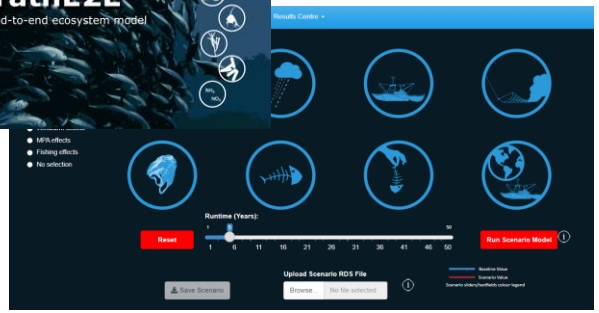




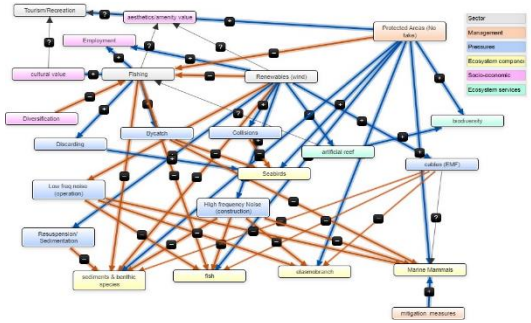




Multi faceted
Windfarms
anthropogenics
cooperation
Nutrients
overexploitation
missinformation
Climate change
bycatch
Overfishing
Commercial Fishing
co-existence

17 Sectors, 20 pressures, 26 ecological components

3 stakeholder meetings



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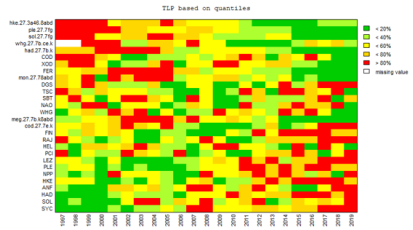

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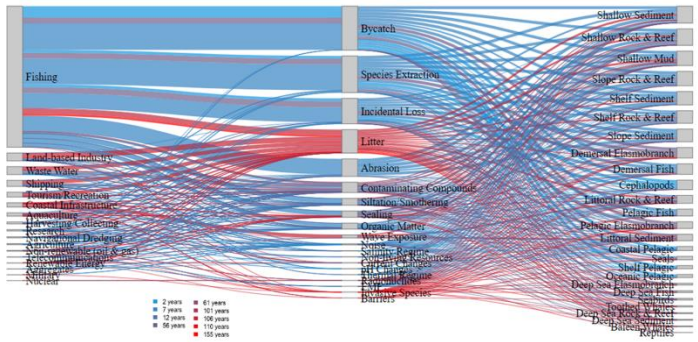
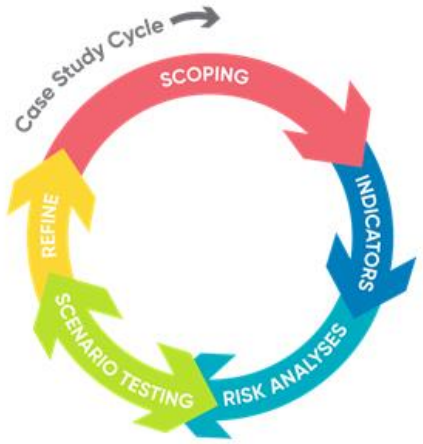


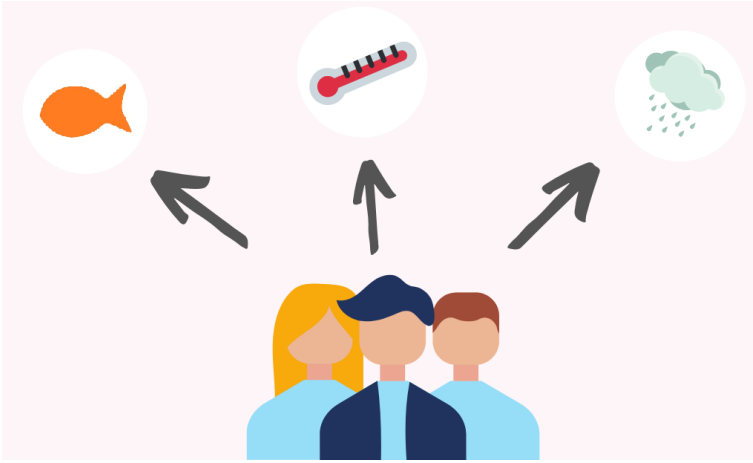
Primary driver = fishing, not environment

Temperature and Primary production have remained relatively stable

Scenario Co-development

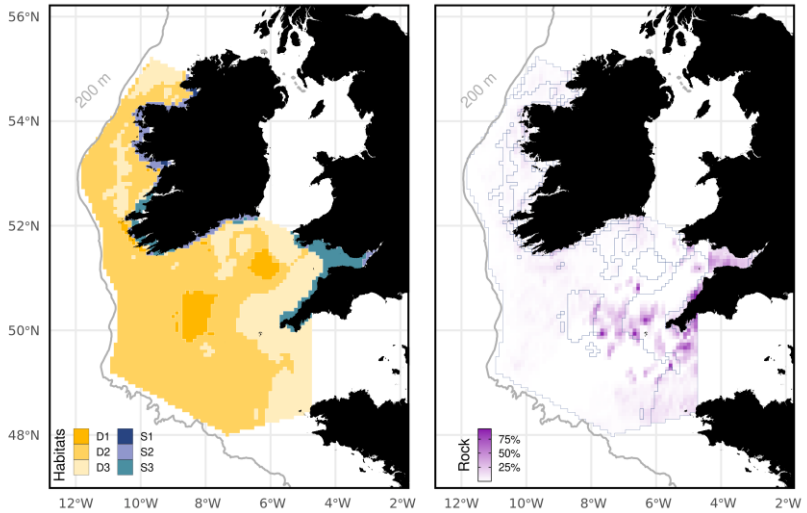


- **Scenario 1**: what are the potential ecosystem impacts of an increase of ORE
- **Scenario 2**: fisheries impacts of increase in ORE; various displacement scenarios
- **Scenario 3**: addition of conservation measures: MPAs vs. OECM
  - Strict exclusion
  - ORE as OECM
  - ORE as OECM with potters
- **Climate change context**
  - Increasing temperature in line with selected IPCC scenarios

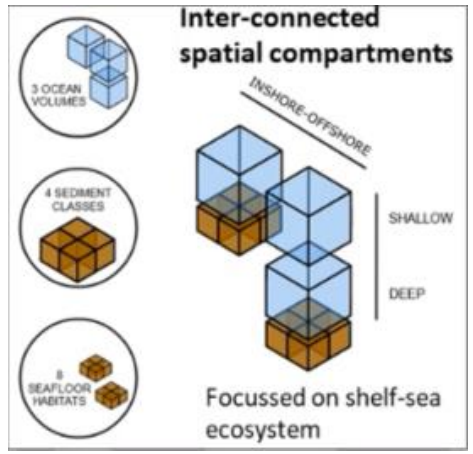


StrathE2E scenarios

- StrathE2E is a comprehensive ecosystem model. It is not designed for spatial questions
- However, we committed to attempting scenarios
- Carried out on webapp, so anyone can repeat



- The model has different spatial elements, but does not distinguish within those elements
  - Impacts on Deep Coarse Sediment are the same no matter the geography
  - Impacts taking place in one confined spatial area impact only a proportion of that habitat/component
  - Therefore, we must remember the SCALE of the questions we ask…..and the abilities of the model we are using



https://outreach.mathstat.strath.ac.uk/apps/StrathE2EApp/

Scenario 1: What are the potential **ecosystem and fisheries impacts** of an **increase of ORE** in the Celtic Sea.

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Current ORE sites with Maritime Area Consent used

Impacts informed by conceptual model built with stakeholder group, and risk assessment

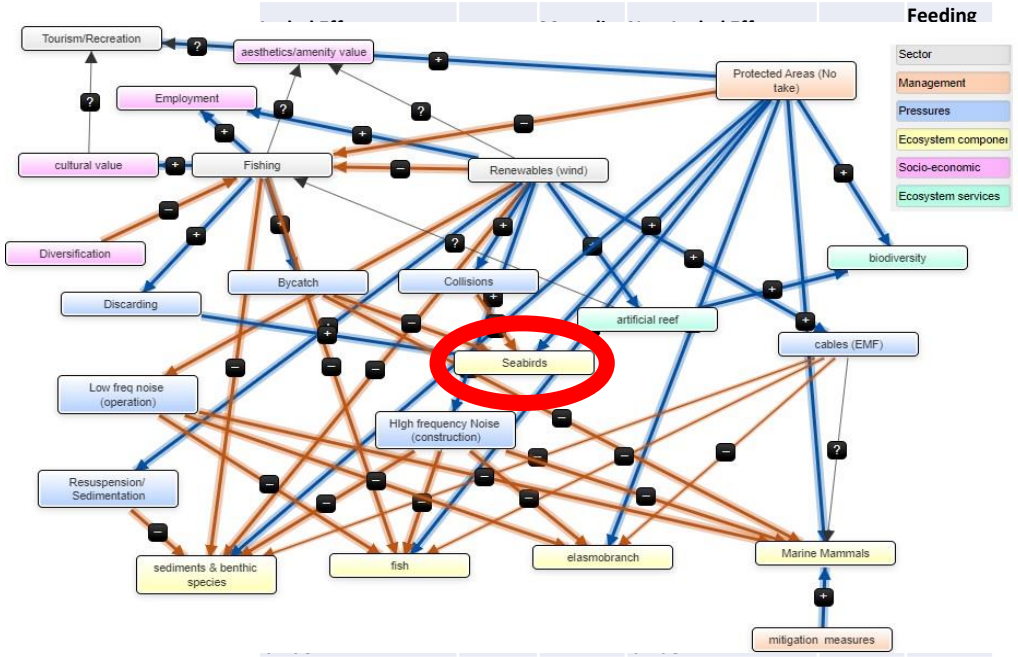
Lethal effects expected on Seabirds

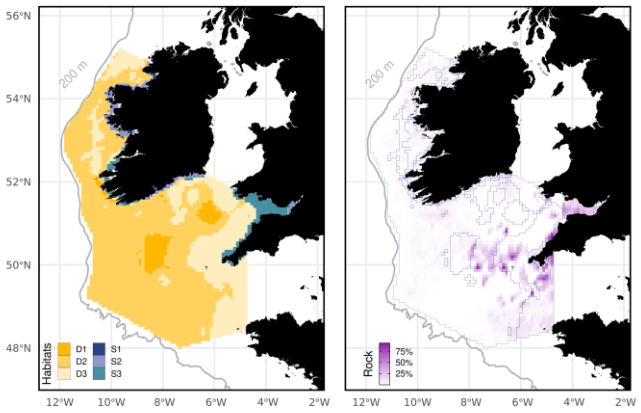
Non-lethal effects (e.g. from noise and electromagnetic fields) expected to affect fish, and seabirds

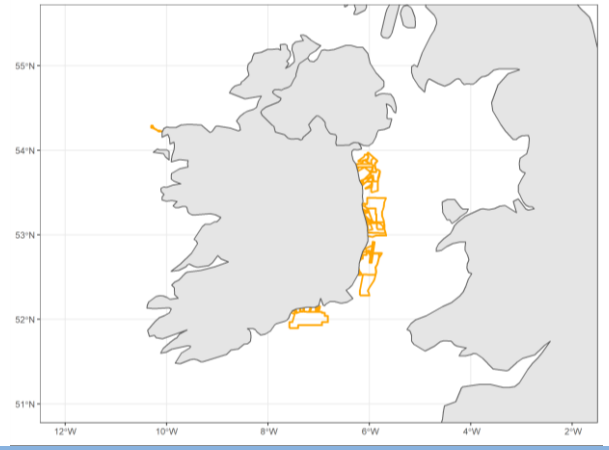
Effects expected to be predominately inshore

Run on webapp for maximum time period (50 years)

Remember, changes relate to populations across the WHOLE study area…. ORE area is ~1% of total area







Carnivore/scavenge feeding benthos larvae			Carnivore/scavenge feeding benthos larvae		
Suspension/deposit feeding benthos			Suspension/deposit feeding benthos		
Carnivore/scavenge feeding benthos			Carnivore/scavenge feeding benthos		
Seabirds	Inshore	+10%	Seabirds	Inshore	-5%
	Offshore	+1%		Offshore	-1%
Pinnipeds (seals)			Pinnipeds (seals)	Inshore	-5%
				Offshore	-1%
Cetaceans			Cetaceans	Inshore	-5%
				Offshore	-1%

Horizon 2020 European Union Funding for Research & Innovation

Foras na Mara Marine Institute

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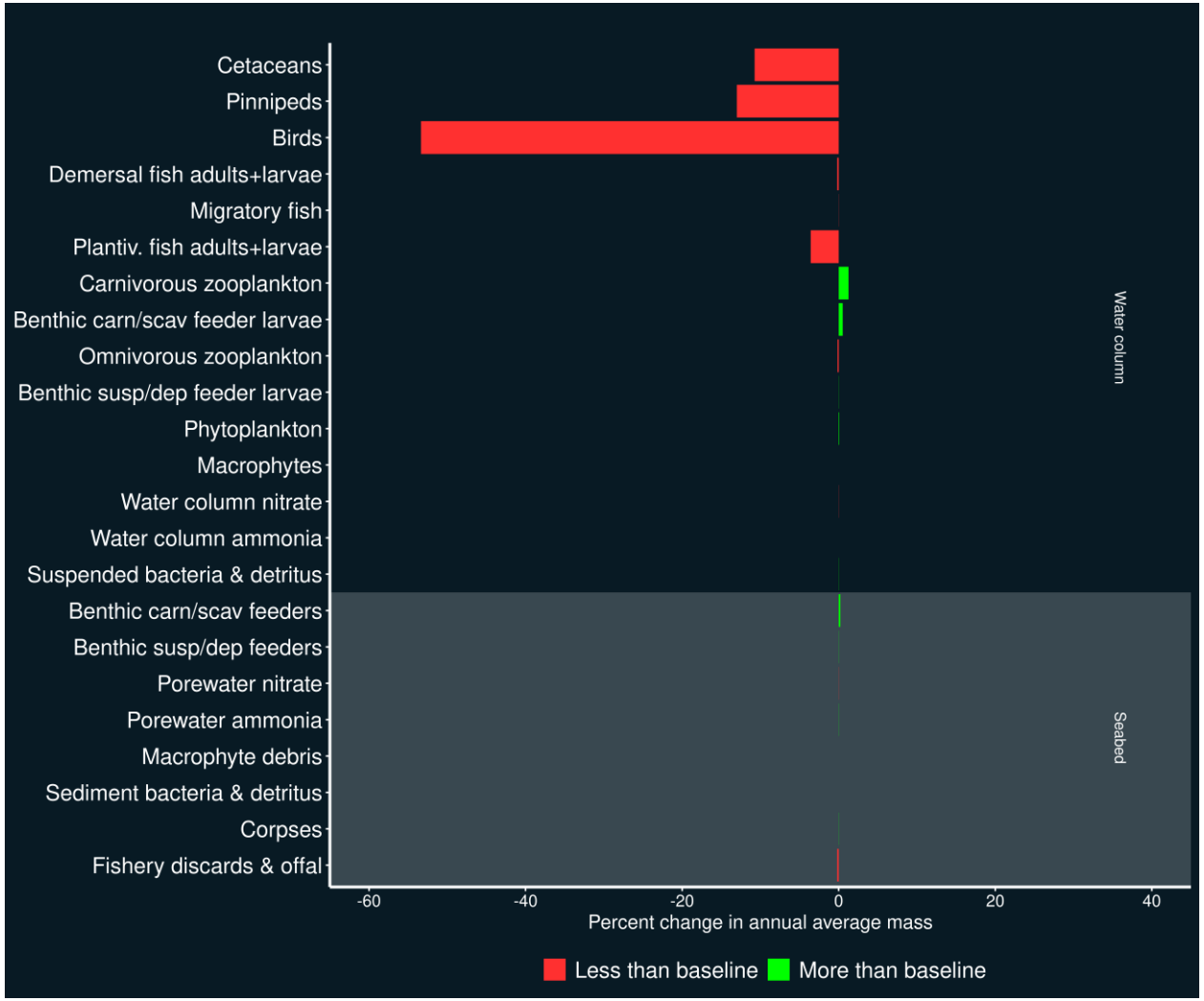
Scenario 1: What are the potential **ecosystem** and fisheries **impacts** of an **increase of ORE** in the Celtic Sea.



Decreases reflect the inputs….some spp (demersal and migratory fish) appear to be more robust to changes in feeding rate

Higher impacts on planktivorous fish is likely due to high turnover/rapid growth of these species

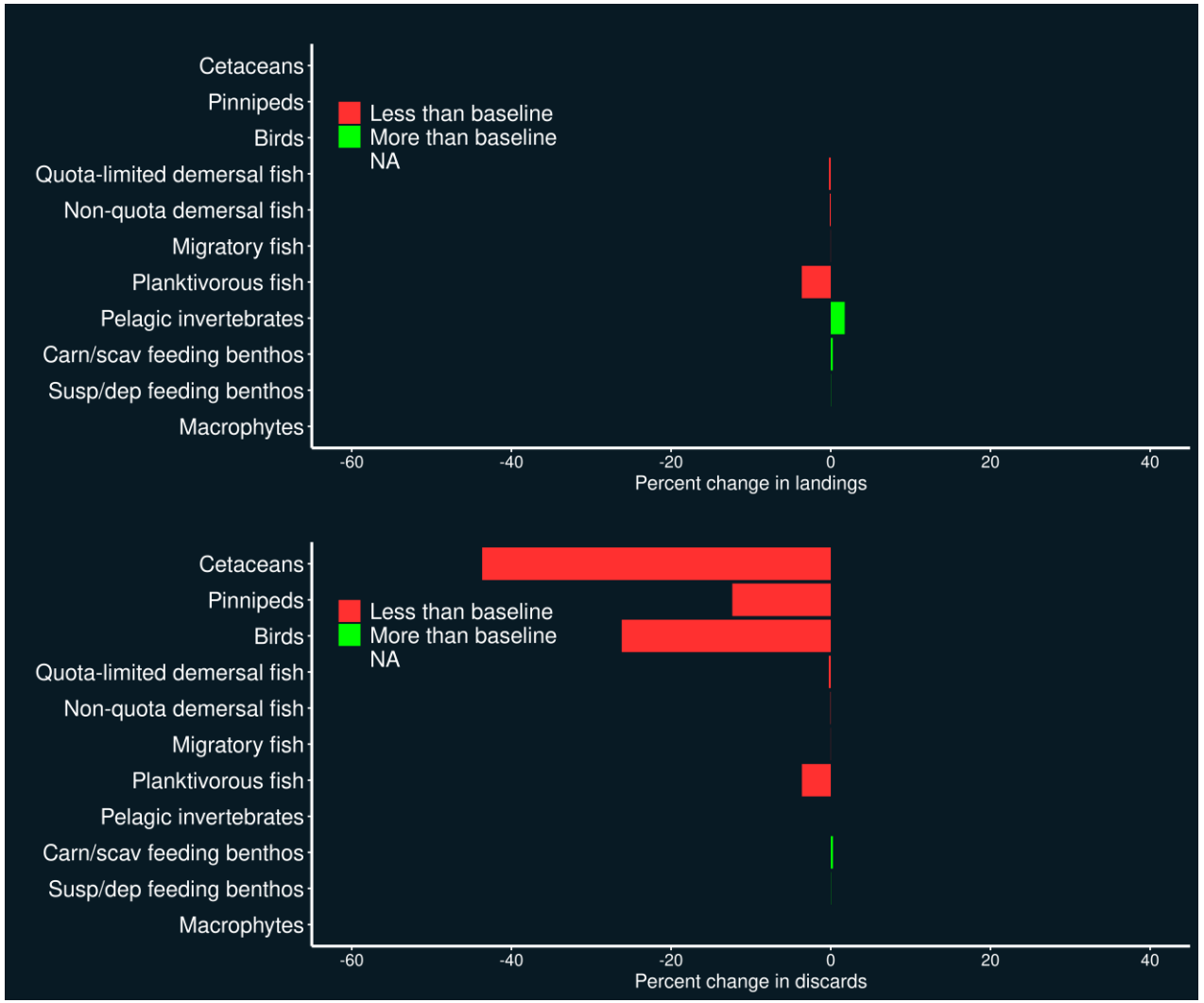
Cetaceans, Pinnipeds and Birds are both directly affected by the impacts we implemented, and by the foodweb effects (impacted by decrease in planktivorous fish)

Minor increase in carnivorous zooplankton (competition release?)

Rest of system largely undisturbed.

Remember impact estimates are likely overestimates given the scale…..

Scenario 1: What are the potential ecosystem and **fisheries impacts** of an **increase of ORE** in the Celtic Sea.



Decreased planktivorous fish biomass = decreased landings of planktivorous fish

Minor increase in Pelagic invertebrate landings (cephalopods) – predation/competition release?

Less Cetacean, Pinniped, Bird, planktivorous biomass = less caught = less discards

Again, impact estimates are likely overestimates given the scale …..

Scenario 1: What are the potential **ecosystem and fisheries impacts** of an **increase of ORE** in the Celtic Sea.

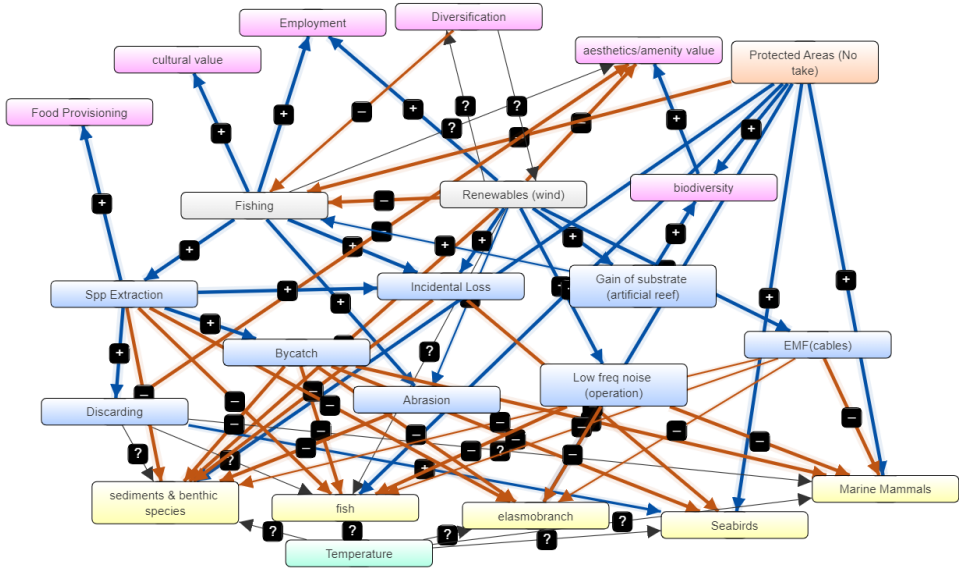
What does the conceptual model say?

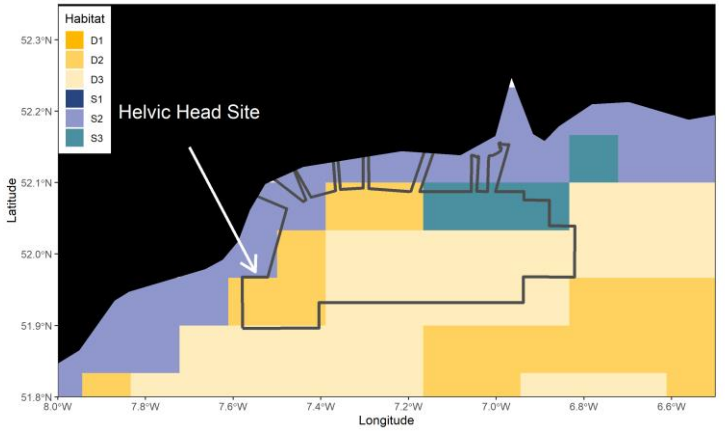
Things to note!

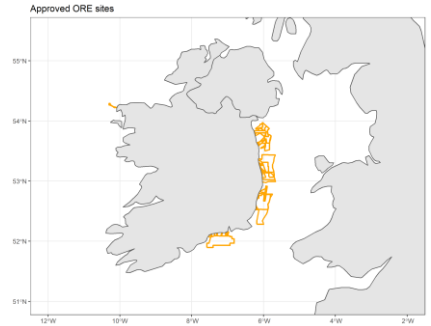
- This does not have any spatial scale associated with it. It just looks at interactions – what happens where the things are happening…
- It does not have a specific timeline associated with it
- The majority of interactions are absolute – they increase (+1) or decrease (-1). This is because we cannot really determine 'how much' they will increase or decrease by.
    - We can play with different scenarios and see what that looks like, or run another workshop to put values on these interactions.
    - We have put impacts we are less sure about the interactions at lower values

Modifications:

- Focus on ORE, Fishing, MPAs only







Scenario 1: What are the potential **ecosystem and fisheries impacts** of an **increase of ORE** in the Celtic Sea.

What does the conceptual model say?

Increase of ORE (+1)

Model reflects what we expect from the way we built it! – Sensible output

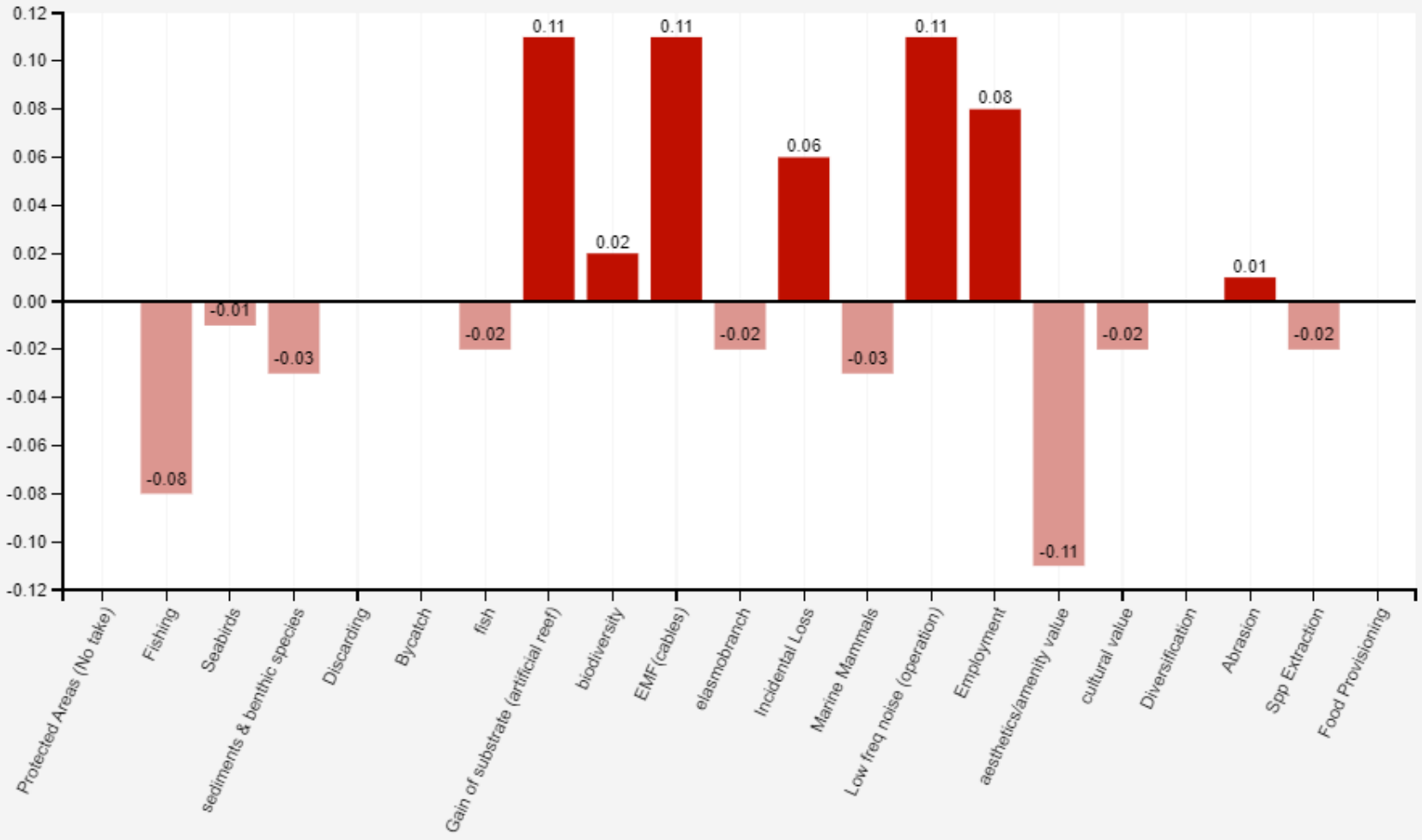
Decrease in fishing (assuming displacement) and Aesthetic/Amenity value

Increase in artificial reef leads to increase in biodiversity

Increase in associated ORE impacts (electromagnetic fields, incidental loss, noise)

Increase in employment

NOTE: not great at capturing second order effects, e.g. decrease in fishing may negatively affect employment

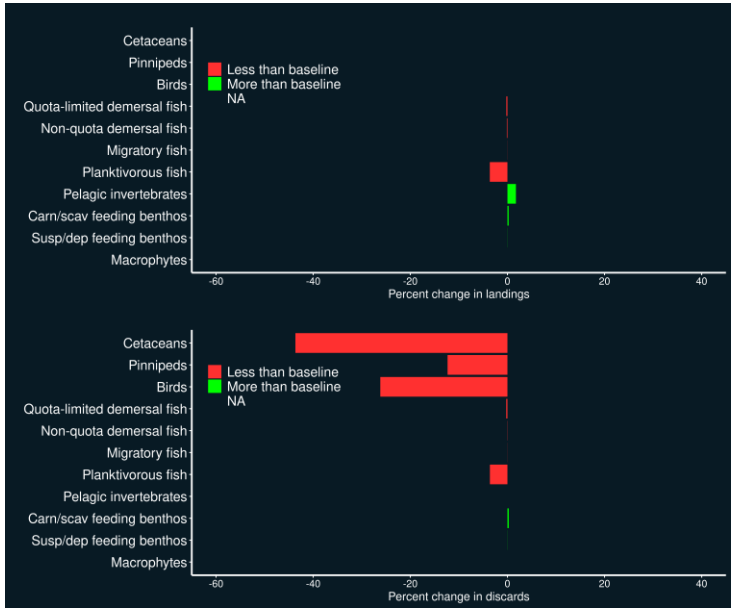


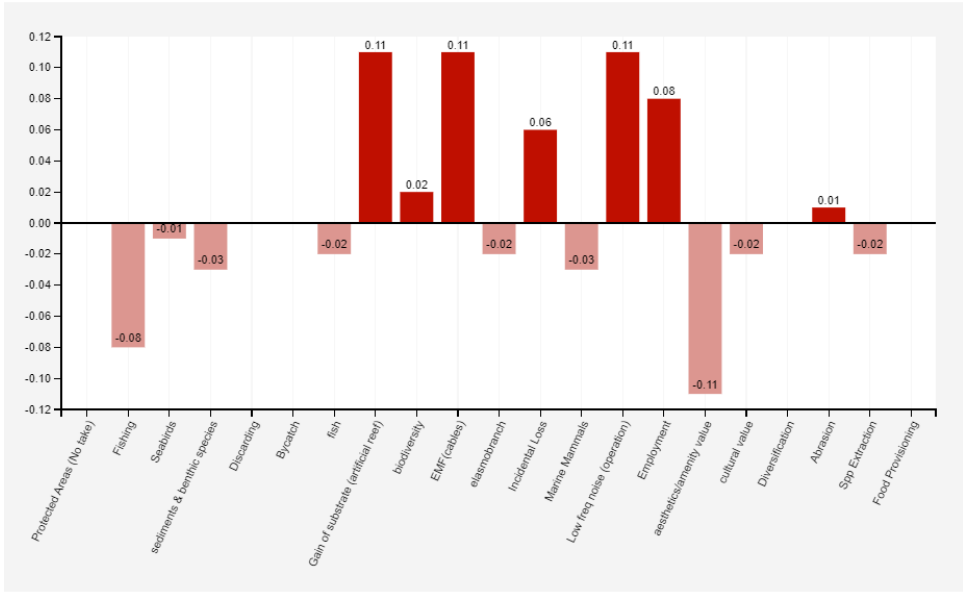
Comparison

Both suggest decrease in cetaceans, seabirds, fish

SE2E suggests decrease in bycatch of cetaceans, seals and birds, MM does not detect changes in bycatch (second order effects)

MM suggests decrease in fishing, SE2E suggests decreases in pelagic fish, and moderate increases in squid and shellfish





Scenario 1: What are the potential **ecosystem and fisheries impacts** of an **increase of ORE** in the Celtic Sea.

Additional investigations

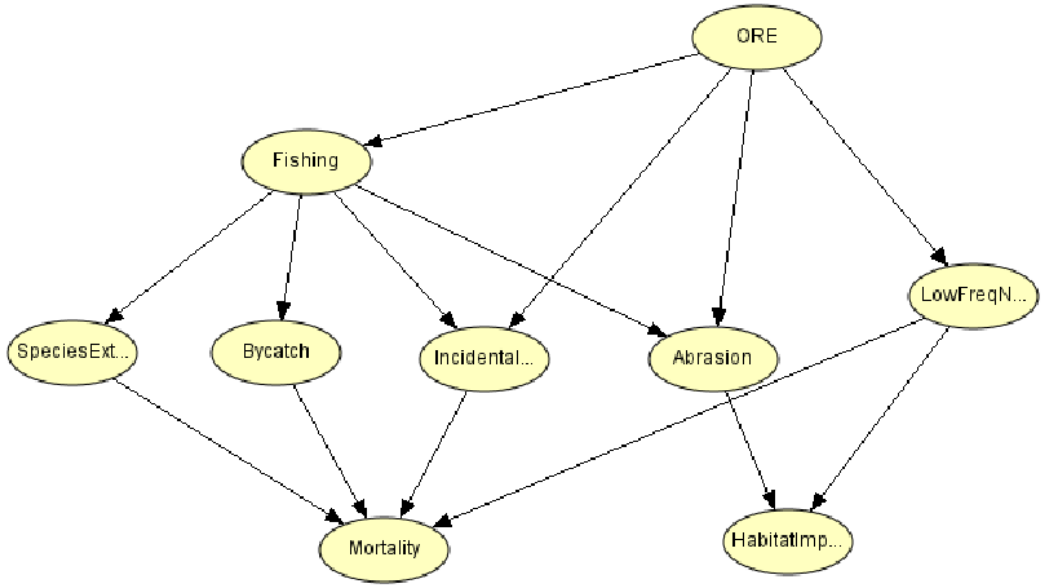
Bayesian Belief Networks (BBN) (still learning!)

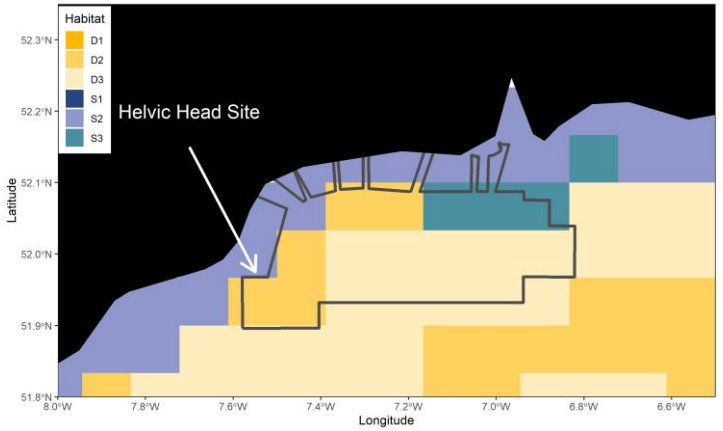
Built informed by mental model – simplified to core components

Accounts for interactions in a similar way, BUT easier to proportion out the level of impact expected, or to test alternatives as a decision-support tool (what happens if….)

Based on choices and predicted outcomes from those choices

DOES NOT HAVE SPATIAL SCALE or TIME – so reflects impacts at the site!





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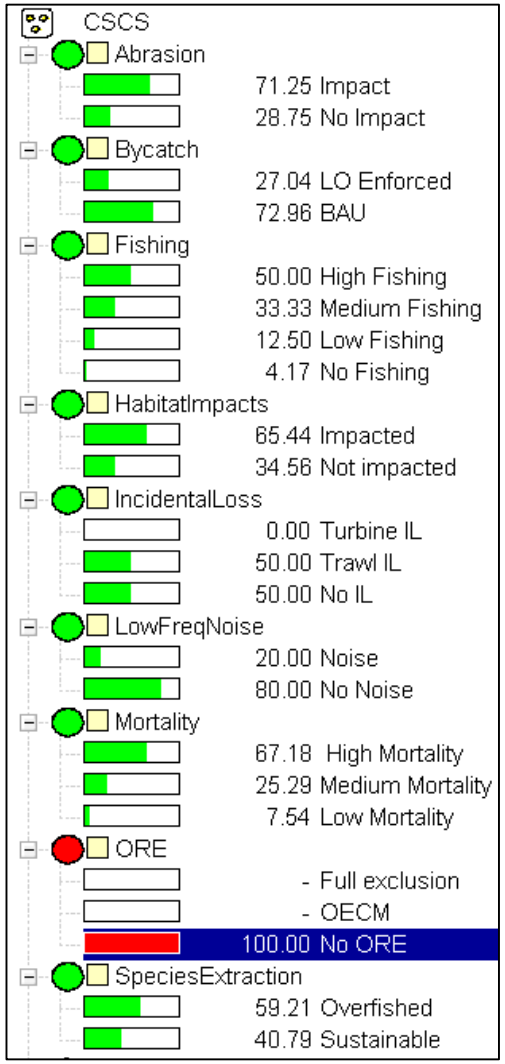
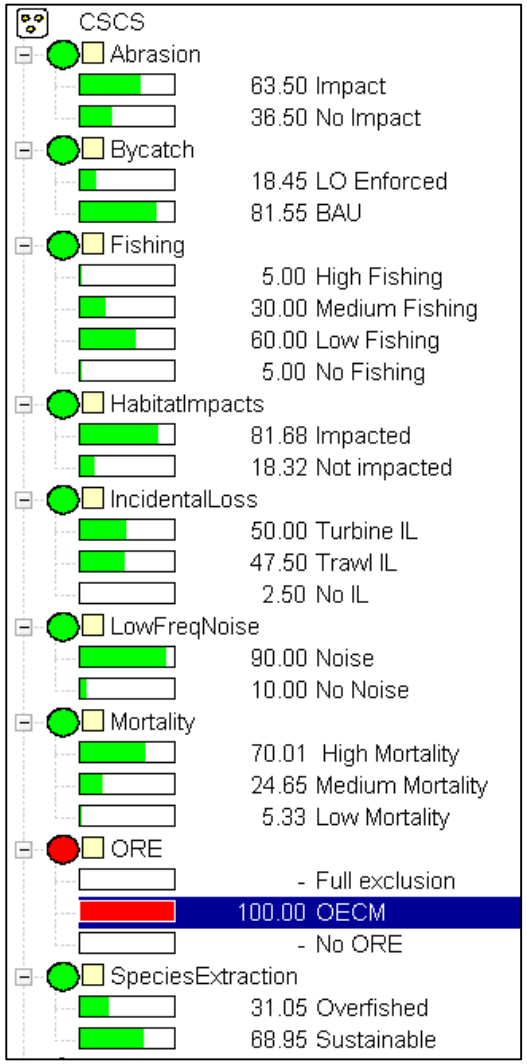
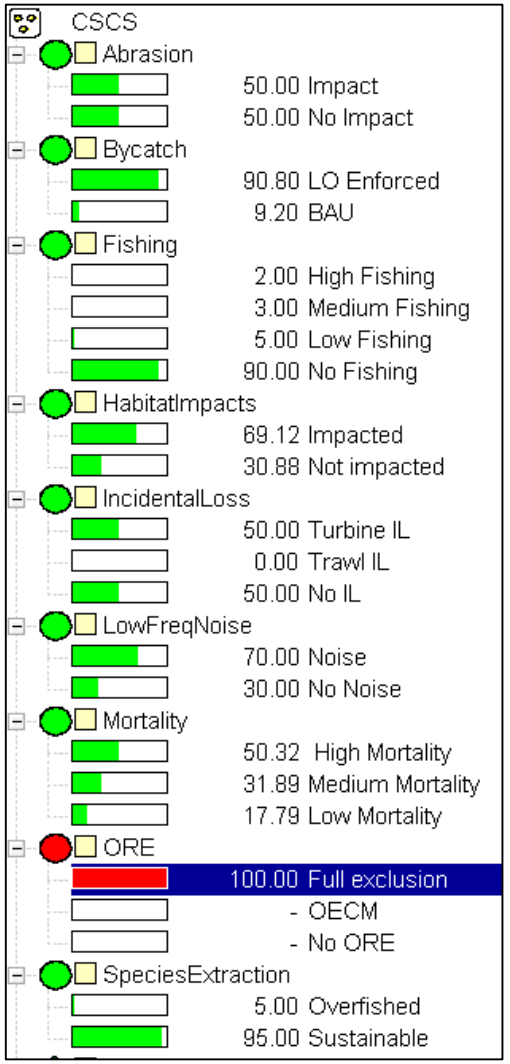
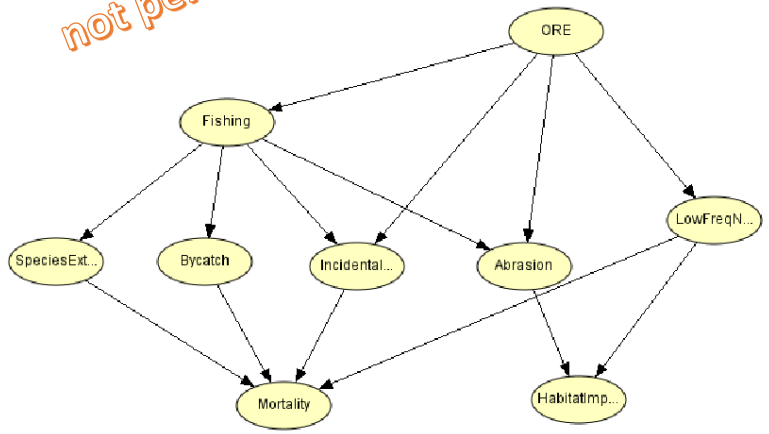
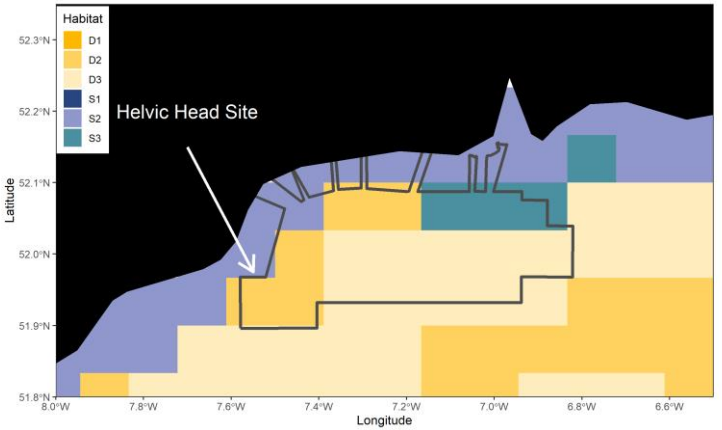






Probability – not percent!





Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

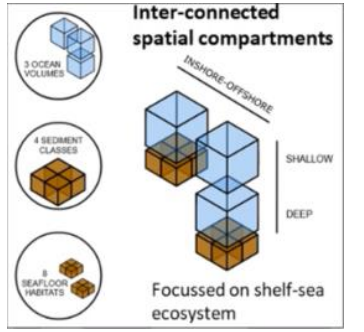
Scenario 2a = displacement to same substrate elsewhere (total exclusion all metiers)

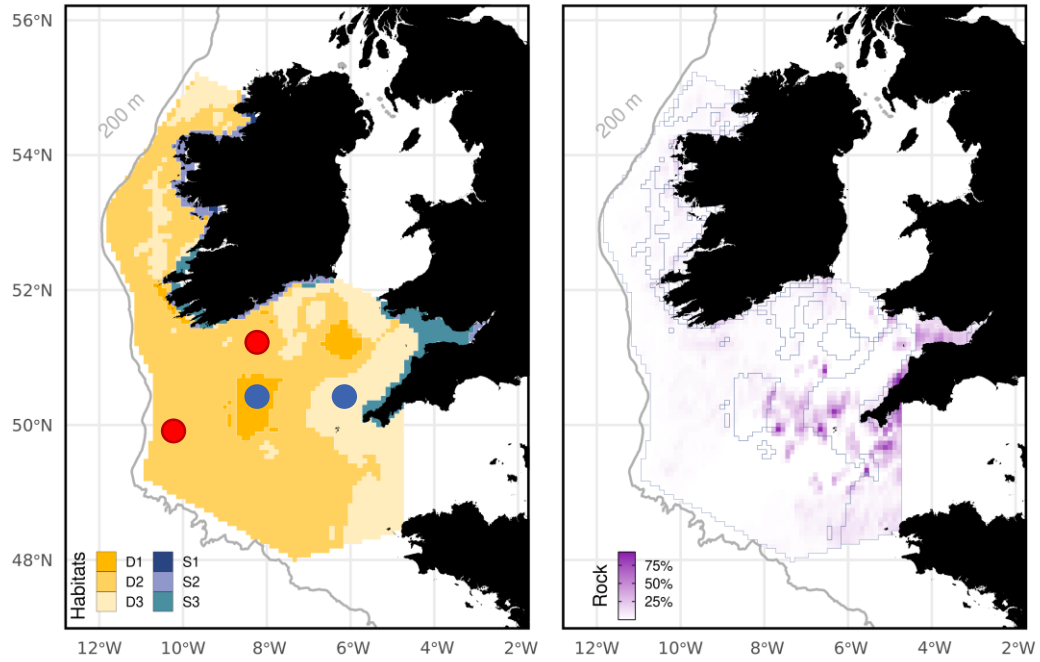
Scenario 2b = displacement of all metiers except potters

StrathE2E does not register displacement unless it is a change from one substrate to another.

Ecologically, effects on the same substrate are the same no matter where they are located.

It cannot detect the change between the red dots, only from a red to a blue dot





Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

ORE sites and overlap with Fishing

No <12m vessel data!

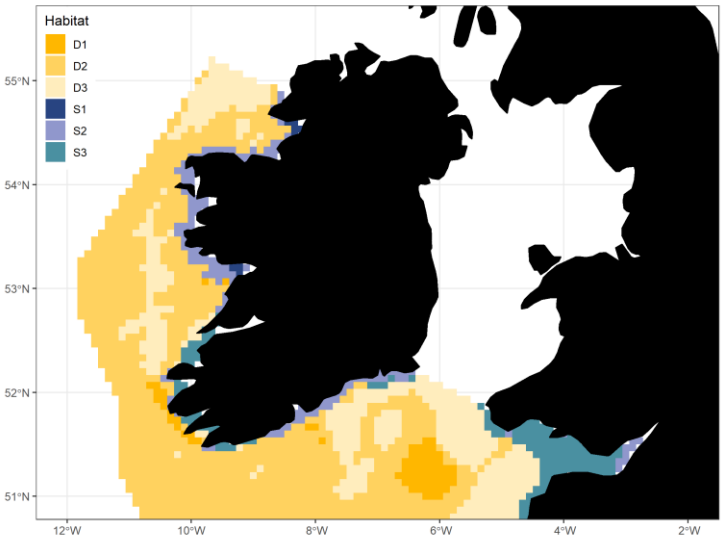
2014 data used, international data may not be complete

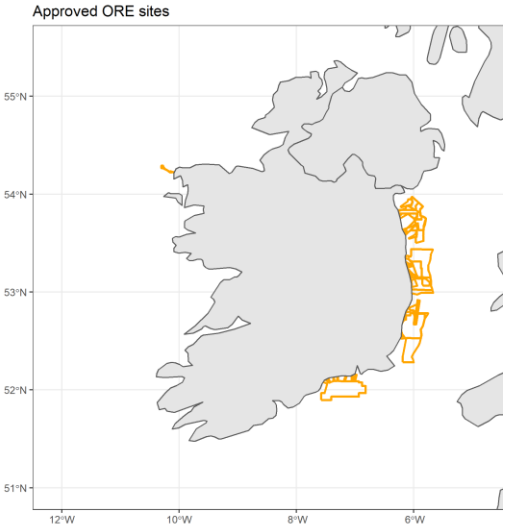
Irish vessels recorded in the Helvick Head site (at any point)

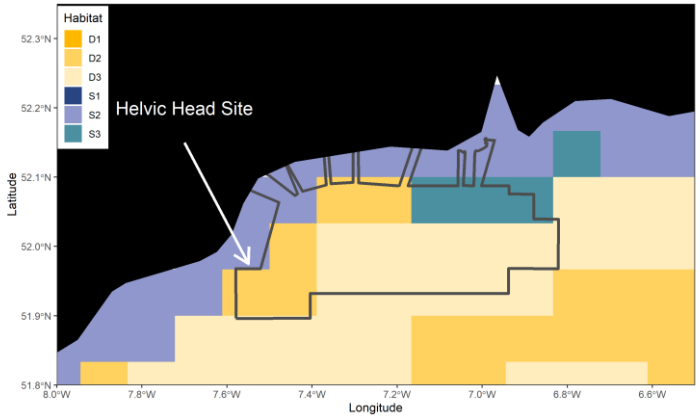
- 17% (162) of vessels operating in case study area visited the site
- 83% (135) spent less than 25% of their time
- 10% (16) spent 25-50% of their time
- 4% (6) spent 50-75% of their time there
- 3% (5) spent over 75% of their time there

International Data

- No Belgian, German, Danish, Spanish, Faroese, Lithuanian, Dutch, Norwegian or Portuguese effort
- 1% of all fishing effort recorded in site
- France: 0.3%, UK 0.4%, Ireland 99.3%







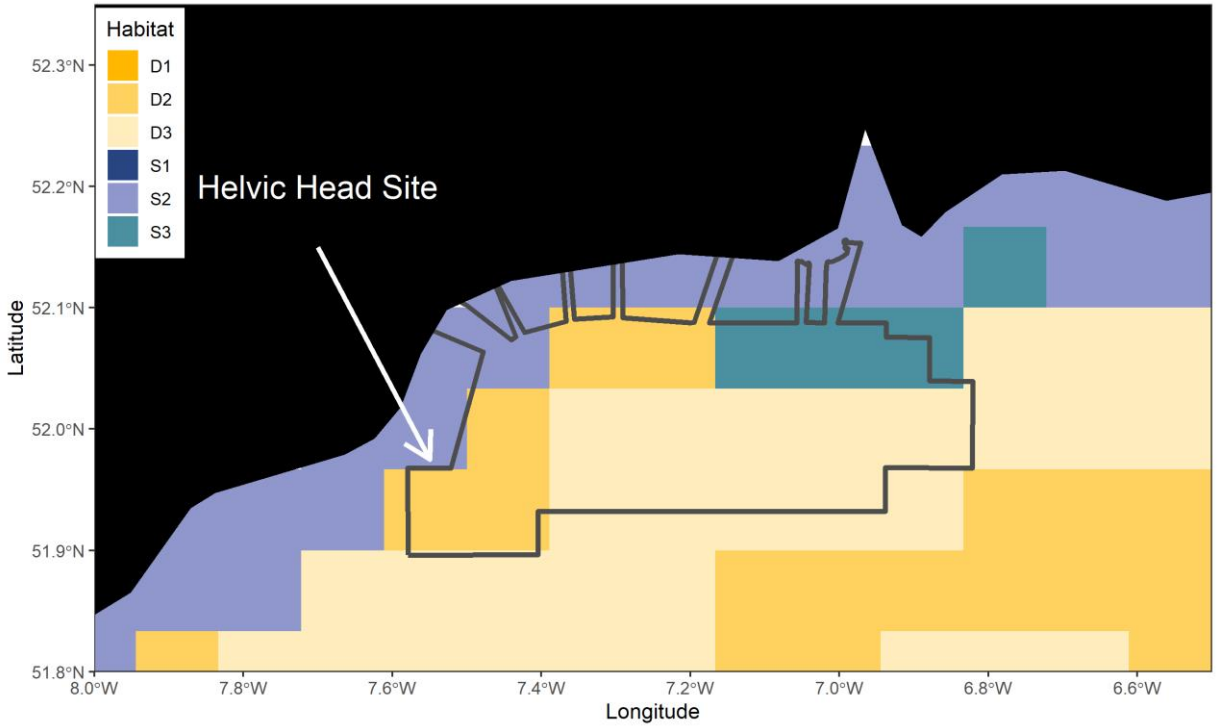
Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

ORE sites and overlap with Fishing

Scenario 2a = displacement to same substrate elsewhere (total exclusion all metiers)

Fishing activity per substrate – most of the activity is very inshore. So we can displace fron current location to deeper location with the same substrate

	Current Activity
D1 Fine	0.0%
D2 Medium	0.3%
D3 Coarse	2.7%
S1 Fine	0.0%
S2 Medium	6.4%
S3 Coarse	16.8%

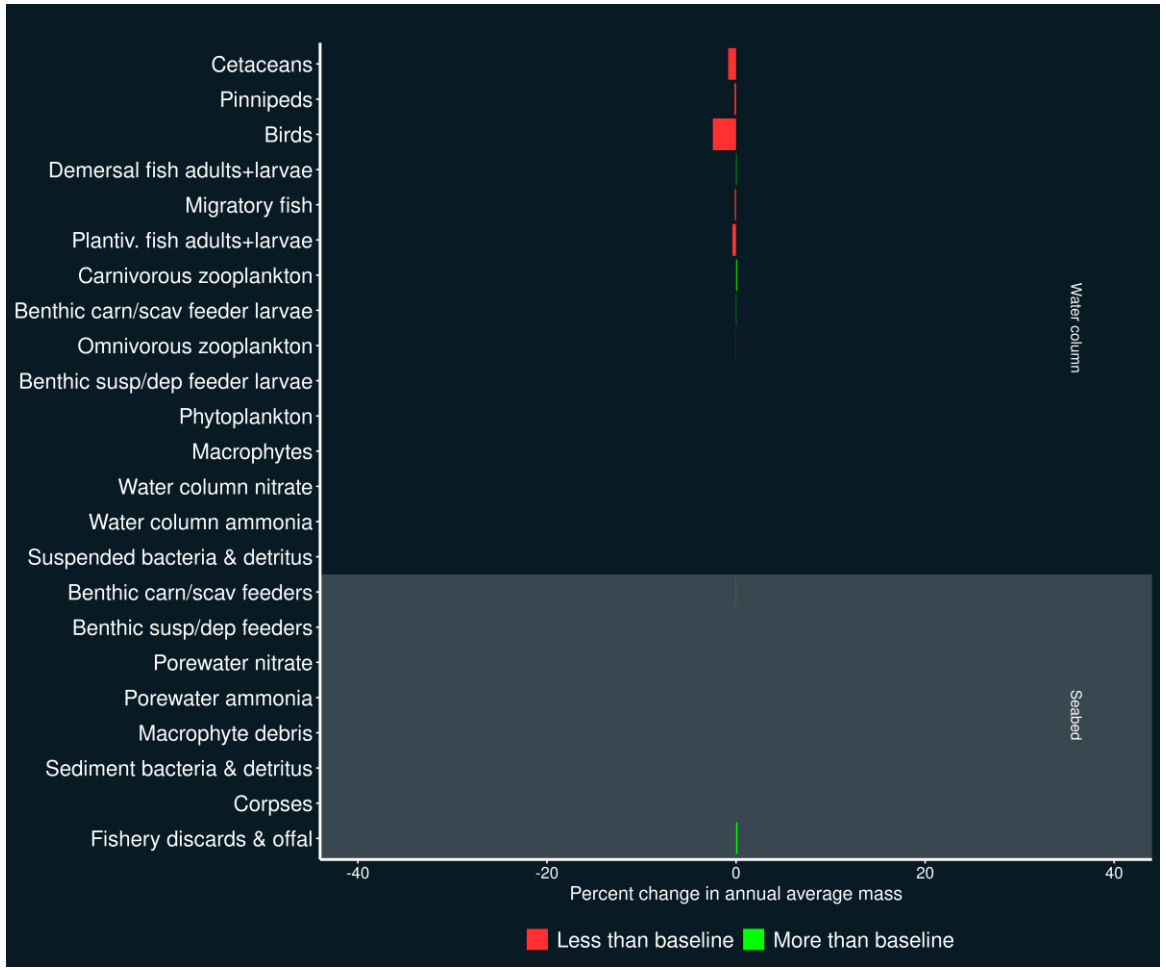


Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

PRELIMINARY RESULTS

Remember: no <12m vessel data

	Effort Split			
	In shore	Offshore	Proportion of Effort in ORE Area	Effort to displace
Pelagic Trawl+Seine (ALL)	9.4237	90.5763	19.537%	1.84%
Demersal Seine activity	0.7631	99.2369	25.111%	0.19%
Demersal Otter Trawl TR1 activity	0.4813	99.5187	35.781%	0.17%
Otter30-70mm+TR3(sandeel+sprat) activity	1.1559	98.8441	7.104%	0.08%
Mollusc Dredge	15.5068	84.4932	52.097%	8.08%
Beam Trawl BT1+BT2 activity	1.4006	98.5994	2.523%	0.04%
Gill Nets+Longline demersal activity	3.3893	96.6107	1.242%	0.04%
Nephrops Trawl TR3 activity	1.2047	98.7953	2.661%	0.03%



Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

PRELIMINARY RESULTS

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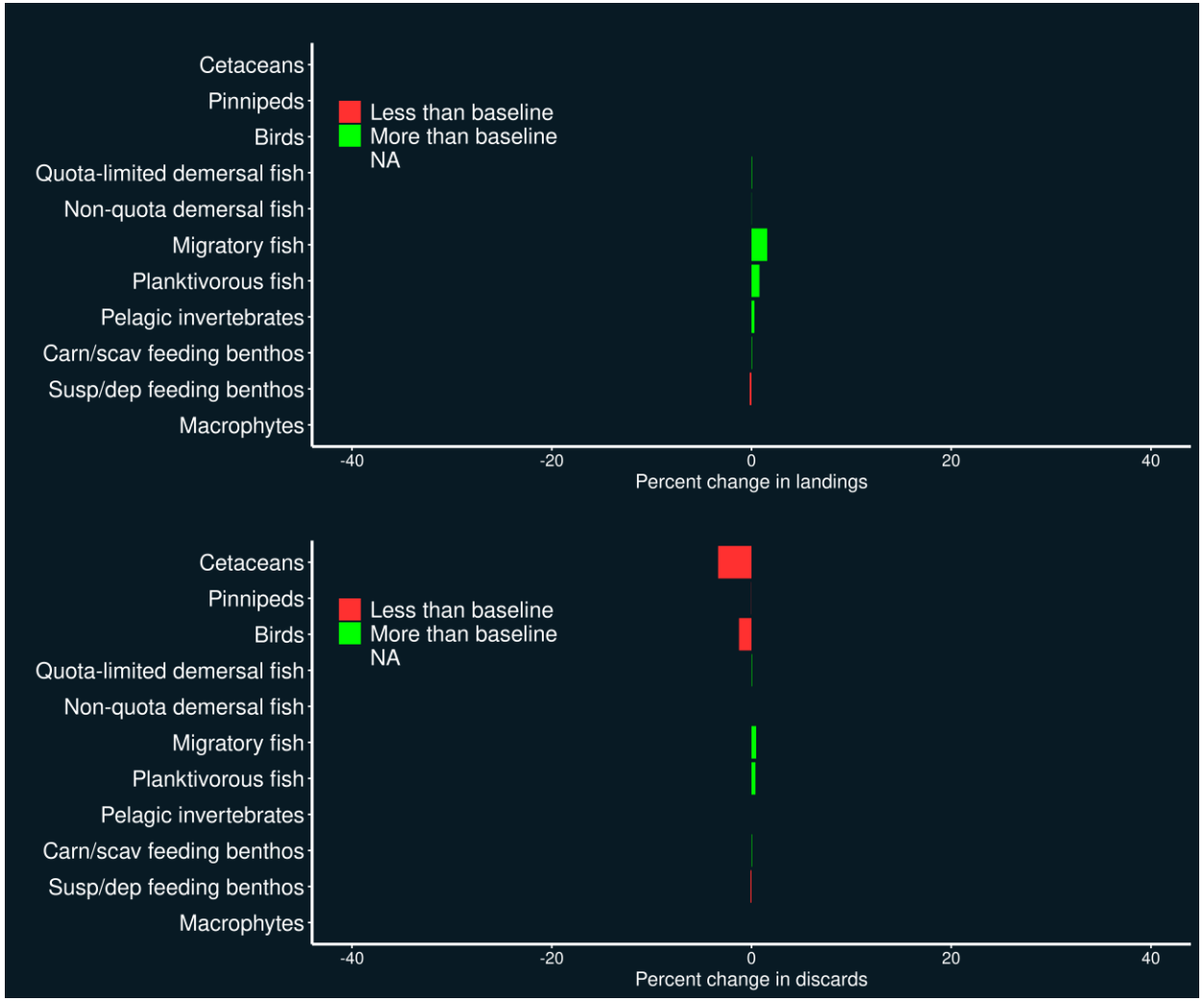

Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

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PRELIMINARY RESULTS

Remember: no <12m vessel data

Add displacement to ecosystem impacts:

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	In shore	Offshore	Proportion of Effort in ORE Area	Effort to displace
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Lethal Effects		Mortality	Non-Lethal Effects		Feeding Rate
Macrophytes (kelp)			Macrophytes (kelp)		
Phytoplankton			Phytoplankton		
Ominivorous zooplankton			Ominivorous zooplankton		
Carnivorous zooplankton (e.g. squids)			Carnivorous zooplankton (e.g. squids)		
Planktivorous fish larvae			Planktivorous fish larvae		
Demersal fish larvae			Demersal fish larvae		
Planktivorous fish			Planktivorous fish	Inshore	-5%
				Offshore	-1%
Migratory fish			Migratory fish	Inshore	-5%
				Offshore	-1%
Demersal fish			Demersal fish	Inshore	-5%
				Offshore	-1%
Suspension/deposit feeding benthos larvae			Suspension/deposit feeding benthos larvae		
Carnivore/scavenge feeding benthos larvae			Carnivore/scavenge feeding benthos larvae		
Suspension/deposit feeding benthos			Suspension/deposit feeding benthos		
Carnivore/scavenge feeding benthos			Carnivore/scavenge feeding benthos		
Seabirds	Inshore	+10%	Seabirds	Inshore	-5%
	Offshore	+1%		Offshore	-1%
Pinnipeds (seals)			Pinnipeds (seals)	Inshore	-5%
				Offshore	-1%
Cetaceans			Cetaceans	Inshore	-5%
				Offshore	-1%

Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

PRELIMINARY RESULTS

Remember: no <12m vessel data

Add displacement to ecosystem impacts:

Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

PRELIMINARY RESULTS

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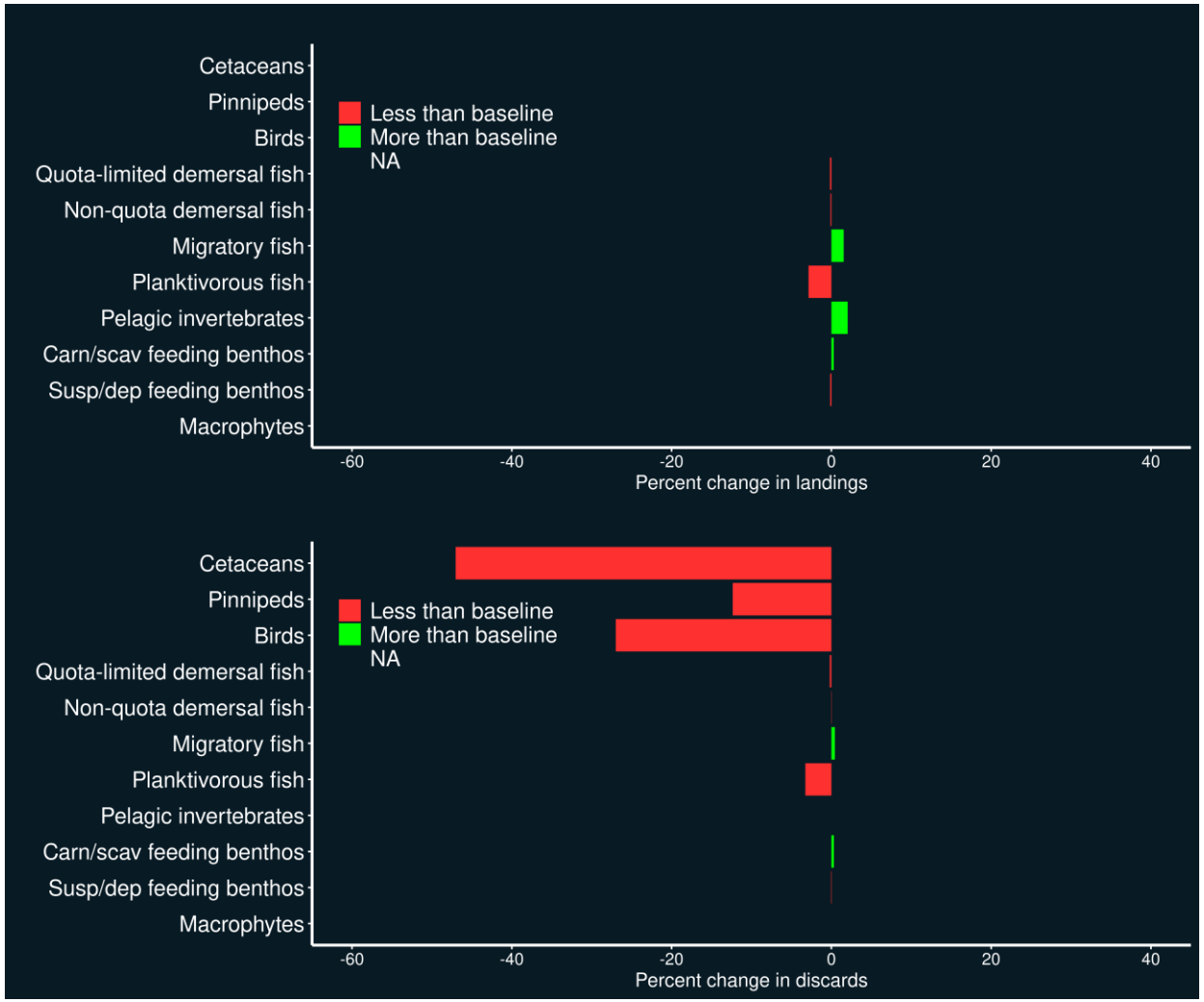
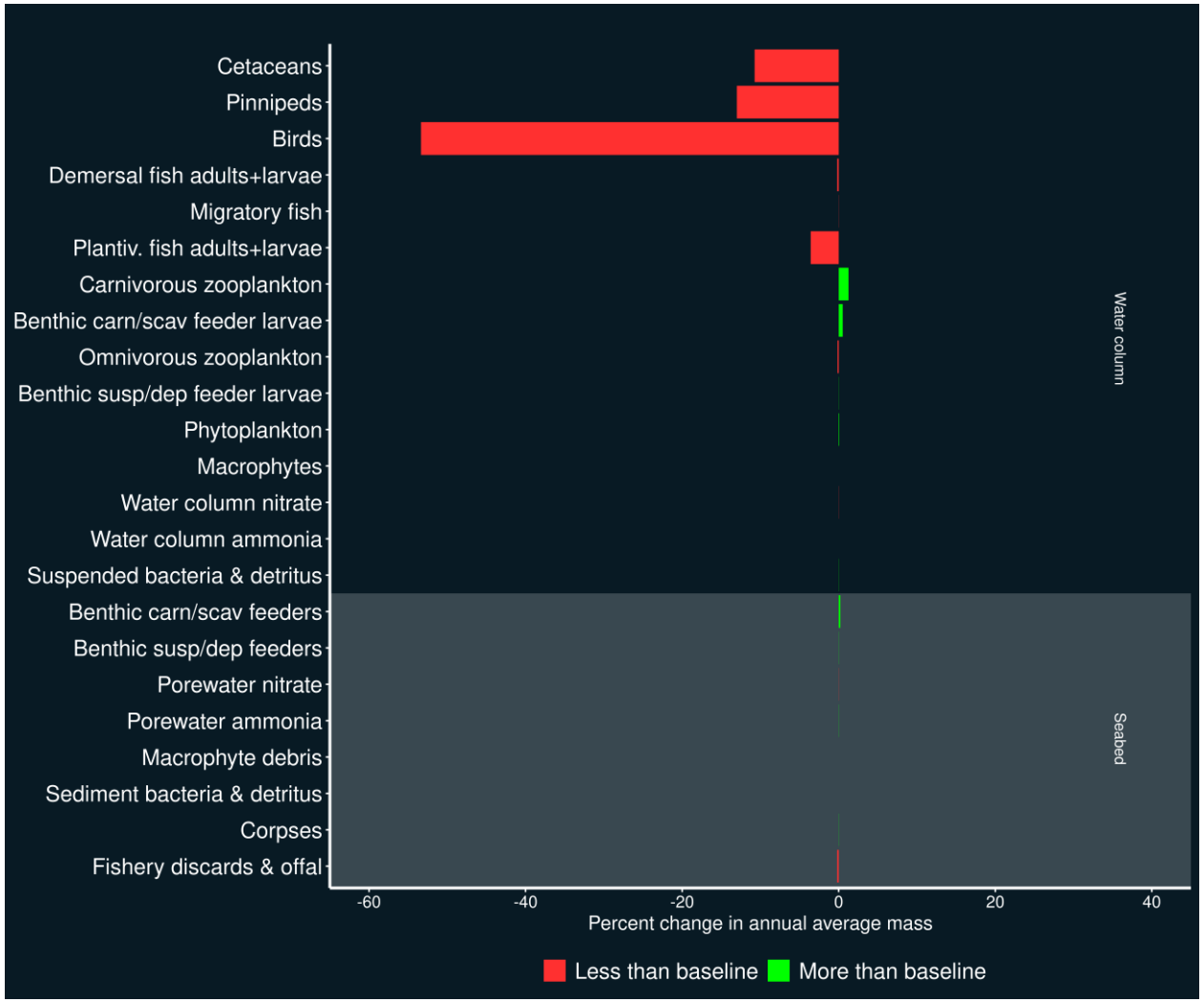
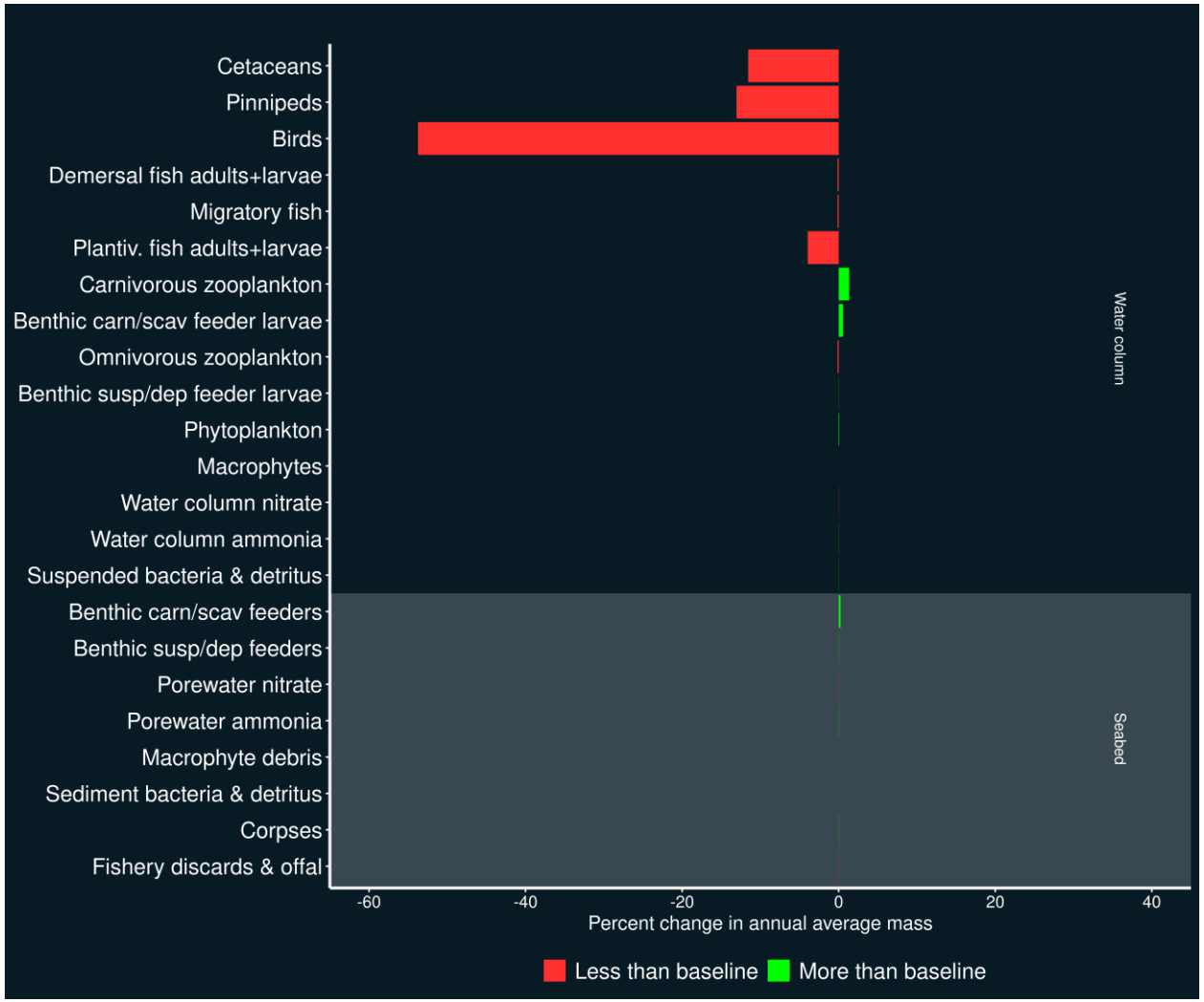
Add displacement to ecosystem impacts:



Comparison: ORE & ORE + Displacement Effects





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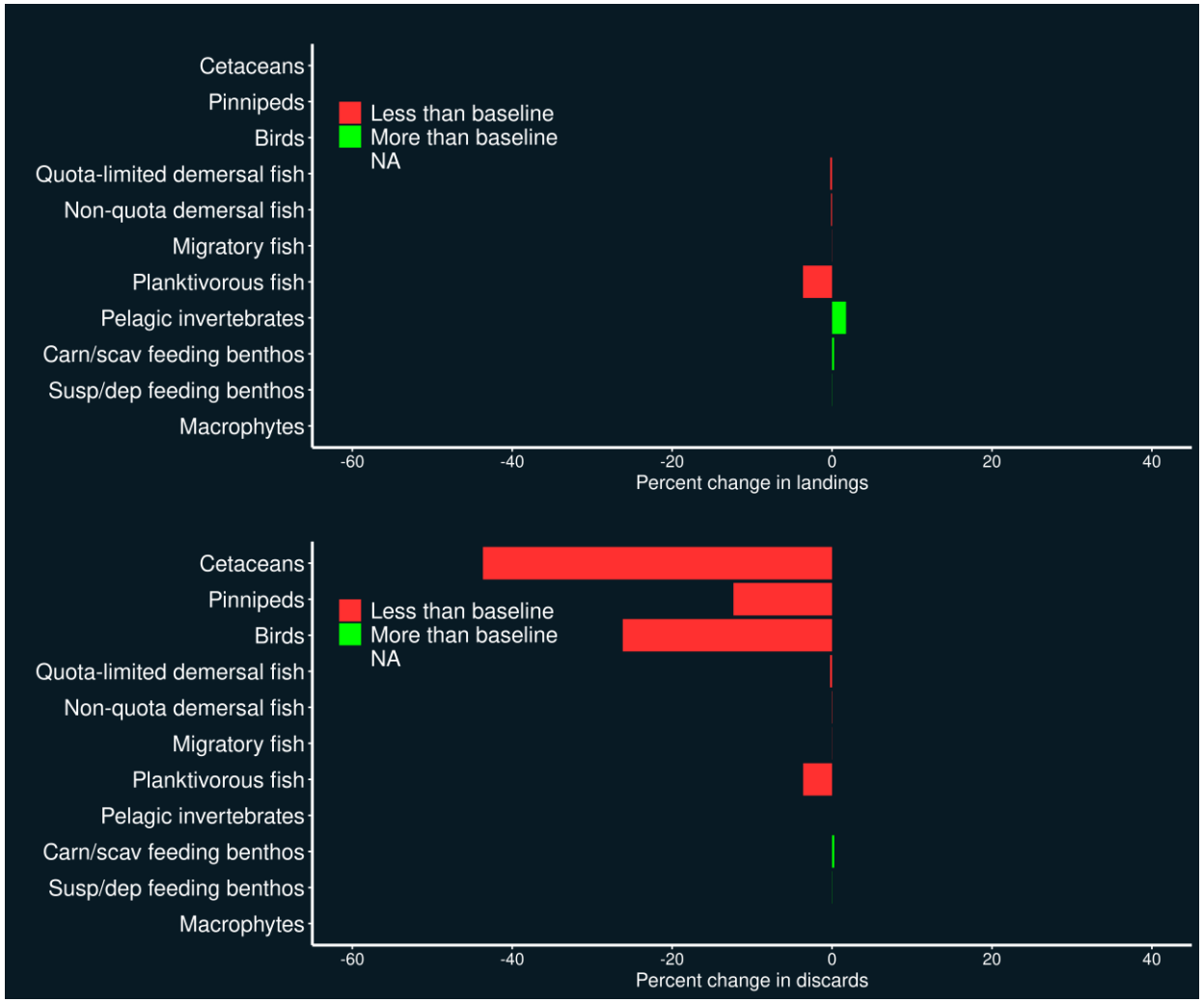
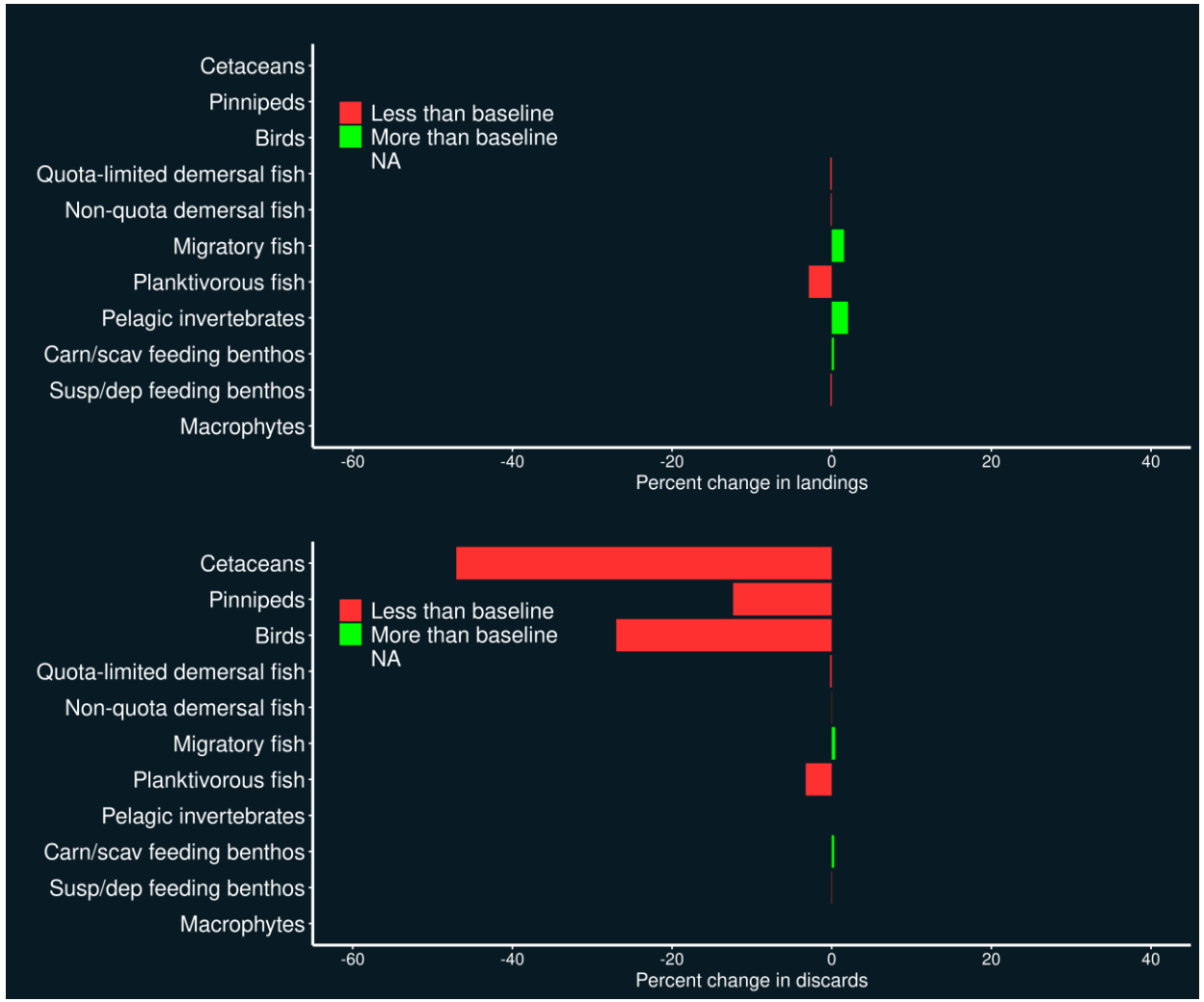


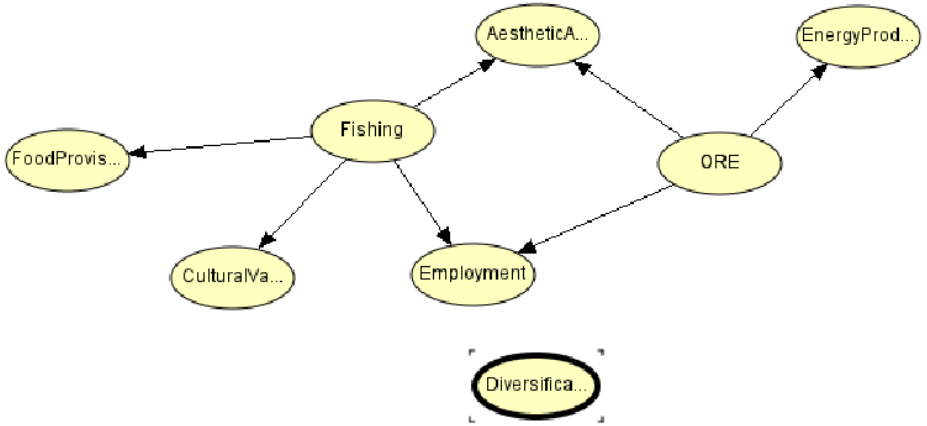


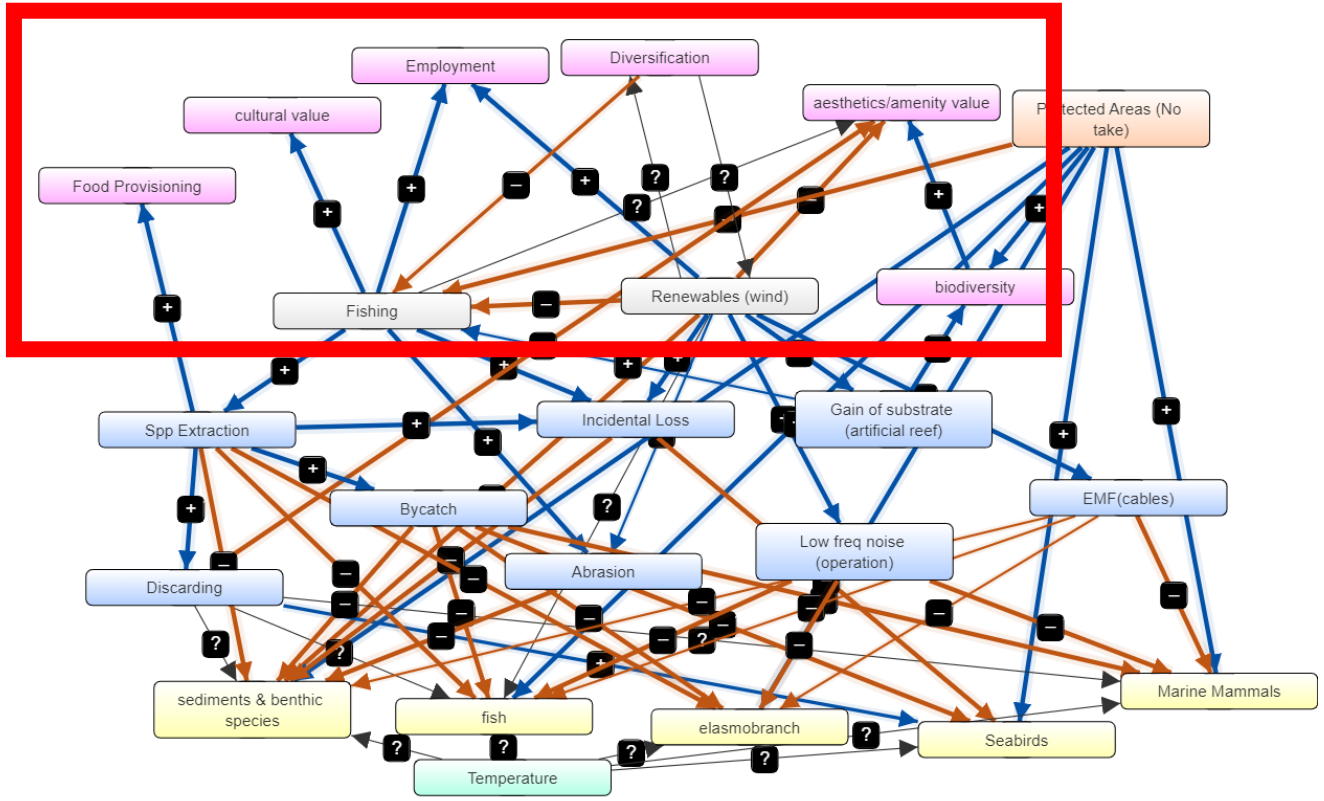
Scenario 2: What are the displacement effects of ORE on fisheries and ecosystems?

Part of the question seems to have been what are the socio-economic impacts on fishing of ORE

We could attempt to answer this using the conceptual model we have already built, and building a BBN from it

Workshop?





Scenario 3: What happens when we add MPAs?

Scenario 3a: Add MPAs assuming strict exclusion zones – 30% of marine area by 2030

Scenario 3b: Assume ORE sites are accepted as OECM and can contribute to 30% MPA target – strict fishing exclusion

Scenario 3c: Assume ORE sites are accepted as OECM and can contribute to 30% MPA target – exclusion of fishing except potters

This requires an explicitly spatial approach….and more information than we currently have…..

MarinePlan

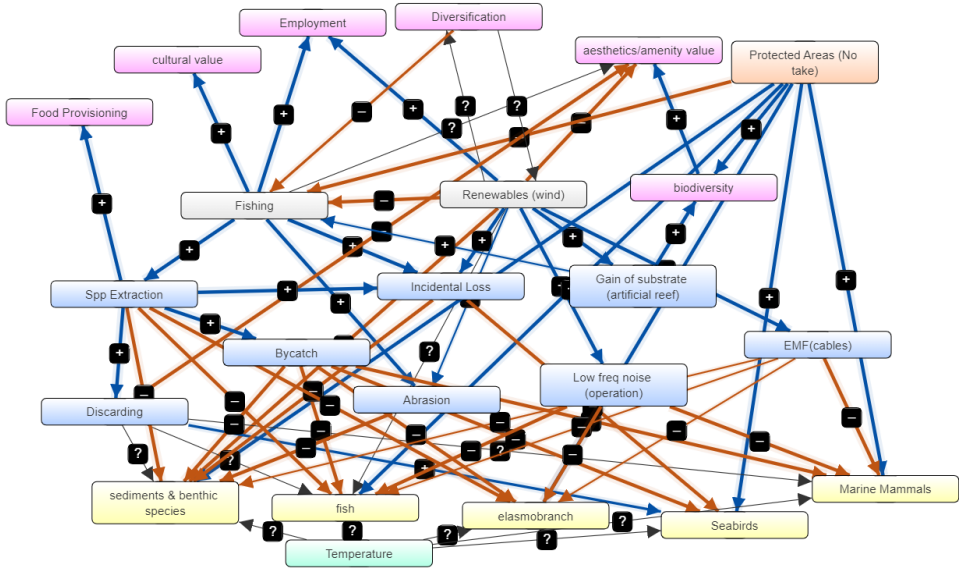
www.marineplan.eu

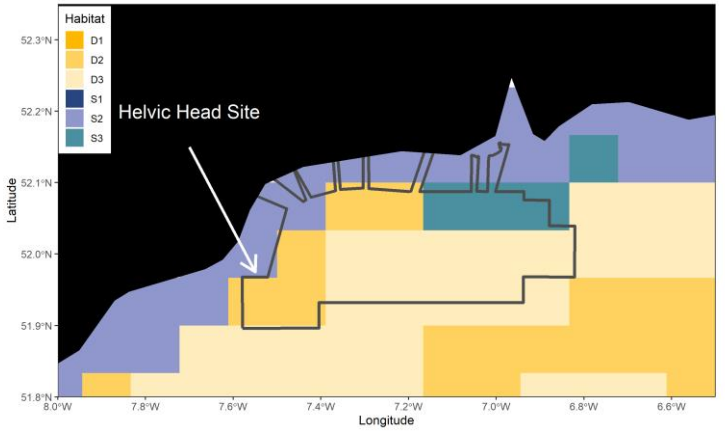
Scenario 3: What happens when we add MPAs?

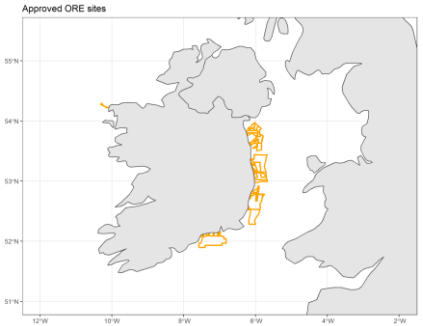
But, we can look at our conceptual model again…

Remember!

- Just interactions
- No explicit spatial aspect – what happens where this happens (specific site)
- No time aspect
- Not good at capturing second order effects







Scenario 3: What happens when we add MPAs?

What does the conceptual model say?

Increase of ORE (+1)

Increase of no-take MPAs (+1)

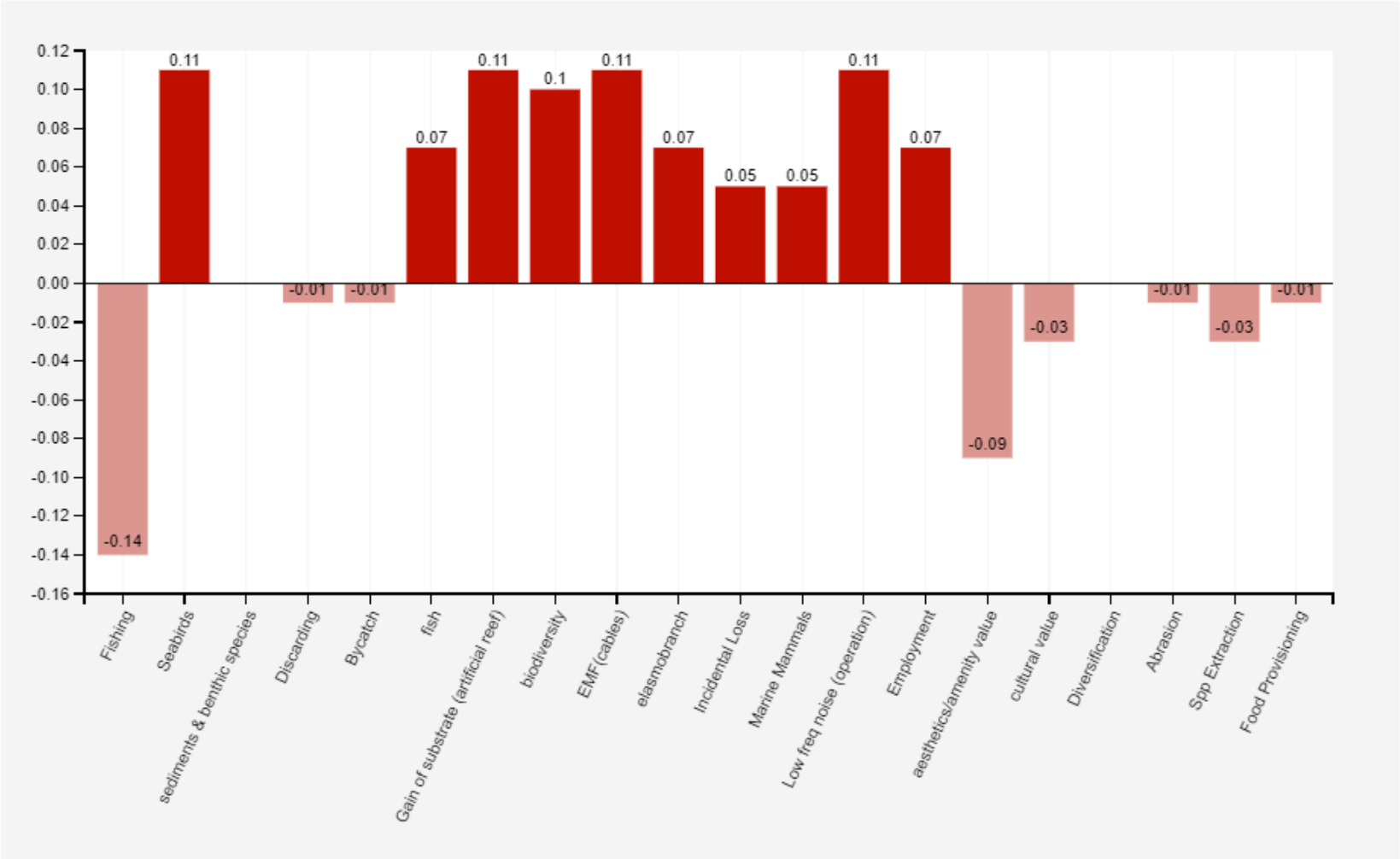
Again model reflects what we expect from the way we built it! – Sensible output

Decrease in fishing (assuming displacement) and Aesthetic/Amenity value

Increase in artificial reef leads to increase in biodiversity, and fish, elasmobranchs, seabirds and marine mammals

Increase in associated ORE impacts (electromagnetic fields, incidental loss, noise)

Increase in employment



Future plans

Possible workshops:

- Participatory mapping of small scale (>12m vessel) fleet effort within case study area
- Socio-economic impacts of ORE: building a BBN
- Scenario refining (strength of impacts and interactions)
- OceanICU – carbon and fishing interactions

Annual meeting:

- Update on projects from research group
- MarinePlan
- SeaWise
- GES4SEAS
- OceanICU
- MarineBeacon

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Foras na Mara
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