European Seafood Production under Climate Change: Assessing Economic and Social Consequences

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Background-Climefish project

Co-creating a decision support framework to ensure sustainable fish production in Europe under climate change

- The forecasting models for fish production
- Identified risks and opportunities and socio-economic implications
- Guidelines for making responsive MPs and climate change adaptation plans
- Guidelines for establishing legal good practice when resources move and diseases occur
- The ClimeFish Decision Support System with accompanying user instructions
- Recommendations for good co-creation practice

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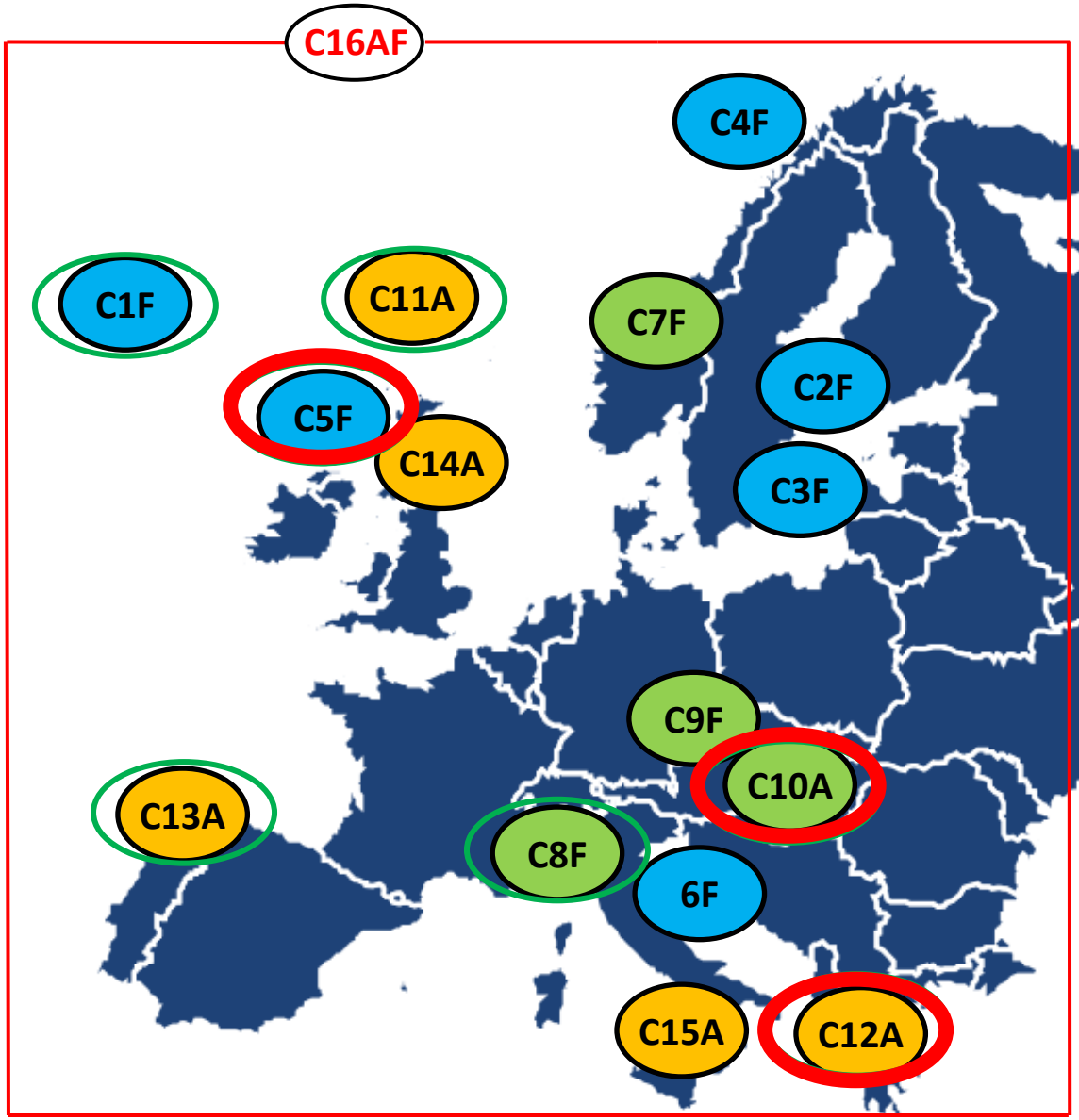
ClimeFish case studies



- C1F NE Atlantic
- C2F Baltic Sea - pelagic
- C3F Baltic Sea - demersal
- C4F Barents Sea
- C5F West of Scotland
- C6F Adriatic Sea
- C7F North Norw. lakes
- C8F Italian Lake Garda
- C9F Czech Rep. lakes
- C10A Hungary
- C11A NE Atlantic
- C12A Greece
- C13A Spain
- C14A Scotland
- C15A Italy
- **C16AF European waters**

Pelagic

Demersal

Lakes & ponds

Aquaculture

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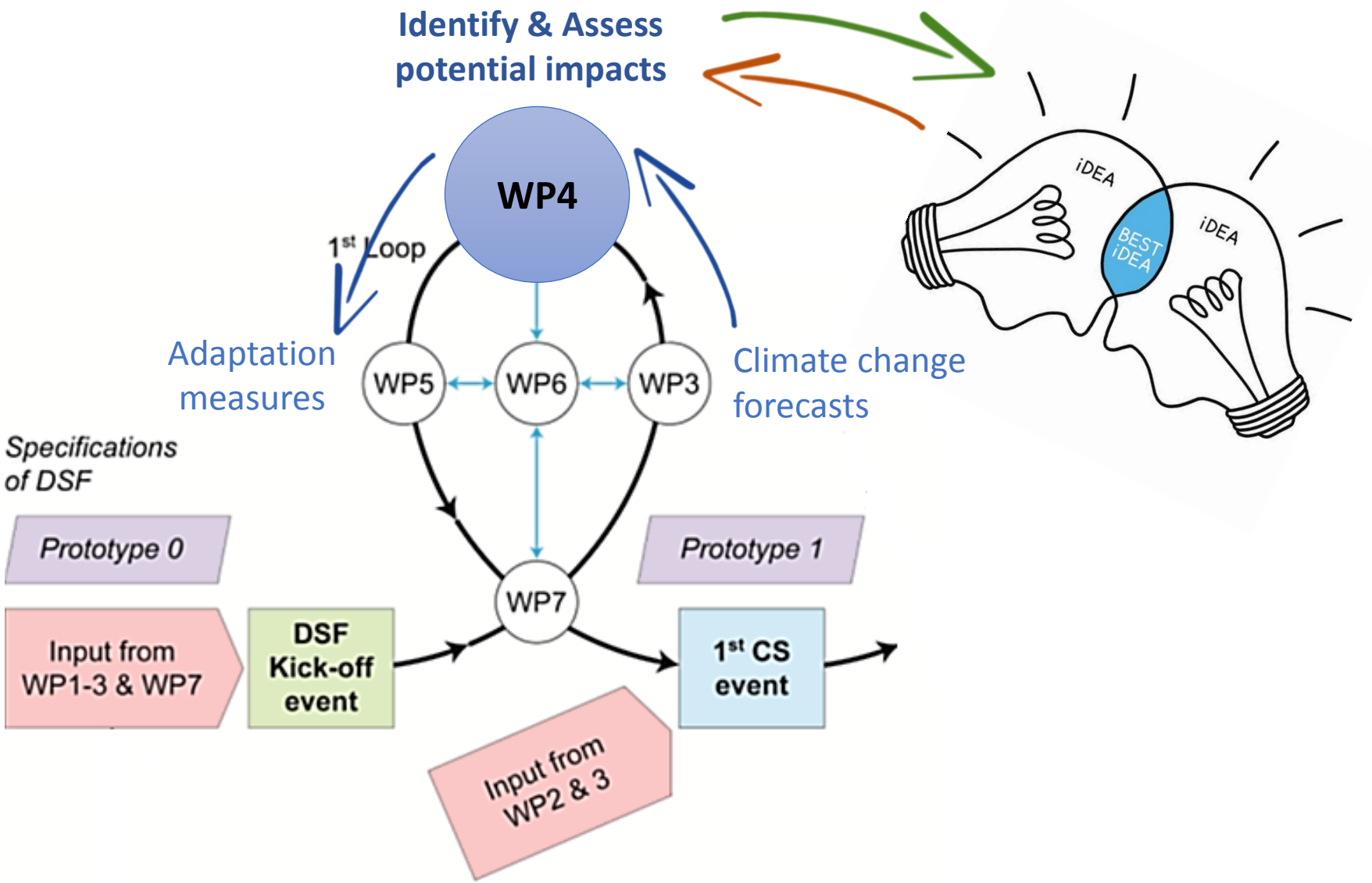
Framework for socio-economics and Impact Assessment



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Scope of Socio-Economic Analysis

- Impact on resources
  - e.g. stock size, distribution, growth rates
  - abiotic effects of climate change: impact on production instrastructure, restricted access to inputs (e.g. water)
- Catching/farming link
  - impact on processing and derived industries will be included
- Impact in each case study area.

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Assessment of Risks and Opportunities

Category	Climate Change Drivers	Potential Impact	R/O	Stakeholder severity score	Stakeholder consensus	Severity Analysis	Consequence ranking	Likelihood Score	Risk score	Risk rating
				S	Std. Dev	A	C = (S, A)	L	R = (C, L)	
The Fisheries	Storminess and waves	11. Deployment and performance of fishing gear reduced due to storminess	R	2	↔ 1.27	2	2	Possible	C2, L Possible	Major
			O	-1		0	-1	Possible	C-1, L Possible	Moderate
	Temperature - changing distribution	12. Potential new fisheries due to emerging species	R	2	↔ 1.26	0	1	Possible	C1, L Possible	Moderate
			O	-2		-2	-2		C-2, L Possible	Major
	Temperature	13. Changes to catchability of target species	R	2	↔ 1.53	1	2	Possible	C2, L Possible	Major
			O	-2		-2	-2		C-2, L Possible	Major
Socio-economics and governance	Storminess and waves	14. Reduced safety at sea for crew due to waves and storminess	R	3	↔ 1.15	2	2	Possible	C2, L Possible	Major
	Storminess and waves	15. Reduced days at sea due to severe weather conditions	R	2	↗ 0.76	2	2	Unlikely	C2, L Unlikely	Moderate
	Increasing rainfall, storminess and waves, sea level rise	16. Damage to ports and land-based facilities due to weather conditions and sea level rise	R	2	↗ 0.83	2	2	Possible	C2, L Possible	Major
	Temperature - changing distribution	17. Increased complexity in negotiations on allocations of shared stocks	R	3	↗ 0.86	3	3	Likely	C3, L Likely	Severe
	Temperature	18. Overfishing of shared pelagic stocks due to unilaterally set quotas	R	3	↗ 0.69	3	3	Likely	C3, L Likely	Severe

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General Findings

- **Different and inequitable impacts across the European case studies**
- For fisheries, change in species composition and abundance
- Warmer temperature can promote fish growth and productivity, but also a risk in terms of changing presence of pathogens
- Change in suitable areas for aquaculture

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Two implementation case studies

Greece Aquaculture case study focusing on European Seabass

Two climate scenarios:
RCP4.5 (low emissions) and RCP8.5 (high emissions)

Fisheries case study in the West of Scotland area

Mixed demersals

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Aquaculture in Greece

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ıding from the
2020 research
ıer grant

Greece: Highest scoring risks and opportunities

Risks	Risk Rating
Increased presence of pathogens	Severe
Seasonal changes in growth and stocking timing	Severe
Water quality deterioration, risk for anoxic conditions	Severe
Inhibition of growth and increase of mortality	Major

Opportunities	Opportunity Rating
Increase in biomass and production capacity	Transformative
Seasonal changes in growth and stocking timing	Transformative
Shift of thermal window suitable for growth	Major
Increased size variability	Major

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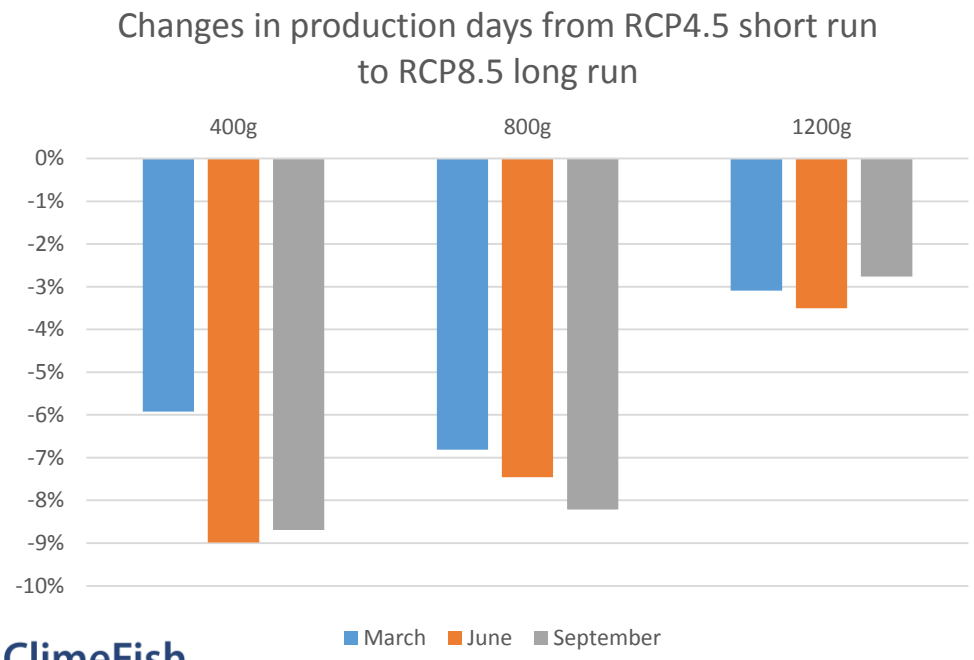
CC impacts Productivity (RCP4.5 short vs. RCP8.5 long)

Production days												
Stocking / Weight	RCP4.5 short run			RCP8.5 long run			Absolute difference			Relative difference		
	400g	800g	1200g	400g	800g	1200g	400g	800g	1200g	400g	800g	1200g
March	544	909	1,048	512	847	1,016	-32	-62	-32	-6%	-7%	-3%
June	519	881	1,039	472	815	1,003	-47	-66	-36	-9%	-7%	-4%
September	603	943	1,087	551	865	1,057	-52	-77	-30	-9%	-8%	-3%



Climate Change reduces the production time substantially.

The largest changes occur in 400g and 800g.

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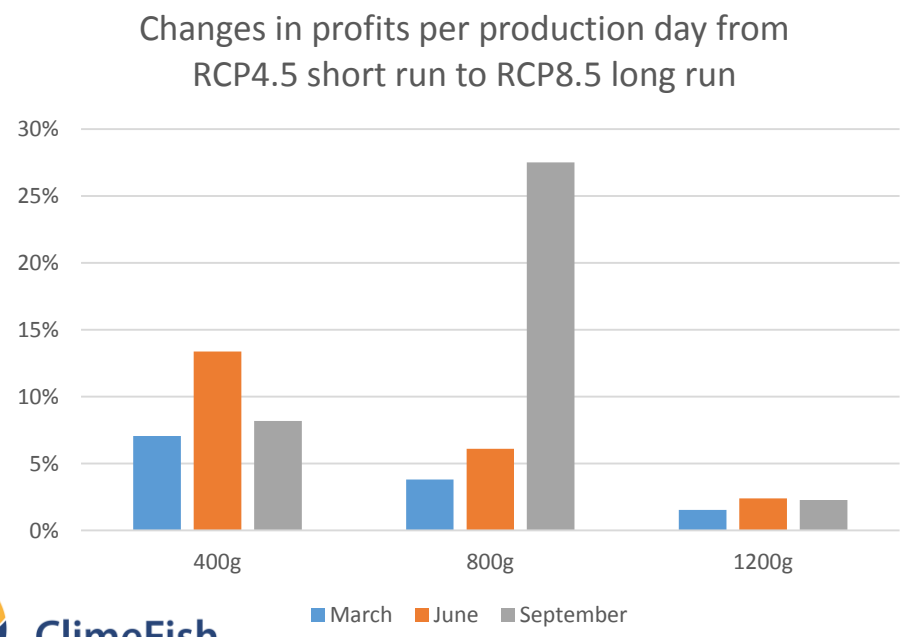
CC impact on Profitability (RCP4.5 short vs. RCP8.5 long)

Profits per production day												
Stocking / Weight	RCP4.5 short run			RCP8.5 long run			Absolute difference			Relative difference		
	400g	800g	1200g	400g	800g	1200g	400g	800g	1200g	400g	800g	1200g
March	153	326	734	164	339	745	11	12	11	7%	4%	2%
June	177	370	809	200	392	828	24	23	19	13%	6%	2%
September	146	319	853	158	406	873	12	88	19	8%	27%	2%



The shorter production time increases profits.

Notice the large increase in profits in 800g in September stocking. This is due to a smaller feed consumption and high growth of juveniles.

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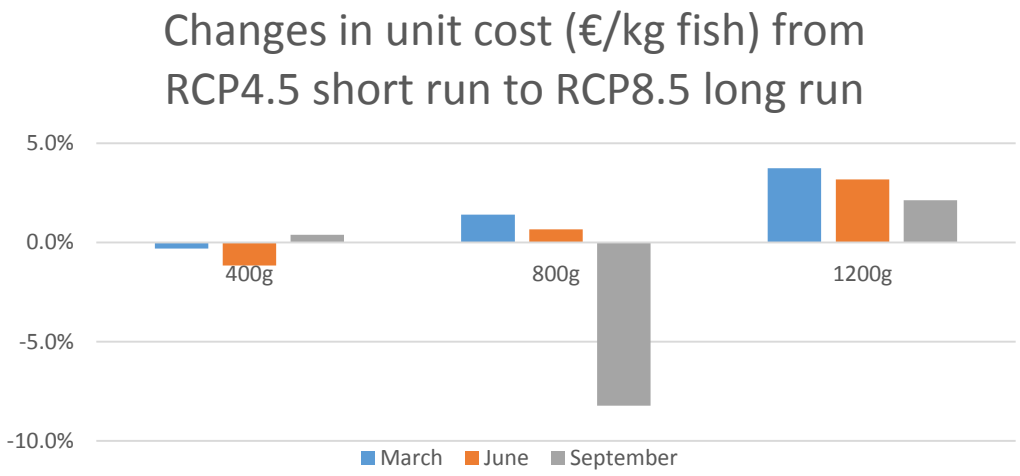
CC Impact on Cost (RCP4.5 short vs. RCP8.5 long)

Cost structure	400 g	800 g	1200 g
Feed	54%	65%	69%
Juveniles	23%	11%	7%
Wages	11%	13%	14%
Other	11%	9%	6%
Depreciations	3%	4%	4%

Cost Unit (€/kg fish)												
Stocking	RCP4.5 short run			RCP8.5 long run			Absolute difference			Relative difference		
Weight	400g	800g	1200g	400g	800g	1200g	400g	800g	1200g	400g	800g	1200g
March	3.66	4.07	4.45	3.65	4.12	4.61	-0.01	0.06	0.17	0%	1%	4%
June	3.59	3.96	4.28	3.55	3.98	4.41	-0.04	0.03	0.14	-1%	1%	3%
September	3.67	4.21	4.04	3.68	3.86	4.13	0.01	-0.35	0.09	0%	-8%	2%



Notice the unit costs (€/kg fish) of large fishes increase in all stocking times. Unit cost of fish size 800g stocking in September decreases significantly.
Cost structure is the same among CC scenarios.

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Some Conclusions for Greek Aquaculture

- Climate change reduces the production time substantially, especially in the RCP8.5
- Temperature promotes fish growth and productivity. A potential opportunity?
- CC may increase extreme weather events
- CC may have negative effects on disease spread
- Potential for farming other warm-water species
- Reduction in suitable areas for farming

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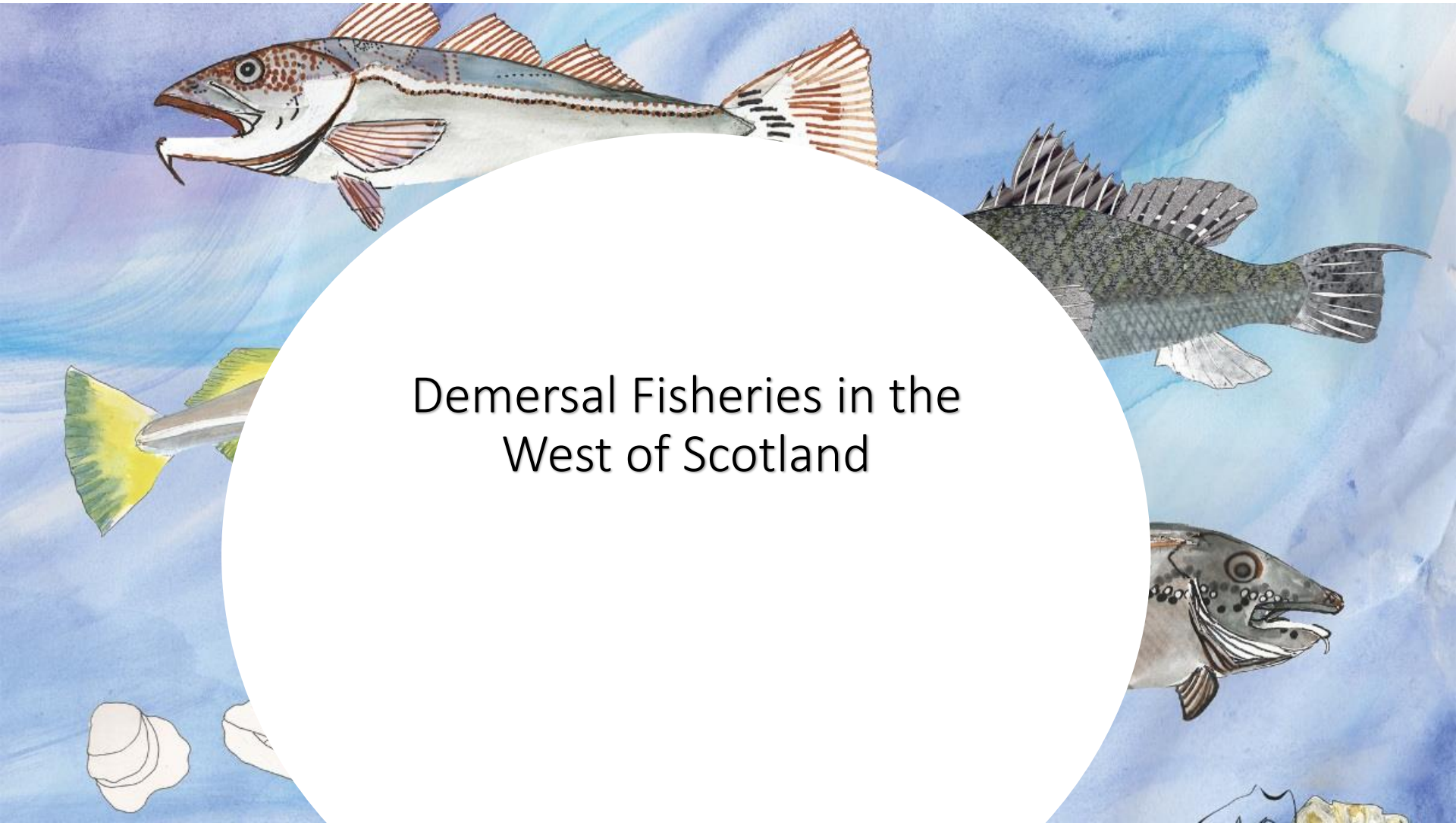

Demersal Fisheries in the West of Scotland

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Highest scoring risks and opportunities

Risks	Risk Rating
No recovery of cod biomass	Severe
New emerging species due to expanding northwards limits	Severe
Alterations to year-class strengths incl. larval survival	Severe
Lack of TACs	Severe

Opportunities	Opportunity Rating
Increased biomass of Whiting and Hake	Major
New emerging species due to expanding northwards limits	Major
Changes in species phenology, including timing of spawning	Major
change in catch composition	Major

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West of Scotland: Socio-Economic Results

		RCP8.5 Scenario					
		2020	Δ ABSOLUT	2030	Δ ABSOLUT	2050	Δ ABSOLUT
Biomass and catches							
Spawning stock biomass	tonnes	453,065	**-356**	443,452	**5813**	447,945	**-3870**
Weighted spawning stock	tonnes	469,025	**-805**	457,274	**2747**	462,555	**-7123**
Catches	tonnes	131,791	**-180**	126,716	**1356**	126,947	**-2162**
Weighted catches	tonnes	125,458	**-239**	120,483	**633**	120,999	**-2546**
Business economics							
Income	1,000 €	215,120	**-410**	206,590	**1086**	207,474	**-4365**
Wages and salaries	1,000 €	54,536	**-104**	52,374	**275**	52,598	**-1107**
Operating costs	1,000 €	153,974	**-211**	148,044	**1584**	148,314	**-2526**
Operating profits	1,000 €	6,610	**-96**	6,172	**-774**	6,562	**-733**
National economics							
GVA in fisheries	1,000 €	61,147	**-200**	58,546	**-498**	59,160	**-1839**
Backward linking	1,000 €	117,637	**-161**	113,107	**1211**	113,313	**-1930**
Forward linking	1,000 €	80,291	**-153**	77,107	**405**	77,437	**-1629**
Flow-on	1,000 €	266,720	**-508**	256,144	**1346**	257,239	**-5412**
Total GVA	1,000 €	525,795	**-1022**	504,904	**2464**	507,150	**-10810**
Vessels and employment							
Vessels	#	129	**0**	124	**1**	124	**-2**
Employment in fisheries	#	1,347	**-2**	1,295	**14**	1,297	**-22**

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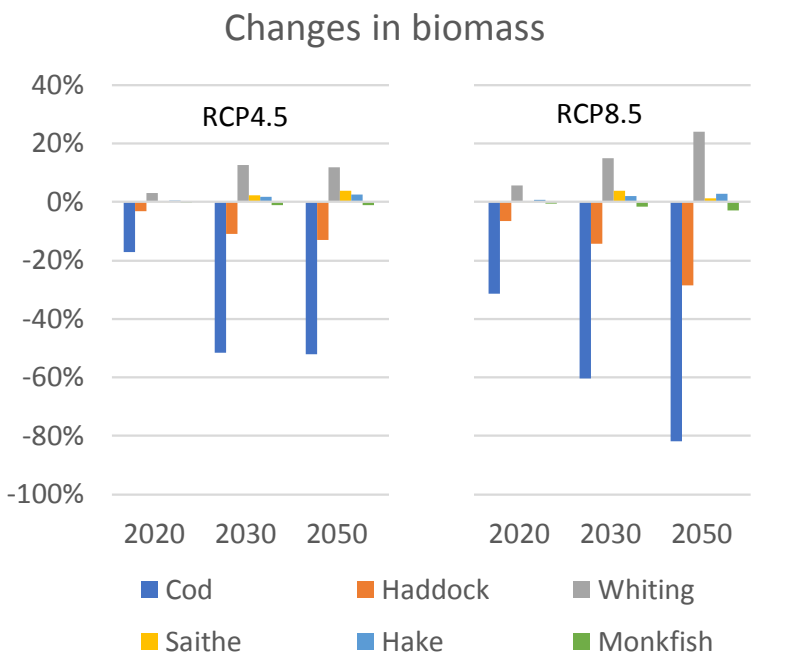
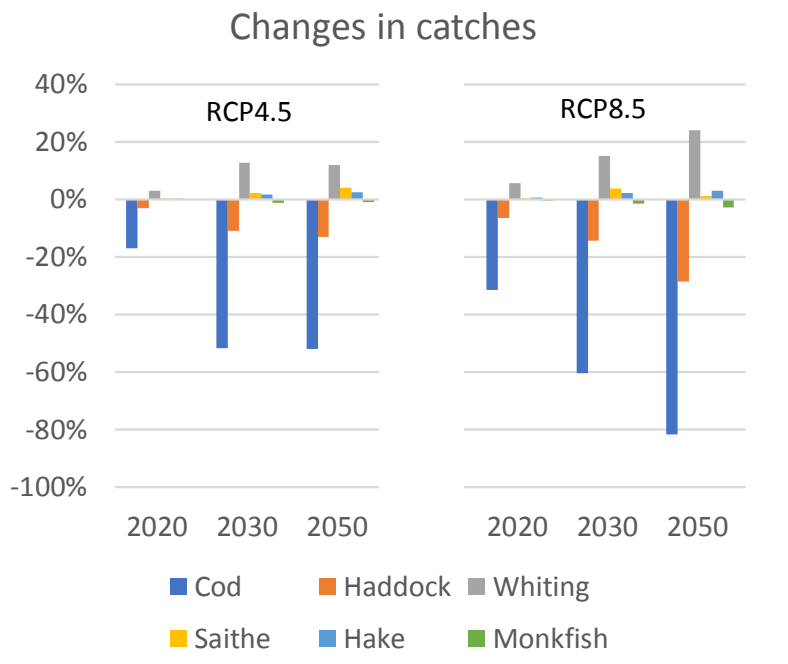
Biomass and Catches





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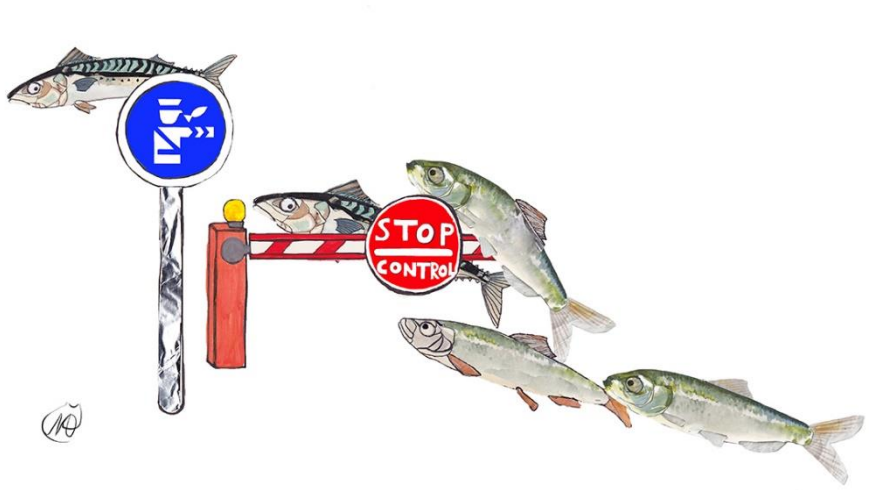
Some conclusions on West of Scotland

- Composition of species will change in area – increased presence of warm water species
- Quantity of catches largely the same
- Relative changes in socio-economics remains relatively stable (0-3%)
- Profitability will reduce due to decreased abundance of most valuable species



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Thank you for your attention!

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