

DAMARA: Developing a decision support tool for mixed fisheries management in the Celtic Sea

Cóilín Minto (GMIT)

Norman Graham (MI), Paul Dolder (CEFAS), Marianne Robert,
Lionel Pawlowski (IFREMER), Simon Mardle (Fisher Ltd), Richard
Curtin (BIM), David Goldsborough, Marloes Krann, Brita Trapman
(IMARES), Dorleta García (AZTI)

6th Annual Beaufort Socio-Economic Marine Research Workshop

November 24, 2015

Celtic Sea advice 2016

Species	TAC (tonnes)	% change
Cod	3,569	-30
Haddock	8,590	-27
Whiting	19,076	+3



<http://www.pisces-rfr.org>

Mixed fisheries advice

Mixed fisheries advice

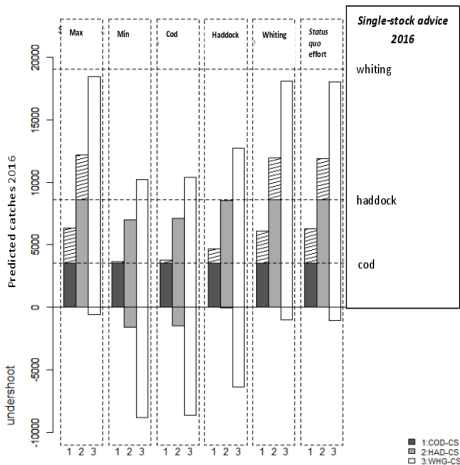
- Mixed fisheries: where, in a fishing operation, more than one stock is captured in the same net. OR where several different fisheries exploit the same stock.

Mixed fisheries advice

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Mixed fisheries advice

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- Mixed fisheries are *the dominant* type of fishery within Europe
- ICES has been presenting mixed fishery advice for the North Sea since 2012, the Celtic Sea in 2015.



Landing Obligation (CFP reform: Article 15)

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- Landing obligation due to come into force from 2016
- Phased by stock-fishery until 2019
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- Landing obligation due to come into force from 2016
- Phased by stock-fishery until 2019
- **The** major driver in fisheries policy (CFP)
- Fishing @ levels consistent with **msy** by 2015, or 2020 at the *latest*

RAC initiative for Celtic Sea mixed fishery management plan

NWWRAC Framework and Objectives for Developing a MAMP for Mixed Demersal Fisheries in Celtic Sea

Wednesday, 02 November 2011

Opinions and Advice

Framework and Objectives for developing a Mixed Fisheries Management Plan in VIIIg

Continue

NWWRAC Proposal on Gear Selectivity Measures for Celtic Sea

Thursday, 13 October 2011

Opinions and Advice

Use of square mesh panels (SMP) in trawl and seine fisheries catching haddock and whiting
NWWRAC Proposal Selectivity Measures SMP Celtic Sea 13102011 EN.pdf

Continue

NWWRAC Opinion on management measures for Celtic Sea demersal fisheries

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Top-down regulatory To Regionalisation

L 344/20



Official Journal of the European Union

24.12.2008

COUNCIL REGULATION (EC) No 1342/2008

of 18 December 2008

establishing a long-term plan for cod stocks and the fisheries exploiting those stocks and repealing Regulation (EC) No 432/2004

THE COUNCIL OF THE EUROPEAN UNION,

having regard to the Treaty establishing the European Community, and in particular Article 37 thereof,

having regard to the proposal from the Commission,

having regard to the Opinion of the European Parliament (1),

Whereas:

- (1) Council Regulation (EC) No 432/2004 of 18 February 2004 on establishing measures for the cod (Gadus morhua) stocks in the Celtic Sea, the North Sea, the Kattegat and the eastern Channel, in the Skagerrak, the Southern and the Irish Sea, to the protection of which is also referred by various other instruments, is to be repealed by 31 January 2009.
- (2) Recent scientific advice from the International Council for the Exploration of the Sea (ICES) has called for the reduction in cod catches arising from the effect of total allowable catches (TACs) and other measures, including monitoring and control, to ensure the catching and landing of cod caught from non-target and nonregulated fishing. Such measures are sufficient to reduce fishing mortality to levels required to allow the cod stocks to rebuild and most of the four cod stocks covered by Regulation (EC) No 432/2004 show clear signs of recovery, although the stocks in the North Sea are showing some signs of improvement.
- (3) It appears necessary to reinforce the regime and to introduce a long-term plan in order to achieve sustainable exploitation of cod stocks on the basis of maximum sustainable yield.
- (4) According to most scientific advices, in particular on long-term trends of marine ecosystems, desirable long-term levels of biomass cannot be determined with accuracy. As a consequence, the objective of the long-term plan should be changed from a biomass-based target to a fishing mortality-based target, which should also be applied to nonregulated levels of fishing effort.

(1) Opinion of 21 October 2008 (not yet published in the Official Journal), OJ L 30, 8.3.2009, p. 8.

(5) The North Sea cod stock is shared with Norway and is jointly managed. The measures provided for in this Regulation should take due account of consultations with Norway pursuant to the Agreement on Fisheries between the European Economic Community and the Kingdom of Norway (2).

(6) In the event that the Scientific, Technical and Economic Committee for Fisheries (STECF) is not able to advise on a TAC due to lack of sufficiently accurate and representative information, provisions should be established to ensure that a TAC can be set in a consistent manner once certain post-date conditions.

(7) In order to ensure the attainment of fishing mortality and to contribute to increasing diversity, opportunities in terms of fishing effort need to be found at levels which are consistent with the common strategy. Such fishing opportunities should, as far as possible, be defined by types of fishing gear on the basis of current fishing practices. It is appropriate to provide for a potential switch of the effectiveness of the management system and to ensure, in particular, that when cod stocks reach levels that allow for exploitation including maximum sustainable yield, the system of regulating fishing effort is reviewed.

(8) Incentives should be introduced to encourage fishery operators to engage in sustainable practices, such as catch shares or discard reductions, as are more likely to succeed if they are developed in cooperation with the fishing industry. Accordingly, such programmes developed with Member States should be considered an effective means of promoting sustainability and their development should be encouraged. Moreover, Member States should ensure their power to allocate access to fishing for cod stocks so as to encourage their fishermen to fish to keep low levels in order to reduce fishing and are less harmful to the ecosystem.

(9) The establishment and allocation of catch limits, the fixing of the maximum and precautionary levels of stocks and of the level of fishing mortality rates, as well as the maximum allowable fishing effort for each effort group by Member State and the inclusion of certain groups of vessels from the effort register laid down in this Regulation are measures of particular importance for the common fisheries policy (CFP). It is appropriate that the Council should ensure for itself the right to exercise supervening powers directly in relation to these specific matters.

(2) OJ L 226, 19.4.1985, p. 46.

Scientific support for the development of a management plan in the Celtic Sea

A mixed-species fisheries Decision Support Tool (DST) in response to: EC Open Call for Tenders No MARE/2012/22

Marine Institute, Galway, Ireland, March 2013

(Demersal Mixed fishery Analysis tool for Regional Advice)

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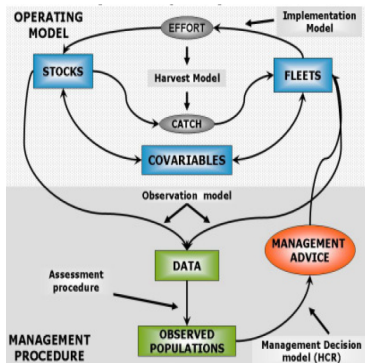
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 - Effective manager/stakeholder involvement
 - Relevant indicators (multiple levels) to support management intervention
 - Accessible, interpretable (to many), credible (to all) outputs

Simulation framework

- Built around FLBEIA (Bio economic Impact Assessment implemented in FLR)
- Modular, flexible, extendable
- Focus in detail on component of interest (e.g. management intervention over assessment performance)
- Incorporate uncertainty (multiplicative)



General dynamics

Population dynamics	
ASPG <i>Non-recruits</i> <i>Recruits</i> Biomass-dynamic Fixed Population	$N_{a,t} = (N_{a-1,t-1}e^{-M/2} - C_{a-1,t-1})e^{-M/2}$ $R_{a=arec,t} = \alpha SSB f(SSB)$ $B_t = B_{t-1} + rB_{t-1} (1 - B_{t-1}/K) - C_{t-1}$ $B_t = \eta, \eta \gg C_{t-1, \dots, T}$
Catch production	
Cobb-Douglas	$C_{f,m,s,t} = q_{f,m,s} \cdot E_{f,m,t}^\alpha \cdot B_{f,m,s,t}^\beta$
Fleet dynamics	
Fixed effort	$E_{f,t} = \text{fixed}$
SMFB	$E_{f,t} = \min(E_{f,t,s1}, E_{f,t,s2}, E_{f,t,s3}, \dots)$
Profit Maximisation	$\max_{[\gamma_1, \dots, \gamma_{n,m,t}]} \sum_m \sum_s \sum_a (q_{m,s,a} \cdot B_{s,a}^{\beta_{m,s,a}} \cdot (E \cdot \gamma_m)^{\alpha_{m,s,a}}) \cdot p_{m,s,a} \cdot E \cdot \gamma_m \cdot VC_m - FC$

Population dynamics

Stock	Pop dyn	Natural Mortality	Production	HCR
Anglerfish	Fixed Pop*	-	-	Fixed Advice
Cod	age-struc	age-dep	SegReg	ICES
Haddock	age-struc	age-dep	SegReg	ICES
Nephrops (FU22)	BiomassDyn	-	Logistic	FixedAdvice
Northern Hake	age-struc	age-dep	SegReg	ICES
Northern Megrim	age-struc	fixed	SegReg	AnnexIV
Plaice	age-struc	fixed	SegReg	AnnexIV
Sole	age-struc	fixed	SegReg	ICES
Whiting	age-struc	age-dep	SegReg	ICES

Fleet dynamics

- Capital Dynamics

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Simulate investment/disinvestment, incl. exit/entry and employment, i.e. what might a [profitable] fleet structure look like in future under a scenario

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Elasticity, price varying by age/market grade

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Impact of fuel price changes, interest rates..
- Effort dynamics

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SMFB ('choke'), Profit maximisation (with constraints)

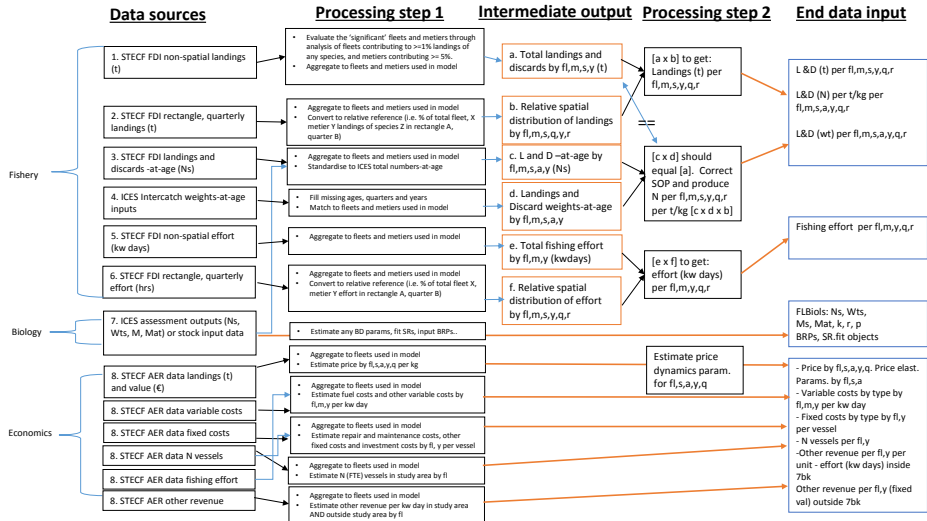
Fleet dynamics

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Impact of fuel price changes, interest rates..
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SMFB ('choke'), Profit maximisation (with constraints)

16 fleets simulated, each in operating in multiple métier, fishing multiple stocks → complex system → focus on scenarios

Data sources

Fl = fleet, m = metier, s = stock, y = year, q = quarter, a = age, r = rectangle, t = tonne, kg = kilogram, N = numbers, M = natural mortality, mat = proportion mature,



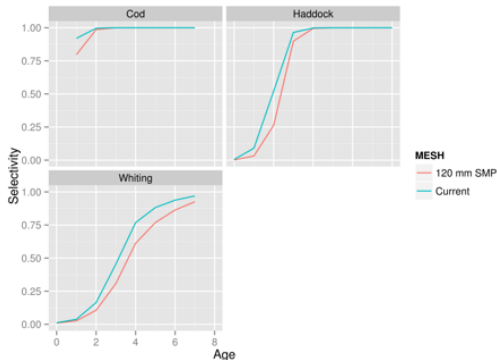
Stakeholder process

- Five one-day workshops involving industry, scientists and authorities
- Understanding the basic elements of the model, including limitations
- Defining relevant scenarios and methods for communication of complex model outputs



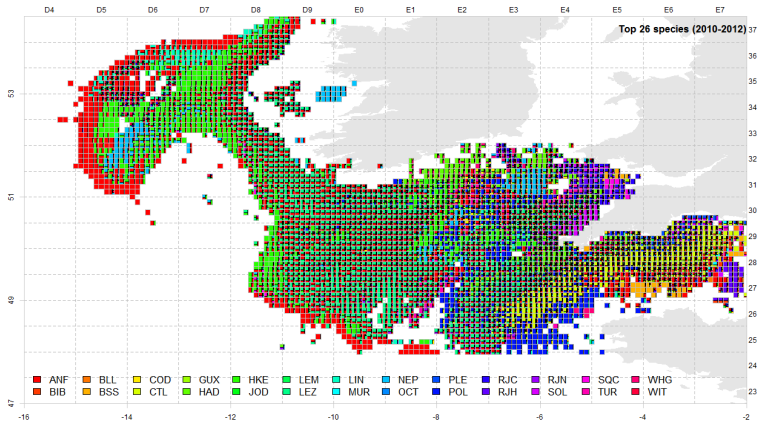
Management interventions: selectivity changes

Uses a meta-analysis of available comparative selectivity trails to define selectivity ogives at age for given métier (based on Fryer *et al*, 2014)



Fryer, R. J., F. G. O'Neill, et al. (2014). "A meta-analysis of haddock size-selection data. *Fish and Fisheries*. DOI: 10.1111/faf.12107

Management interventions: area closures



Scenarios

- Fmsy in 2016, LO in 2017 ('Fmsy2016')
- Fmsy in 2020, LO in 2017 ('Fmsy2020')
- Fmsy in 2016, LO in 2017, Closure ICES rectangle 30E4 to TR1 ('Closure_TR1_30E4')
- Fmsy in 2016, LO in 2017, TR1/TR2 use SMP ('SMP_selectivity')
- Fmsy 2016, LO in 2017, No TR2 cod catch ('TR2_no_cod')
- Fmsy 2016, LO in 2017, Profit Maximisation ('MaxProfit')
- Fmsy 2016, LO in 2017, Capital Dynamics, Price flex ('FullEconomics')



Indicators

Stock level

F

SSB

Catch/Yield

Inter-annual
variability

Risk (wrt
BRPs [Blim,
Bpa etc...])

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7*8*9

Indicators

Stock level

F
SSB
Catch/Yield
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variability
Risk (wrt
BRPs [Blim,
Bpa etc...])
7*8*9

Fleet level

Landings
Discards
Revenue
Effort
Costs
(Depreciation,
Investment,
Fuel etc.)
Profit
Price
BER
GCF
NetProfit

Indicators

Stock level

F
SSB
Catch/Yield
Inter-annual
variability
Risk (wrt
BRPs [Blim,
Bpa etc...])
7*8*9

Fleet level

Landings
Discards
Revenue
Effort
Costs
(Depreciation,
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Fuel etc.)
Profit
Price
BER
GCF
NetProfit
7*13*16

Indicators

Stock level

F
SSB
Catch/Yield
Inter-annual
variability
Risk (wrt
BRPs [Blim,
Bpa etc...])
7*8*9

Fleet level

Landings
Discards
Revenue
Effort
Costs
(Depreciation,
Investment,
Fuel etc.)
Profit
Price
BER
GCF
NetProfit
7*13*16

Métier level

Effort
allocation
Landings
Discards
Effort

Indicators

Stock level

F
SSB
Catch/Yield
Inter-annual
variability
Risk (wrt
BRPs [Blim,
Bpa etc...])
 $7*8*9$

Fleet level

Landings
Discards
Revenue
Effort
Costs
(Depreciation,
Investment,
Fuel etc.)
Profit
Price
BER
GCF
NetProfit
 $7*13*16$

Métier level

Effort
allocation
Landings
Discards
Effort
 $7*4*16*5$

Indicators

Stock level

F
SSB
Catch/Yield
Inter-annual
variability
Risk (wrt
BRPs [Blim,
Bpa etc...])
7*8*9

Fleet level

Landings
Discards
Revenue
Effort
Costs
(Depreciation,
Investment,
Fuel etc.)
Profit
Price
BER
GCF
NetProfit
7*13*16

Métier level

Effort
allocation
Landings
Discards
Effort
7*4*16*5

Society level

Capacity
Employment

Indicators

Stock level

F
SSB
Catch/Yield
Inter-annual
variability
Risk (wrt
BRPs [Blim,
Bpa etc...])
 $7*8*9$

Fleet level

Landings
Discards
Revenue
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Costs
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Profit
Price
BER
GCF
NetProfit
 $7*13*16$

Métier level

Effort
allocation
Landings
Discards
Effort
 $7*4*16*5$

Society level

Capacity
Employment
 $7*5*2$



DAMARA

About

Dashboard

Stock

Fleet stock

Fleet economics

Summary

Stakeholder feedback

Set your scenario options here

Landings obligation scenario

Species-year

Haddock 2016

TR1 gear configuration

Cod-end mesh

110

120

Square mesh panel

None

First year in plots

1980

2004

2015

1980 1984 1988 1992 1996 2000 2004 2008 2012 2016

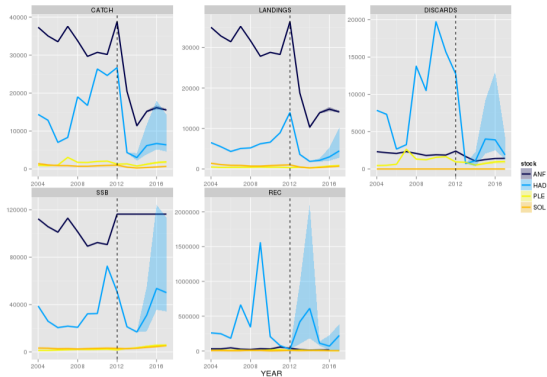
- About
- Dashboard
- Stock
- Fleet stock
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Stock-level predictions

Select stocks to display



Select indicator to display



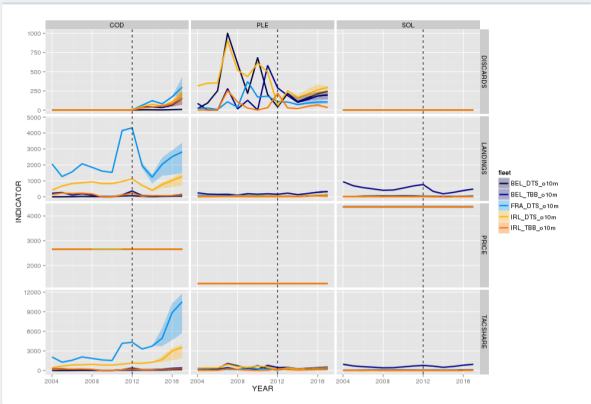


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Fleet-level predictions of stock-relevance

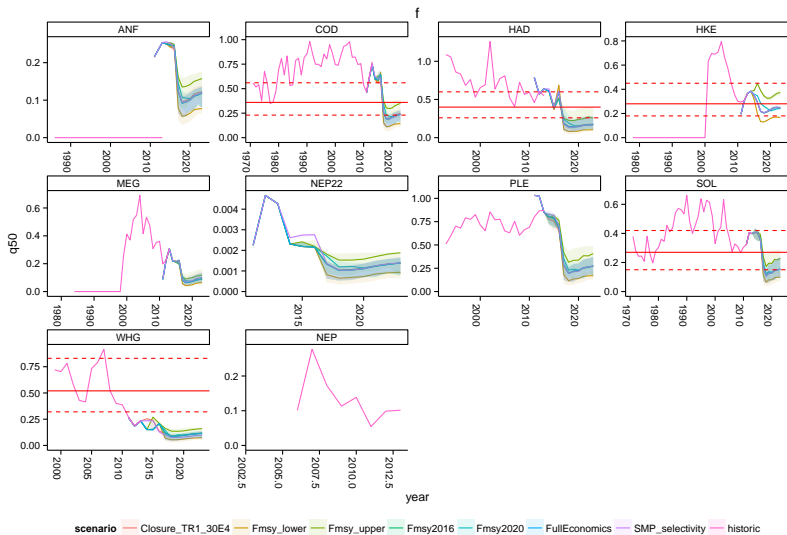
Select fleets to display +

Select stock and indicator to display +

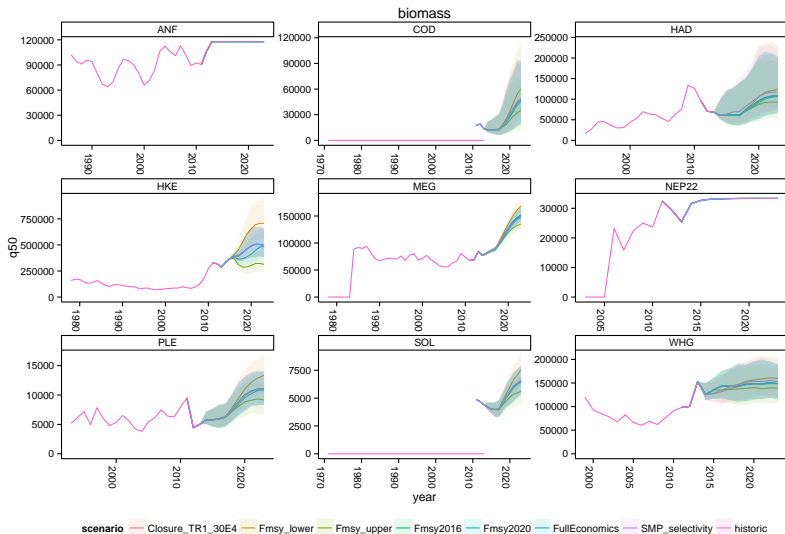


The screenshot shows a web application interface. At the top, a blue header bar contains the text "DAMARA" on the left and a hamburger menu icon on the right. Below the header is a dark grey sidebar with a list of navigation items: "About", "Dashboard", "Stock", "Fleet stock", "Fleet economics", "Summary", and "Stakeholder feedback". The "Stakeholder feedback" item is highlighted. The main content area has a light blue background and features a form titled "Stakeholder feedback" with an orange header. The form includes a "User name" label above a text input field containing the placeholder text "User name". Below the input field is a large, empty text area for feedback. At the bottom of the form is a "Submit" button.

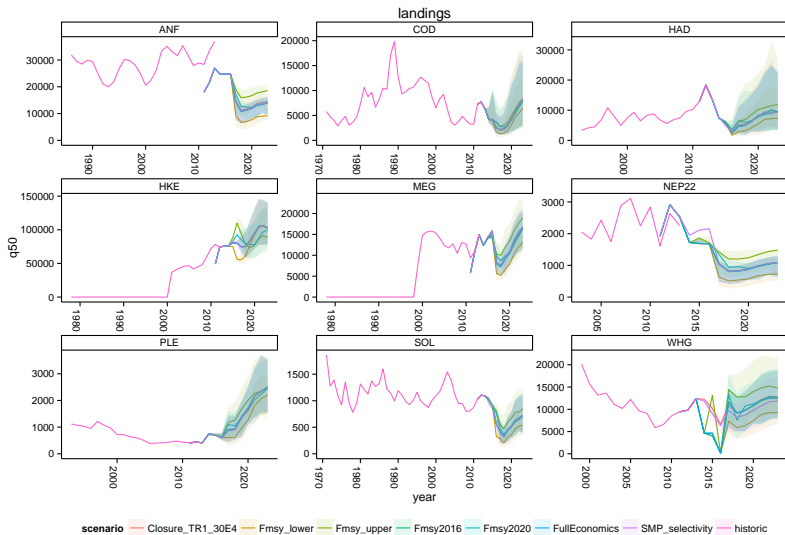
Preliminary results



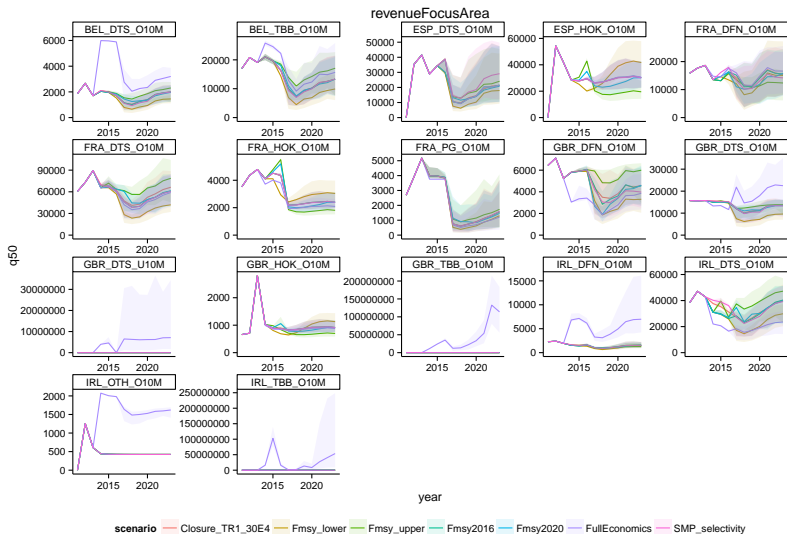
Preliminary results



Preliminary results



Preliminary results



Stakeholder feedback

- 16 interviews of stakeholders (incl. scientists)
- Summarising experience, lessons and next steps
- Project fulfils need of stakeholders » “Trust”, “open dialogue”, “no hidden agendas”
- Key areas of stakeholder involvement: scenarios; economic focus; user interface; fleet capacity indicators
- Improvements:
 - Better understanding behavioural aspects
 - Refined and improved data
 - Include non-commercial fish species
 - Improve run-time
 - Provide training

Summary

- Obj. to design a tool to compare different management interventions for multi-stock mixed fisheries from multiple perspectives/angles

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- Highly adaptable but depends on the data available
- Allows focus to be given to improving modelling of processes of key importance in deciding between options
- Future work depends on ensuring that tools are:
 - embedded in regional governance structures
 - further developed and supported
 - involved stakeholders have a platform for further collaboration

Acknowledgements

- **Project team** Norman Graham (MI), Paul Dolder (CEFAS), Marianne Robert, Lionel Pawlowski (IFREMER), Simon Mardle (Fisher Ltd), Richard Curtin (BIM), David Goldsborough, Marloes Krann, Brita Trapman (IMARES).
- **FLBEIA team** Dorleta García, Raúl Prelezzo, Sonia Sánchez, Marga Andrés, Agurtzane Urtizberea [AZTI]
- **Stakeholders** NWWAC: Jacques Pichon, Emile Brouckaert, Sean O'Donoghue, Eibhlin O'Sullivan, Barrie Deas, Paul Trebilcock
- Colm Ó Súilleabháin (DAFM)
- **Funding** European Commission LOT 1 MARE/2012/22