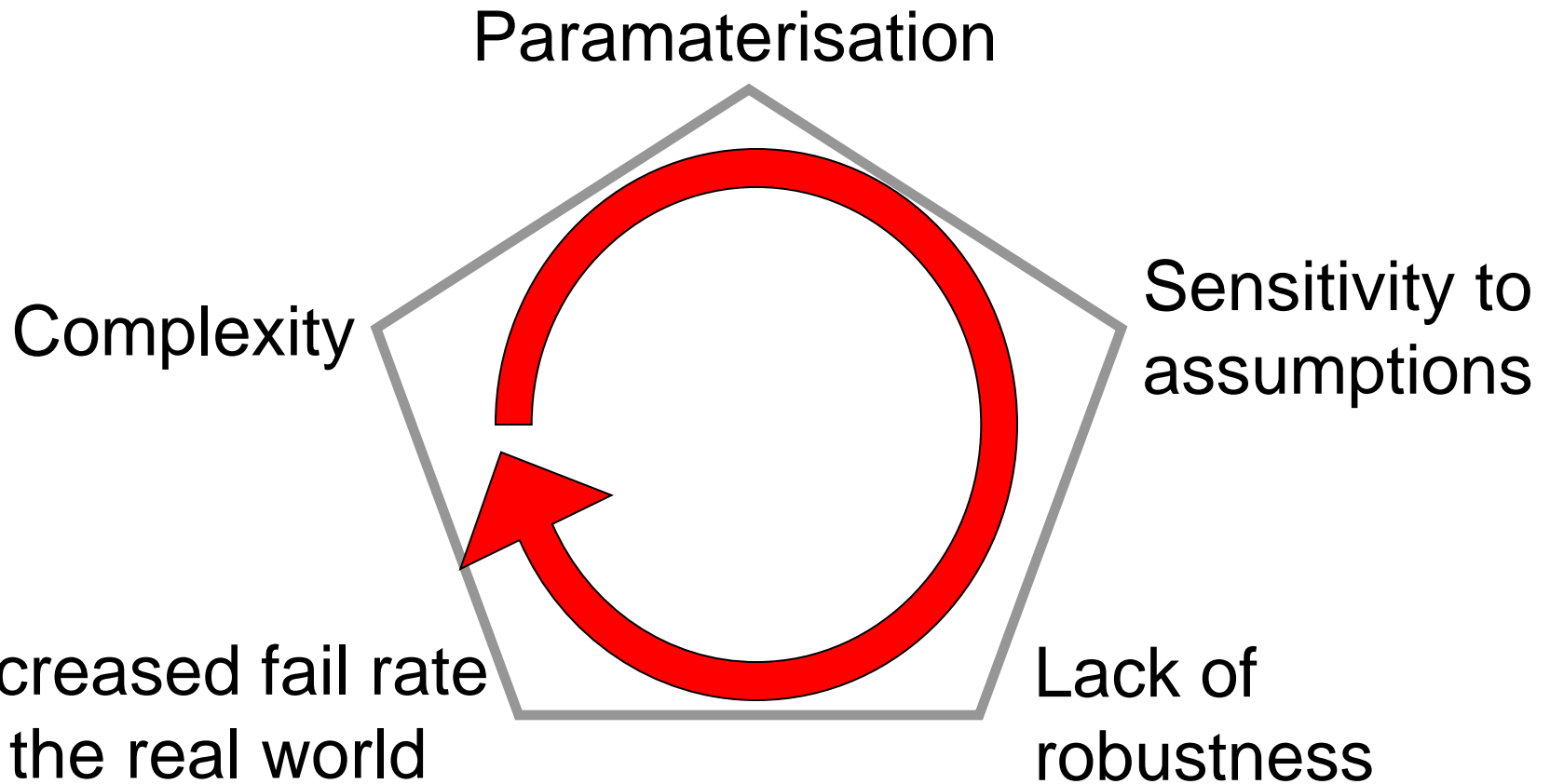


21st century assessment & advice

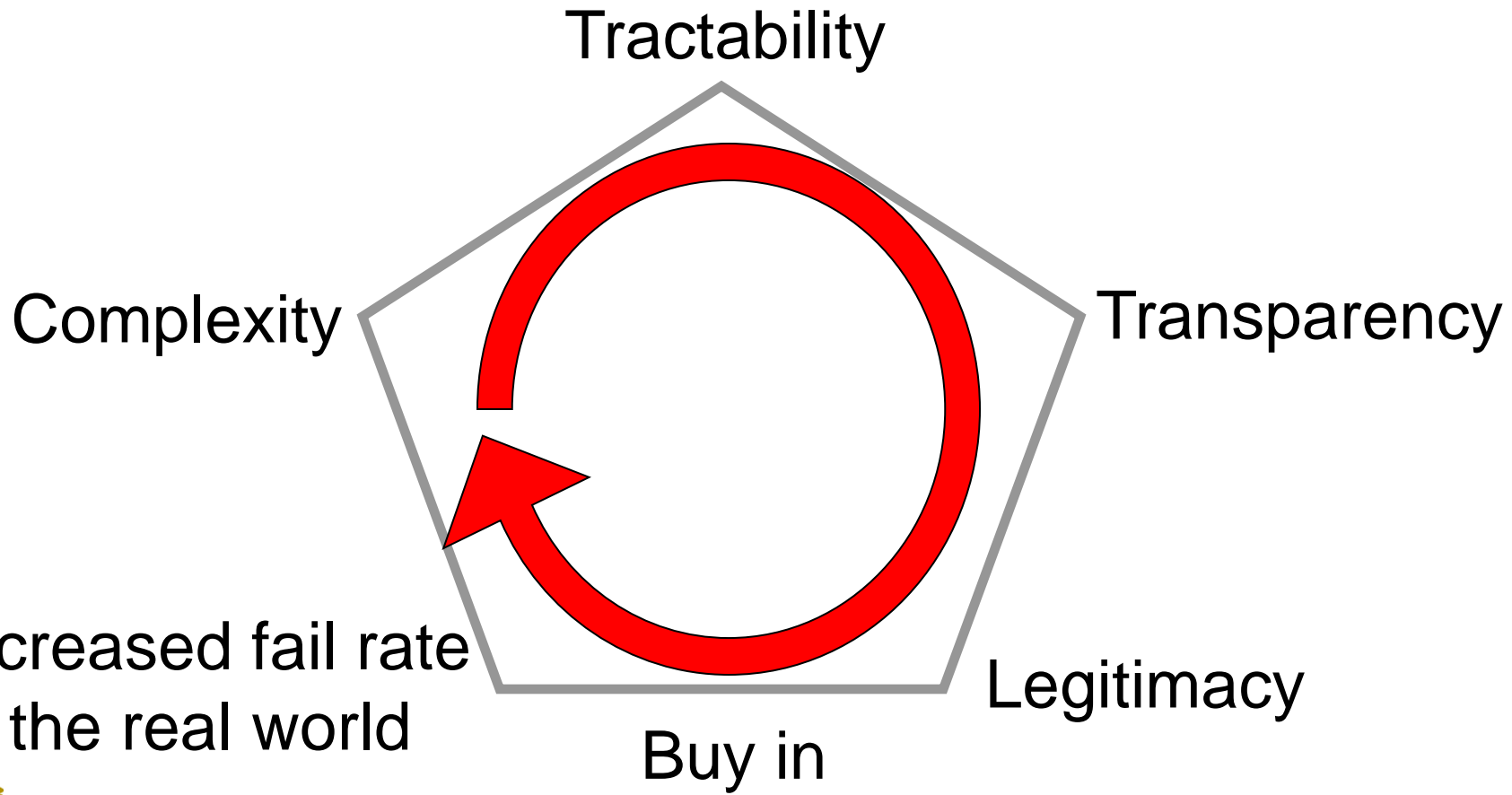
Taking a step back for progress

Dr Ciarán Kelly Marine Institute Ireland

1. The scientists world



1. The fishers world



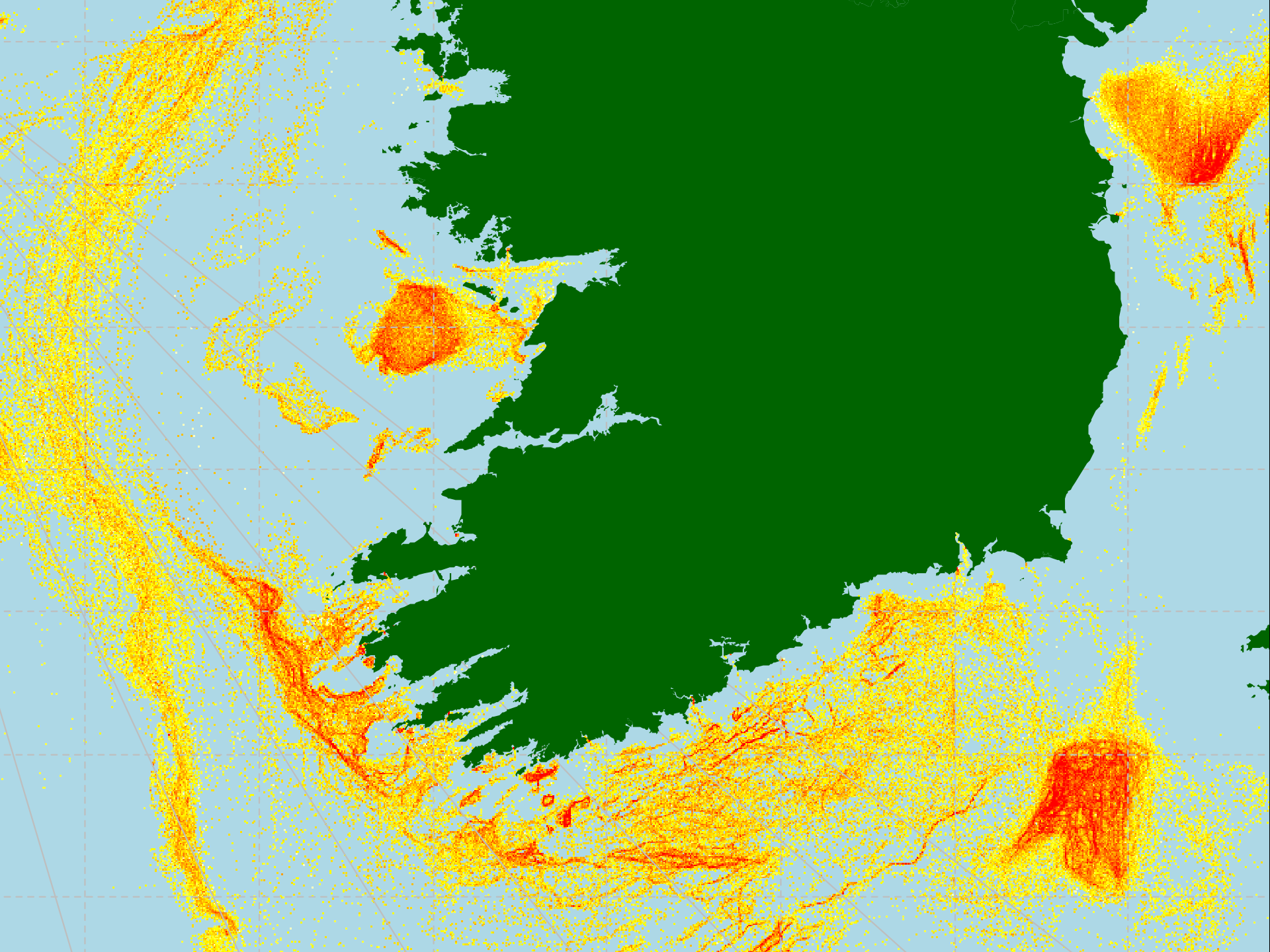


VICIOUS CYCLE



The mixed fisheries problem

- Fishing sustainably for one species and avoiding discards has meant rather blunt trade offs.
- Stop landing one species when its quota is reached, thus discarding the species when the quota is exhausted.
- Or stop fishing all species when the first species quota has been exhausted.



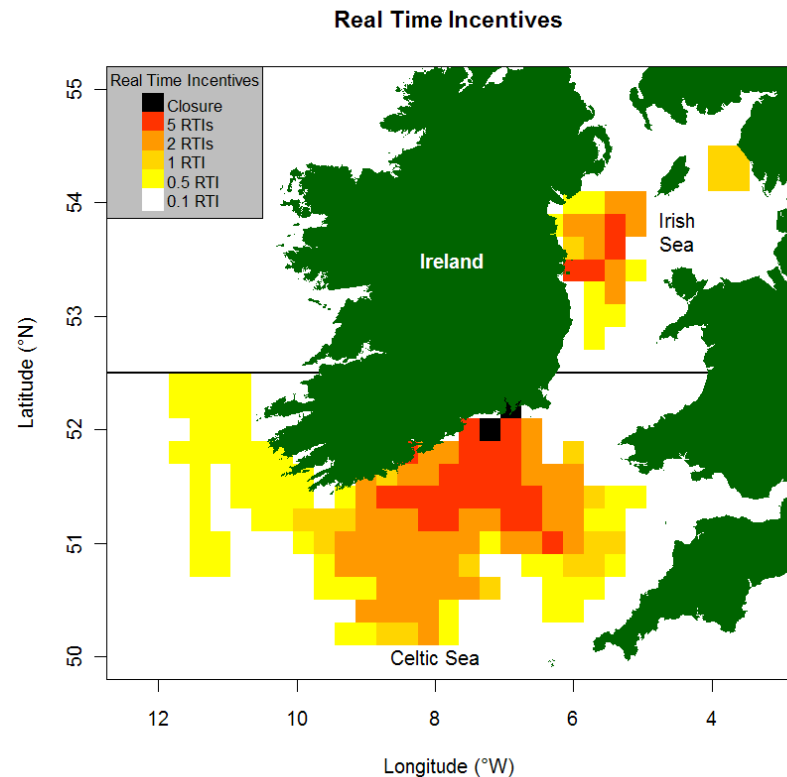
Real Time Incentives (RTI)

(... analogous to Real Time Closures...)

- RTIs or RTI-credits can be seen as fishing-impact equivalents;
 - Each vessel gets an annual quota of RTIs

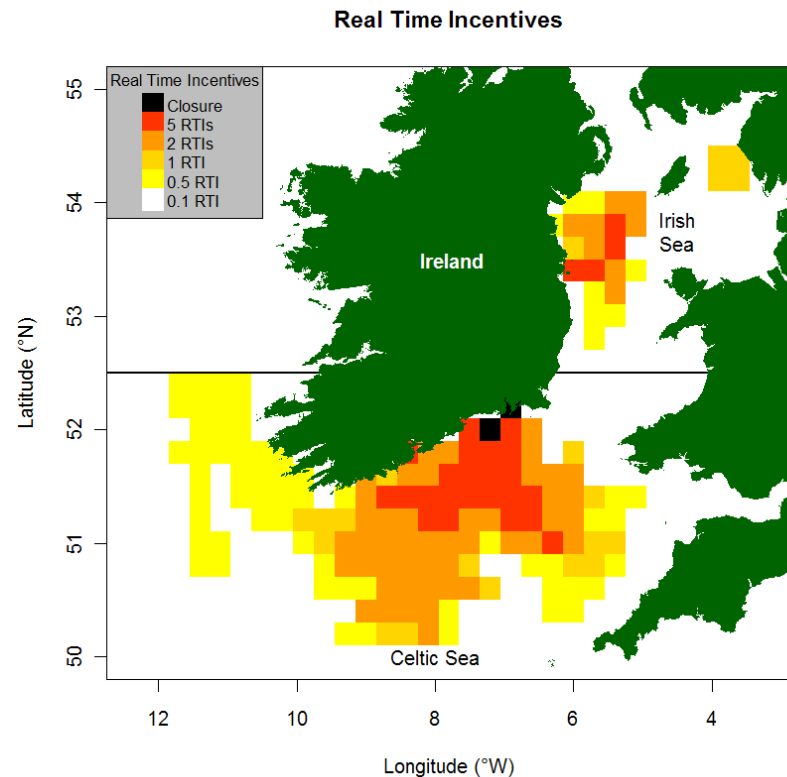
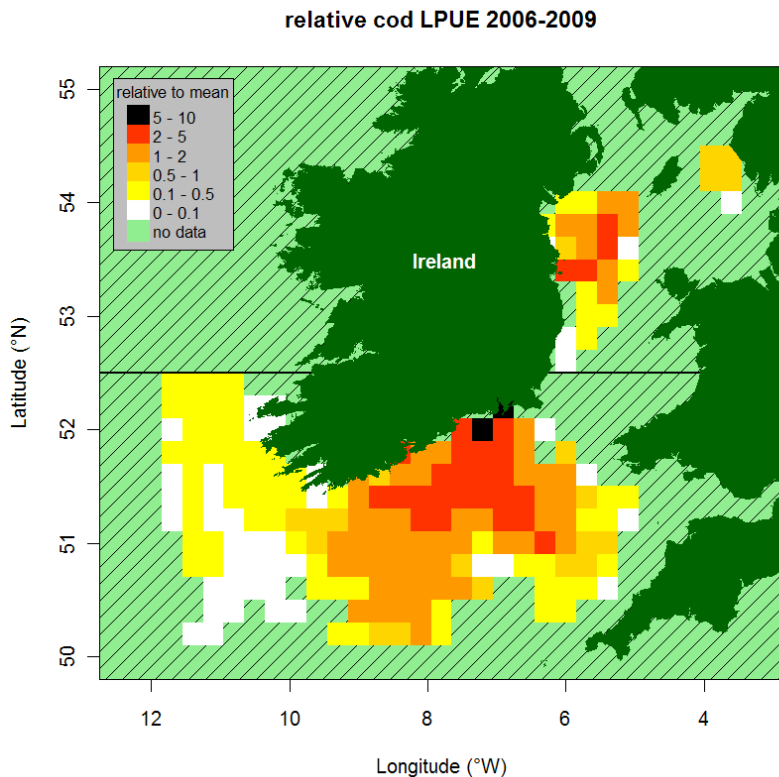
Real Time Incentives

- Fishers can fish wherever they want, except in the closed black areas, and they will have to 'pay' 0.1, 0.5, 1, 2, or 5 per day of their RTIs respectively when fishing in the other areas.



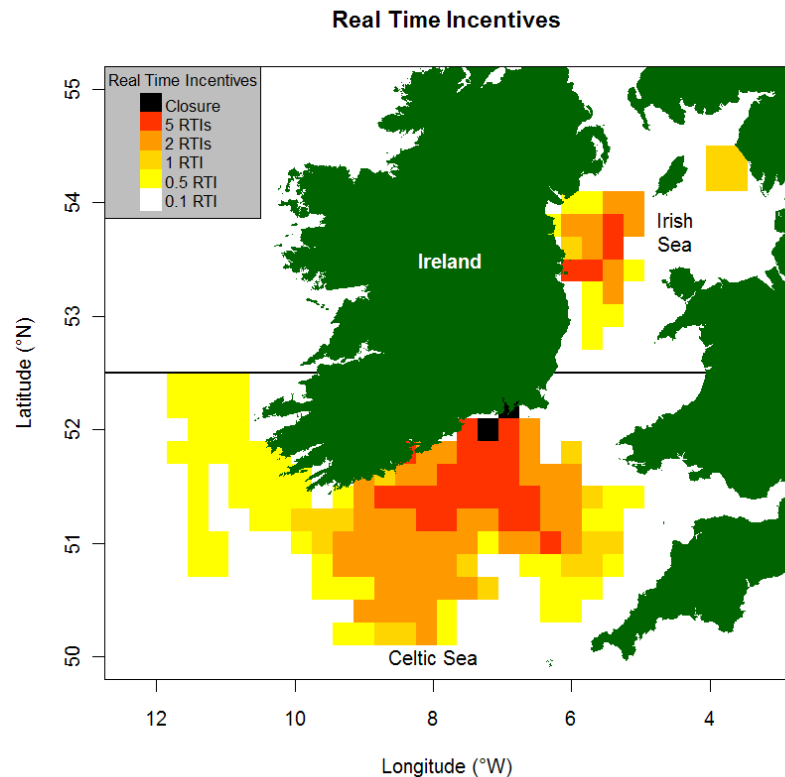
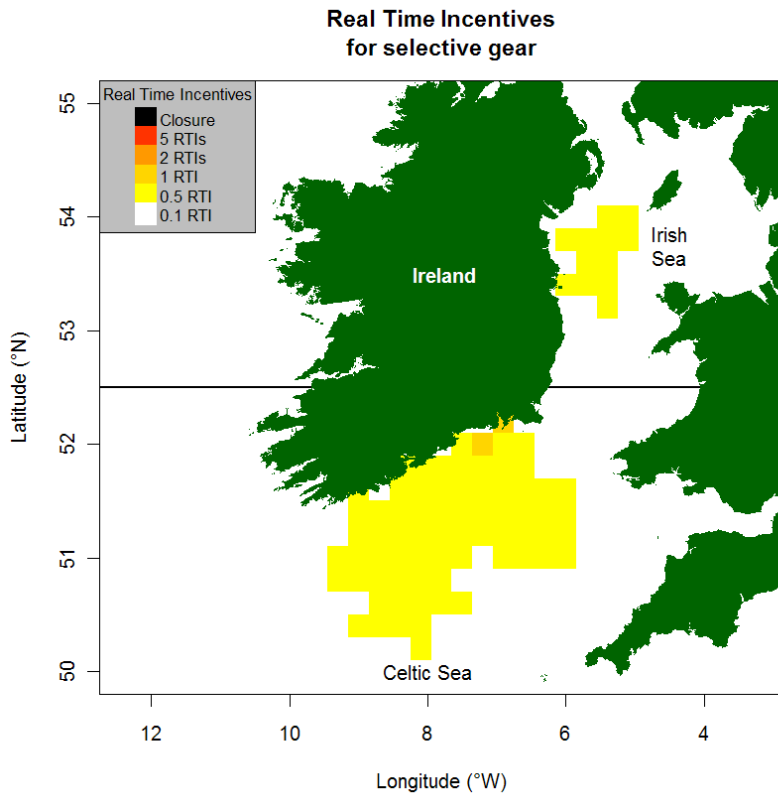
Real Time Incentives

- Tariffs are based, e.g., on relative cod LPUE
- RTI quota are related to intended/agreed F



Real Time Incentives

- Different tariffs when fishing with selective gear
 - e.g. for which cod vulnerability is 10% relative to 'default' gear



Discards of prohibited and no-catch elasmobranchs

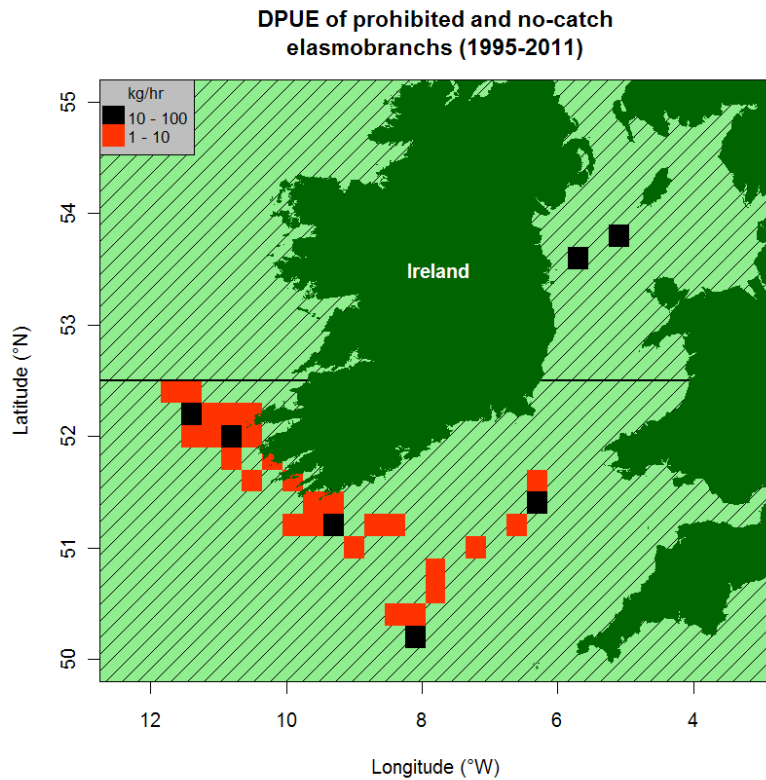
Prohibited:

- Common skate – *Dipturia batis*
- Longnose skate – *D. oxyrinchus*
- White skate – *Rostroraja alba*
- Angel shark – *Squalina squalina*

No catch species:

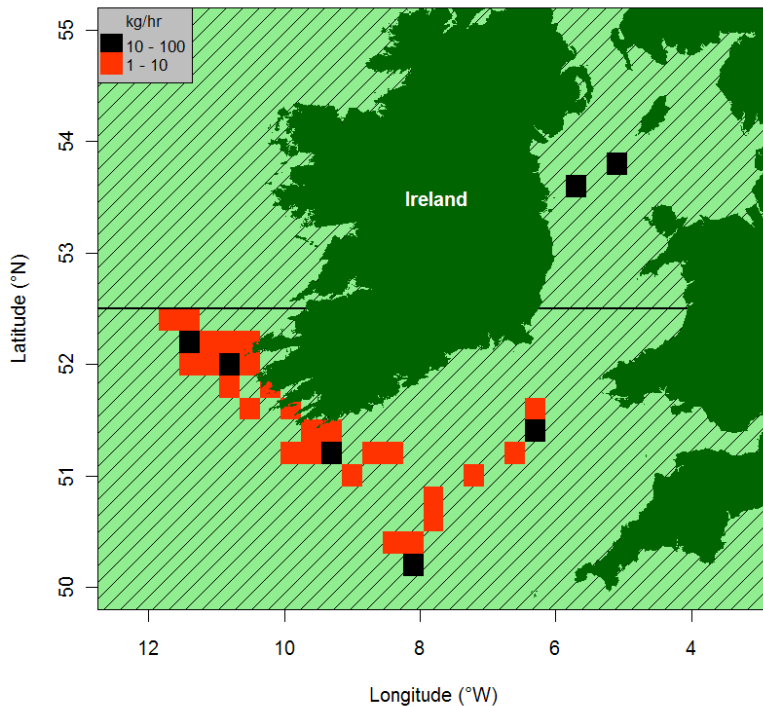
- Spurdog – *Squalus acanthias*
- Porbeagle – *Lamna nasus*
- Basking shark – *Cetorhinus maximus*

Discards of prohibited and no-catch elasmobranchs

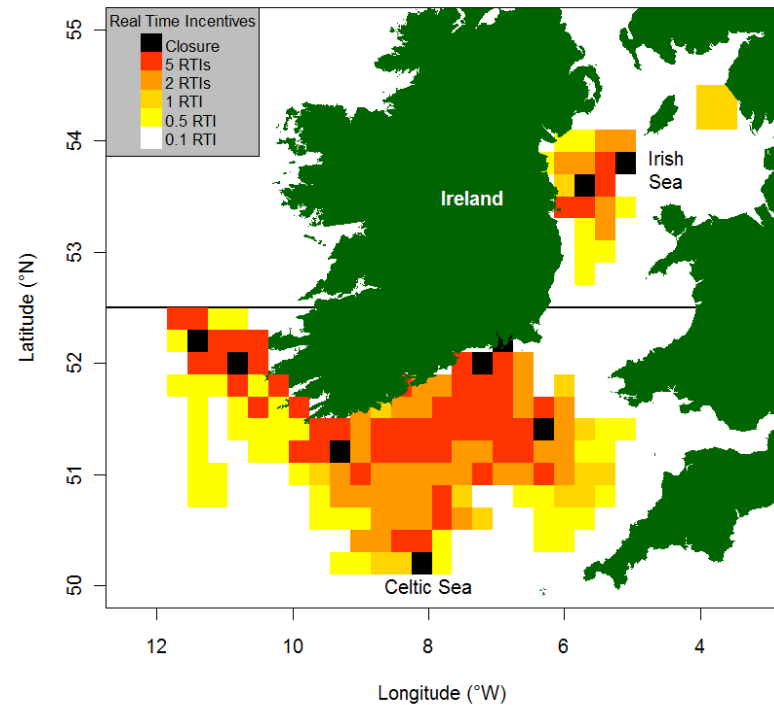


Discards of prohibited and no-catch elasmobranchs

DPUE of prohibited and no-catch elasmobranchs (1995-2011)

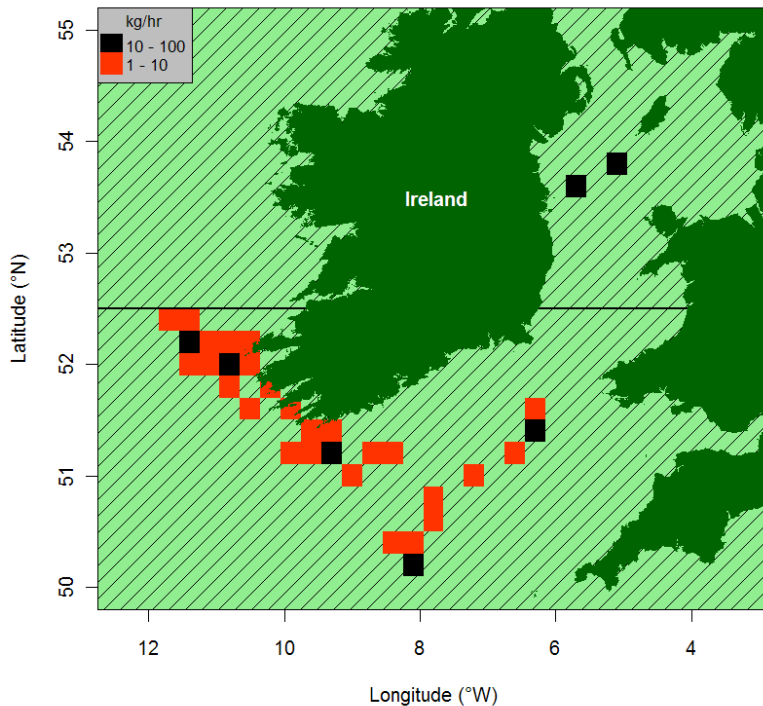


RTI levels modified by elasmobranch discard data

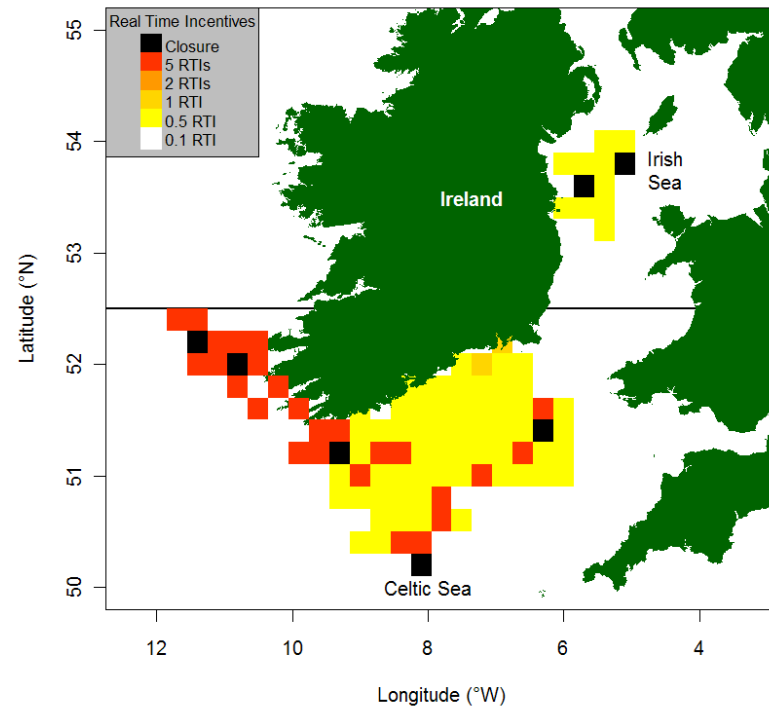


Discards of prohibited and no-catch elasmobranchs

DPUE of prohibited and no-catch elasmobranchs (1995-2011)



RTI levels modified by elasmobranch discard data for selective gear



Real Time Incentives

- The essence of the RTI system is that the regulations do not *prescribe and forbid*, but instead while allowing fishers to choose how they want to fish, the 'costs'* are internalized and have to be 'paid'* by the fishers.

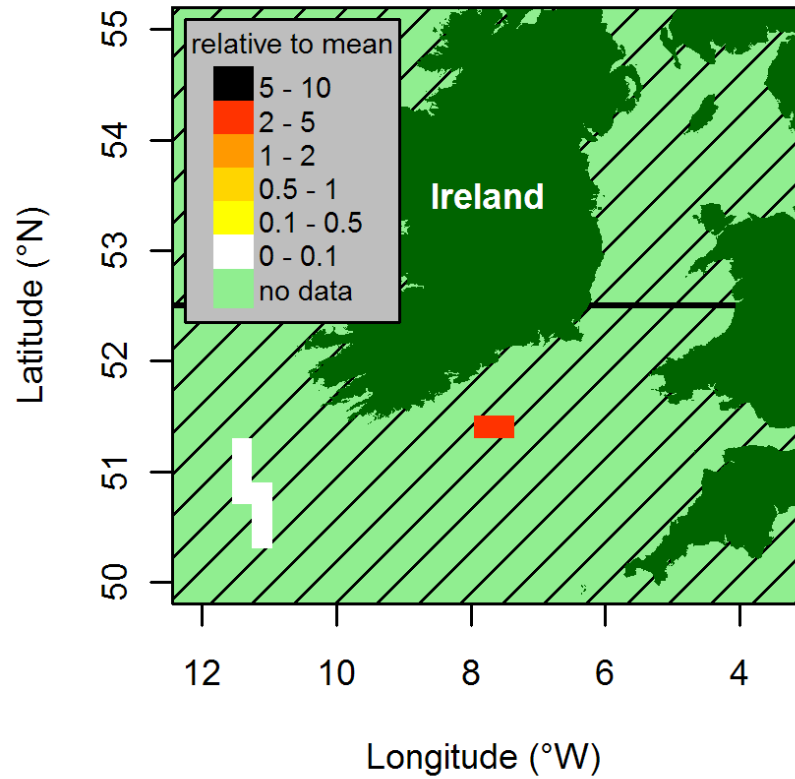
*Not monetary costs paid in monetary currency,
but ecosystem costs paid as reduced fishing opportunities

Let's take the RTIs based on 2006-2009 as a baseline, and then update every week with **Real Time information** of 2010.

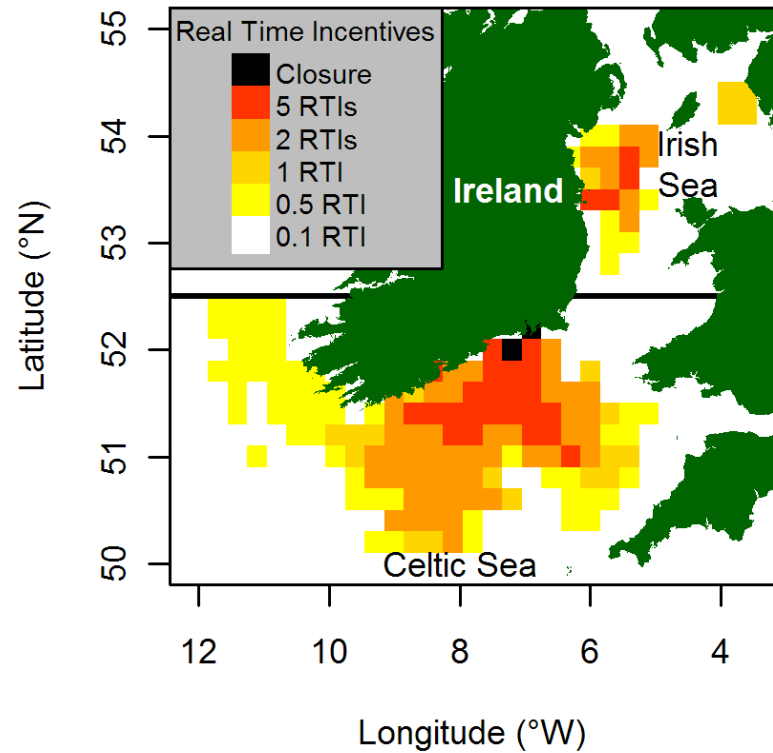
In this case the elasmobranch information is not included, but it could be.

a

**relative cod LPUE
week 1 2010**

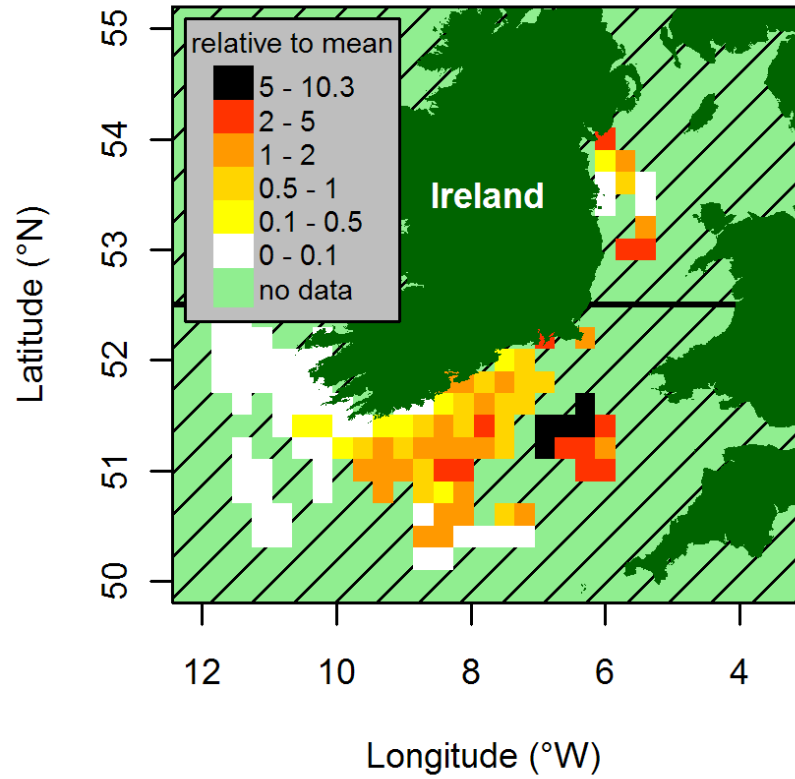
**b**

**RTI levels for week 2
updated by week 1 data**

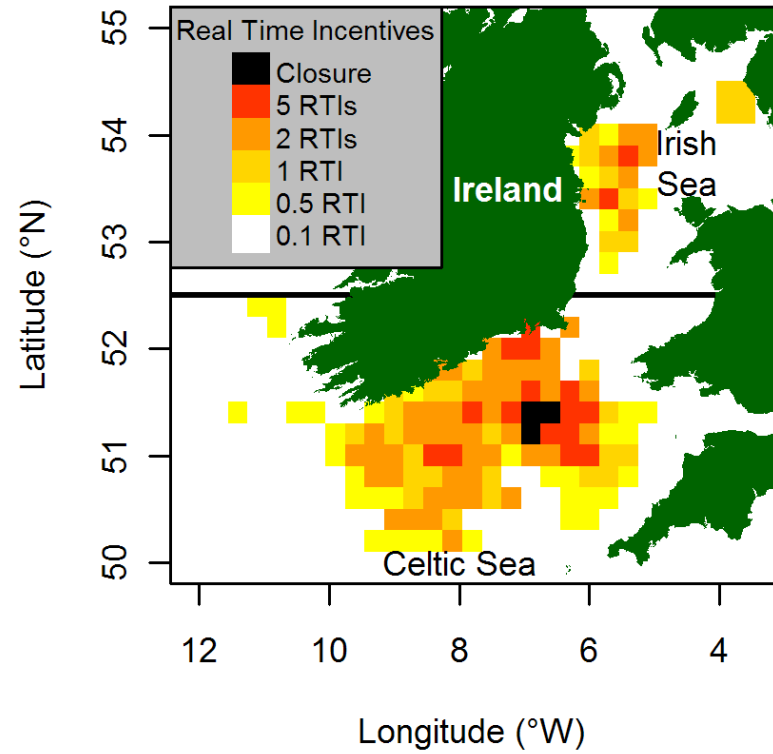


c

**relative cod LPUE
week 2 2010**

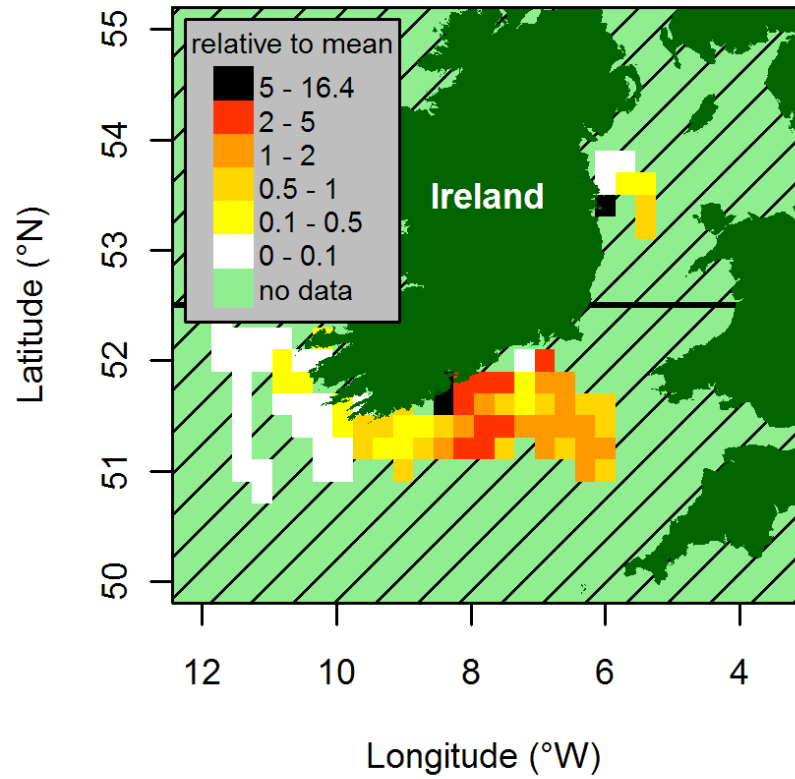
**d**

**RTI levels for week 3
updated by week 2 data**

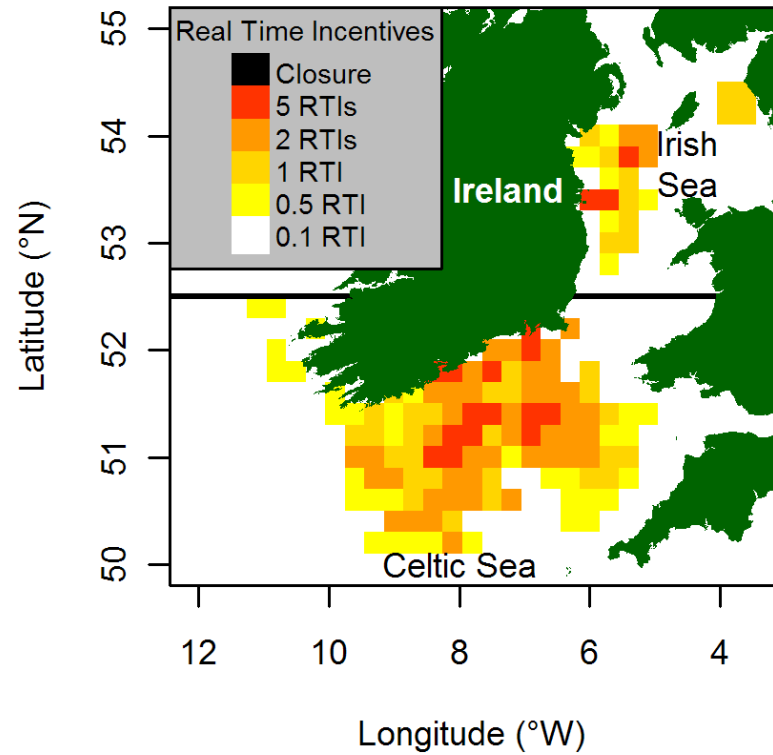


e

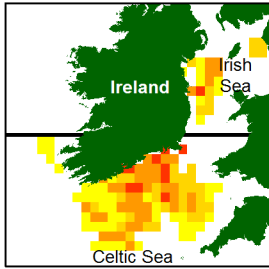
**relative cod LPUE
week 3 2010**

**f**

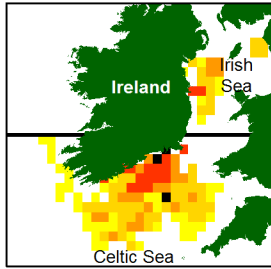
**RTI levels for week 4
updated by week 3 data**



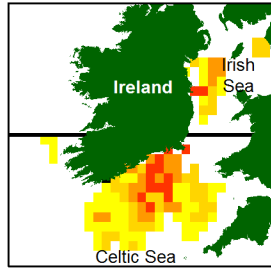
RTI levels for week 5 updated by week 4 data



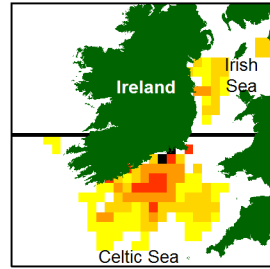
RTI levels for week 6 updated by week 5 data



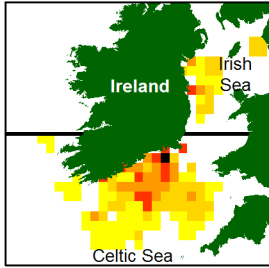
RTI levels for week 7 updated by week 6 data



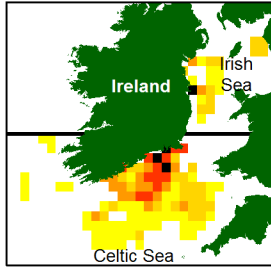
RTI levels for week 8 updated by week 7 data



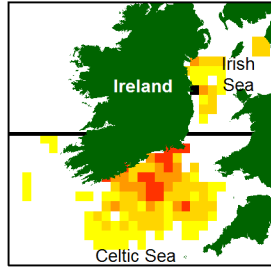
RTI levels for week 9 updated by week 8 data



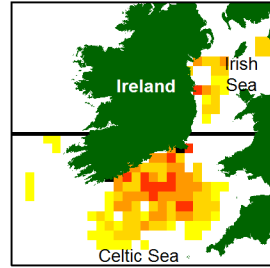
RTI levels for week 10 updated by week 9 data



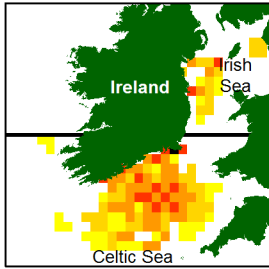
RTI levels for week 11 updated by week 10 data



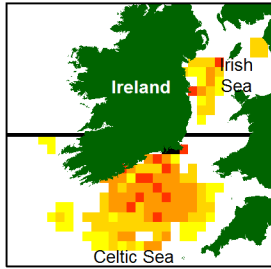
RTI levels for week 12 updated by week 11 data



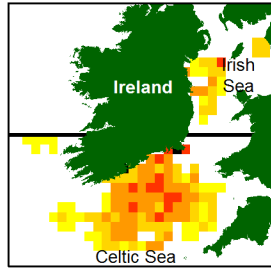
RTI levels for week 13 updated by week 12 data



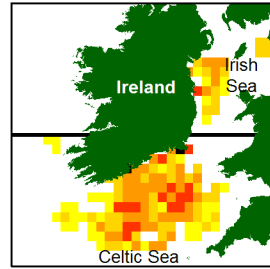
RTI levels for week 14 updated by week 13 data



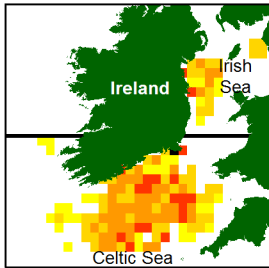
RTI levels for week 15 updated by week 14 data



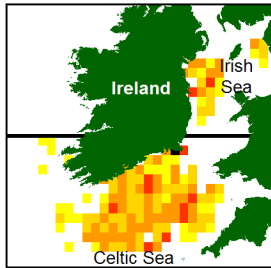
RTI levels for week 16 updated by week 15 data



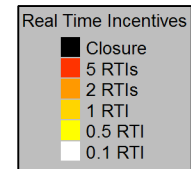
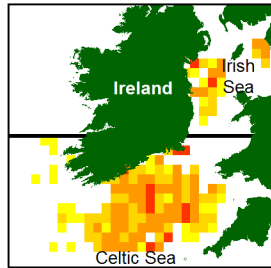
RTI levels for week 17 updated by week 16 data



RTI levels for week 18 updated by week 17 data



RTI levels for week 19 updated by week 18 data



Advantages

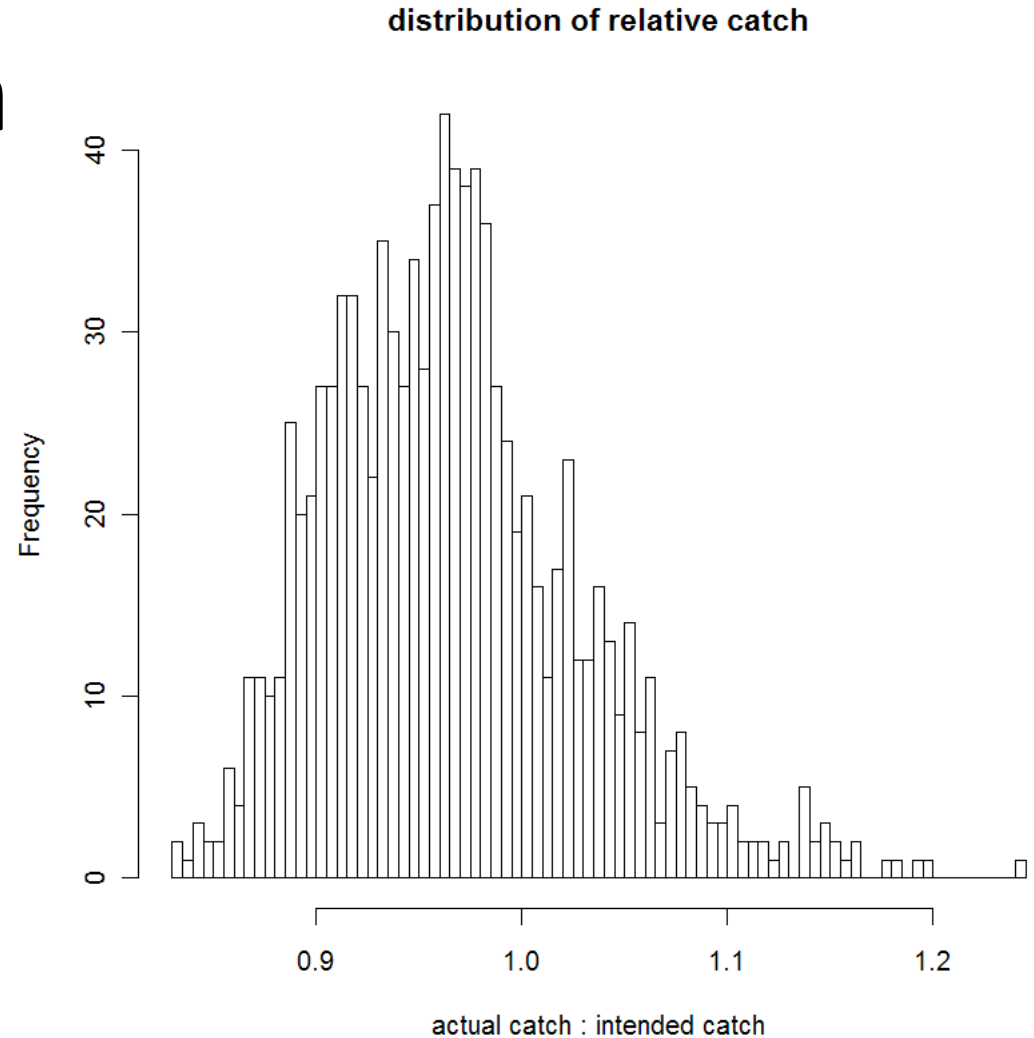
- Costs in terms of discards and other costs to ecosystem are internalized: fishers have to take them into account in their business decisions
 - Apart from that they are flexible in their options
- Accounting of RTI-quota can be done by VMS and e-logbooks
- Maps can be dynamically updated with any kind of information and information can be weighted according to any objectives/aims

Risk

- Risk of over-catching intended levels
- E.g. if spatial patterns of impact ('catchability') in the past do not predict future patterns; specifically, that those of week x do not predict those of week $x+1$;

Simulation

Simulations of risk for the setting and adjusting of tariffs are inherent aspect of the approach



Risk of exceeding the intended level is ~ 25%;
but risk of exceeding >10% is only ~3%

Okay but what about data poor?

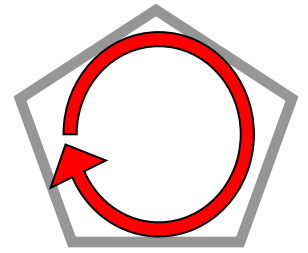




What can we do with less/different data?



An alternative paradigm?



- If we don't have the right kind of data or we haven't the resources to get it we can get bogged down by the classical approach.
- We get stuck when we try to answer questions like "what is the stock size?" with imprecise low contrast or incoherent data.
- If the question was "do I need to adjust the exploitation next year?" then this question lends itself to an approach called process control.



Process Control



- Process control evolved in the early 20th C to manage QC in the manufacturing industry.
- The essential element is that it is more efficient to detect and react to system change than monitor every small variation in an endless struggle stay “on course”.
- Some of the theory has roots in human psychology.
- Statistical Process Control is a paradigm for stepwise optimisation.



Process Control



- The system change can be anything from a shift in mean to a change in variance.
- The elegance of the approach lies in the statistical basis.
- Persistent change can be detected using CUSUM control charts



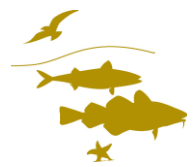
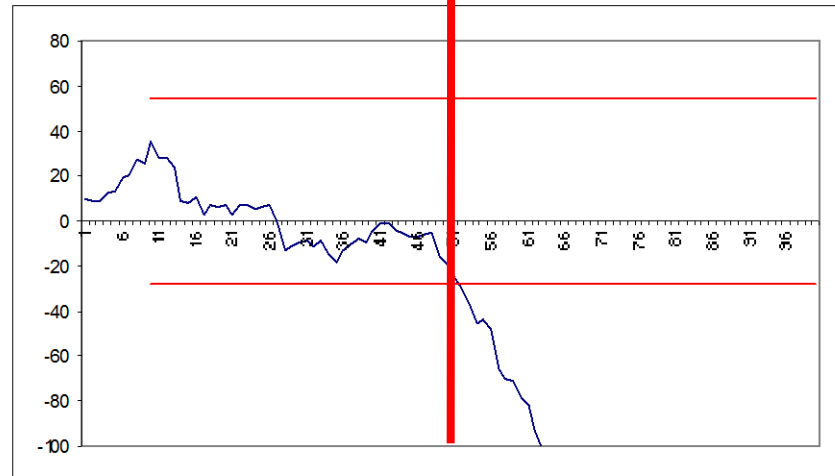
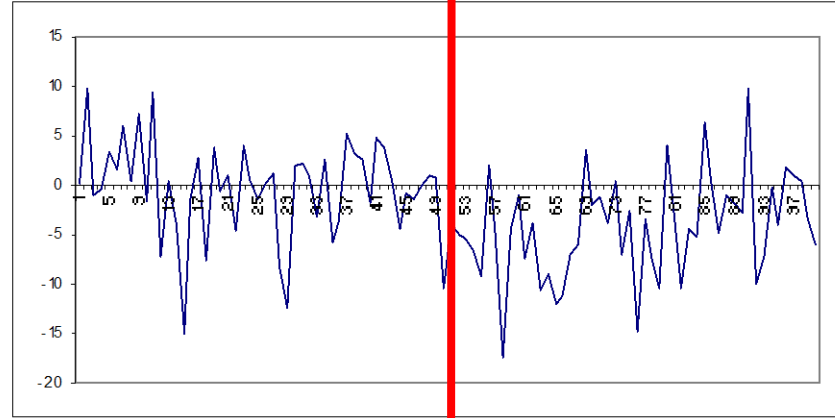
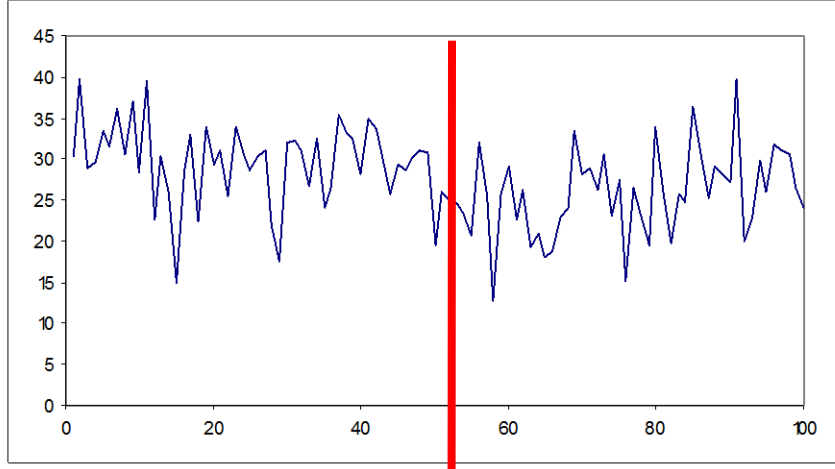
CUSUM



- CUSUM is based on the cumulative sum of deviations about a mean. It can be based on several distributions but taking the most common (normal), we expect most observations to fall inside $\pm 2SE$.
- The sum of deviations should drift without trend when the underlying data has a fixed mean of μ and a fixed variance of σ^2 (i.e. random walk) .
- When there is a shift in μ the distribution will centre on a new line with a slope =shift in mean



- A linear drift in μ will give a quadratic shape to CUSUM plot



Combination CUSUM signals

	Recruitment	Age Proportion
Upper	Signal	No Signal
Lower	No Signal	Signal

When the biomass is moving towards MSY from above, the signal is **Signal**. The **SSB** is going down and the **MSY** is going up.

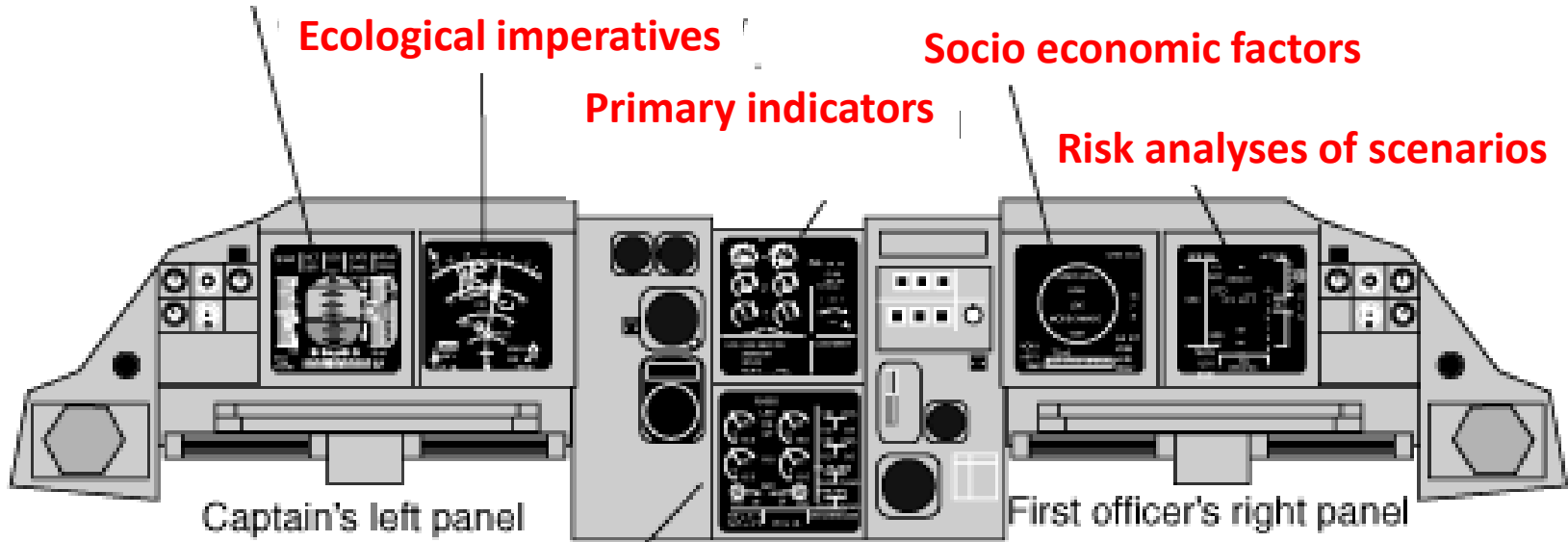
Tempo-spatial considerations

Ecological imperatives

Socio economic factors

Primary indicators

Risk analyses of scenarios



Captain's left panel

First officer's right panel

Secondary indicators

**THANKS
FOR
LISTENING**

Credits

- Deepak George Pazhayamadom UCC
- Sarah Kraak – Marine Institute/UCC
- Hans Gerritsen - Marine Institute