

# Scientific sampling – things that need to be considered

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Anglesey, LL59 5AB, UK.*



# Structure

**Data poor species**

**Scallops**

**Whelks**

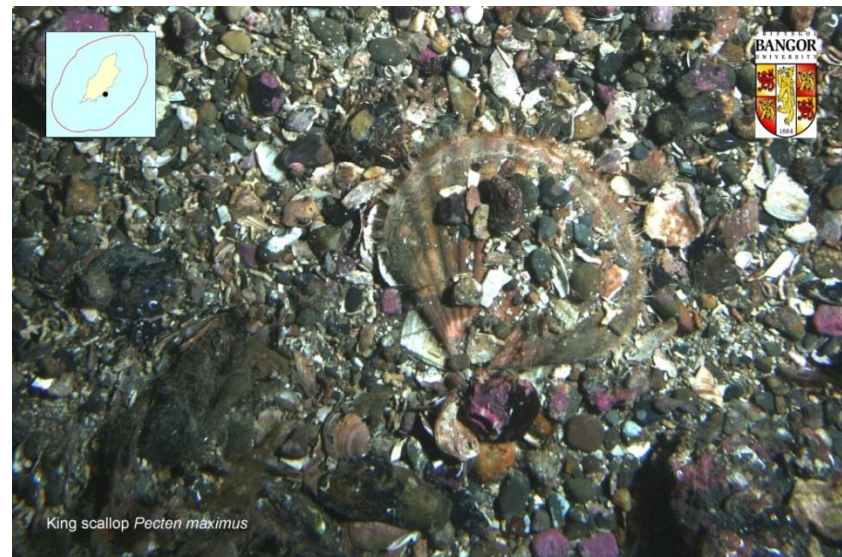
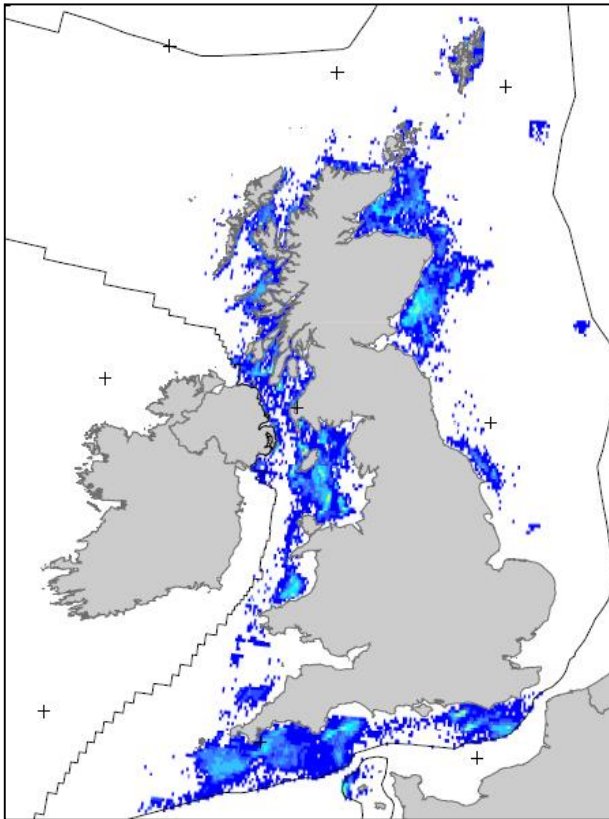
**Crabs**

**Bass**

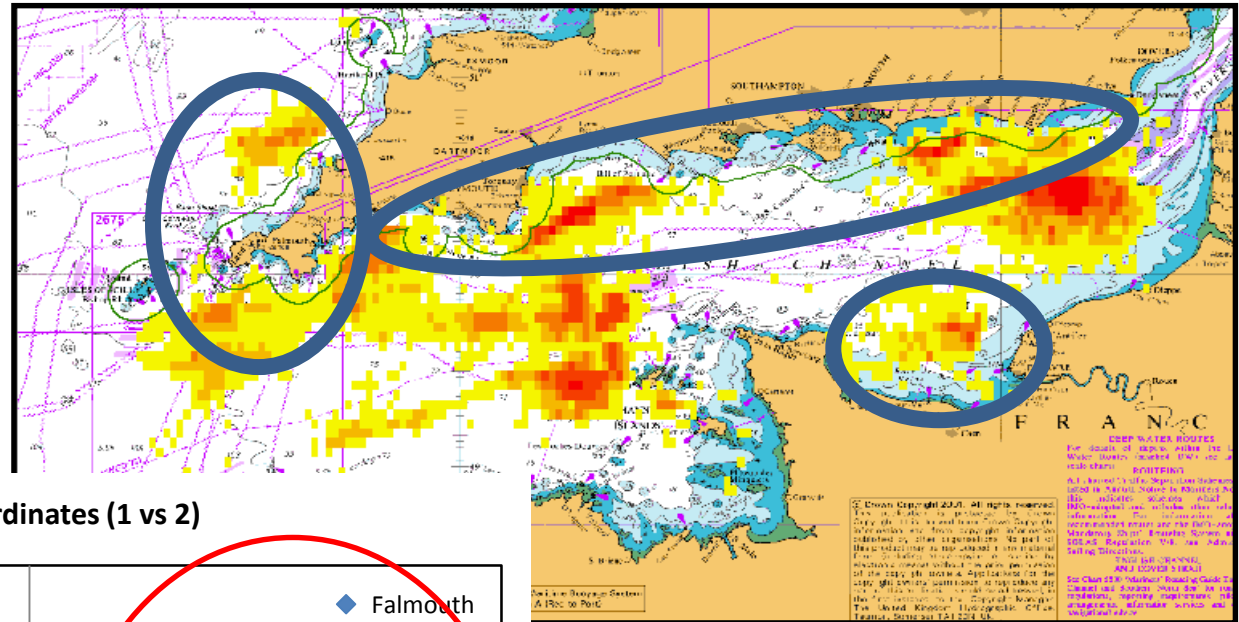


# Scallops

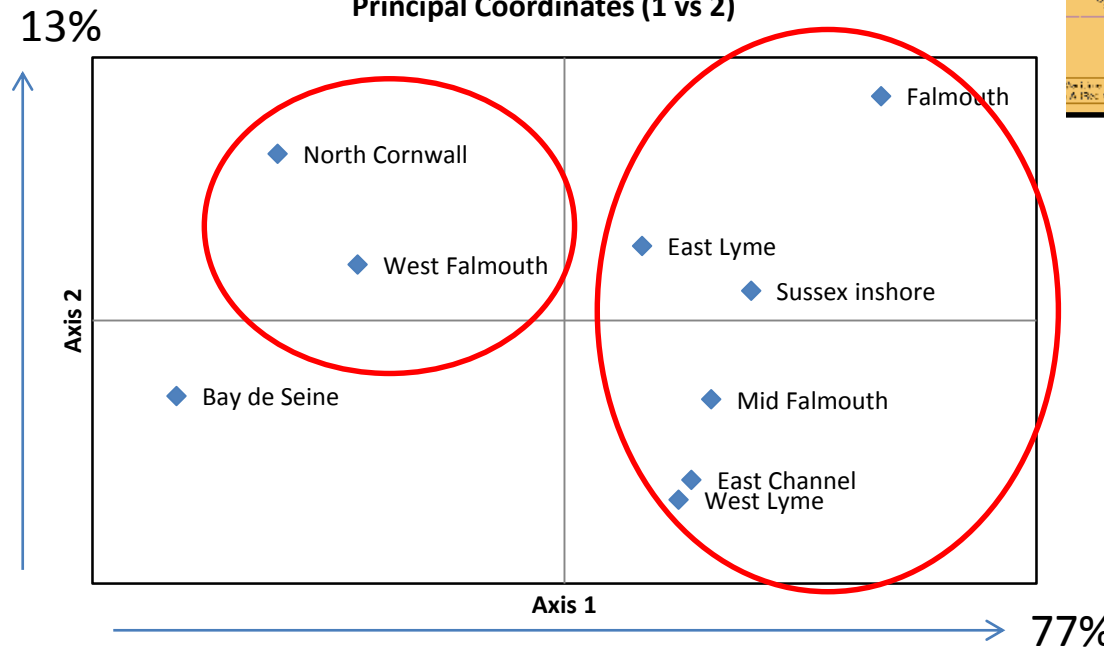
Widely dispersed based on landings by area



# What is the appropriate management unit?



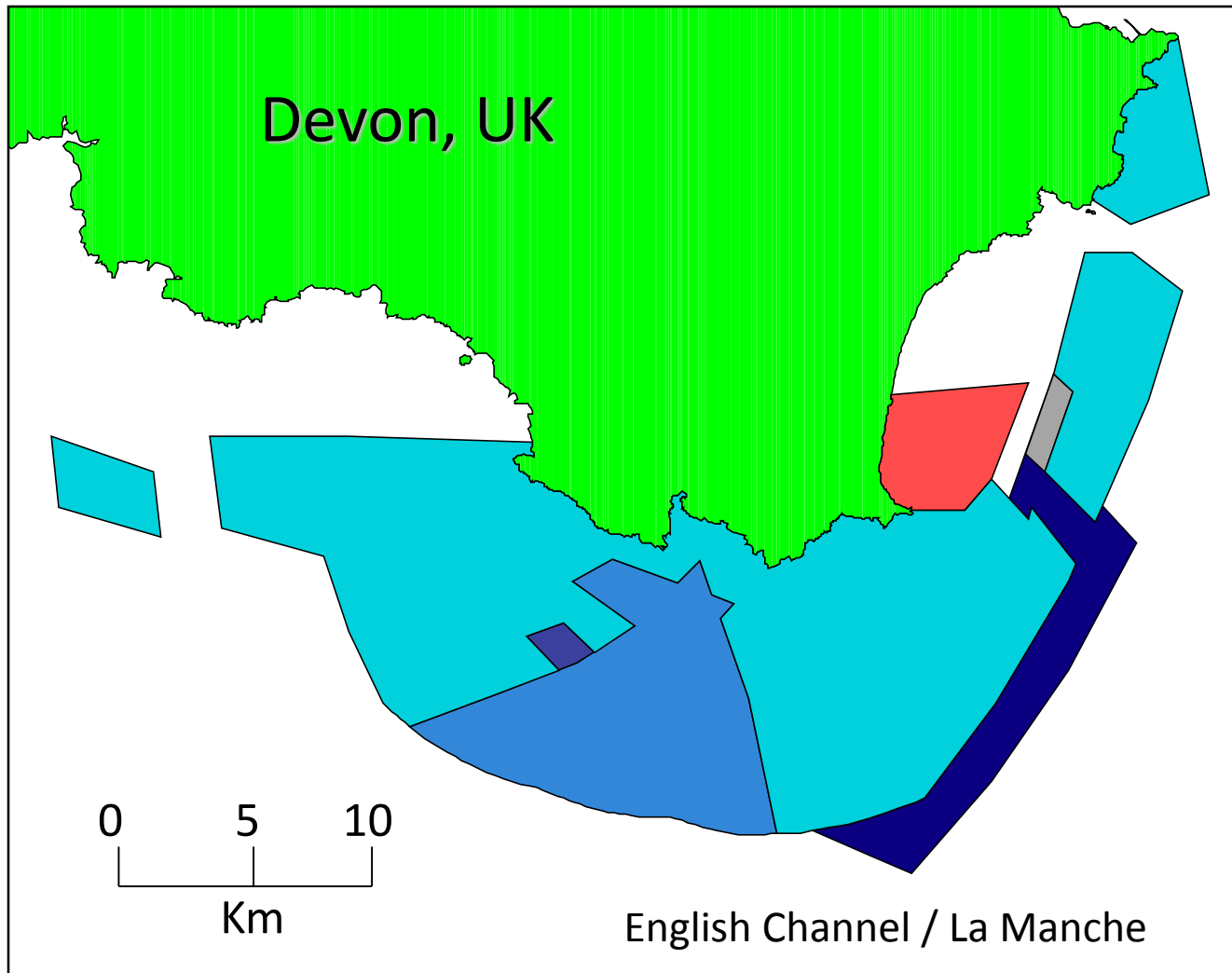
Principal Coordinates (1 vs 2)









Scallops are less mobile than fish and hence rely on broadcast spawning – hence oceanography plays a large role in connecting or isolating one area from another

Genetic analysis shows how related they are from different areas

# For animals like scallops - high densities are important for successful breeding



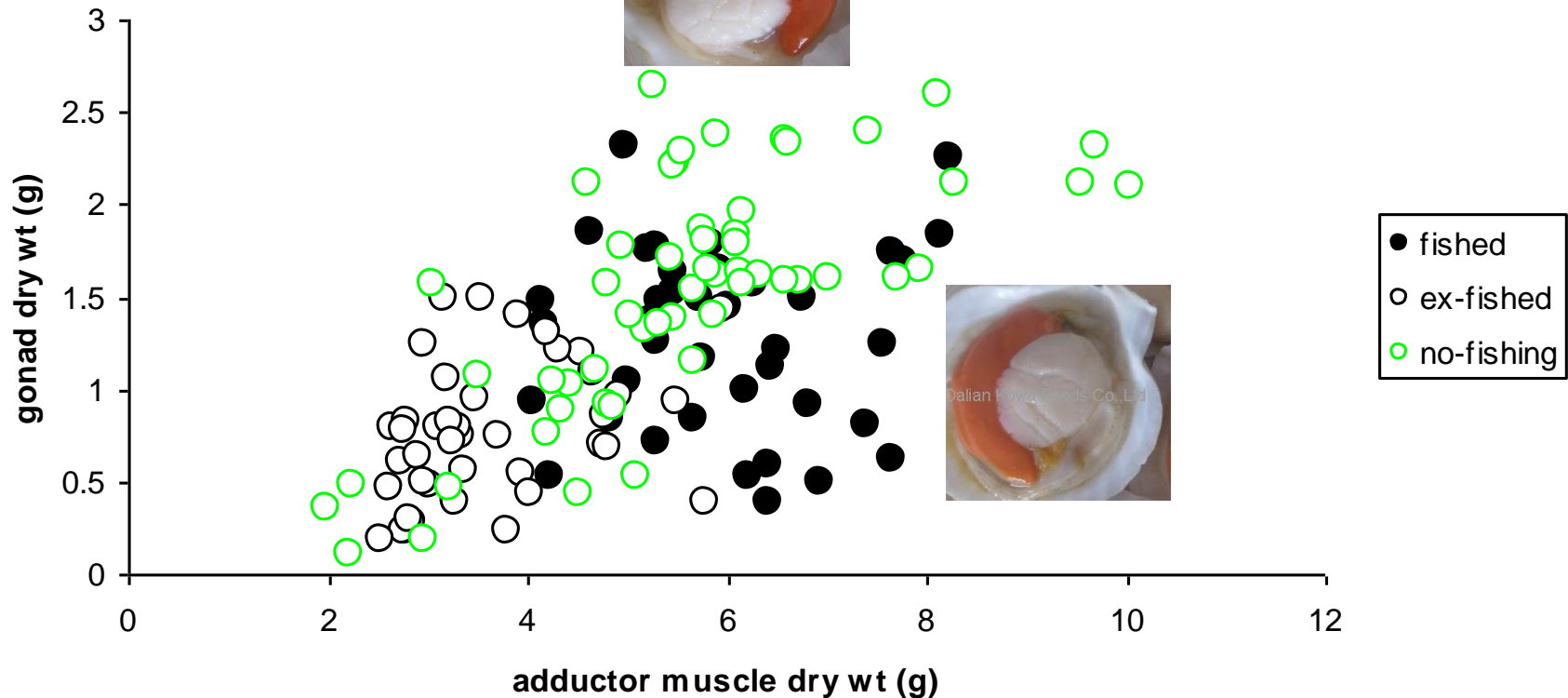
This fishery area is c.  
500 km<sup>2</sup>

-  = Static gear.
-  = Static: Jul - Jan.
-  = Static: Apr - Dec.
-  = Static: Sept - Jan.
-  = Static: Sept - Mar.
-  = No towed gears.



# Secondary effects of fishing on fecundity

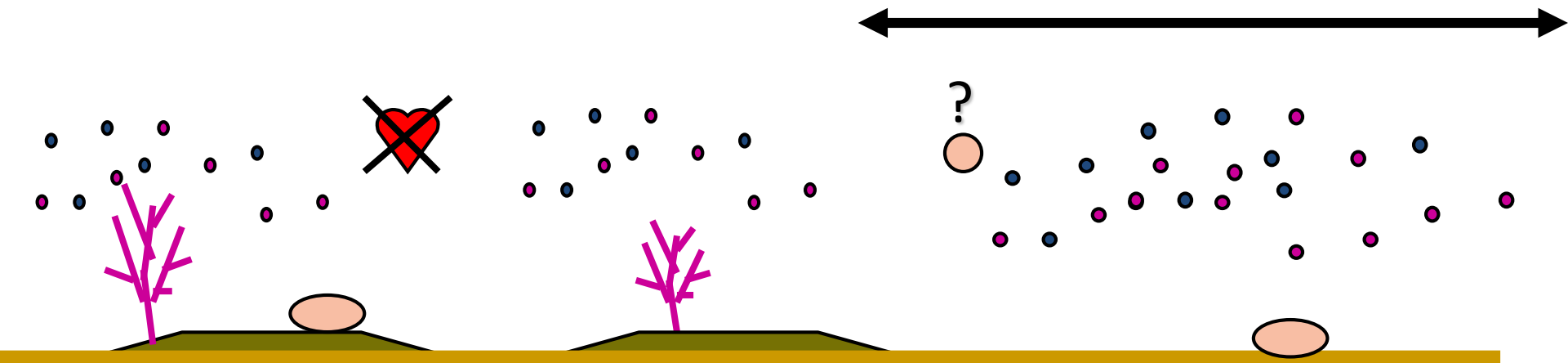
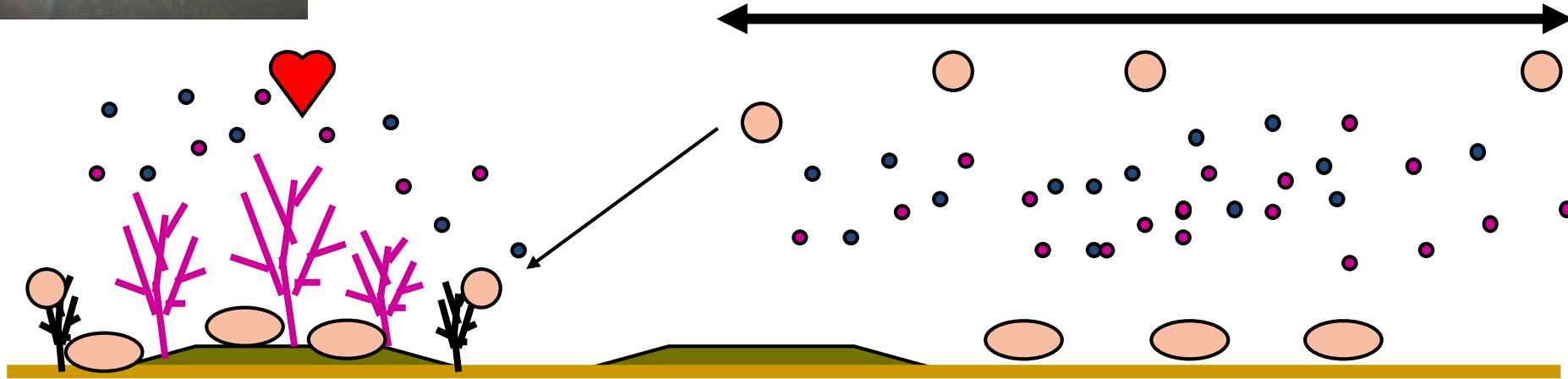
Greater abundance and biomass of scallops in protected areas, but more importantly bigger gonads for animals of the same size



# Allee effects

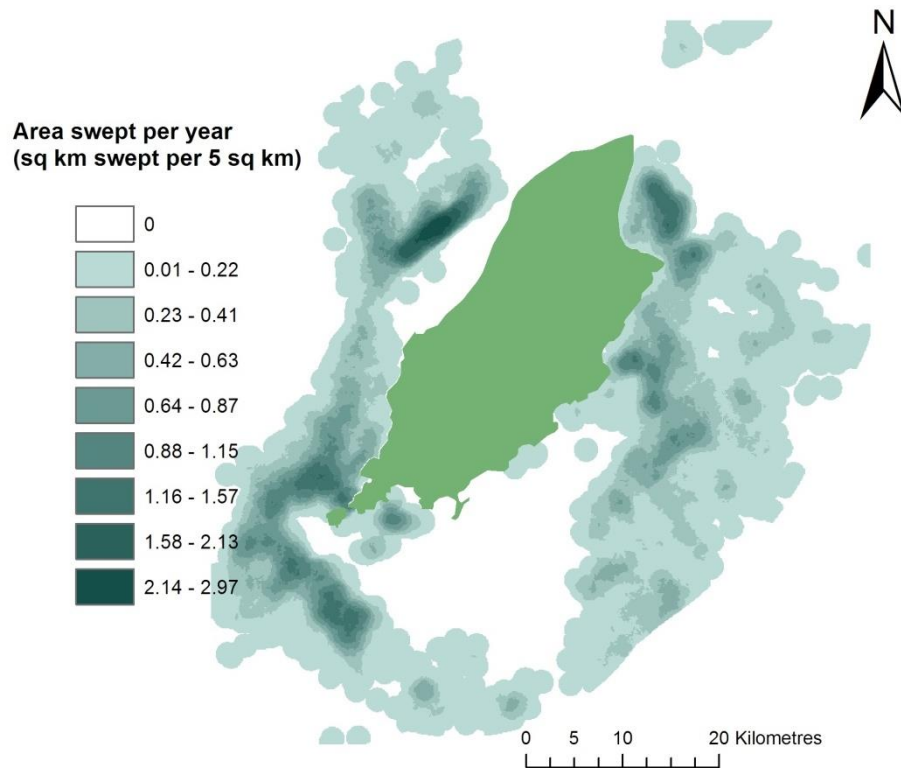


50 km?

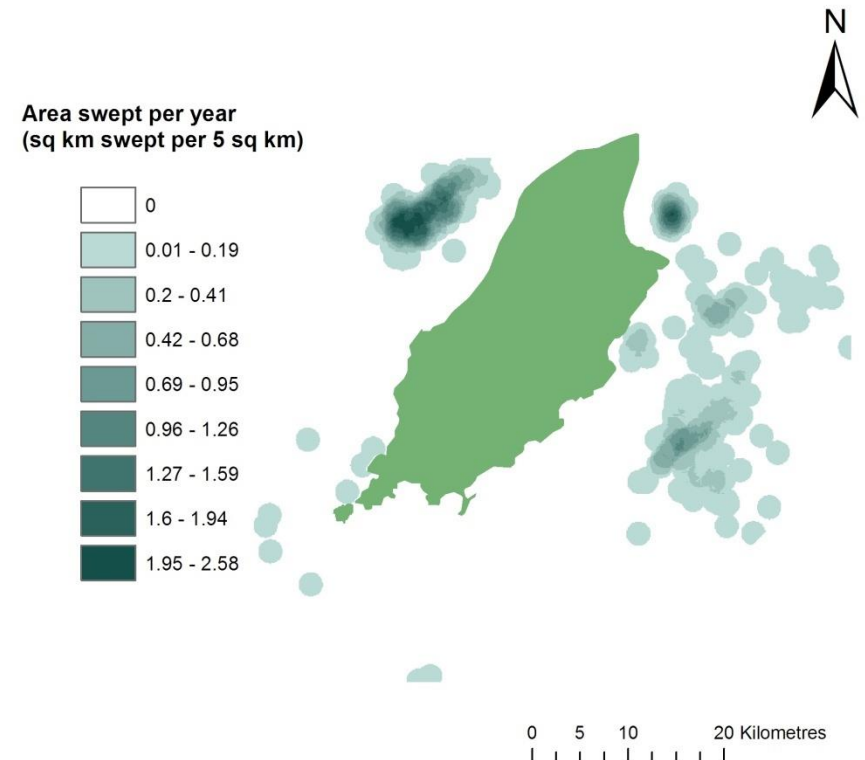


# Using fishing vessels to provide data

*Pecten maximus*



*Aequipecten opercularis*

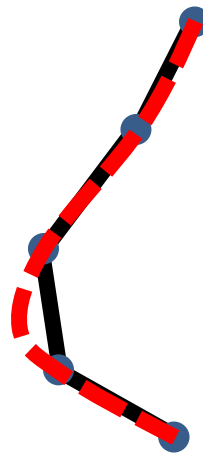
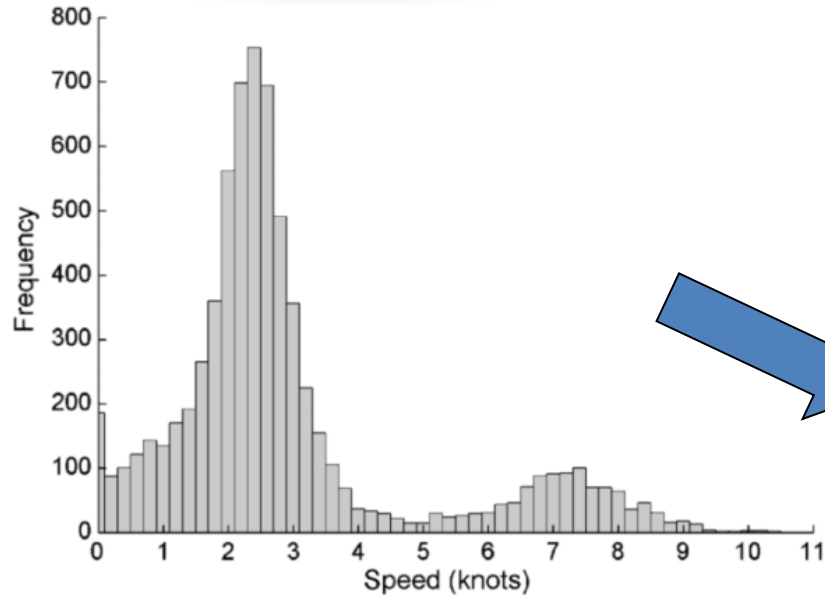


**Distribution of fishing effort for *Pecten maximus* (left) and *Aequipecten opercularis* (right) by Isle of Man registered fishing vessels from November 2007 to May 2008. Units: km<sup>2</sup> seabed swept 5km<sup>-2</sup>. Maps produced using ArcGIS.**



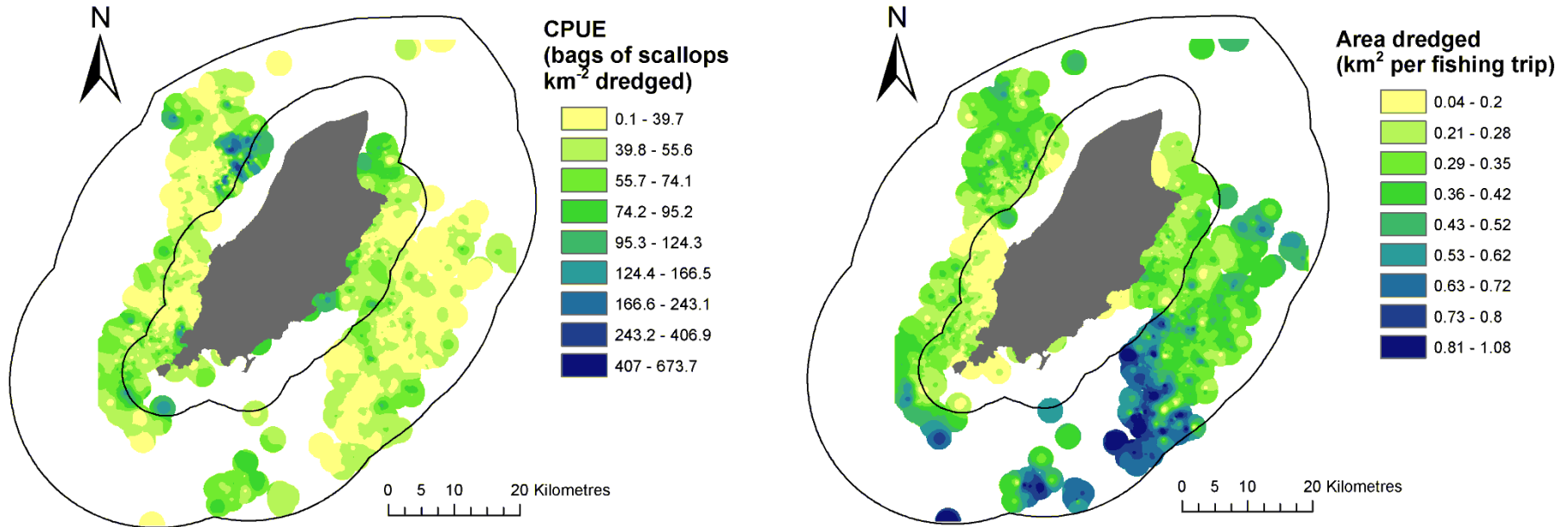
A circular image showing a satellite in orbit over a blue and white Earth, with solar panels extended.

<b>NO 101</b> / 057659		Isle of Man Government Log-book										
Name of vessel(s) and radio call sign(s) if any (1)		External identification (2)										
OVER 10M VESSEL NAME		PL6666										
Name of master(s) (3)		Master's NAME										
Address(es) ADDRESS												
Day		Month										
Year		2010										
Departure (4)		03.05.05 from PEEL										
Return (5)		03.05.17.30 to PEEL										
Landing (6)		03.05. at PEEL										
Name and/or radio call sign of any												
Gear (8)		Mesh size (9)										
DRB		100										
Dimension (10)		25x10										
In case of trans-shipment (7)		Day										
Month		External identification and nationality of recipient vessel										
Catch by species kept on board in kilograms (see weight or number of units (15))												
<table border="1"> <thead> <tr> <th>Species</th> <th>Weight (kg)</th> <th>Number of units</th> </tr> </thead> <tbody> <tr> <td>Atlantic Herring</td> <td>346</td> <td></td> </tr> <tr> <td>Other</td> <td>45</td> <td></td> </tr> </tbody> </table>				Species	Weight (kg)	Number of units	Atlantic Herring	346		Other	45	
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## Mapping fishing activity

# Integrating VMS and logbook data



Mapping fishing activity – shows areas where most efficient to fish



# WHELK FISHERIES In Wales

## *Buccinum undatum*

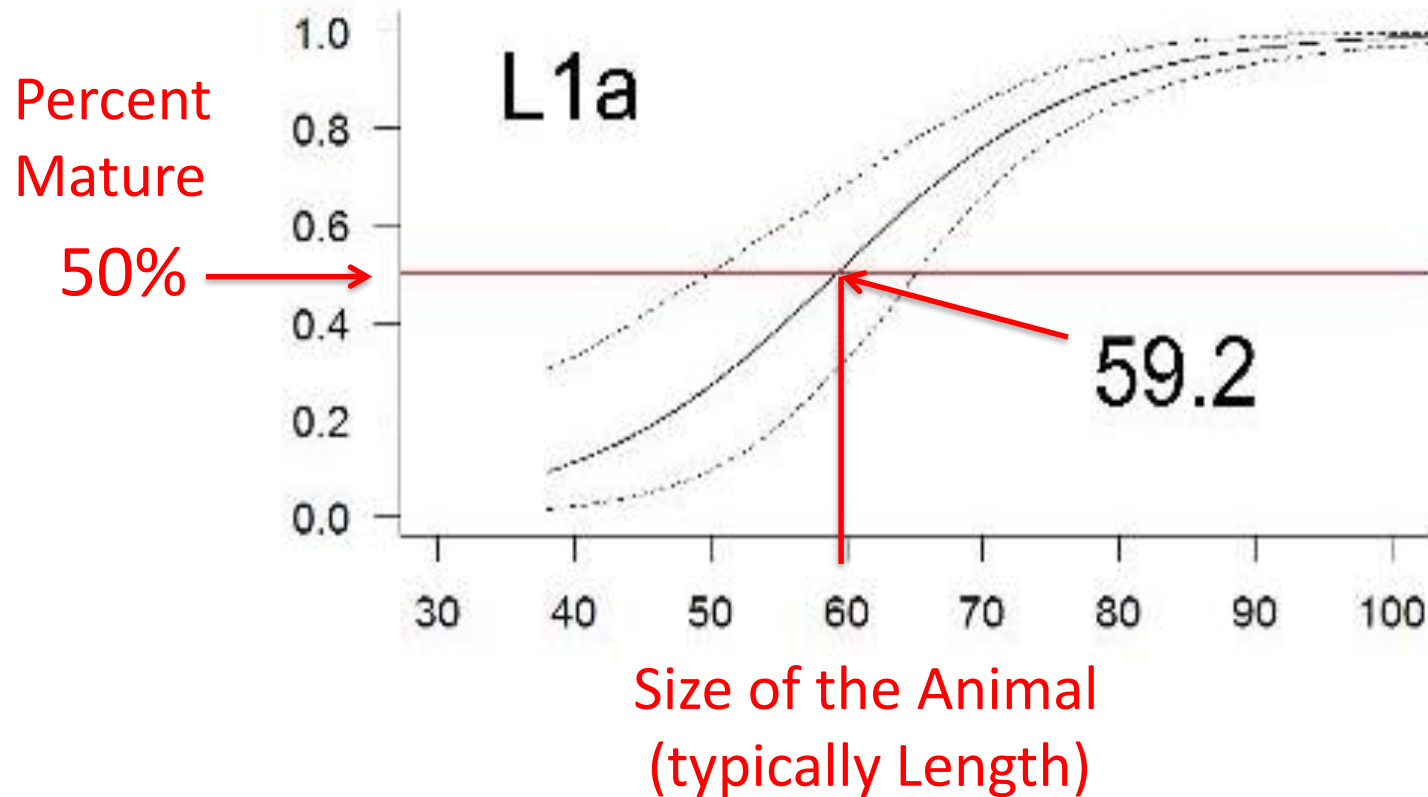


# The research

- 4 Fishers in Wales
  - 2 in North Wales
  - 1 in Pembrokeshire
  - 1 in Swansea
- Science pot – “fish-tec”
- 13 month sampling science pots
  - Seasonal and Regional variation in biological processes
- Summer mark recapture study (abundance, density and movement)
- 2 months of on-board observing (N & S)

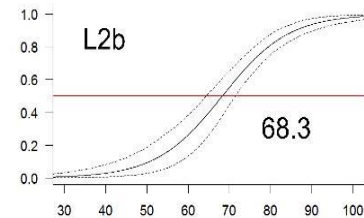
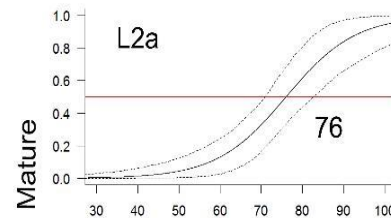
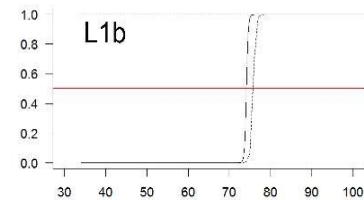
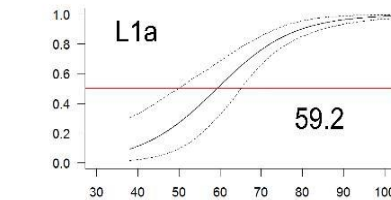
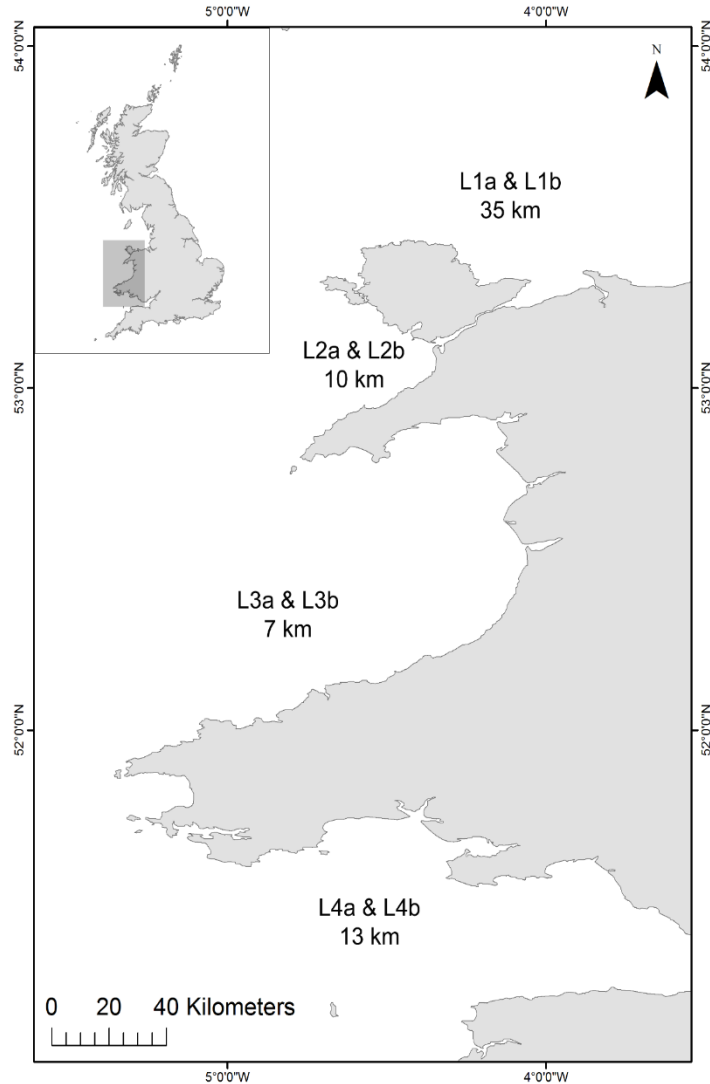


# What is $L_{50}$ ?

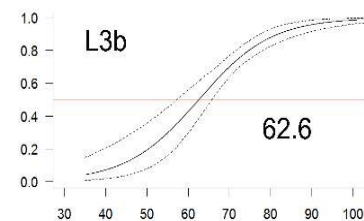
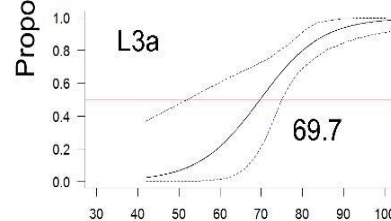




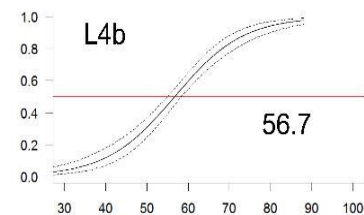
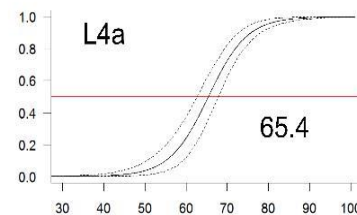
# Whelk Maturity in Wales



7.7



7.1

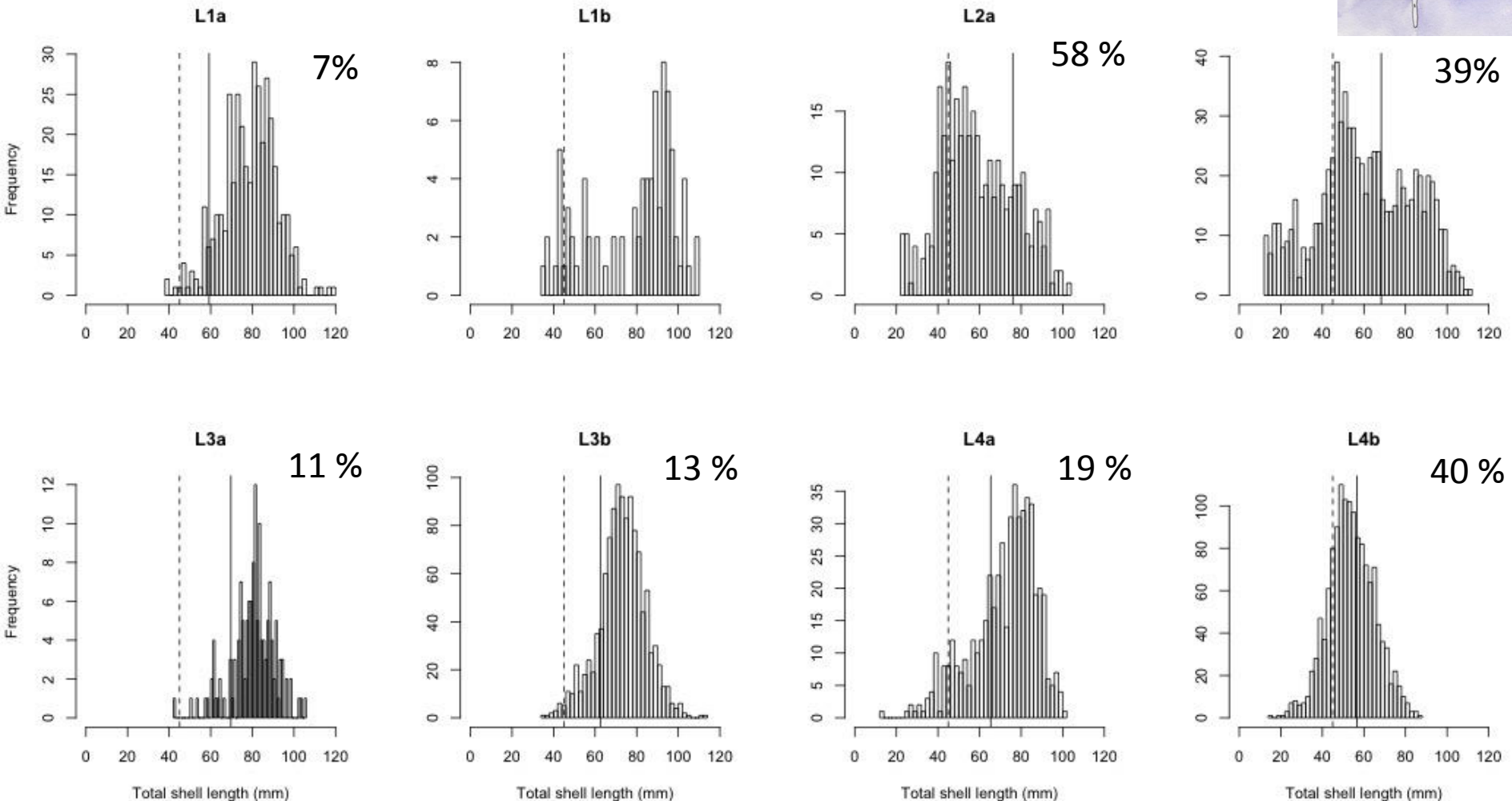


8.7

Total Shell Length (mm)

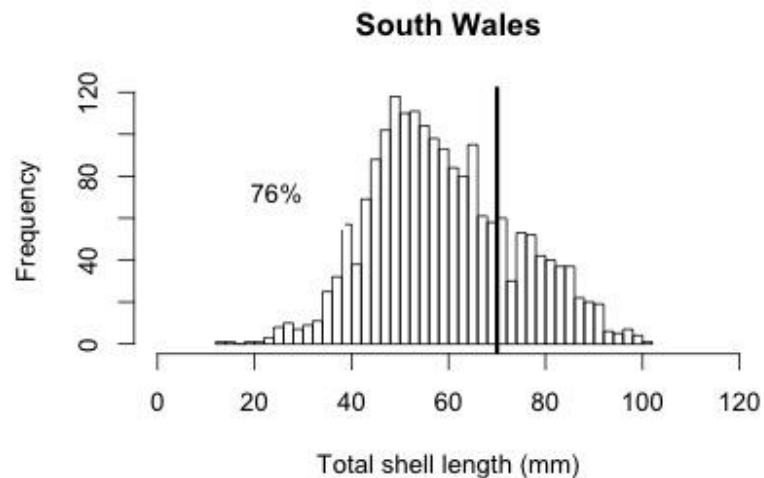
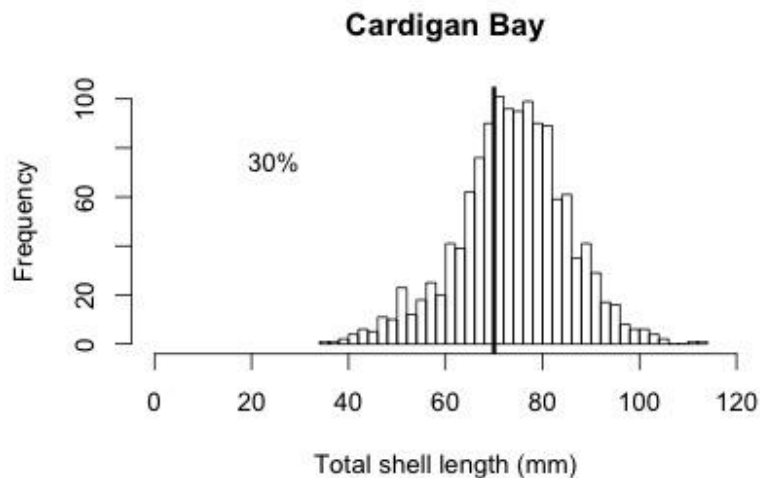
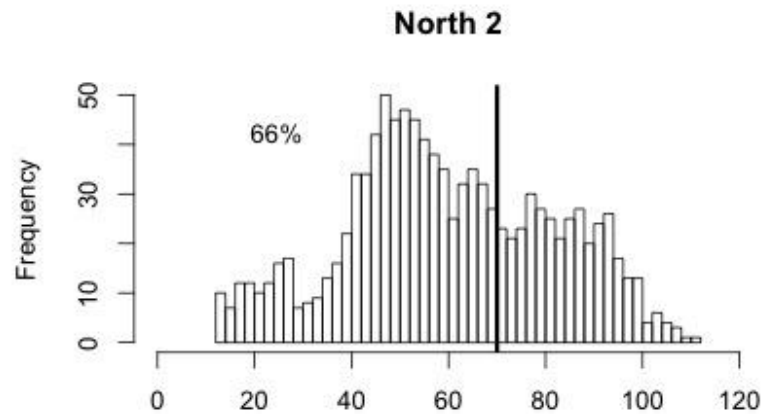
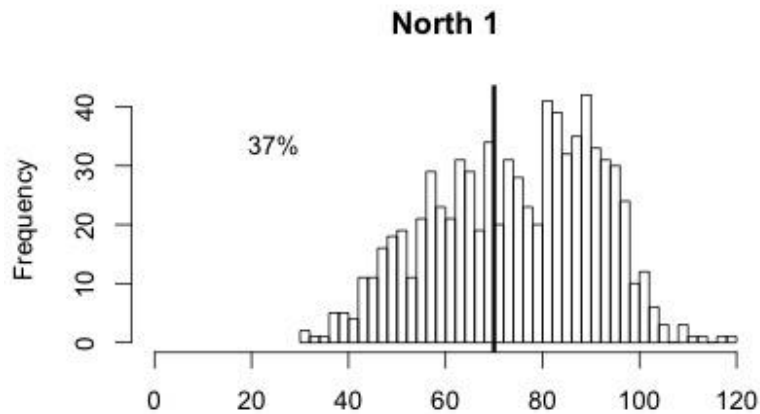


# Length frequency for different areas above MLS and above Lmat

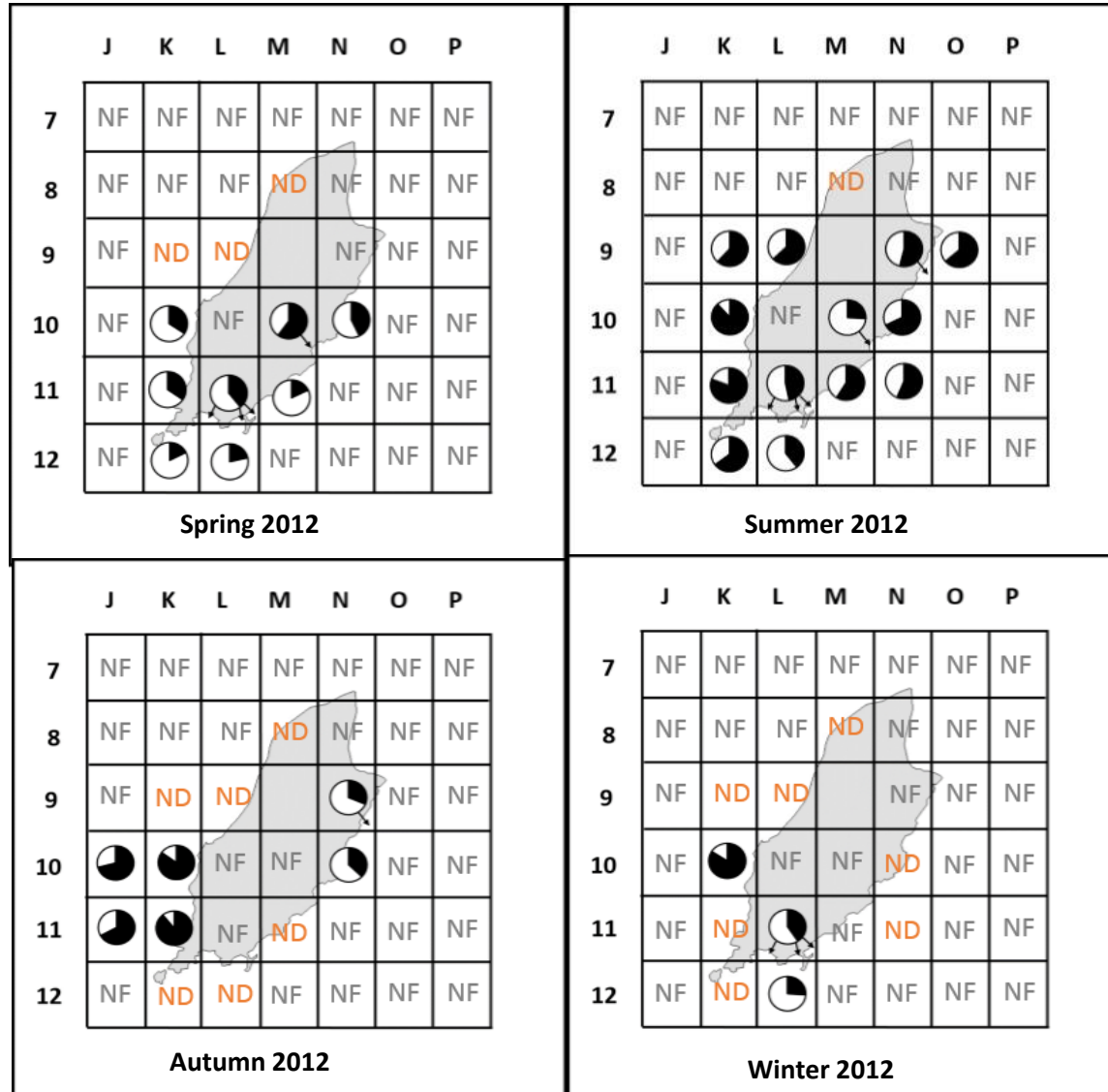


Currently MLS of 45 mm TSL

# Scenario of MLS change to 70 mm TSL



# THE CATCH CHARACTERISTICS AND POPULATION STRUCTURE OF THE BROWN CRAB



Seasonal change in sex ratios of crabs caught in commercial pots

Black = females

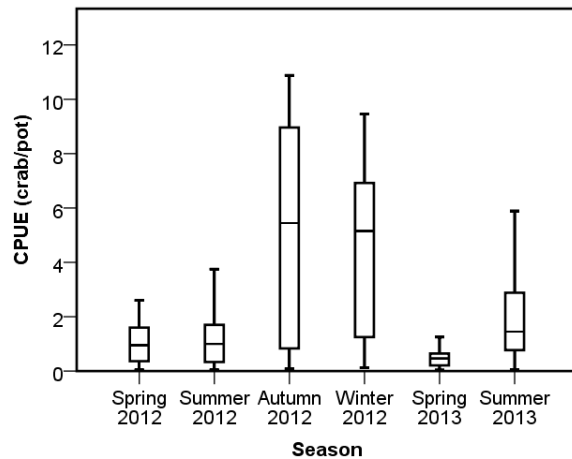
White = males.

Does this indicate spawning migrations? More evidence needed to be sure perhaps using a tagging study.

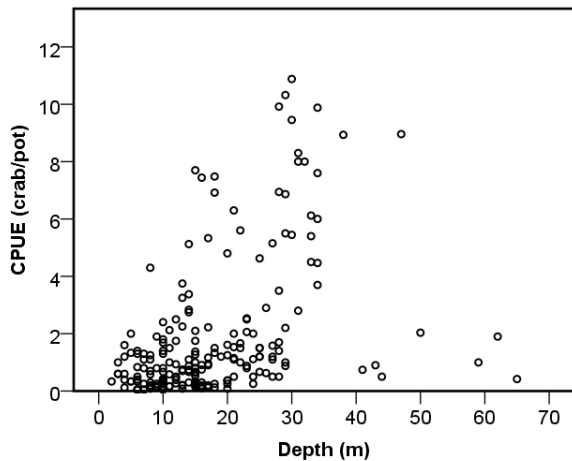


# Variation with environment and season: When you sample matters depending on the question

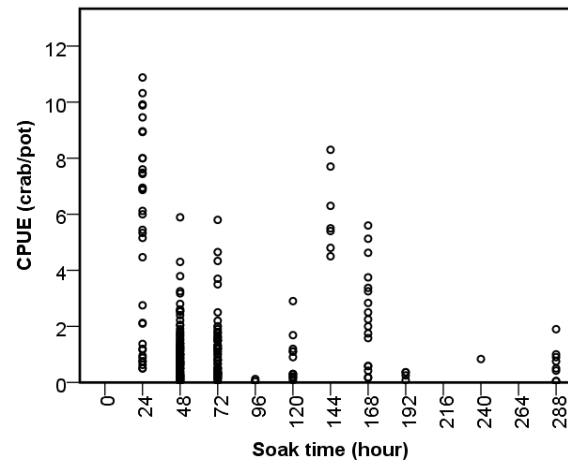
(A)



(B)



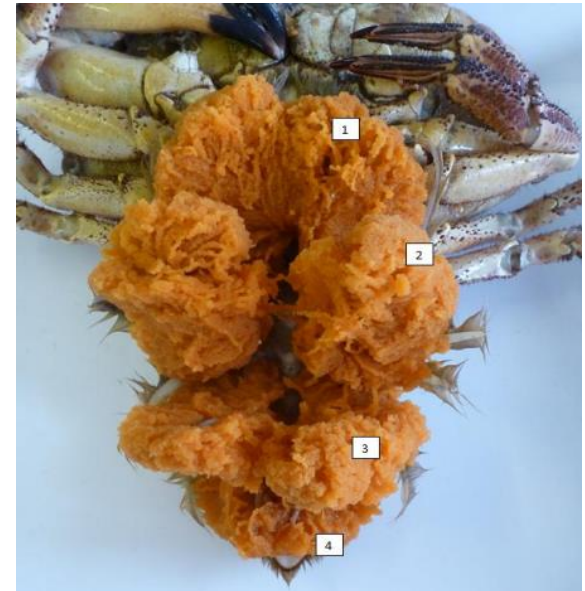
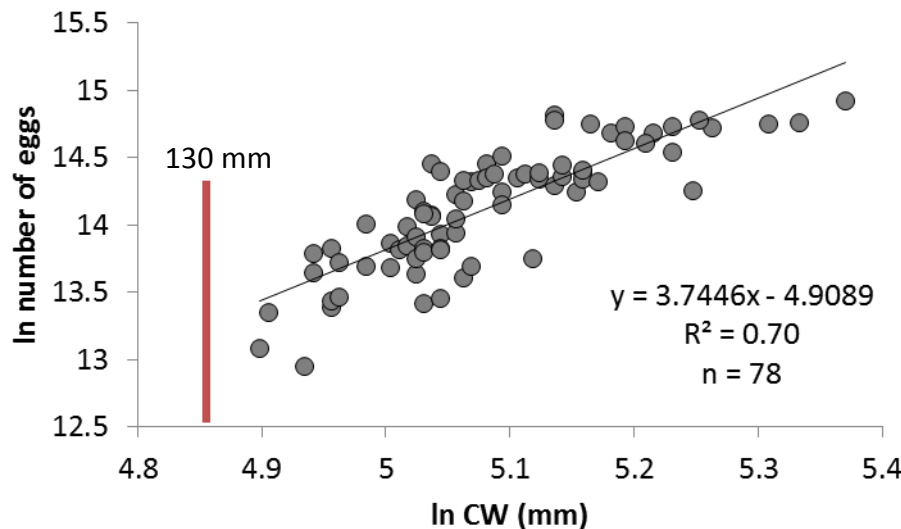
(C)



Scientific CPUE of brown crab depends on (A) season (from spring 2012-summer 2013) (B) Depth; (C); soak time range from 24-288 hour.

# Bigger females produce more eggs

Ovigerous crabs varied in size from **134 to 215 mm** carapace width, and they carried an estimated **0.4 – 3.0 million** eggs.



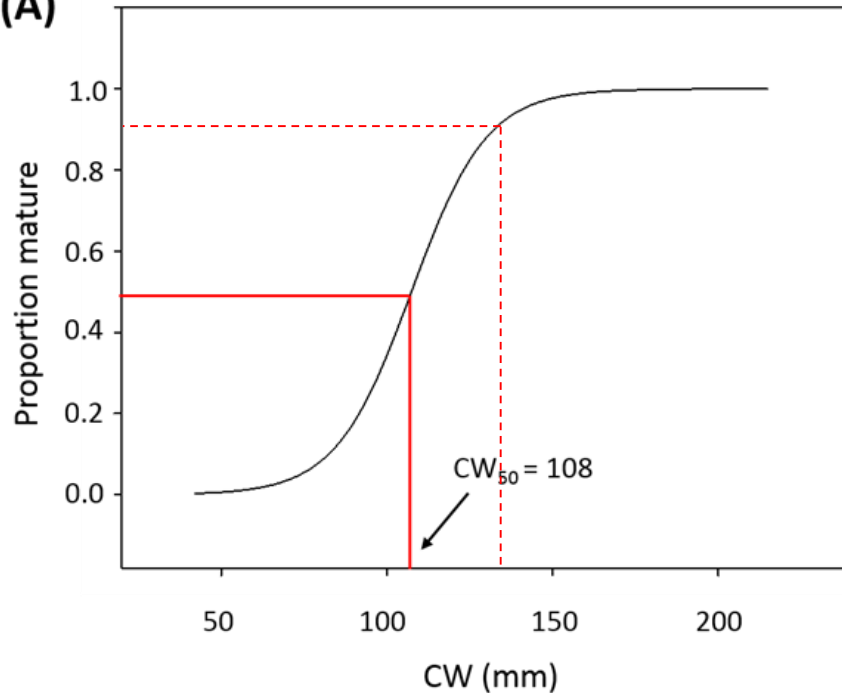
The relationship between ln number of eggs and ln carapace width (ln CW) for brown crab (*C. pagurus*) sampled from the waters around the Isle of Man.

# How do we set Minimum Landing size (MLS)?



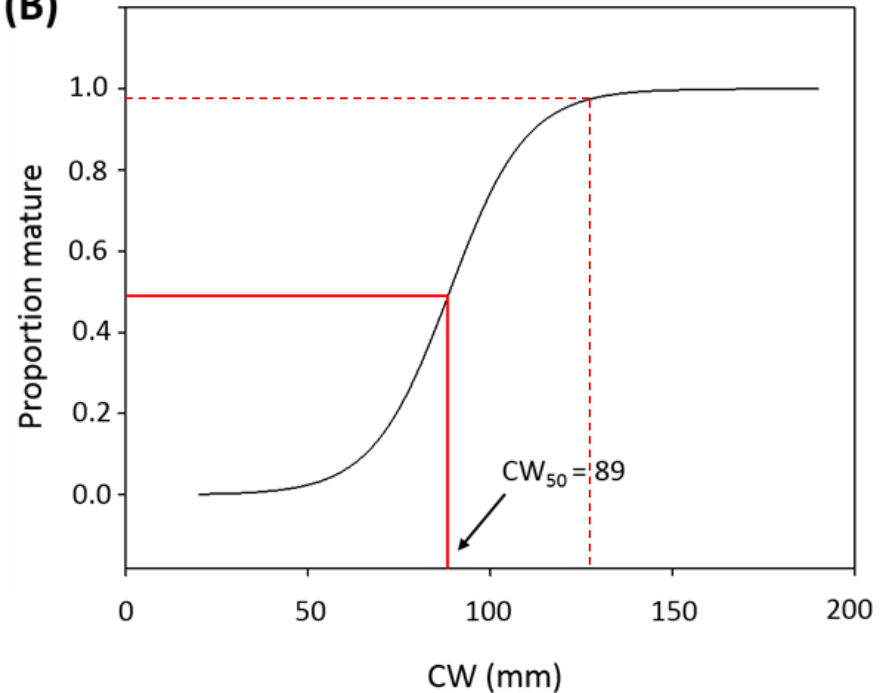
FEMALES

(A)



MALES

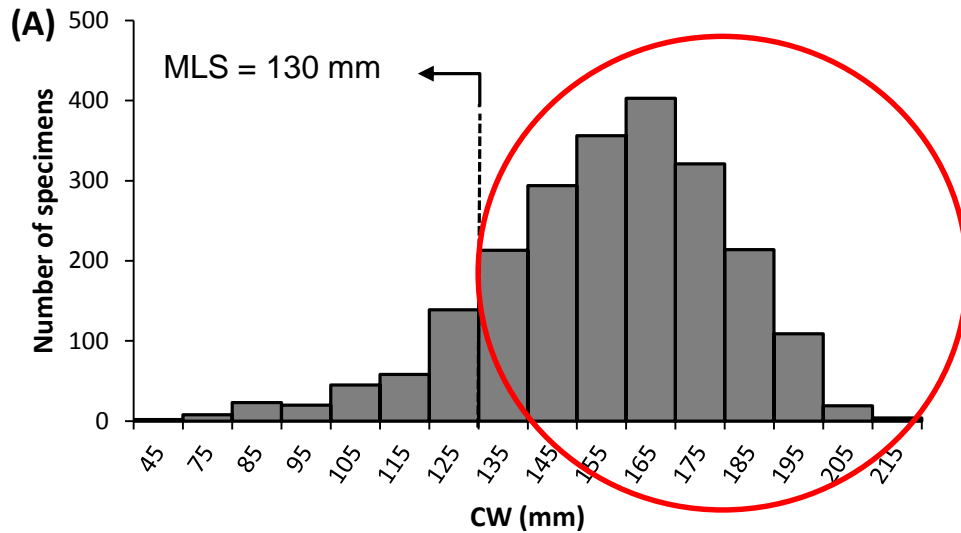
(B)



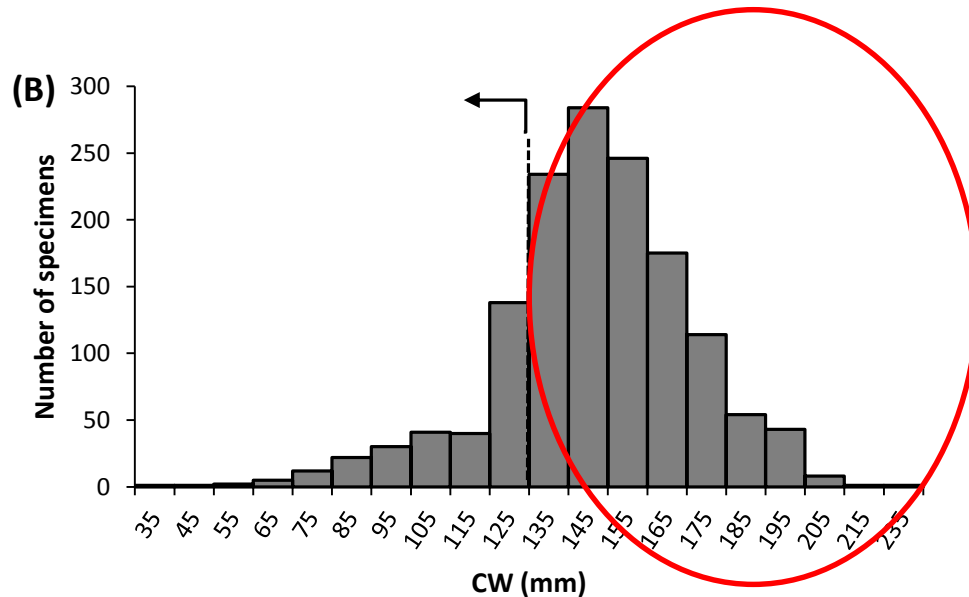
*Cancer pagurus*. A) Predicted size at maturity based on ovary development in females; B) Predicted size at maturity based on testes development in males



# Size structure shows that the fishery is healthy because majority of animals are well above the MLS



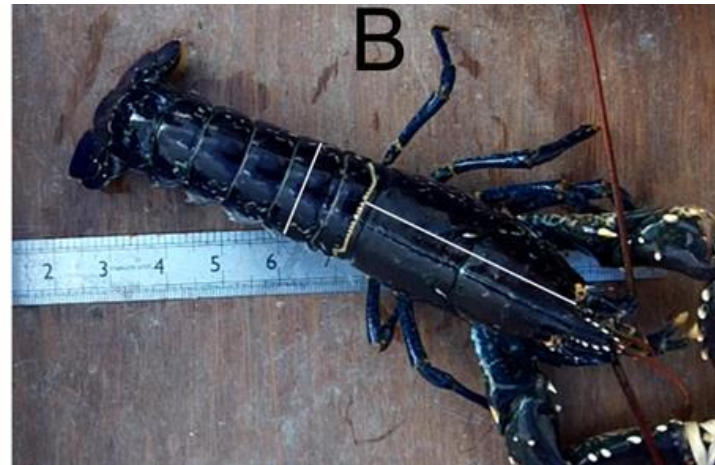
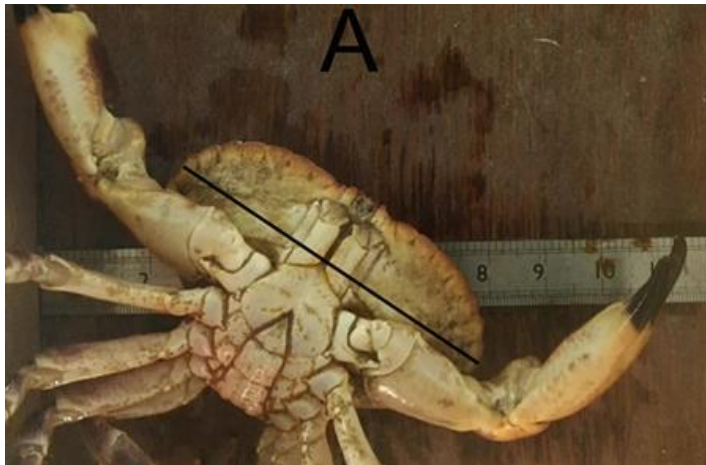
87% of **FEMALE**  $\geq$  MLS



80% of **MALE** crabs  $\geq$  MLS

# Fishermen collecting data - video capture of crustacean fisheries data

Experience from Wales and the Isle of Man

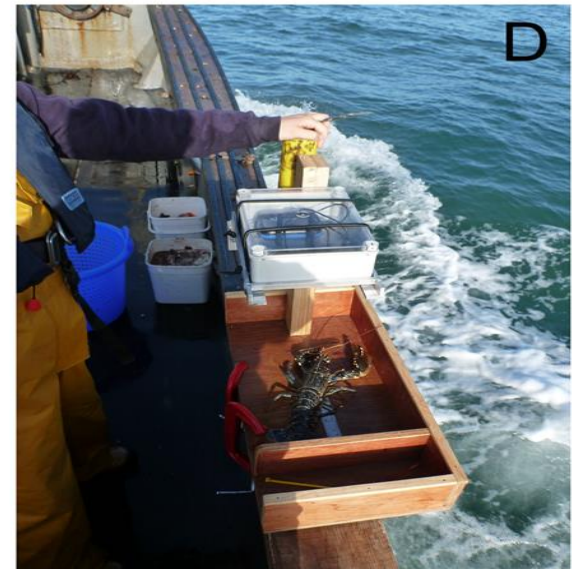
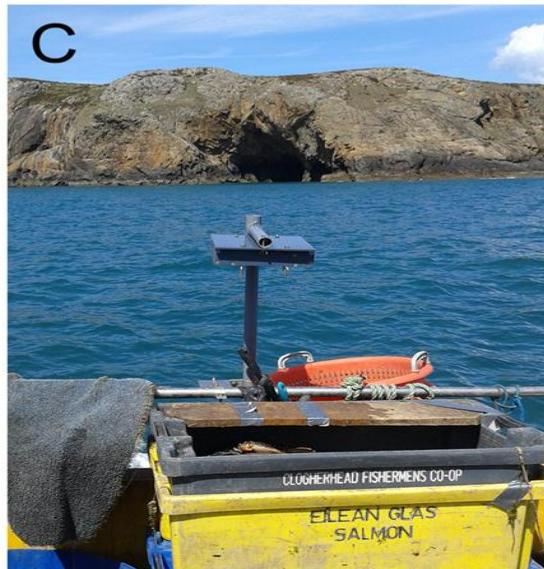
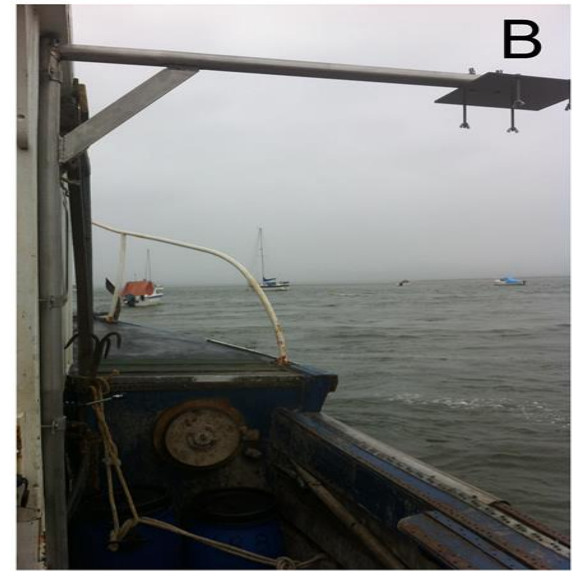
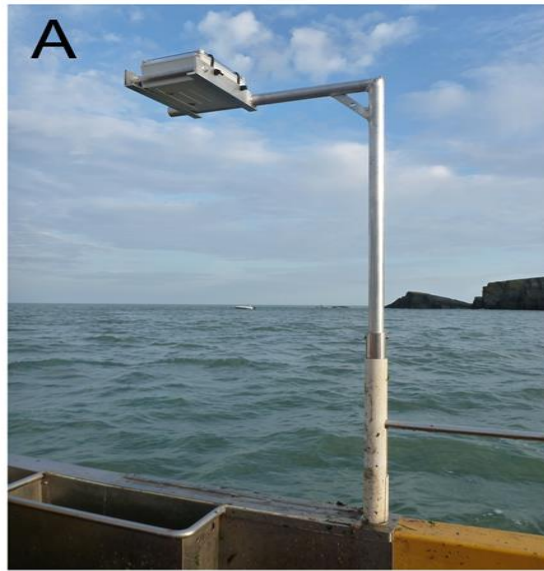


## On-board cameras

Each system's mounting bespoke for each vessel.

Must be safe for the crew and practical.

Some are hard mounted, others more 'mobile' e.g. on fish box





# On-board cameras



**Power is from a re-chargeable 12V battery pack housed in a waterproof case.**

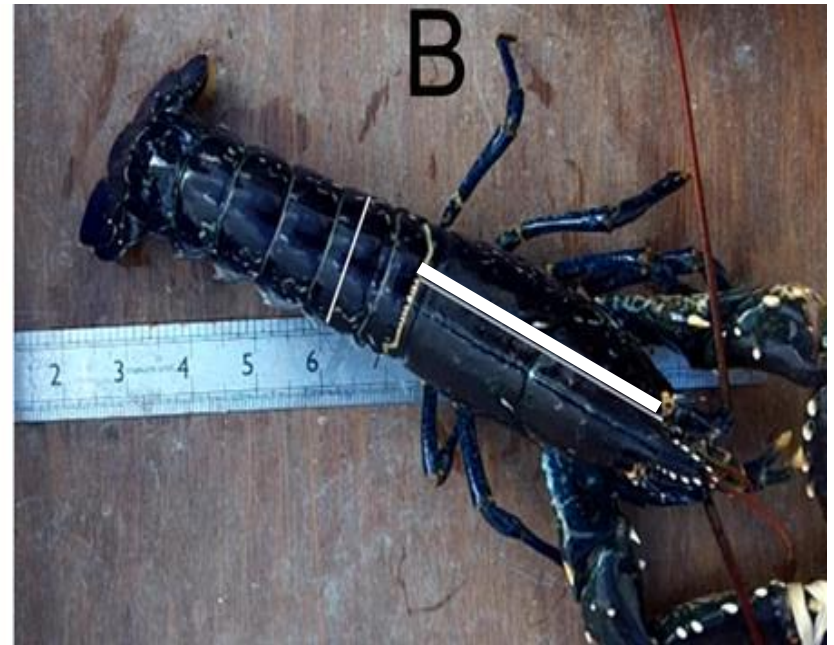
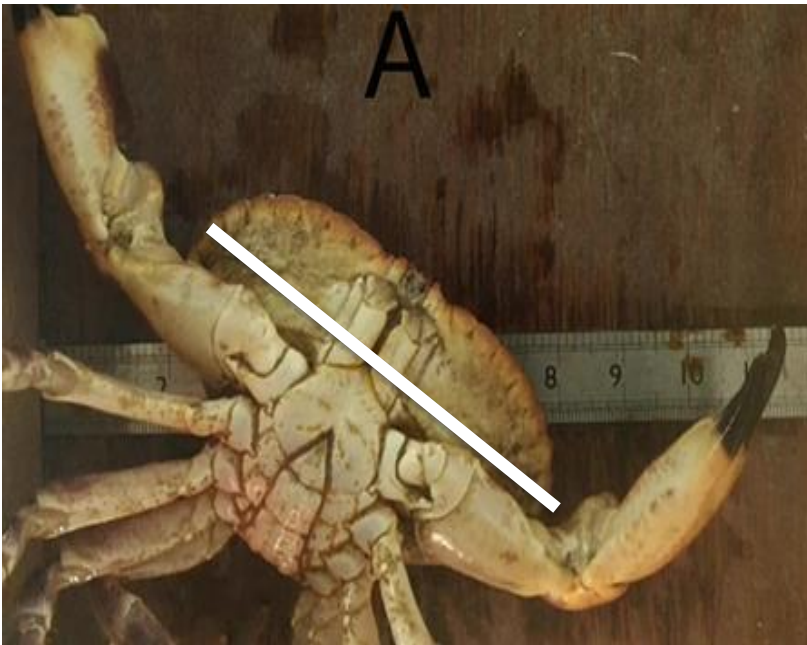
**We collect the SD cards from the camera and analyse the data. We can also train fishermen to do this as well if required. Data is returned to fishermen.**

**Camera and pair of lasers are housed in light rugged box. An external big on/off switch is under fisherman's control. You switch it on when you want, and leave it off if you want.....you choose to record.**

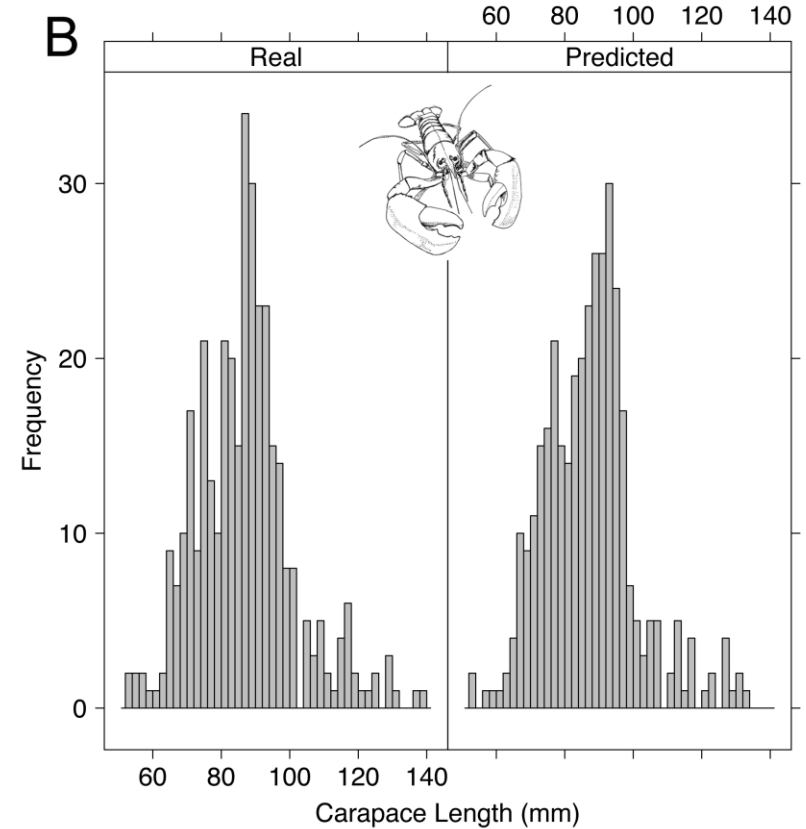
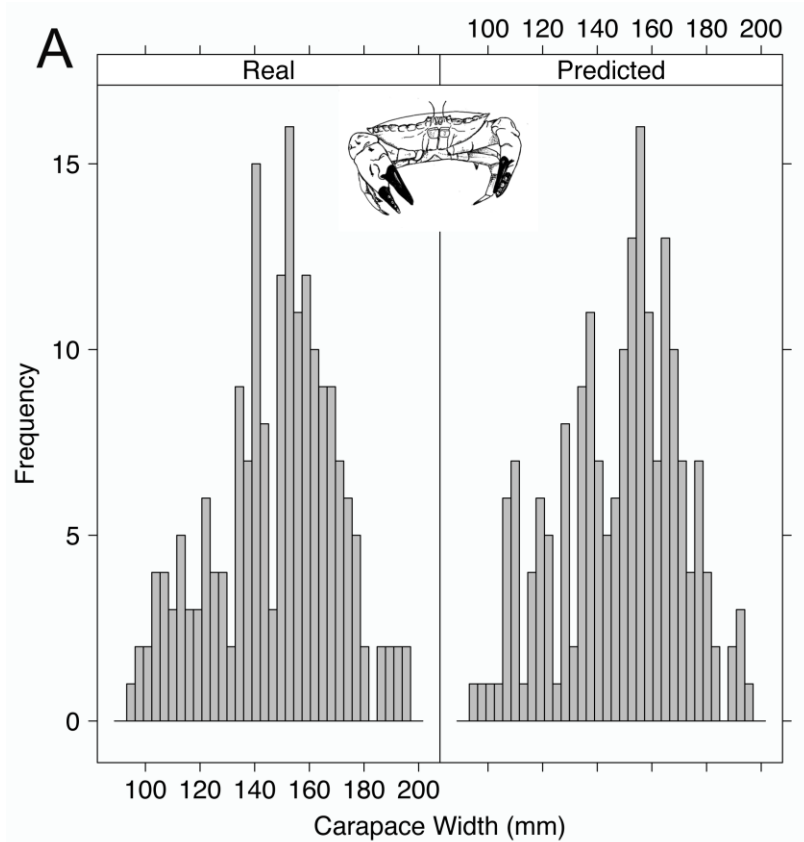


# On-board cameras

Measurements taken from video: A) Crab carapace width B) Lobster carapace length and abdomen width. Crabs can be sexed by looking at the size and shape of the abdomen. Lobsters used the ratio of the abdomen width to carapace length as females have wider abdomens.



## No Significant difference between data collected in situ and estimated from video



Error of less than 2% when measuring carapace widths, which is small enough to group measurements into 2mm size classes. So camera is as good as an observer (and doesn't get sea-sick)

In other words .....it works.....really well



# **Life history parameters of bass population around Welsh waters**

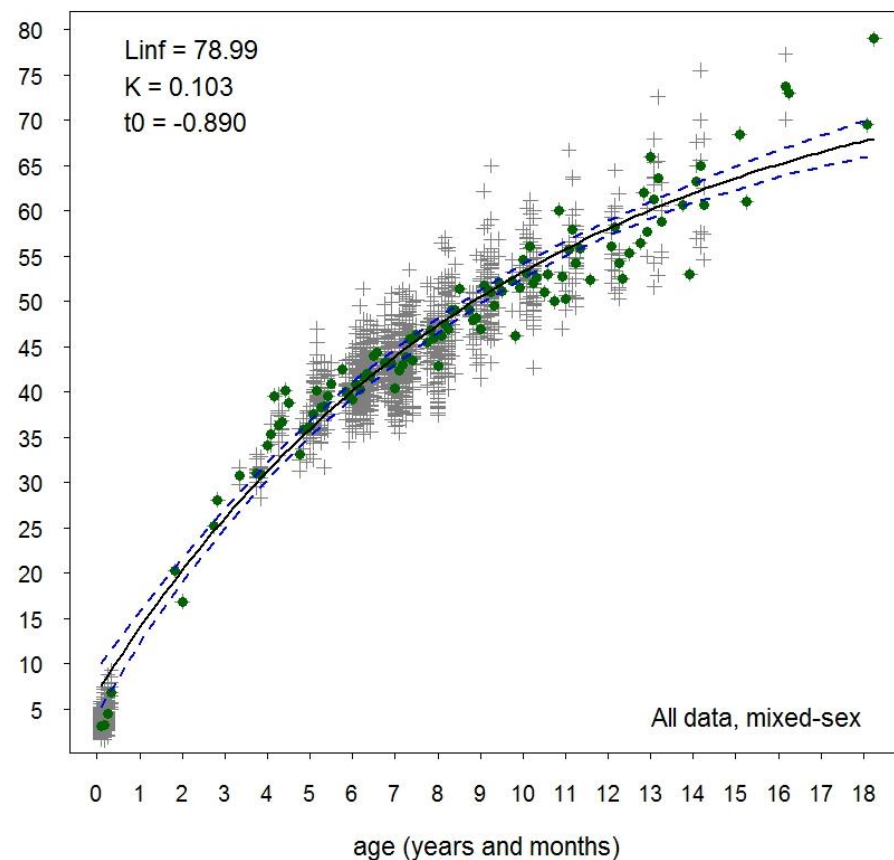
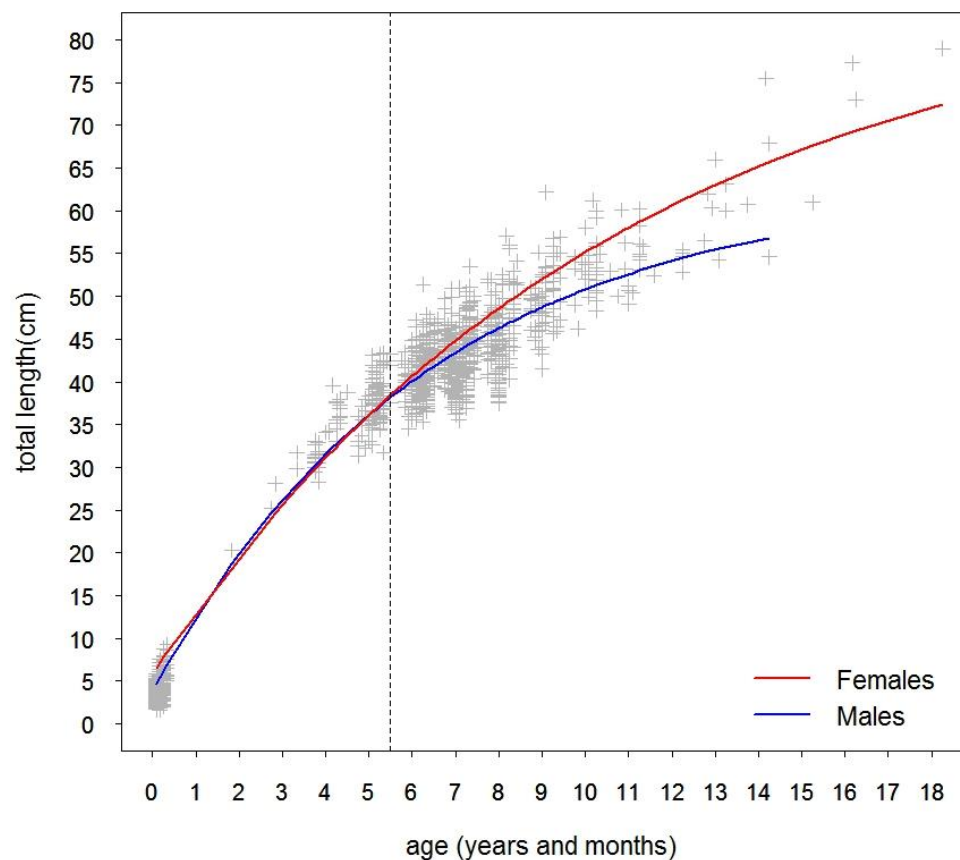


**Comparison with the stock assessment (ICES 2013)**



**Differences found (e.g. maximum bass length, size at maturity) between ICES areas VIIa, VIIg, and VIIf and Wales**

**Does this suggestion regional management needed?**



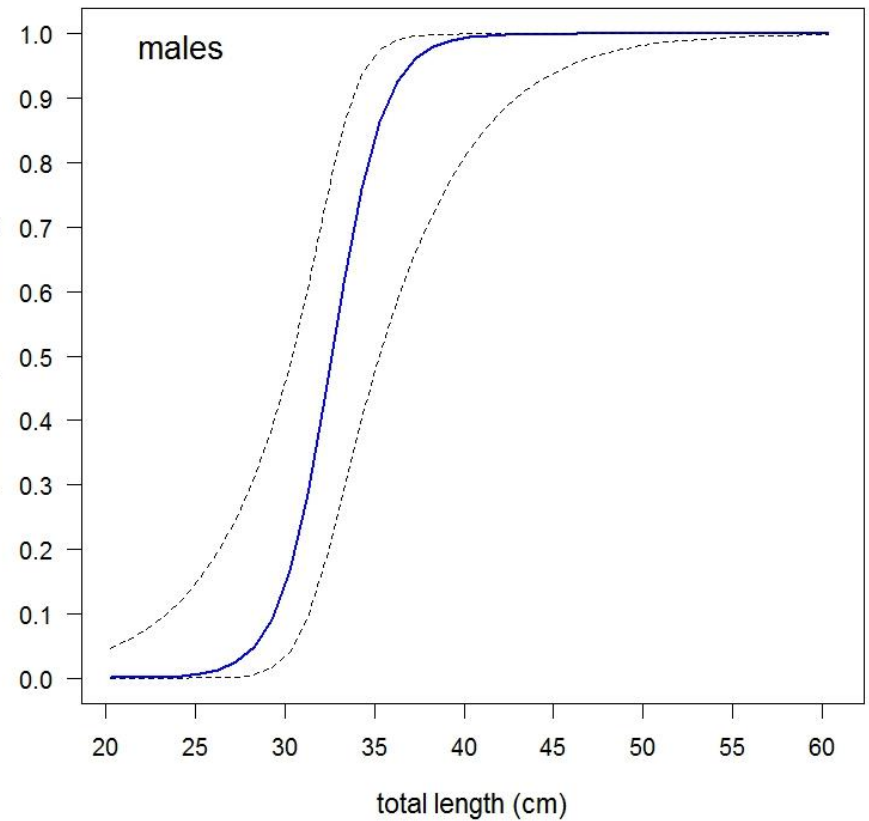
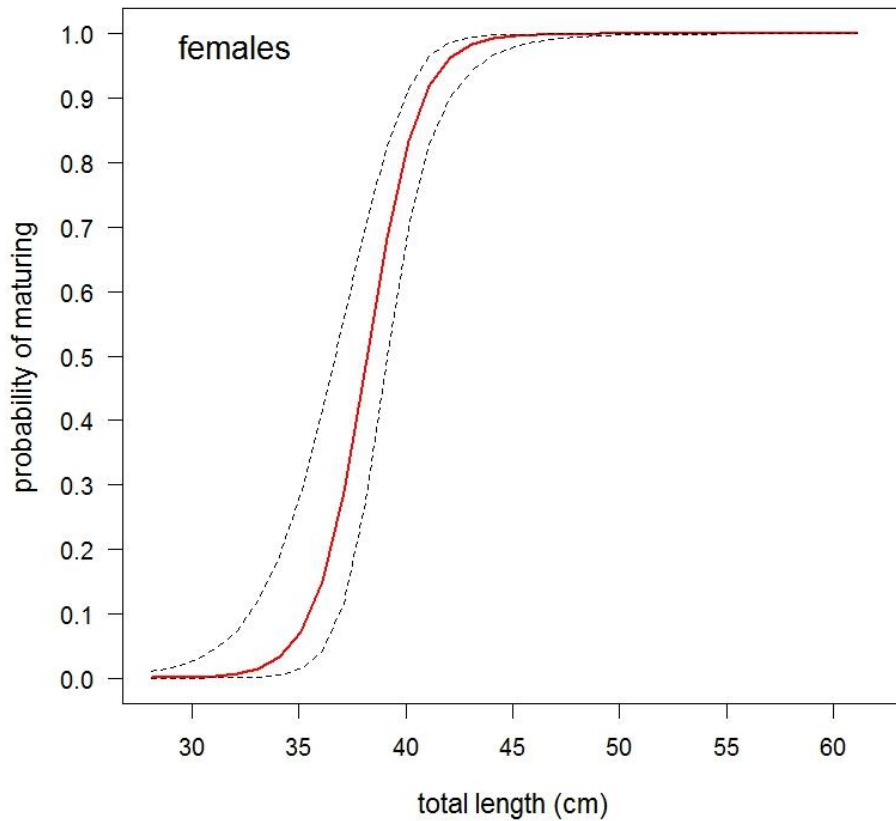
### Maximum length (sex combined)

ICES areas VIIagf (ICES 2013)  
(1985-2011)

85.48 cm

Wales (Bangor University)  
(2013-2015)

78.99 cm



### Size at maturity

sex	ICES areas VIIagf (ICES 2013) (1985-2011)	Wales (Bangor University) (2014-2015)
females	40.65 cm	39.1 cm
males	34.67 cm	32.7 cm

## **European Commission is planning to increase the MLS to 42 cm (based on the ICES stock assessment)**

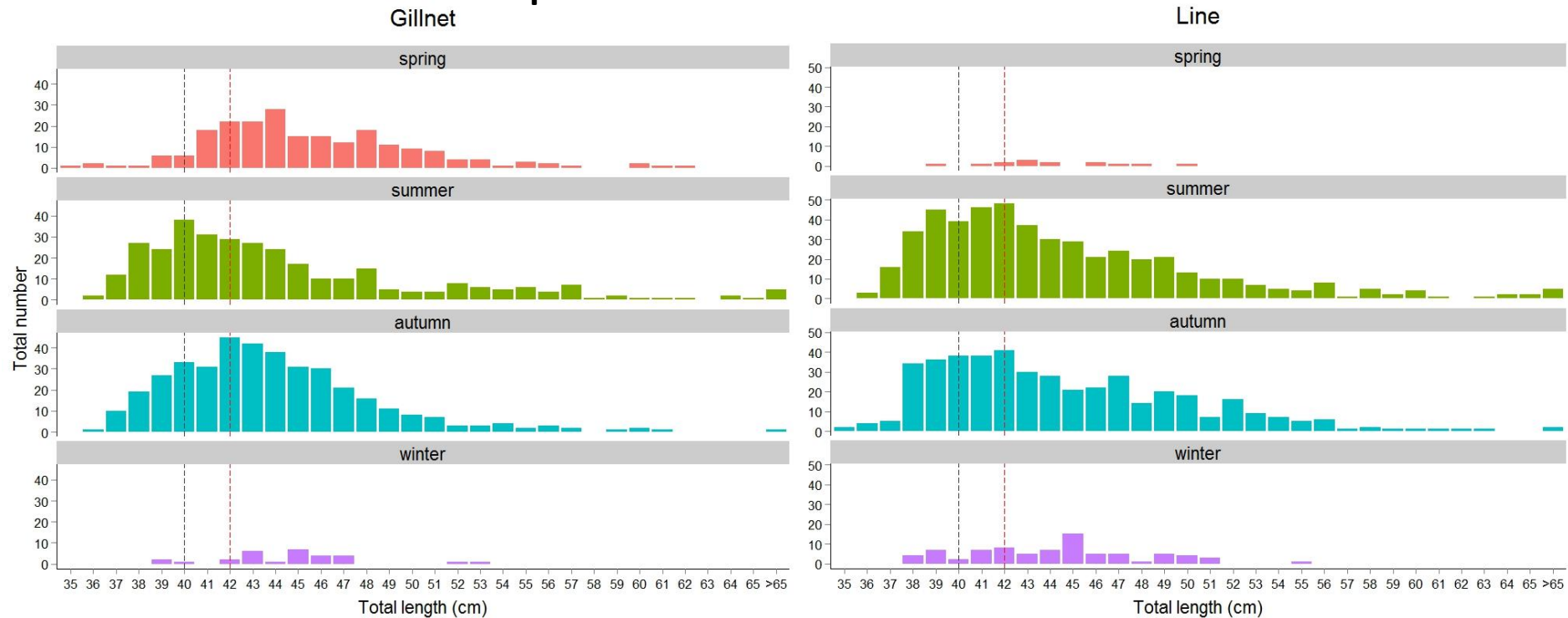
The actual MLS (36 cm) is below the size at maturity of bass females.

➔ An increase of the MLS to 40 cm would allow 82% of the females to spawn at least once (based on data from Wales)

➔ An increase of the MLS to 42 cm would allow 96% of the females to spawn at least once (based on data from Wales)

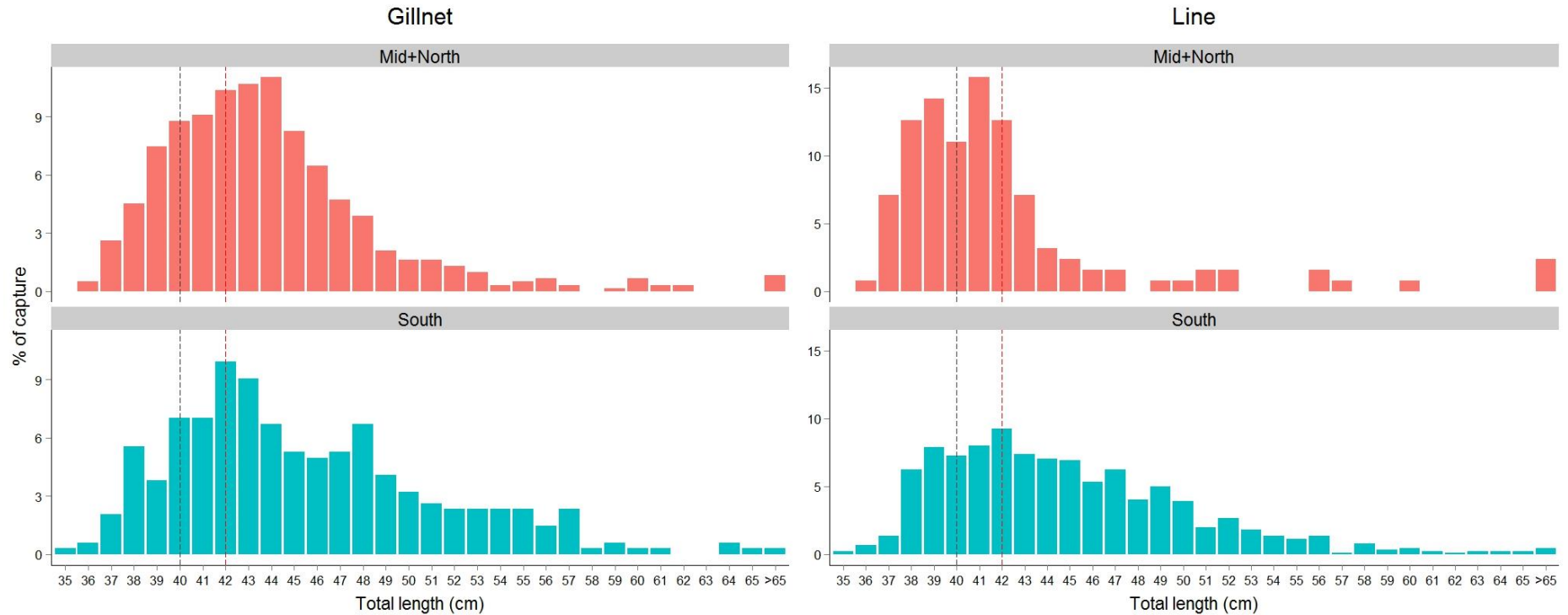
**BUT WHAT DOES THIS IMPLY FOR FISHERS?**

# Impact on different fisheries with season



gear	season	Capture loss (%)	
		40 cm MLS	42 cm MLS
gillnet	spring	5.1	7.9
	summer	19.8	40.7
	autumn	14.5	30.9
	winter	6.9	10.3
line	spring	7.1	14.3
	summer	19.9	37.1
	autumn	18.5	35.8
	winter	13.9	25.3

# Regional impacts in Wales for different fisheries



gear	area	Capture loss (%)	
		40 cm MLS	42 cm MLS
gillnet	Mid + North Wales	15.1	32.9
	South Wales	12.3	26.3
line	Mid + North Wales	34.6	61.4
	South Wales	16.4	31.6



## Loss of catches on a yearly basis....

### Gillnet

MLS 40 cm



-11.6%

MLS 42 cm



-22.3%

### Line

MLS 40 cm



-14.8%

MLS 42 cm



-28.1%



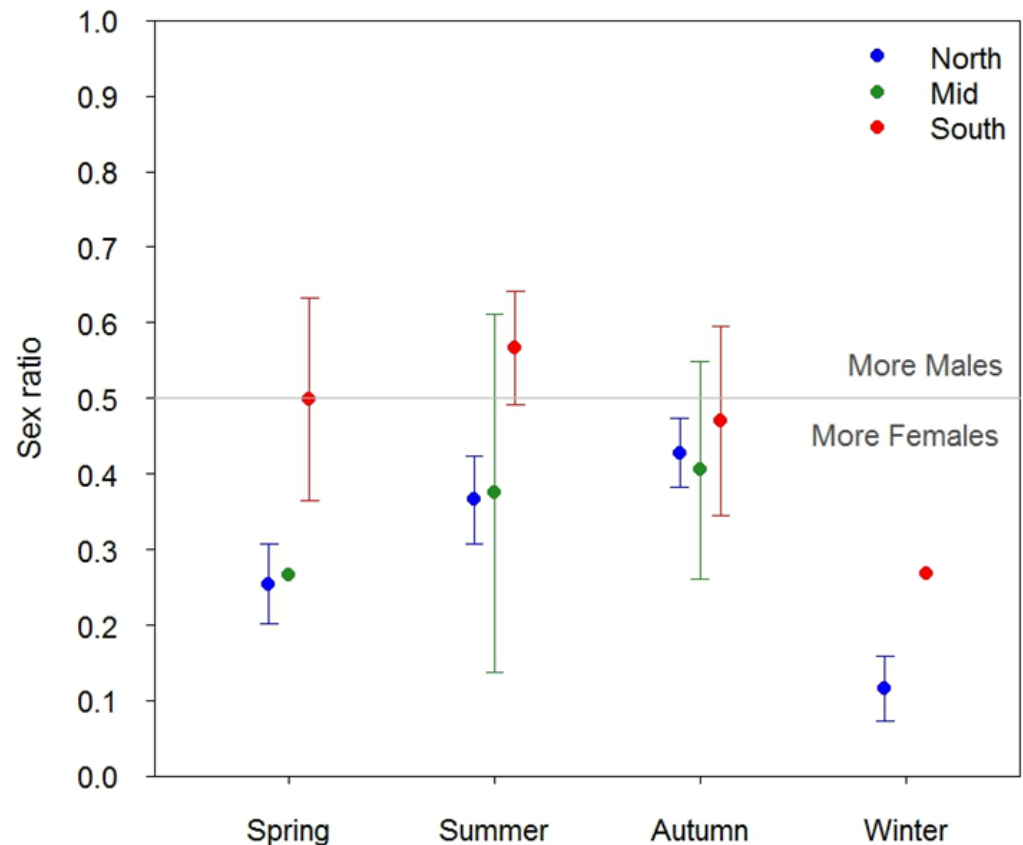
## Moreover...ICES stock assessment does not take into account specific characteristics of bass stock in Wales...

- In **North Wales** sex-ratio is highly skewed in favour of females during all seasons. But...picture from fishery-dependent data....

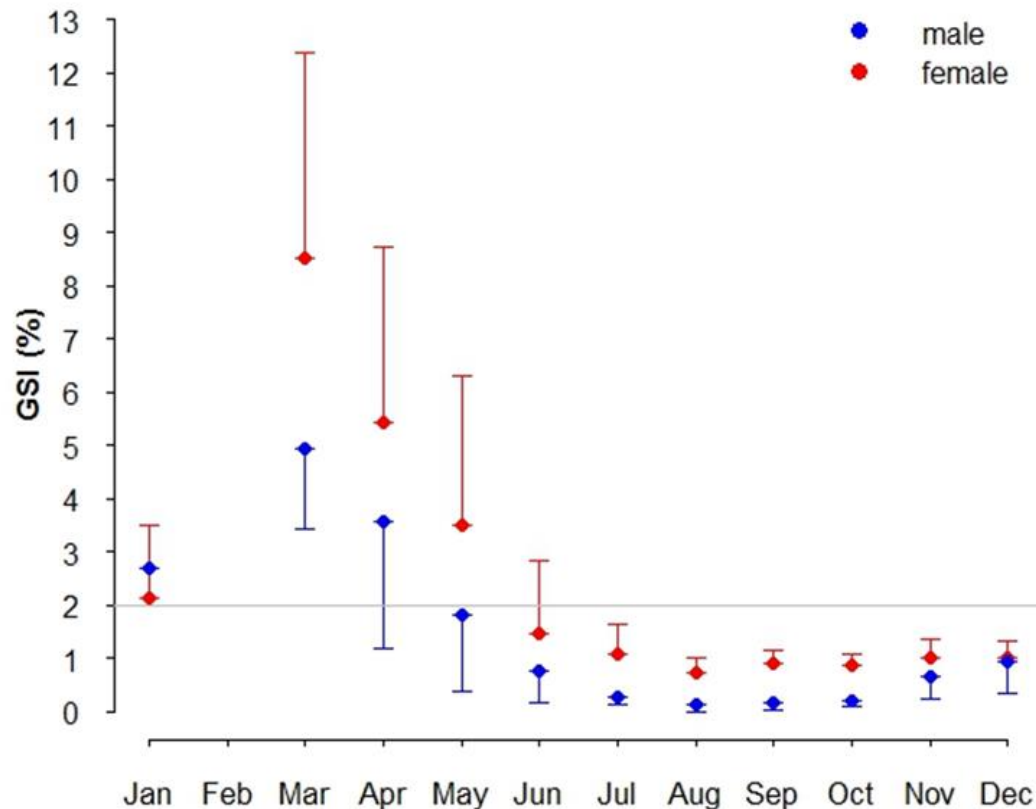
Does this reflect the natural sex ratio of the stock or fishery harvesting is biased towards females?



**Different management implications**



- The spawning season of bass around Welsh waters has been estimated to be between January and May from the Gonad Somatic Index (GSI)



All five months should be considered if protecting bass during the spawning period (currently the pelagic trawls targeting sea bass are banned until end of April).

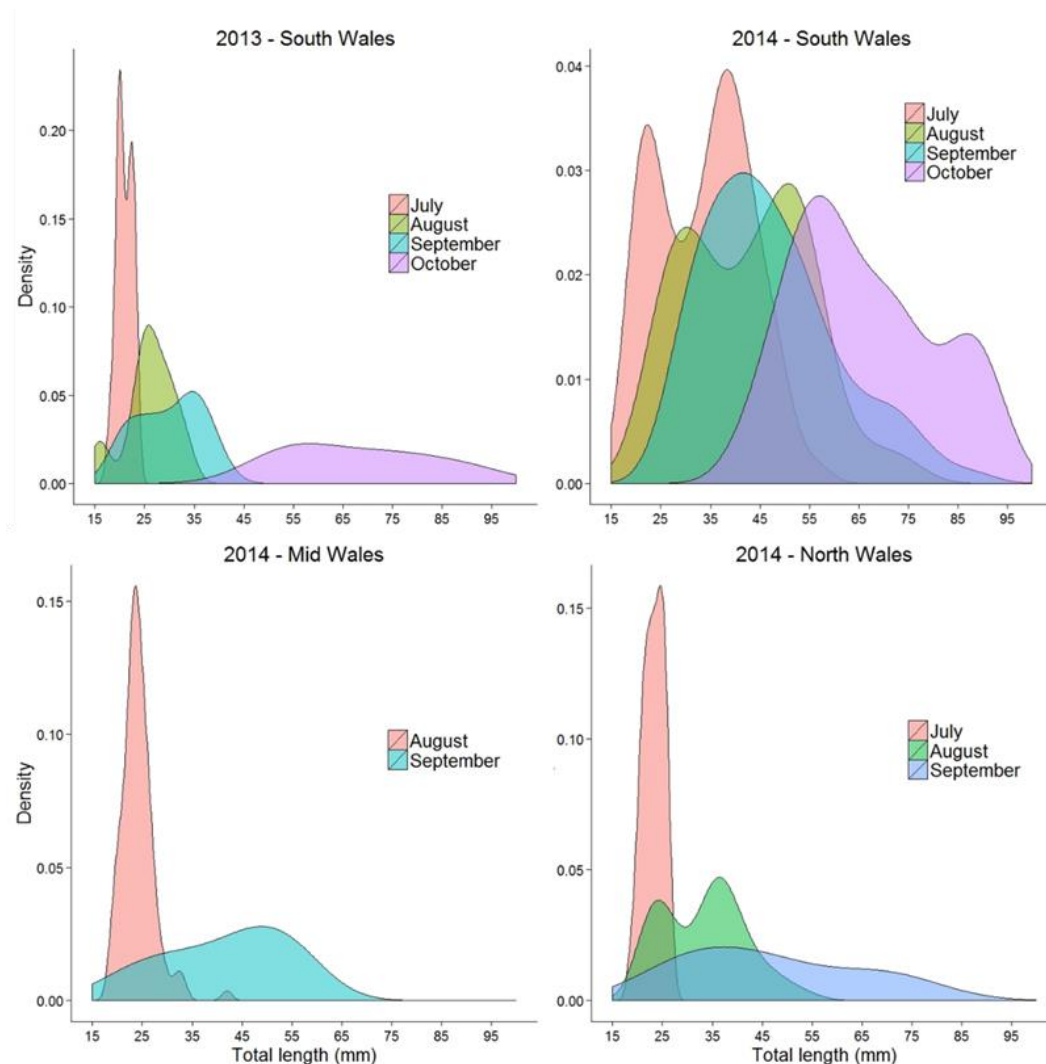
- Bass recruits not only in South Wales: possible local spawning ground in Mid/North Wales




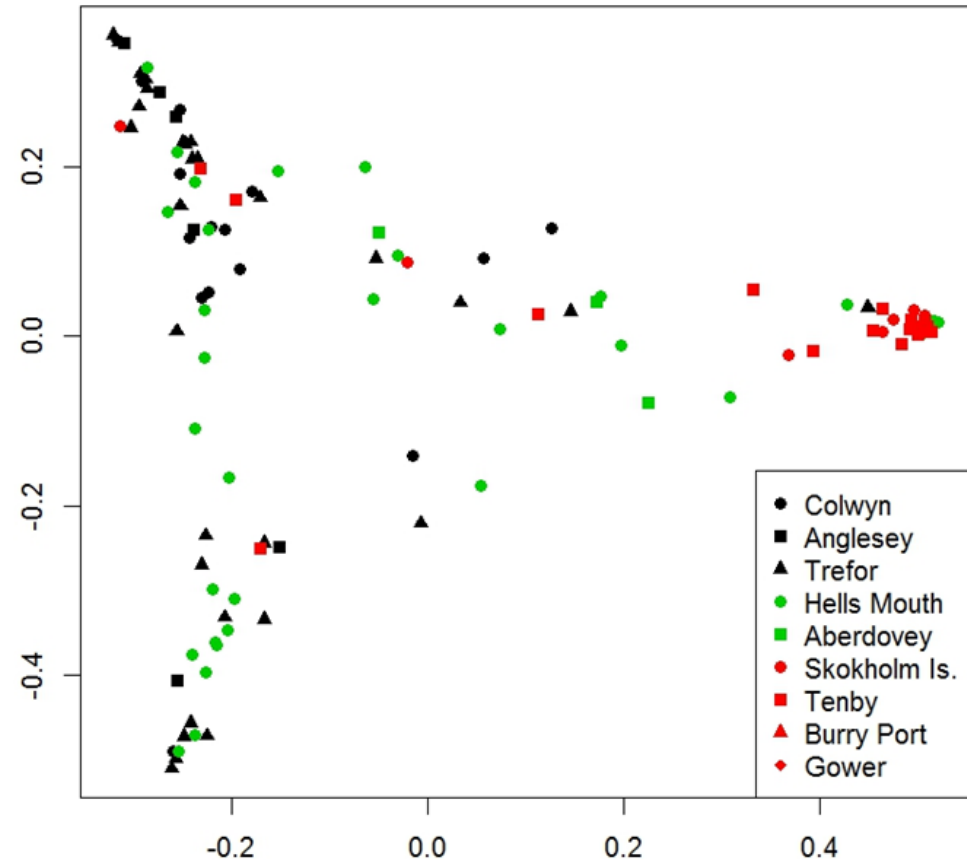
- Bimodal pulse of newly-settled recruits: protracted spawning and possibly late-season pulse in spawning



**Protection of spawners during all spawning period**



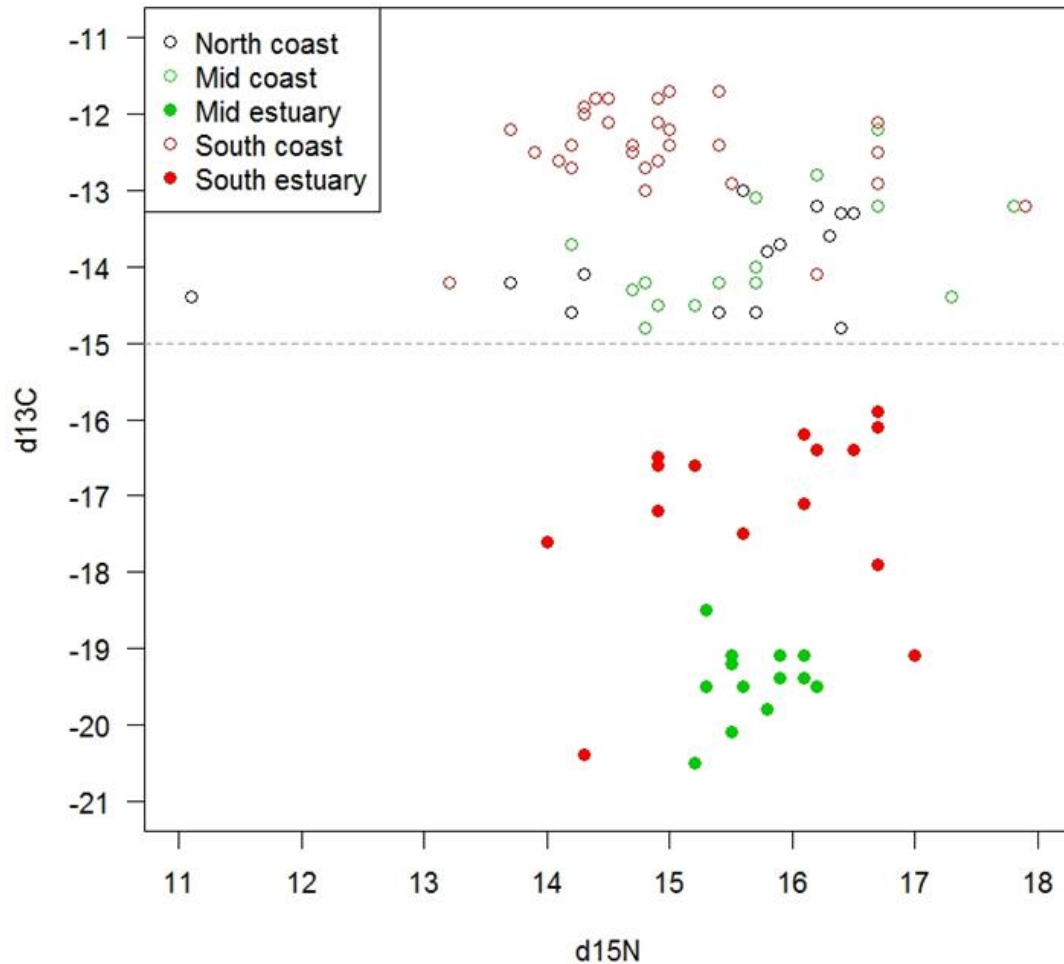
- 
- Analysis of fish scale  $\delta^{15}\text{N}$  and  $\delta^{13}\text{C}$ . Very distinctive isotopic signature in South Wales (red points)



Connectivity between North and Mid Wales for feeding behaviour of adult bass, while fish from South Wales appeared more isolated.

**This suggests the presence of two different management units.**





- All fish with total length >50 cm caught in estuaries areas showed a very low value of  $\delta^{13}\text{C}$ . Part of the largest bass adopt estuaries as preferential feeding areas



**Higher protection levels in estuaries** to protect big spawners during feeding season

## In conclusion...

- Fisheries science isn't perfect.
- For data poor species we need appropriate science at the correct management scale (e.g. national – (any?), regional (scallops), sub-regional (bass) and local (whelks).
- Fishermen can collect very useful data, made easier with technology.
- Fishermen and scientists can learn a lot by listening to each other.