Assessment of Brown Crab stocks (*Cancer pagurus*) in European Waters

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Marine Institute Ireland

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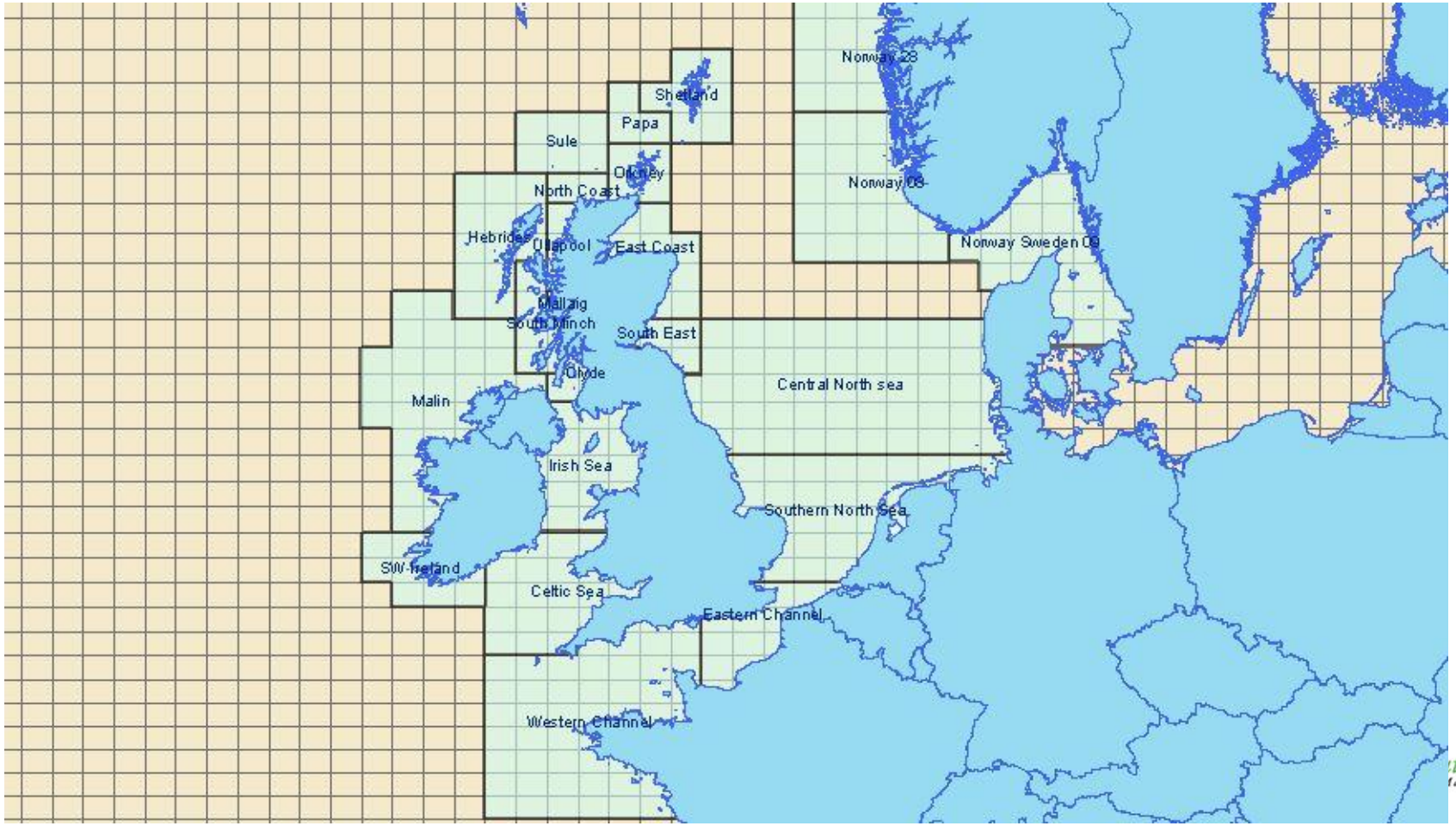
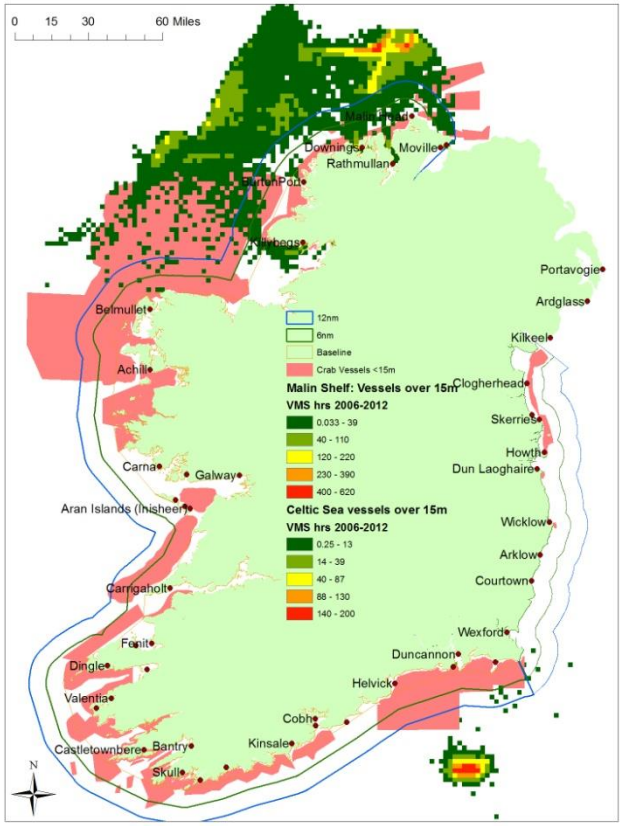
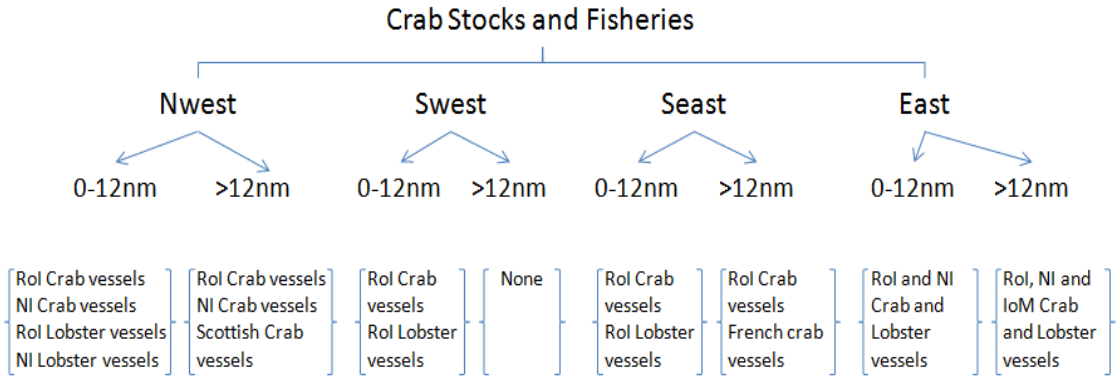
Assessment units (WGCrab)



Crab stocks and fleets around Ireland





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Crab stocks and location of highest catches around England and Wales (English data)

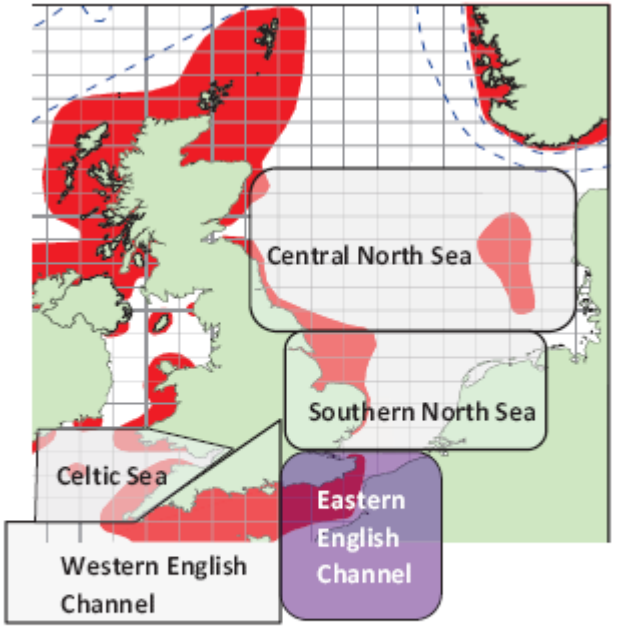

Figure 1. – The CFU's used for the assessment regions. The CFU in purple did not have sufficient data for an assessment in 2014.

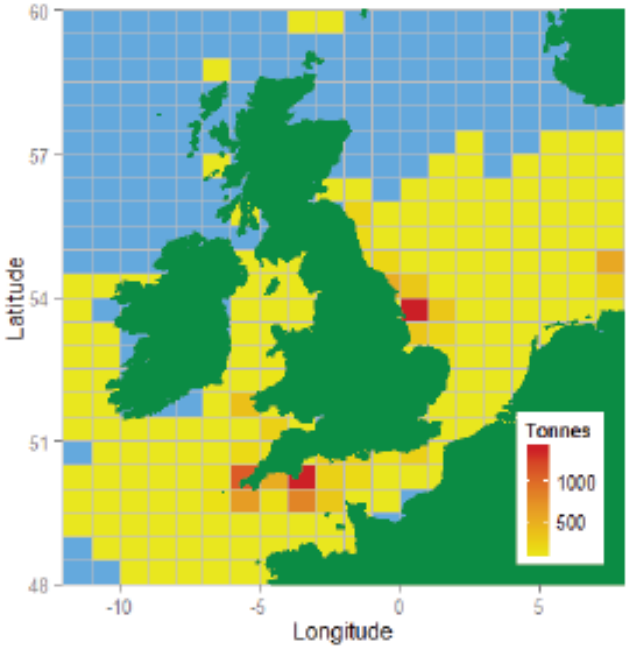

Figure 5 – The average landings per ICES rectangle from 2006 to 2012.

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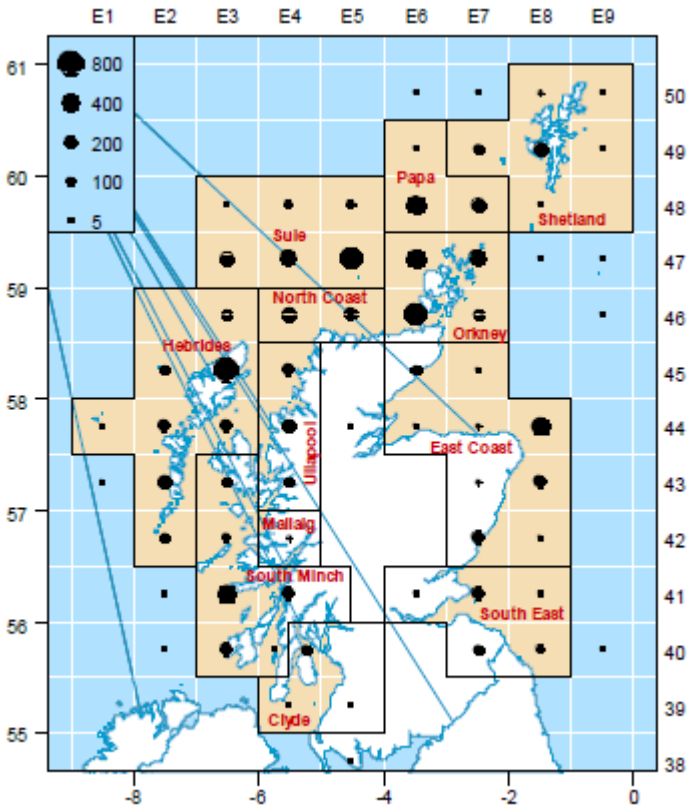
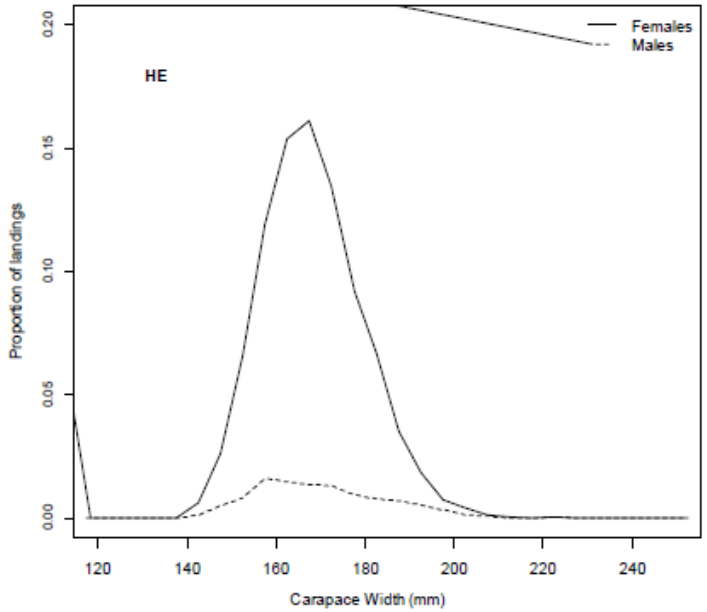
Crab stocks and location of highest catches around Scotland (Marine Science Scotland)





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Landings

Species: *Cancer pagurus*						
Total catch tons						
Site	England	Scotland	France	Norway	Ireland	Jersey, Channel Islands
Year						
1990		4,282	6,076	1,374		
1991		5,485	5,310	1,462		
1992		4,648	5,583	1,316		
1993		3,820	5,896	1,641		
1994		4,759	6,086	1,781		
1995		6,092	6,823	1,806		
1996		5,528	6,527	1,889		495
1997		7,470	7,000	2,205		523
1998		8,021	6,490	2,984		521
1999		7,437	6,087	2,836		473
2000	12,363	9,650	5,182	2,890		440
2001	13,013	8,458	5,513	3,478		447
2002	11,973	7,874	5,963	4,344		524
2003	13,349	7,525	6,327	4,944		540
2004	10,825	6,761	7,813	5,248	11,662	541
2005	8,484	8,332	6,259	5,671	7,911	438
2006	11,043	10,430	5,423	6,205	8,779	349
2007	12,074	11,919	6,178	8,514	6,486	412
2008	11,697	9,336	6,416	5,295	6,737	481
2009	11,001	9,466	4,353	4,970	10,934	361
2010	11,902	10,857	5,487	5,774	11,394	409
2011	12,089	11,859	5,690	5,319	6,964	434
2012	13,844	10,892	5,990	4,981	6,195	474
2013	13,804	10,891	5,570	5,242	5,755	358
2014	16,330	12,306	5901	4,629	7,257	

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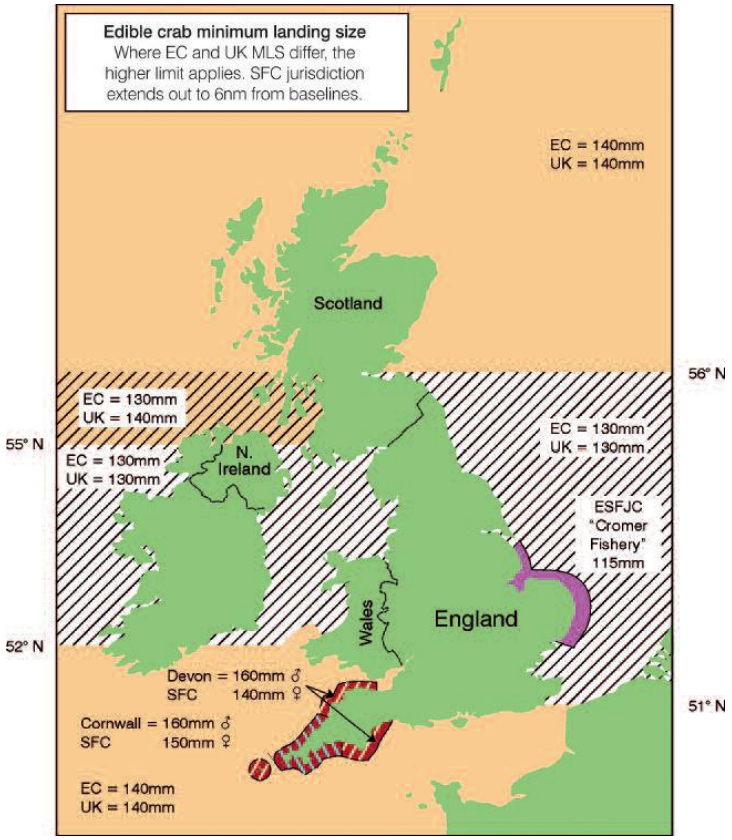
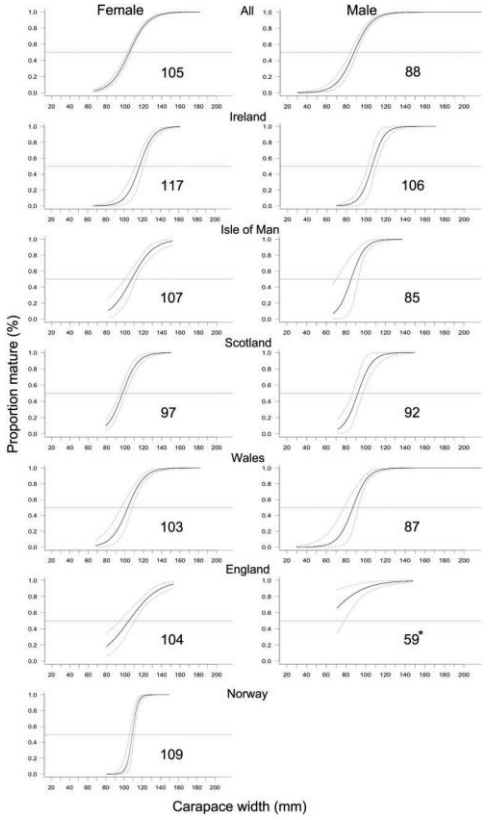


Minimum landing size ranges from 115-160mm www.seafish.org

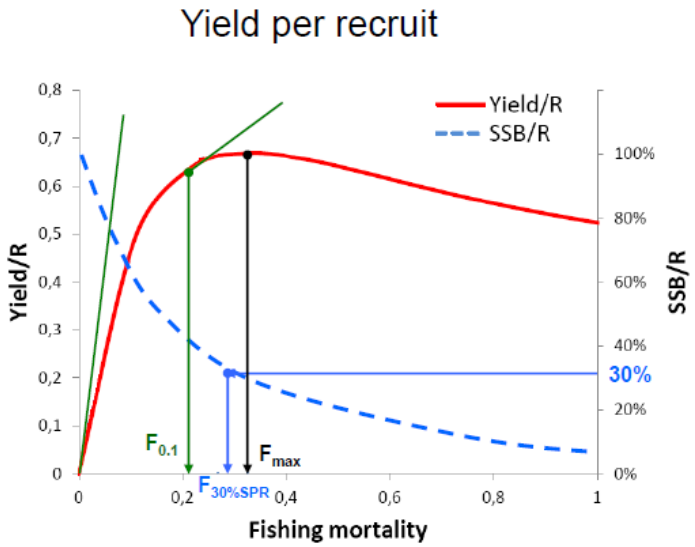


Size at maturity ranges from 95-117mm (female). Haig et al 2016

Stock Assessments

Assessment of exploitation status and stock status: Methods

1. Length cohort analysis (LCA).
    a. Estimates annual F (Fishing mortality rate) and presented in a Yield per recruit and biomass per recruit context (Scotland, Ireland).
    b. Estimates F and reconstructs the population biomass using the landings (England and Wales)
2. Trends in stock status indicators
    a. LPUE, DPUE and CPUE (landings, discards, catch per unit effort indicators derived from commercial fleet data) (Ireland, France)



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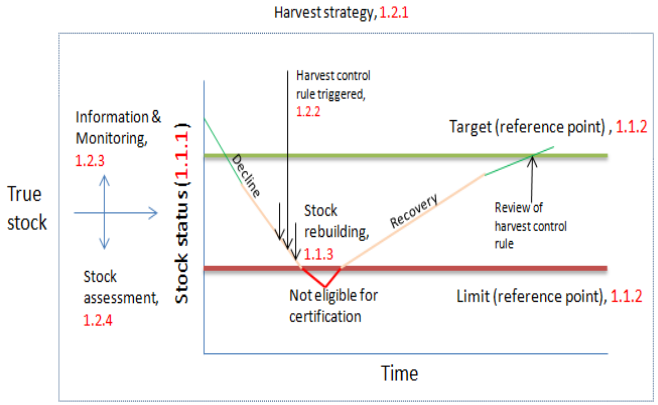
Stock Assessments: reference points

1. **Fishing mortality** reference points
   a. F_{msy} or the fishing mortality that will result in B_{msy} in the long term
2. **Stock biomass** reference points
   a. Target: SPR35% or the spawning potential per recruit that produces 35% of the unexploited level of egg production. This is a proxy for B_{msy}.
   b. Limit: Defined as $0.5B_{msy}$ or otherwise SPR 10%.
3. **Catch rate indicators** are assumed to be proxies for stock status but reference levels for these indicators are not defined. What CPUE corresponds to F_{msy} or B_{msy}?



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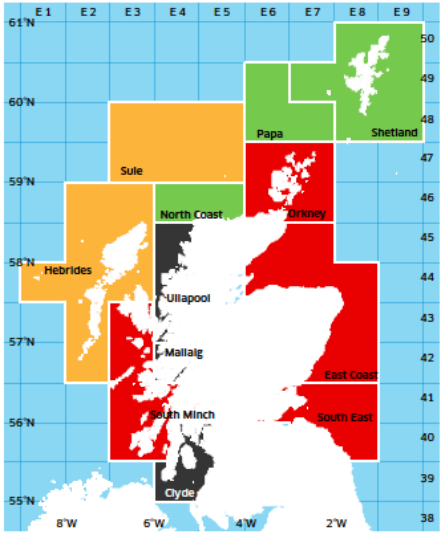
Stock Assessments: length based methods

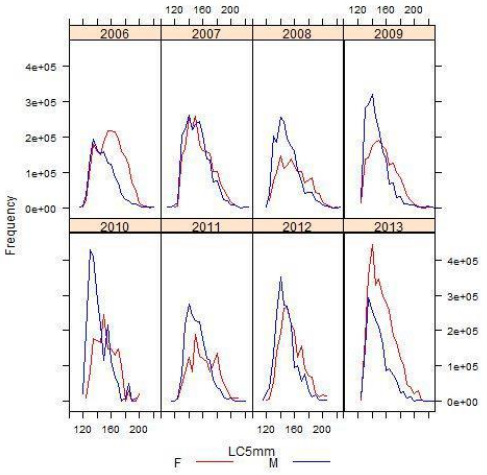
1. Length cohort analysis (LCA).

Marine Science Scotland



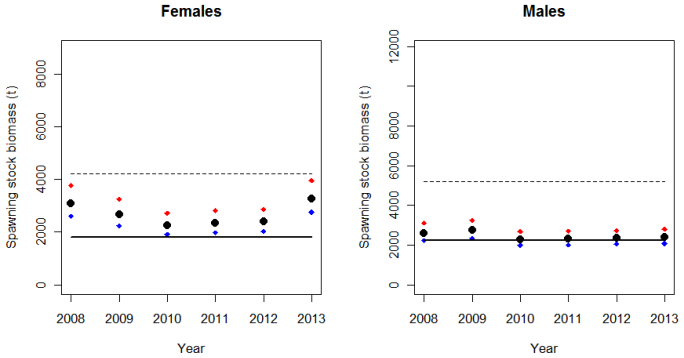
CREEL FISHERY ASSESSMENT UNITS AND ESTIMATED FISHING MORTALITY, 2009 -2012.

- Fishing mortality at or around or below F_{MSY}.
- Fishing mortality above F_{MSY} for either males or females
- Fishing mortality above F_{MSY} for both males and females
- Not assessed for the period 2009 - 2012



CEFAS 2014

F (fishing mortality) is equivalent to the proportion of fish in a given size class taken from the stock annually



SSB from Length based assessment and proxy reference points (35% SPR and 15% SPR)

CEFAS 2014

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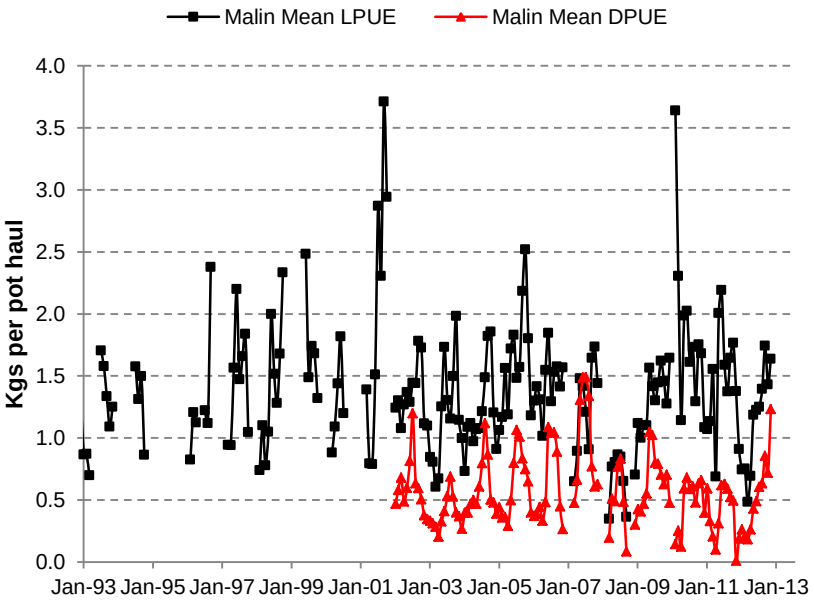
Stock Assessments: indicator trends

2. Trends in stock status indicators

a. LPUE, DPUE and CPUE (landings, discards, catch per unit effort indicators derived from commercial fleet data) (Ireland, France)



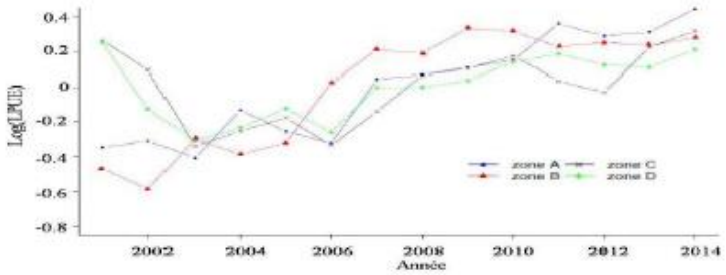


Figure 1. Abundance index in four fishing areas in North Brittany.

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Stock Assessments: Limitations

3. Assumptions and limitations

1. Length Cohort Analysis
    a. Stock is in equilibrium (need to average data across years)
    b. Size composition is responsive to changes in fishing effort
    c. Needs data on growth rate. Growth data is very poor.
    d. Assumes a given natural mortality which is unknown
2. Trends in indicators
    a. Changes in indicators are proportional to changes in stock abundance.

3. Data and biological parameters: representative size structure data?, landings data?, growth, maturity?, representative catch rate data?

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Exploitation and Stock status Summaries for Brown crab stocks

					Exploitation status		Stock status		MLS	
					F (in relation to F_{msy})		B (in relation to Bmsy proxies)			
ICES	Stock Assessment Unit	Main Fleets	Assessment Lab	Assessment	Male	Female	Male	Female	Male	Female
VII	Western Channel	England, France	CEFAS	LCA	F<Fmsy	F<Fmsy	High	High	140-160	140-150
VII	Eastern Channel	England, France	CEFAS	LCA	F=>Fmsy	F=>Fmsy	Moderate	Moderate	130-140	130-140
VII	Celtic Sea, SE Ireland	Ireland, UK, France	CEFAS, IFREMER, MI	LCA, Trends	Unreported	F=>Fmsy	Unreported	High	130-160	130-150
VII	SW Ireland	Ireland	MI	Trends	Unreported	Unreported	Stable	Stable	130	130
VII, VI	Malin	Ireland, N.Ireland, Scotland	MI	Trends	Unreported	Unreported	Stable	Stable	130	130
VII	N Irish Sea	Ireland, IoM, Wales, England	MI	Trends	Unreported	Unreported	Unreported	Unreported	130	130
VI	Clyde	Northern Ireland, Scotland	MSS	LCA per recruit	Unreported	Unreported	Unreported	Unreported	140	140
VI	South Minch	Scotland	MSS	LCA per recruit	F>Fmsy	F>Fmsy	Unreported	Unreported	140	140
VI	Mallaig	Scotland	MSS	LCA per recruit	Unknown	Unknown	Unreported	Unreported	140	140
VI	Hebrides	Scotland	MSS	LCA per recruit	F<Fmsy	F>Fmsy	Unreported	Unreported	140	140
VI	Ullapool	Scotland	MSS	LCA per recruit	Unknown	Unknown	Unreported	Unreported	140	140
VI	North Coast	Scotland	MSS	LCA per recruit	F<Fmsy	F<Fmsy	Unreported	Unreported	140	140
VI	Sule	Scotland	MSS	LCA per recruit	F=Fmsy	F>Fmsy	Unreported	Unreported	140	140
IV	Orkney	Scotland	MSS	LCA per recruit	F>Fmsy	F>Fmsy	Unreported	Unreported	140	140
IV	Papa	Scotland	MSS	LCA per recruit	F<Fmsy	F<Fmsy	Unreported	Unreported	140	140
IV	Shetland	Shetland	MSS	LCA per recruit	F=Fmsy	F<Fmsy	Unreported	Unreported	140	140
IV	East Coast	Scotland	MSS	LCA per recruit	F>Fmsy	F>Fmsy	Unreported	Unreported	140	140
IV	South East	Scotland, England	MSS	LCA per recruit	F>Fmsy	F>Fmsy	Unreported	Unreported	130	130
IV	Central North Sea	England, Ireland	CEFAS	LCA	F>Fmsy	F>Fmsy	Low	Low	130-140	130-140
IV	Southern North Sea	England, Ireland	CEFAS	LCA	F>Fmsy	F>Fmsy	Low	Low	115-130	115-130

New Approaches to Assessment

ICES Data Limited Stocks framework

ICES working groups
- WKLIFE
- WGPROXY

Collection of methods validated by expert groups:
- Length-Based Indicators (LBI)
- Length-Based Spawning Potential Ratio (SPR)
- Surplus production model (SPiCT)
- …

Attempt to use all available data => stock status relative to MSY.

- Length-frequency distribution
- Life history parameter estimates

- Catch over time
- Survey index/CPUEs/Effort series
- Life history parameters estimates

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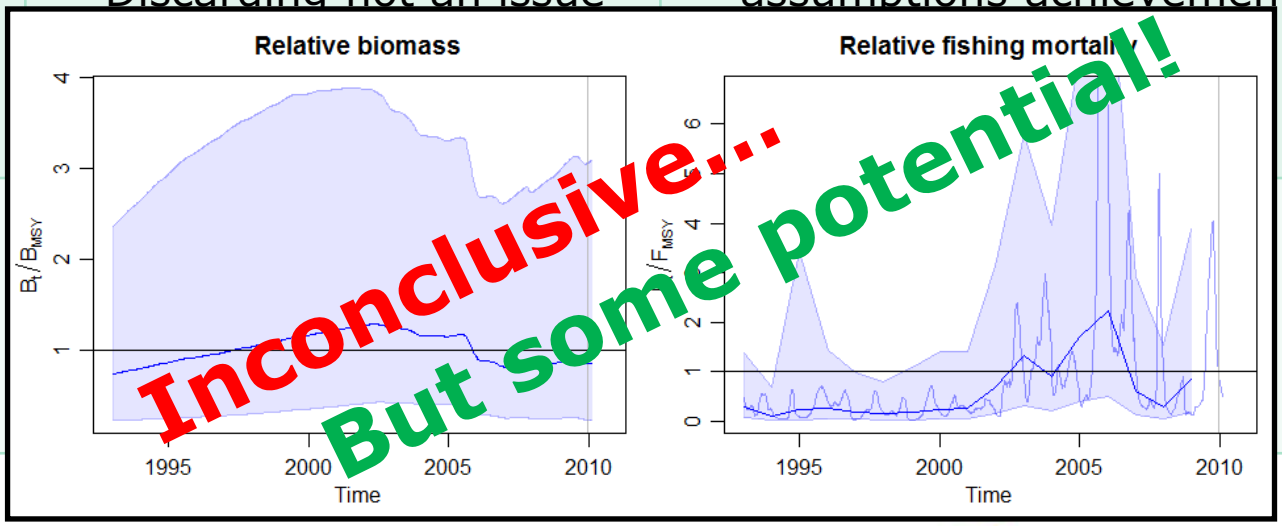
New Approaches to Assessment – Brown crab

Methods (to be) tested:

Length-based indicators	• Easy implementation • Discarding not an issue (high survival).	• F_{MSY} proxy only • No uncertainty
Length-based Spawning Potential Ratio	• Easy implementation • Discarding not an issue	• Sensitivity to assumptions achievement
SPiCT (ongoing tests, NW Ireland)		



New Approaches to Assessment – Brown crab

Uncertainty on achievement of assumptions and data quality:

1. Equilibrium?
2. **Representativeness of length distribution** in catch?
3. **Responsiveness of indices** (LPUEs/CPUEs) to changes in the population abundance?
4. Life history traits (spatial/temporal variability?)
   … notably **Growth!**

Outcome of data scarcity/quality issue:

Requests for more conservative advices as uncertainty increases.

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Improved data provision:

Priorities

a) Landings data especially for vessels under 10m
    a) By-catch volumes in non targeting gears
b) Increase data for stock status indicators (CPUE)
    a) Spatially referenced
    b) Co-variates for standardising (gear type, soak time)
c) Size composition of the catch or landings
    a) Spatial coverage, seasonal coverage. Has to be unbiased!
d) Growth rates
    a) Moult increment and frequency for commercial size classes
e) Maturity
    a) New data recently published (Haig et al 2016)

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Assessment advice relative to changes in management

Choosing methods:

a) The assessment output should be able to track changes in stock when new management measures are adopted!
b) Assessment should be benchmarked against certain criteria
    a) Responsiveness; feedback on management plans
    b) Resolution or sensitivity
    c) Costs and durability

Which management measures?

a) Technical measures
b) Effort limitation
c) Catch limits and TAC advice?

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