Skates in northern Europe:
Status, management and future issues

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NWWAC Focus Group on Skates and Rays

Centre for Environment
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Science

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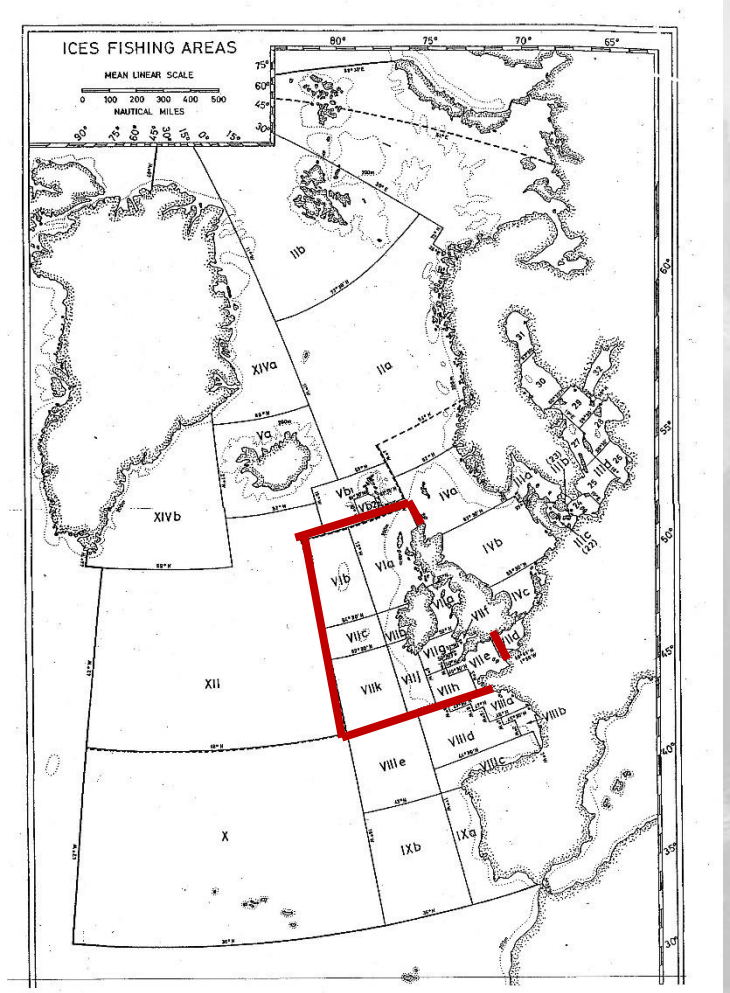
Overview of talk

- Skates in northern Europe
- The work of WGEF
- Status of stocks
- Recent management
- Current issues and data gaps



Skates in northern Europe

Thornback ray
Raja clavata
RJC

FR: Raie bouclée
ES: Raya de clavos

Spotted ray
Raja montagui
RJM

FR: Raie douce
ES: Raya pintada

Small-eyed ray
Raja microocellata
RJE

FR: Raie mêlée
ES: Raya colorada

Blonde ray
Raja brachyura
RJH

FR: Raie lisse
ES: Raya boca de rosa

Undulate ray
Raja undulata
RJU

FR: Raie brunette
ES: Raya mosaica

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Genus *Raja*

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Cuckoo ray
Leucoraja naevus
RJN

FR: Raie fleurie
ES: Raya santiguesa

Shagreen ray
Leucoraja fullonica
RJF

FR: Raie chardon
ES: Raya cardadora

Sandy ray
Leucoraja circularis
RJI

FR: Raie circulaire
ES: Raya falsa vela

Common skate
Dipturus batis
RJB

FR: Pocheteau gris
ES: Noriega

Blue skate
Dipturus batis

Flapper skate
Dipturus intermedia

White skate
Rostroraja alba
RJA

FR: Raie blanche
ES: Raya bramante

Dipturus and *Rostroraja*

The work of WGEF

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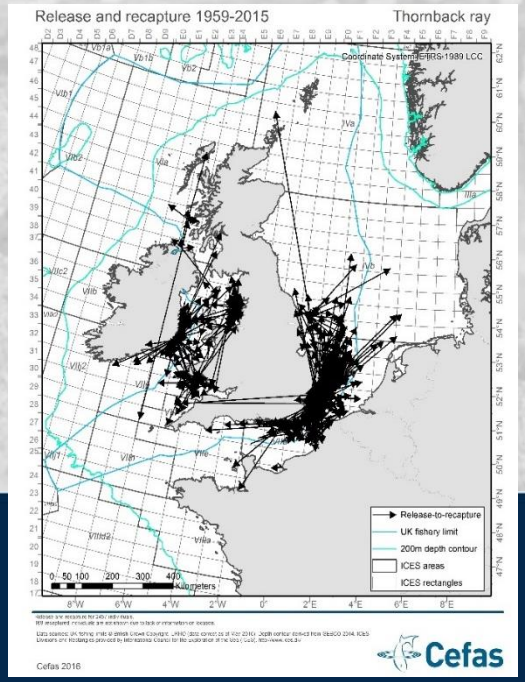
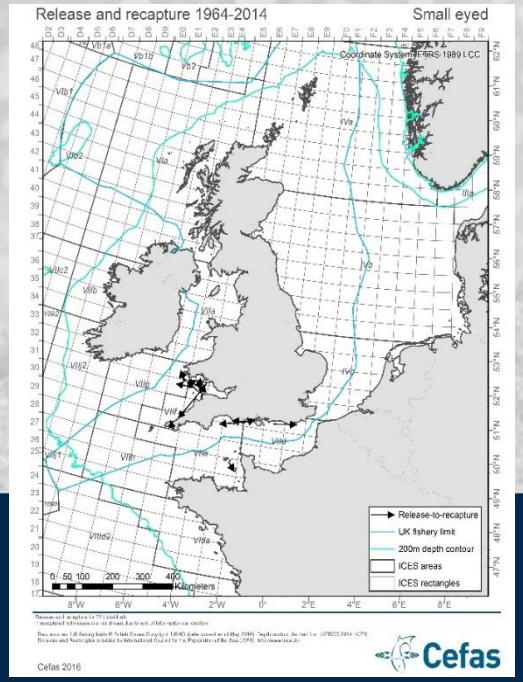
Assessing the stocks

- Mostly based on analyses of survey trends
  - Longest time series of species-specific information
- Some advice based on qualitative '*then v now*' information
- Some stocks are too data-limited
  - e.g. stocks on continental slope, or in very coastal waters
- Landings data variable (catch data uncertain)
  - ICES re-examined landings data in 2016
  - ICES will examine observer data (discards etc.) in 2017
- Stock structure and other aspects of biology uncertain

Stock structure

- Stock structure uncertain for many species
- Some tagging studies, but data lacking for some parts of range
- Few genetic studies
- Some inferred ‘barriers’ due to unsuitable habitat
- Landings of some species from some ICES divisions not yet assigned to stocks





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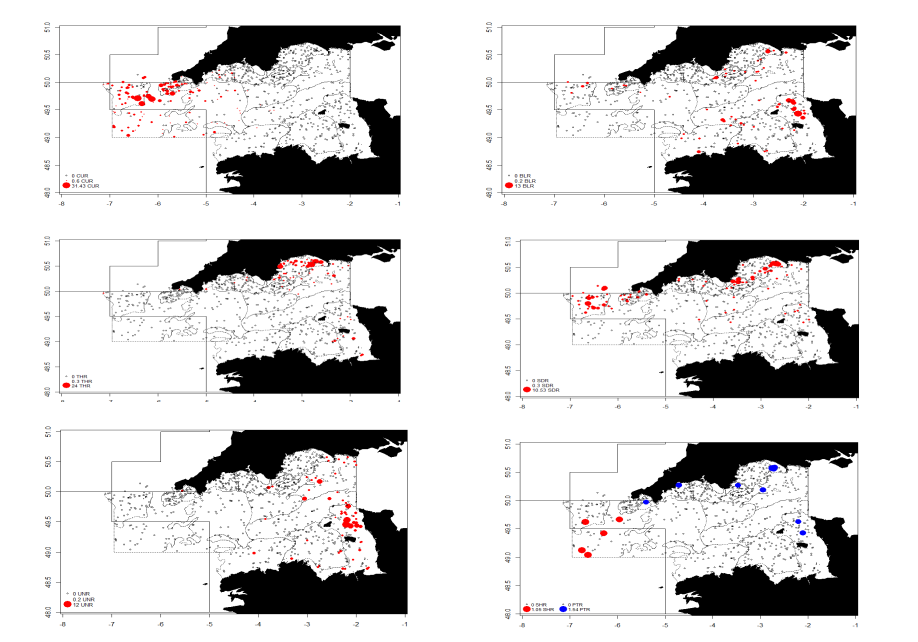
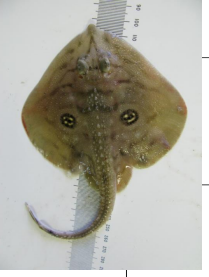
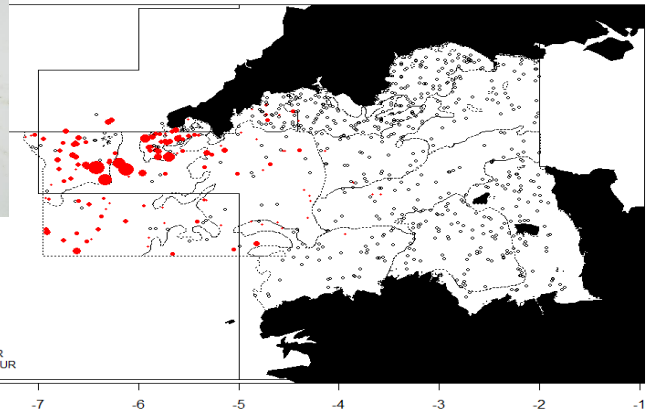
Stock structure II

- Some regional stocks show similar spatial distributions
- English Channel contains different boundaries for various species
- Data limited (Feb-Mar; beam trawl), but indicates that Division 7.e has closer affinity to Celtic Sea for some skate species, sometimes more connectivity with 7.d



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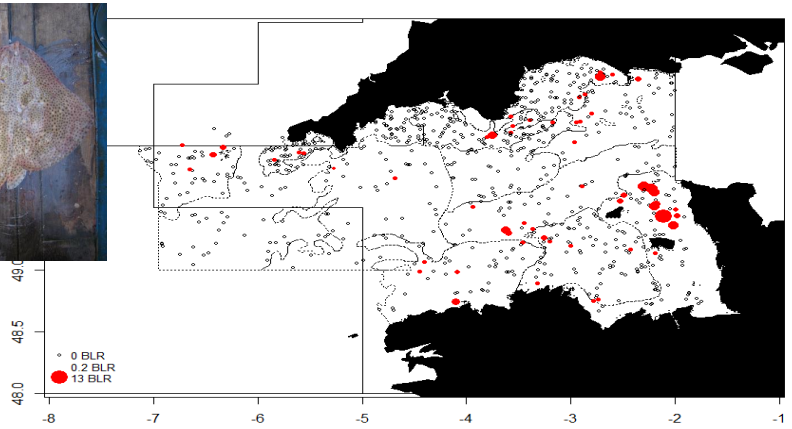
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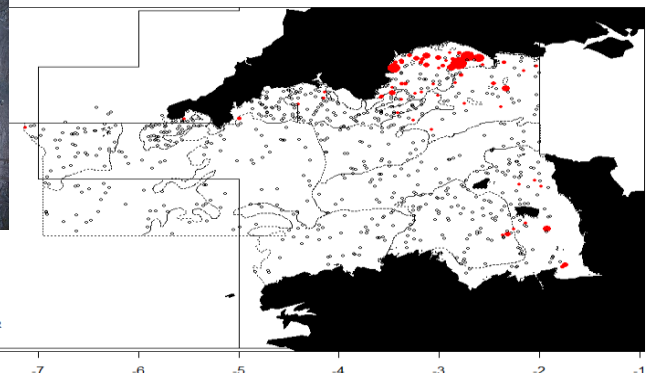
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0.2 UNR
12 UNR

0 SHR
1.05 SHR
0 PTR
1.54 PTR

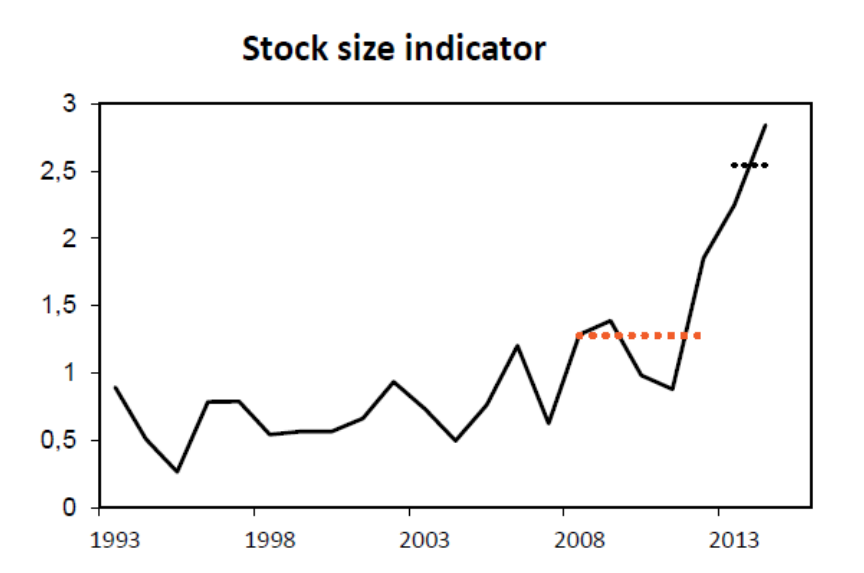
ICES WGEF examine 12 skate species (38 stocks)
Starry ray *Amblyraja radiata* in 1 management area
Common skate *Dipturus batis* complex in 3 management areas
Sandy ray *Leucoraja circularis* in 1 management area
Shagreen ray *L. fullonica* in 1 management area
Cuckoo ray *L. naevus* in 4 management/stock areas
Blonde ray *Raja brachyura* in 5 stock areas
Thornback ray *R. clavata* in 6 stock areas
Small-eyed ray *R. microocellata* in 2 stock areas
Spotted ray *R. montagui* in 5 stock areas
Undulate ray *R. undulata* in 5 stock areas
White skate *Rostroraja alba* in the Northeast Atlantic
"Other skates and rays" in 4 ecoregions

Trawl surveys

- Variety of bottom trawl surveys (GOV, baca, beam trawl)
- Whilst not designed specifically for elasmobranchs, they are usually the best time series of species-specific data for most demersal elasmobranchs
- Don’t sample all species / sizes effectively (e.g. optimal habitat may not be surveyed; may be poor spatial overlap between survey and stock; may be low catchability in gear; limited swept area in beam trawl surveys)

Use in ICES advice

- Data from standardised trawl surveys normalised to long-term mean. Mean of most recent 2 years compared to the mean of the preceding 5 years
- Uncertainty cap (increases cannot be >20%)
- Precautionary buffer (–20%) applied (once) when uncertainty on whether the stock is fished sustainably
- Example: *Raja clavata* in Division 7.d and subarea 4

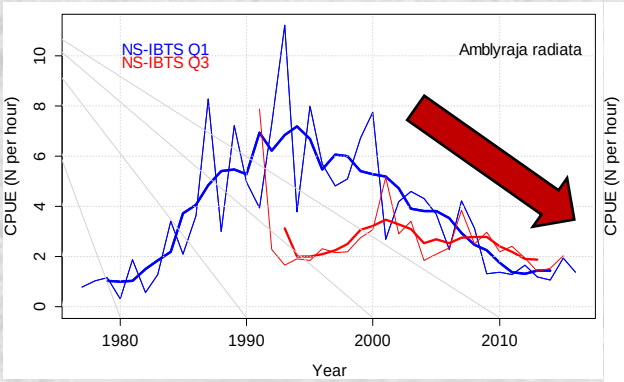


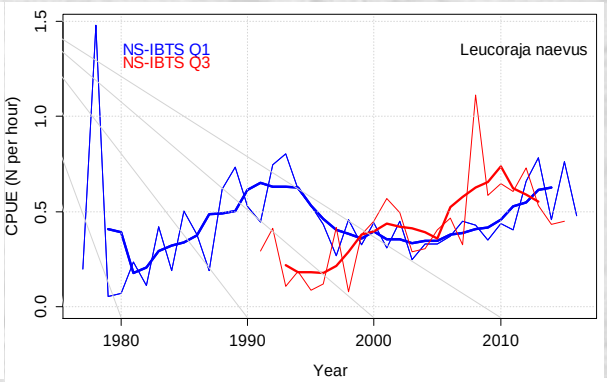
Skate complex

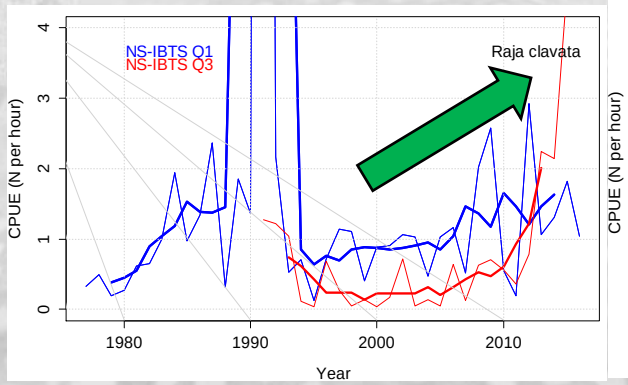
- ICES currently examine individual stocks
- Over the longer-term, larger-bodied species (e.g. RJB, RJA) declined and smaller-bodied species proportionally increased
- If there is ‘competition’ or multispecies interactions, can all skate species increase?
- Future studies required to look at overall skate complex and species composition

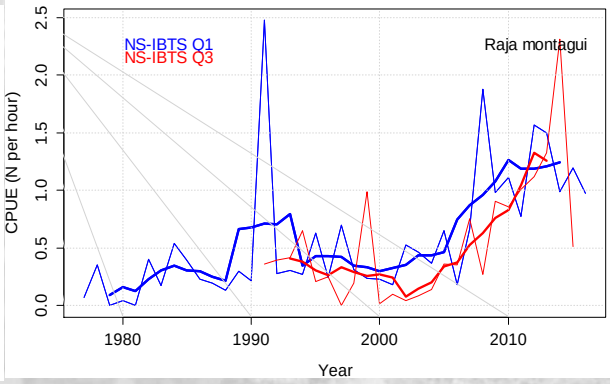
Skate complex

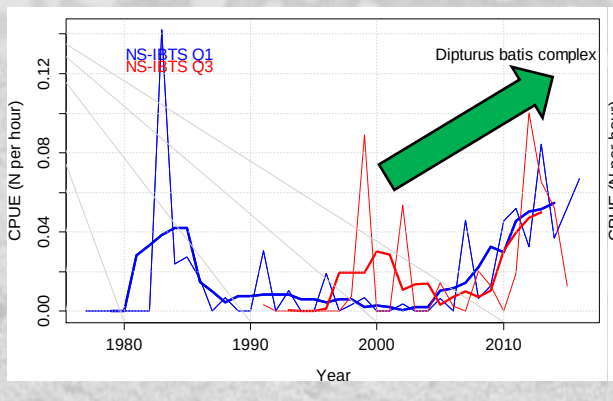
- In North Sea, starry ray now declining and larger species increasing
- Species ID?
- Multispecies interactions?
- Sea temperature?

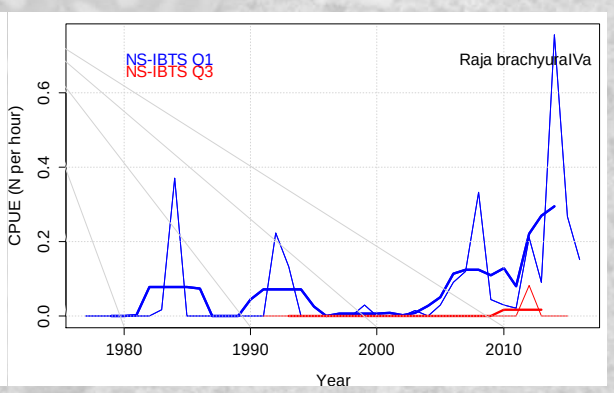












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See also:
Sguotti, C., Lynam, C. P., García-Carreras, B., Ellis, J. R. and Engelhard, G. H. (2016). The distribution of skates and sharks in the North Sea: 112 years of change. *Global Change Biology*, 22: 2729–2743.

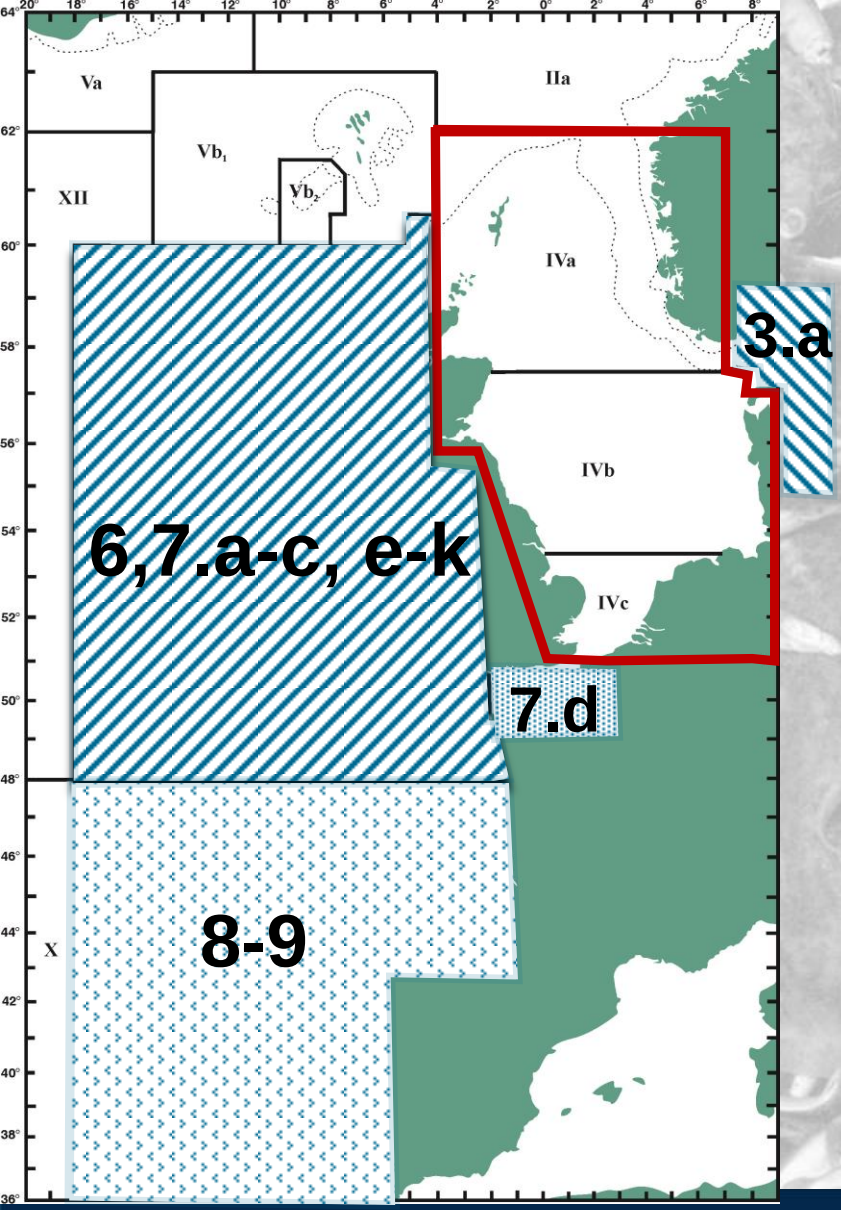
Cefas

Status of stocks

Species	Stock Unit	Survey trend / comment
RJC Thornback ray	6	⇩	Recent ⇩, overall survey trend ⇧
	7.a.f.g	⇧	Overall survey trend ⇧
	7.e	?	
RJM Spotted ray	6, 7.b.j	⇧	
	7.a.e-h	⇧	Overall survey trend ⇧
RJH Blonde ray	7.a.f.g	?	Survey data limited, possible ⇧
	7.e	?	
	6, 4.a	?	Survey data limited, possible ⇧
RJE Small-eyed ray	7.d.e	?	
	7.f.g	⇩	Recent ⇩, overall survey trend ⇔
RJU Undulate ray	7.b.j	?	Concern over fragmented stock
	7.d.e	⇧	
RJN Cuckoo ray	6, 7, 8.a.b.d	⇧	Overall survey trend ⇔
RJI Sandy ray	6, 7	?	
RJF Shagreen ray	6, 7	?	
RJB Common skate	(6,7)	?	Declined (locally common)
RJA White skate	(NE Atlantic)	☒	“Near extirpated”

Species	Stock Unit	ICES advised landings for 2017	
RJC Thornback ray	6	**145 t**	
	7.a.f.g	**1 386 t**	
	7.e	**212 t**	
RJM Spotted ray	6, 7.b.j	**67 t**	
	7.a.e-h	**1 197 t**	
RJH Blonde ray	7.a.f.g	**895 t**	
	7.e	**333 t**	
	6, 4.a	**6 t**	Stock extends to 4.a
RJE Small-eyed ray	7.d.e	**36 t**	Stock extends to 7.d
	7.f.g	**154 t**	
RJU Undulate ray	7.b.j	**0 t**	
	7.d.e	**65 t**	Stock extends to 7.d
RJN Cuckoo ray	6, 7, 8.a.b.d	**2 734 t**	Stock extends to Biscay
RJI Sandy ray	6, 7	**42 t**	
RJF Shagreen ray	6, 7	**210 t**	
RJB Common skate	(6,7)	**0 t**	
RJA White skate	(NE Atlantic)	**Prohibited**	

Recent management



1999: TAC for skates and rays in North Sea and EU waters of 2.a

2008: Species-specific reporting in North Sea

2009: TAC for skates and rays in other areas:

- 3.a
- 6,7.a-c.e-k;
- 7.d
- 8-9

Main skate species to be recorded separately

History of TAC

Year	6,7.a-c, e-k		7.d	
2009		15 748 t		1 044 t
2010	⇩	13 387 t	⇩	887 t
2011	⇩	11 379 t	⇔	887 t
2012	⇩	9 915 t	⇔	887 t
2013	⇩	8 924 t	⇩	798 t
2014	⇩	8 032 t	⇔	798 t
2015	⇔	8 032 t	⇔	798 t
2016	⇔	8 032 t	⇧	966 t

Current management and issues

- TACs for skates (at family level)
- Within these TACs, limits on the landings of some species (e.g. RJU, RJE)
- Prohibited species (RJB, RJA)
  - How to translate ICES advice to TAC, when some stocks straddle management areas?
  - *Status quo*? Stock-specific TACs? More regional skate TACs? Genus-based TACs? Spatial management? Length-based restrictions?

Emerging issues and data gaps

Emerging issues

- Quota management: can it be refined as part of ‘regional management’
- MSY and proxies for sustainable exploitation
- Landing obligation
- MSFD and indicators

Regional management

- Current TACs for skates are at Family level
- Area of interest to NWWAC has >10 species of skate, *ca.* 8-10 species of commercial interest
- Important regional differences in skates assemblages, in relation to latitude and depth (*Raja* generally coastal and inner shelf, *Leucoraja* generally further offshore)
- Not just a NWWAC issue: Ensure comparable approaches to other areas (North Sea; Biscay/Iberia)?

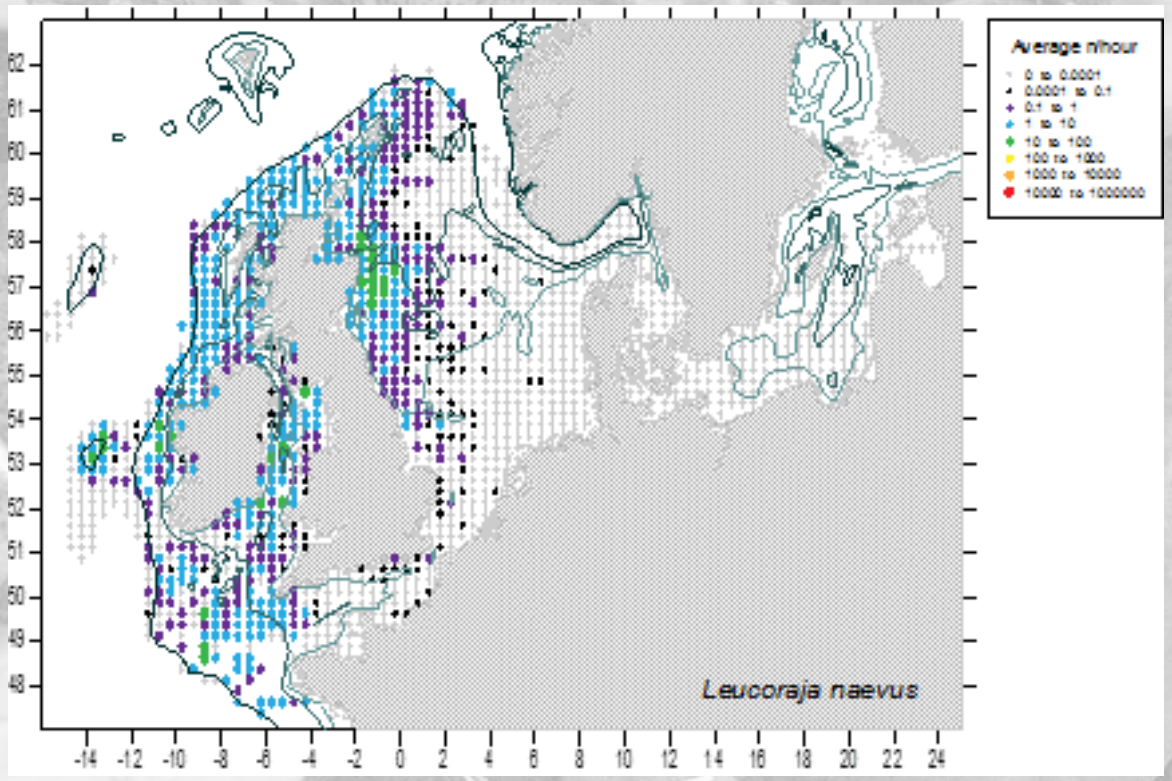
Would Genus-based TACs be more practical?

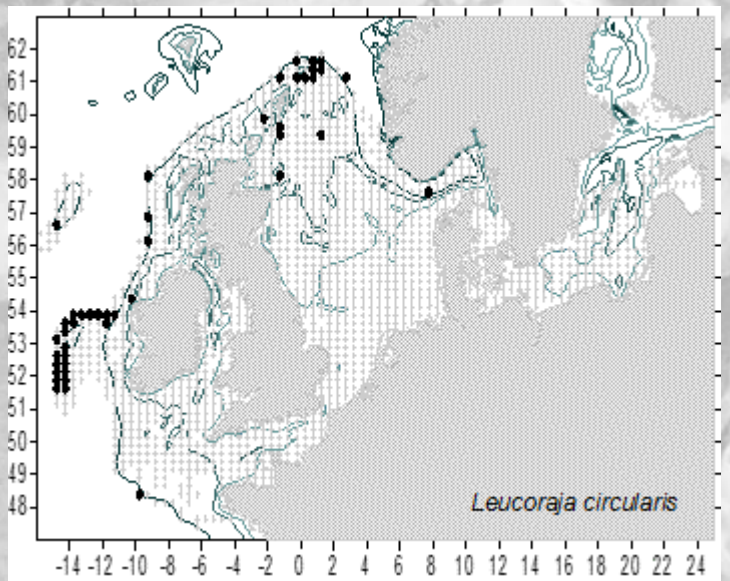
Raja: Blonde ray (RJH), thornback ray (RJC), small-eyed ray (RJE), spotted ray (RJM) and undulate ray (RJU)

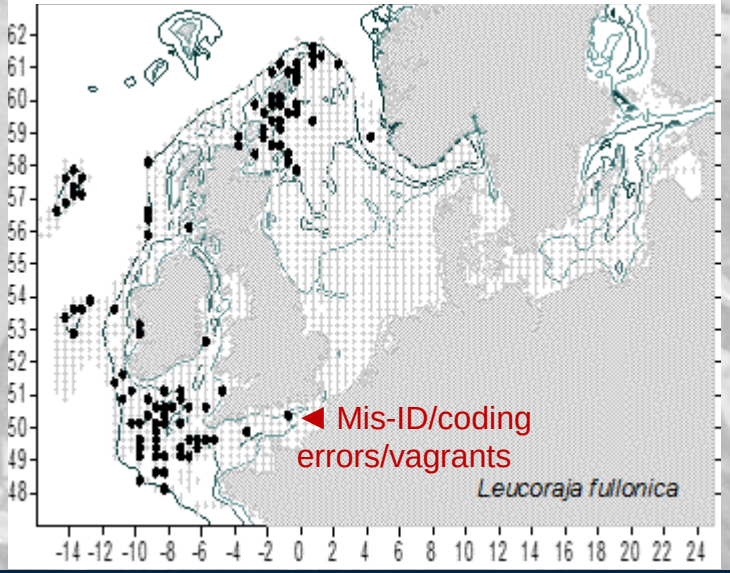
Leucoraja: Cuckoo ray (RJN), shagreen ray (RJF) and sandy ray (RJI)

Dipturus: Common skate complex (RJB), long-nosed skate, Norwegian skate

Distribution of *Leucoraja* spp.







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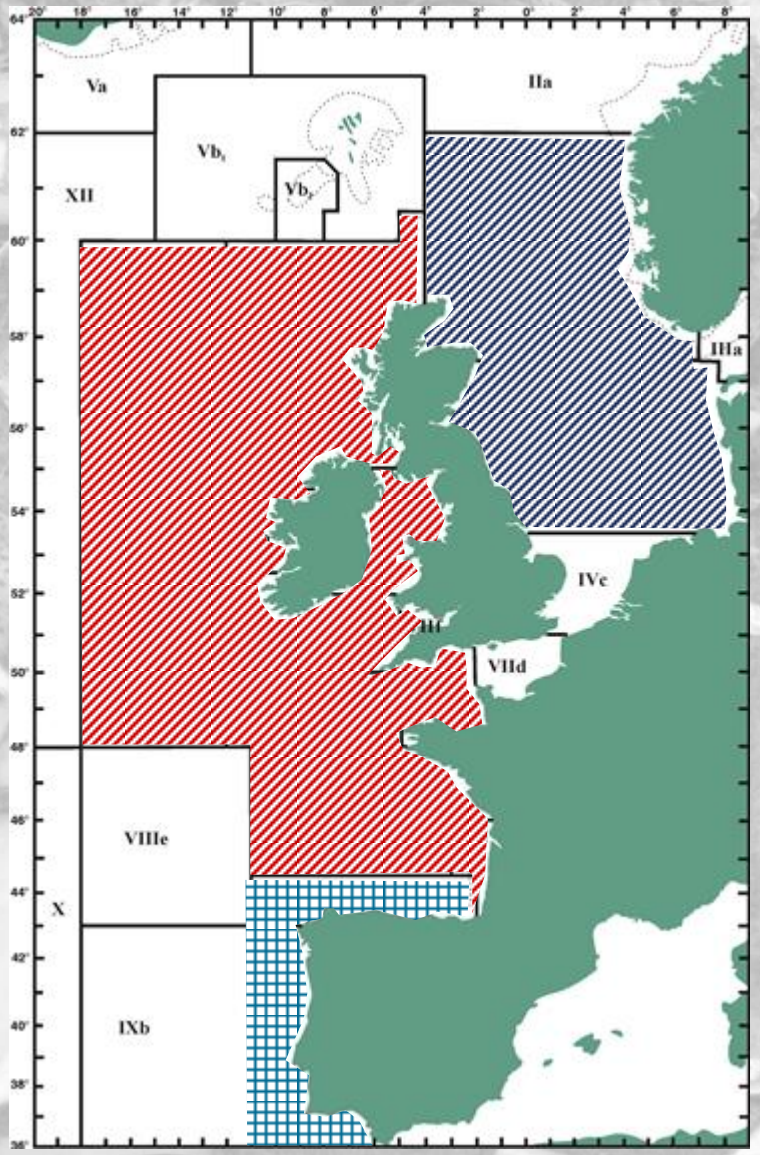
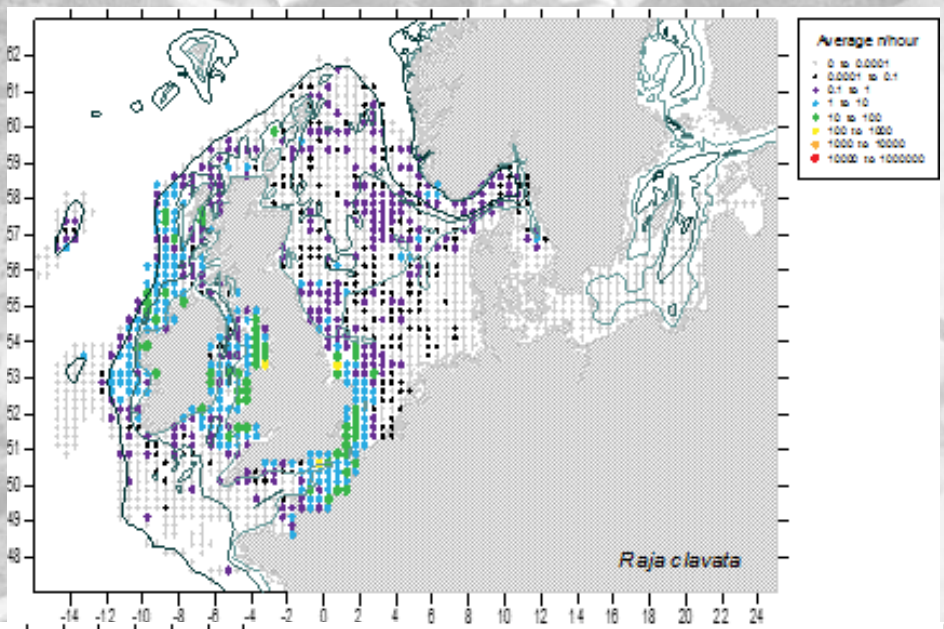
Adapted from:
Heessen, H. J. L., Daan, N. and Ellis, J. R. (Eds.) (2015). Fish atlas of the Celtic Sea, North Sea, and Baltic Sea. Wageningen Academic Publishers / KNNV Publishing, 572 pp.

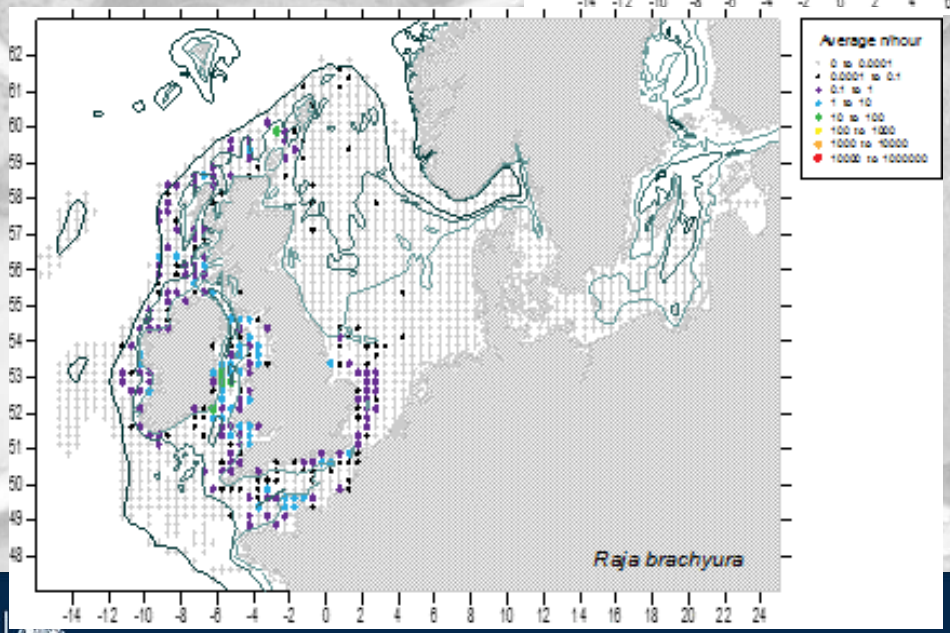
Cefas

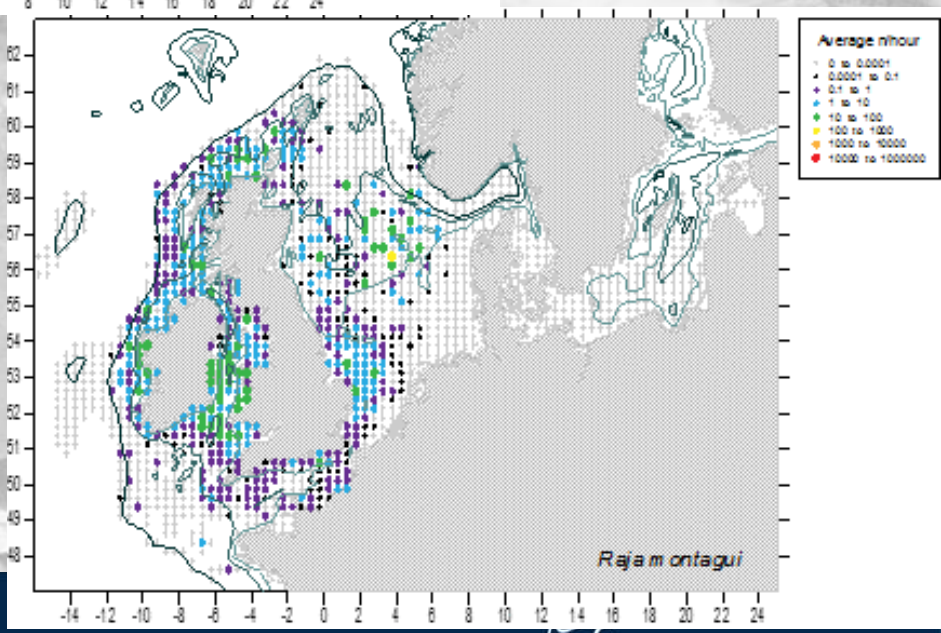


- *Leucoraja* spp. *usually* offshore, with near continuous distribution
- Possible management units of North Sea (4.a.b), Celtic Seas/Biscay (6,7.a-c,e-k, 8.a.b.d.e) and Iberia (8.c, 9.a)
- Catches comprised primarily of RJN
- RJN 'assessment' could inform on fishing opportunities
- RJF and RJI are data limited and stocks of concern. Specific measures (e.g. maximum size, trip limits) could afford some degree of protection to these species

Distribution of *Raja* spp.







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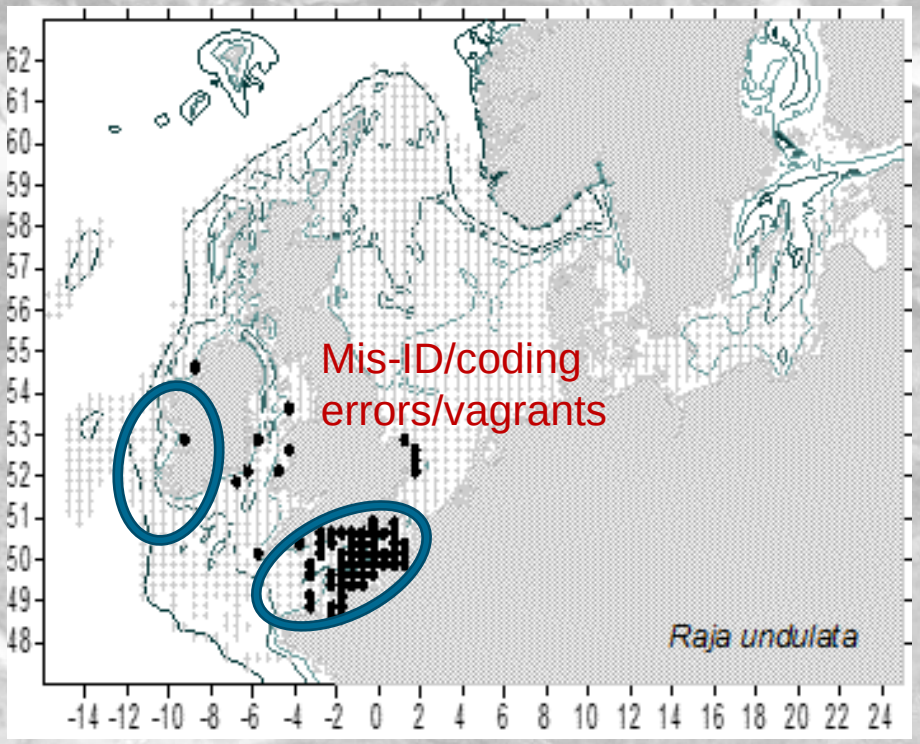
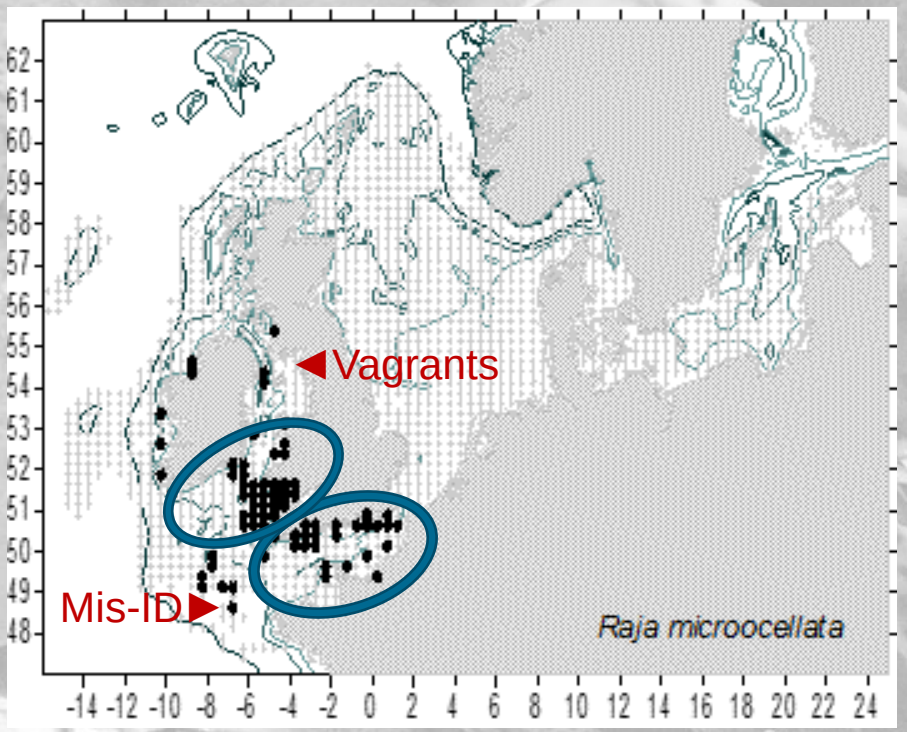
Cefas

Distribution of *Raja* spp. (cont.)





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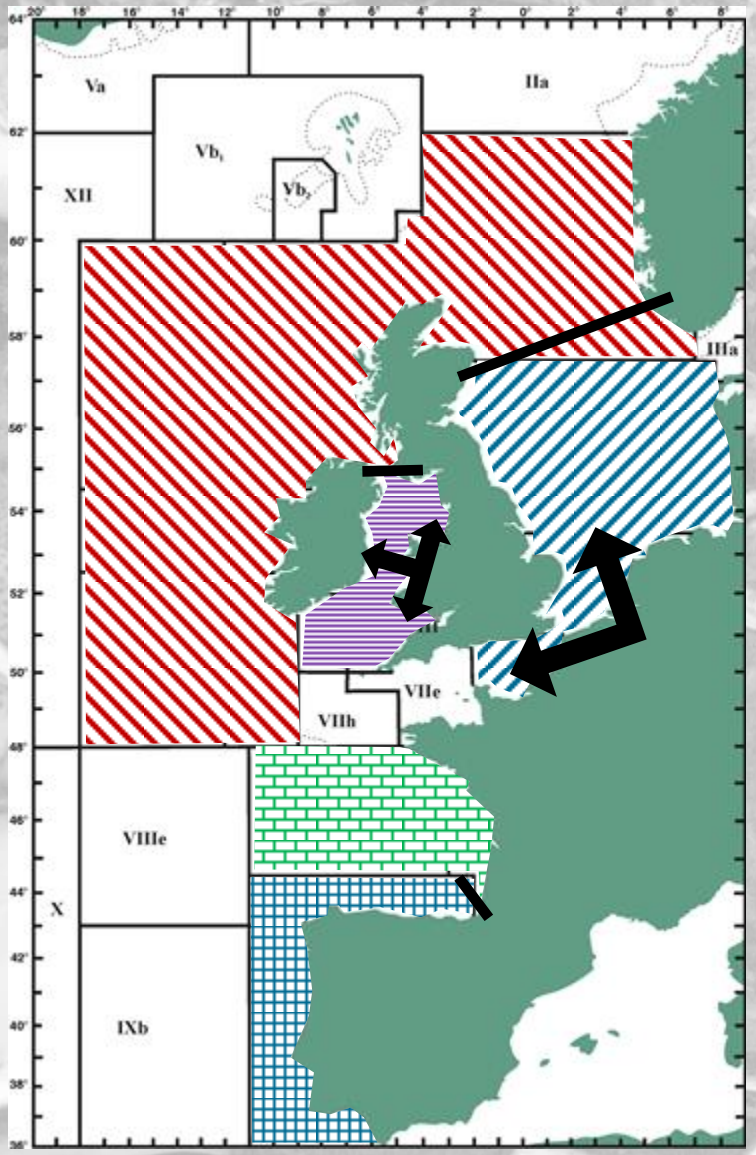
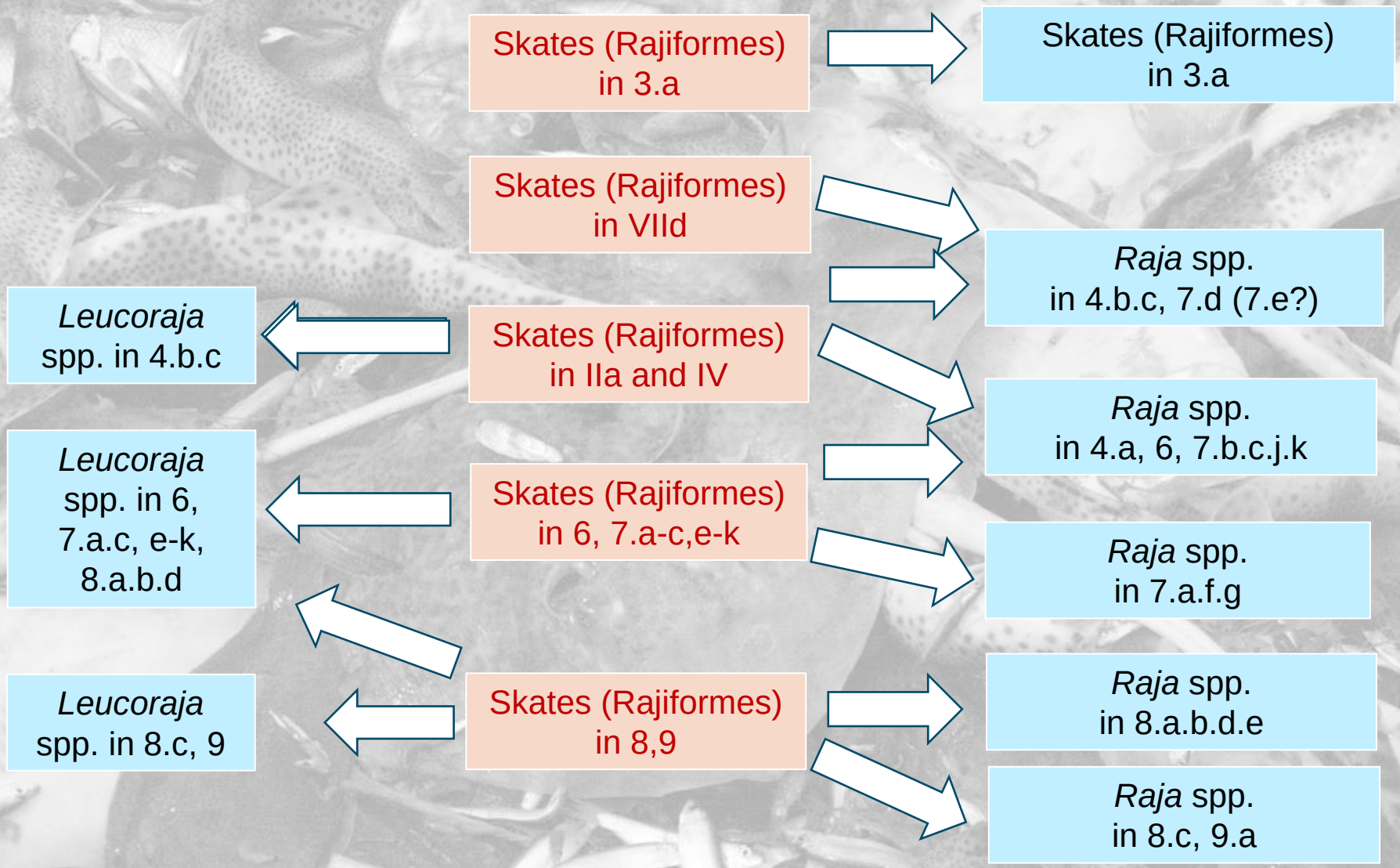


- *Raja* spp. inshore (RJC, RJH), but do extend offshore (RJM) distribution
- North Sea appears to have a split in distributions (at least in recent data)
- Combined 4.b.c-7.d consistent with available tagging data. Extending to 7.e?
- Known connectivity within 7.a.f.g
- North Channel assumed a boundary
- Deep-water between Biscay and Cantabrian shelves assumed a boundary
- *ca.* 5 nominal management units for *Raja* spp.



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Example only

Cefas

- Currently TACs for Rajiformes in **five management areas**
- More than 30 stocks: individual TACs could be complicated, especially as they can be taken in ‘mixed skate’ fisheries
- Is more regional, genus-based management an intermediate solution?

✓ Should allow a clearer link between ‘ICES stock advice’ and TACs

✓ Could allow other management measures to be better targeted to specific, regional issues

? Would it get support from industry and other bodies?

? Potential issues of ‘relative stability’

? Needs scientific consensus for best delineation of units

? Would it increase data needs for derogations from landing obligation

Length-based proxies

- ✓ Length-based parameters usually available
- ✓ Annual length-frequency data usually available (market sampling, surveys, observer programmes)

- ↳ Potential for indicators, reference points and indicator ratios to be calculated (length-based screening)
- ↳ Length-based proxies for state of immature and mature parts of stock as well as MSY
- ↳ Trialled by ICES WKLIFE for *Nephrops* and some teleosts
- ↳ Exploratory studies for elasmobranchs in 2017

Length-based parameters

Term	Description	Thornback ray	Cuckoo ray
L_{birth}	Length at birth or hatching	10 cm	10 cm
L_{mat}	Length at 50% maturity	76.6 cm	59.8 cm (F)
L_{max}	Maximum length observed	115 cm (130 cm)	72 cm
L_{inf}	Von Bertalanffy growth parameter	107-139 cm	74.6 cm (M) 83.9 cm (F)
L_C	Length at 'first capture'	-	-
L_{Opt}	2/3 L_{Inf}	-	-

- L_{birth}, L_{max} and L_{mat} usually known
- Published estimates of L_{inf} variable quality
- L_C needs to be defined more explicitly (fleet specific?)

McCully, S. R., Scott F. and Ellis J. R. (2012). Length at maturity and conversion factors for skates (Rajidae) around the British Isles, with a critique of earlier studies. *ICES Journal of Marine Science*, 69: 1812–1822.

Length-based indicators

Indicator	Calculation	Indicator ratio	Expected value
$L_{Max5\%}$	Mean length of largest 5%	$L_{Max5\%} / L_{inf}$	> 0.8
$L_{95\%}$	95th percentile	$L_{95\%} / L_{inf}$	> 0.8
P_{Mega}	Proportion of ind. > L_{Opt} + 10%	-	> 0.3
$L_{25\%}$	25th percentile	$L_{25\%} / L_{mat}$	> 1.0
L_C	Length at 'first capture'	L_C / L_{mat}	> 1.0
L_{Mean}	Mean length of ind. > L_C	$L_{Mean} / LF=M$ (where LF = M = $(0.75.L_C+0.25L_{inf})$	≥ 1.0

ICES. 2015. Report of the Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V), 5–9 October 2015, Lisbon, Portugal. ICES CM 2015/ACOM:56; 157 pp.

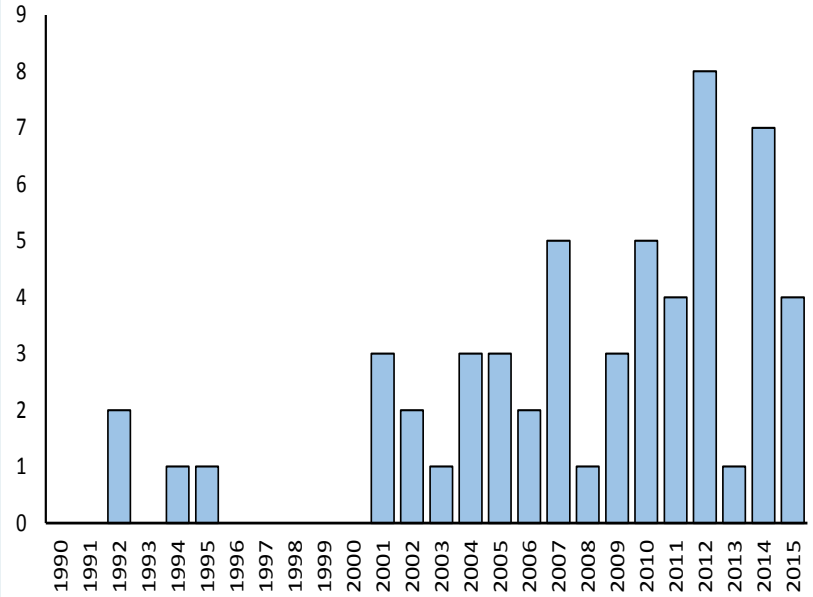
Landing obligation

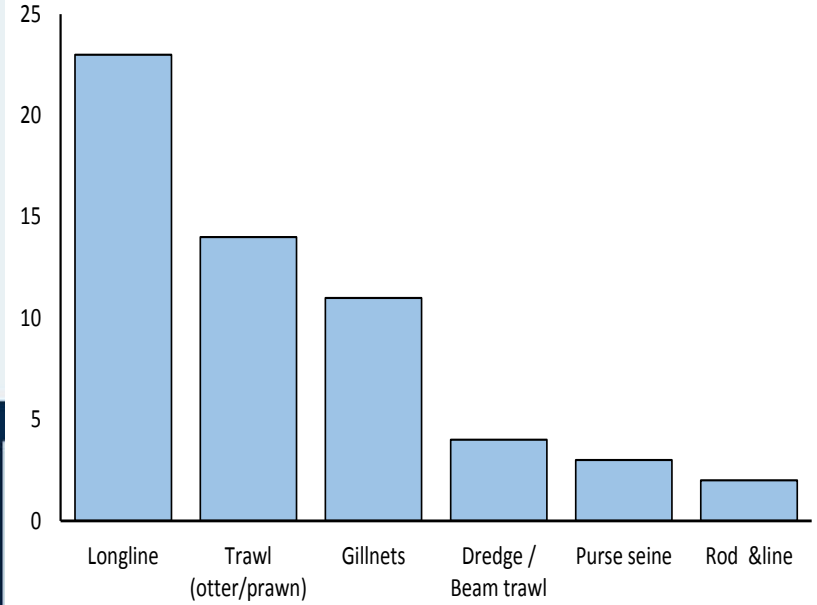
- Affects all quota species, except for ‘prohibited species’, catches falling under *de minimis* exemptions and species with high survival
- Mortality includes ‘*At-vessel mortality’* (proportion of the catch that is dead when the gear is brought aboard) and ‘*post-release mortality’* (proportion of fish discarded ‘alive’ that die due to injuries sustained or physical impairment, including predation by scavengers)
- Data on discard survival will be required for skates and spurdog

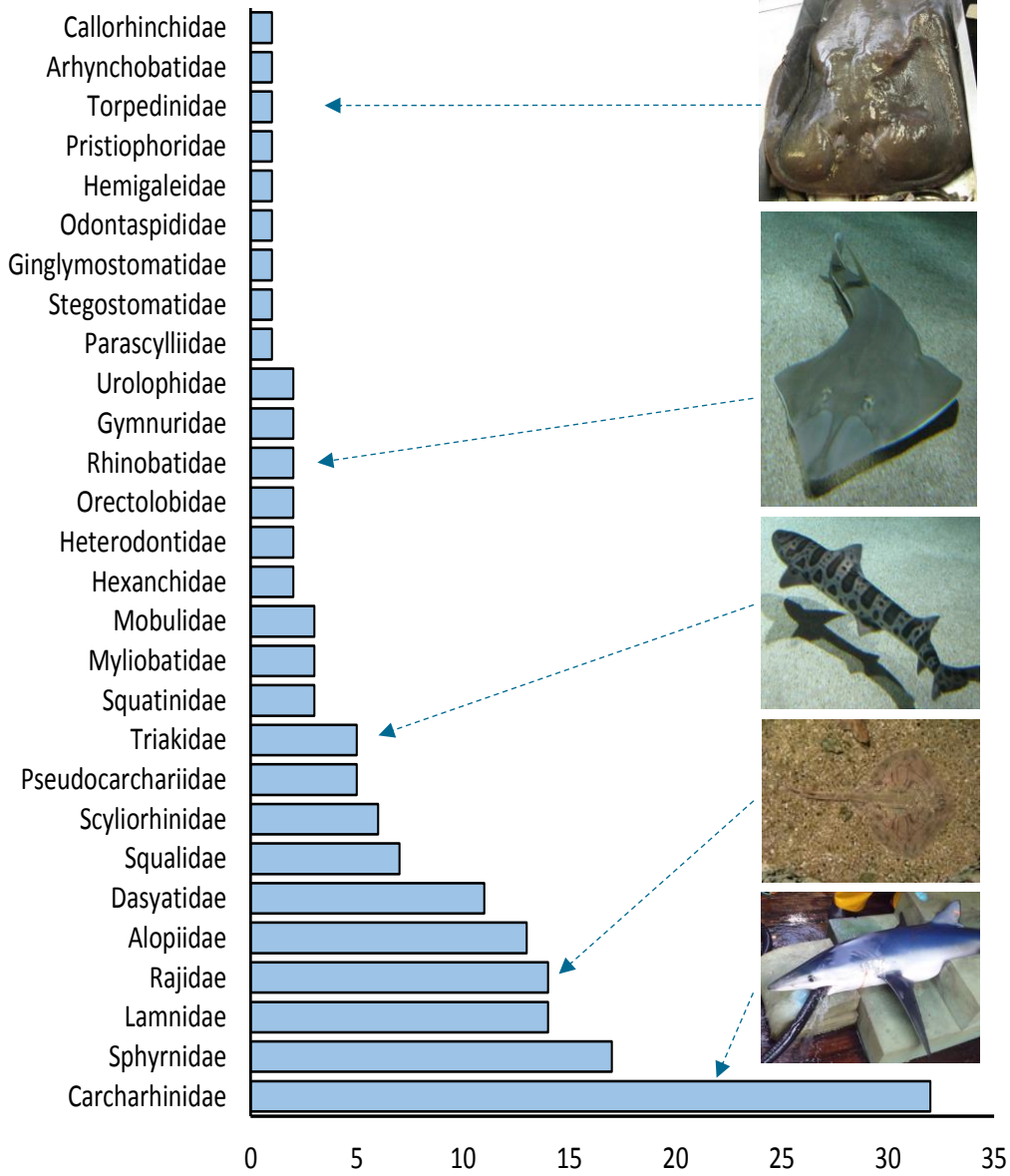


Ellis, J. R., McCully Phillips, S. R. & Poisson, F. (In press). A review of capture mortality of elasmobranch fish. *Journal of Fish Biology*

Published studies and grey literature

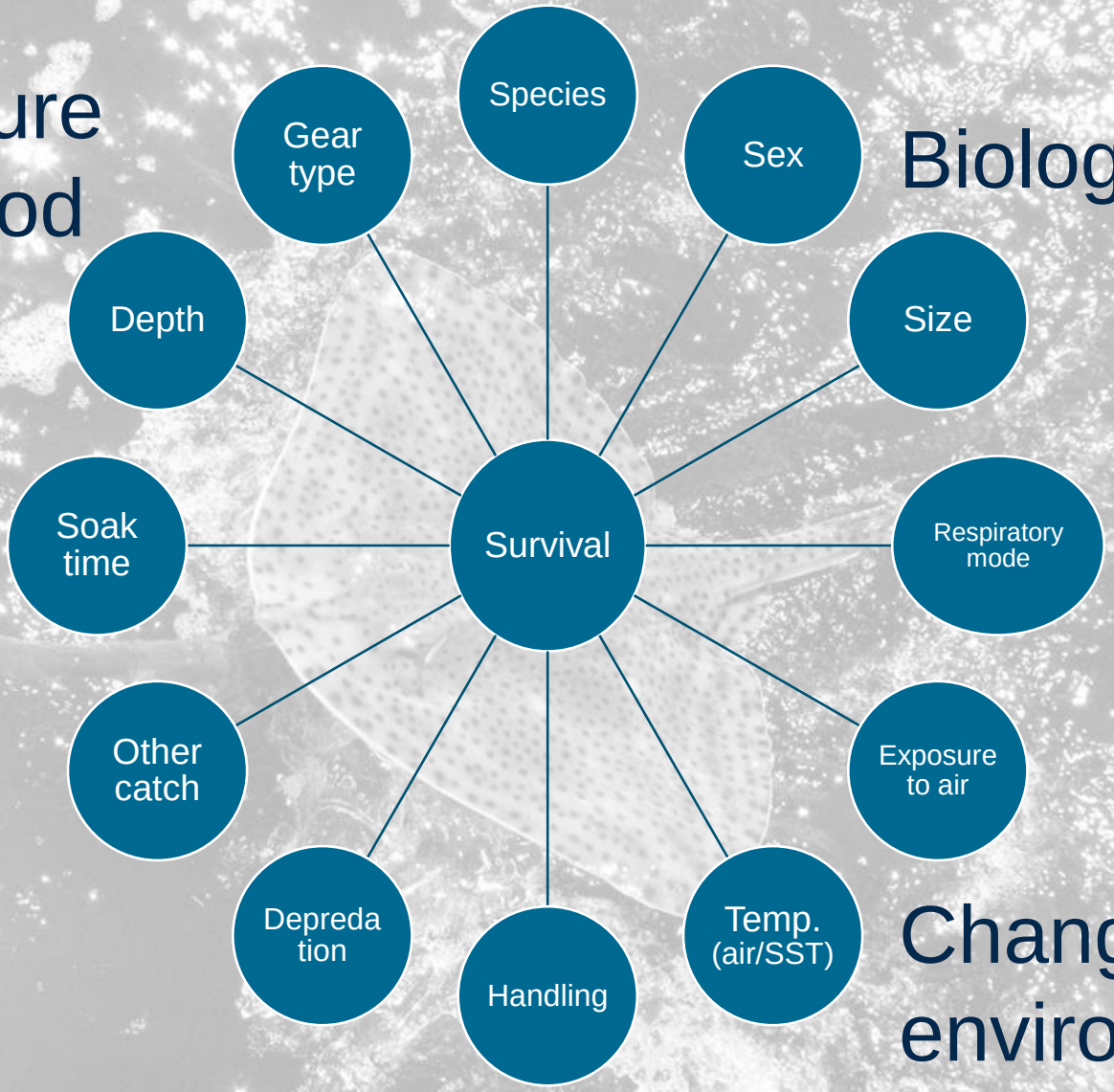






Capture method

Biology



Change in environment

At-vessel mortality may be low: Thornback ray in the southern North Sea

Vessel	Gear	Lively		Sluggish		Dead	
		No.	%	No.	%	No.	%
Vessel A	Trawl	591	63.1	323	34.5	22	2.4
Vessel B	Trawl	1 608	91.3	152	8.6	1	0.1
Vessel C	Trawl	1 122	99.7	3	0.3		
Vessel C	Longline	104	94.5	6	5.5		
Vessel D	Longline	690	97.6	17	2.4		
Vessel D	Gillnet	388	73.2	142	26.8		
Vessel E	Gillnet	436	98.0			9	2.0

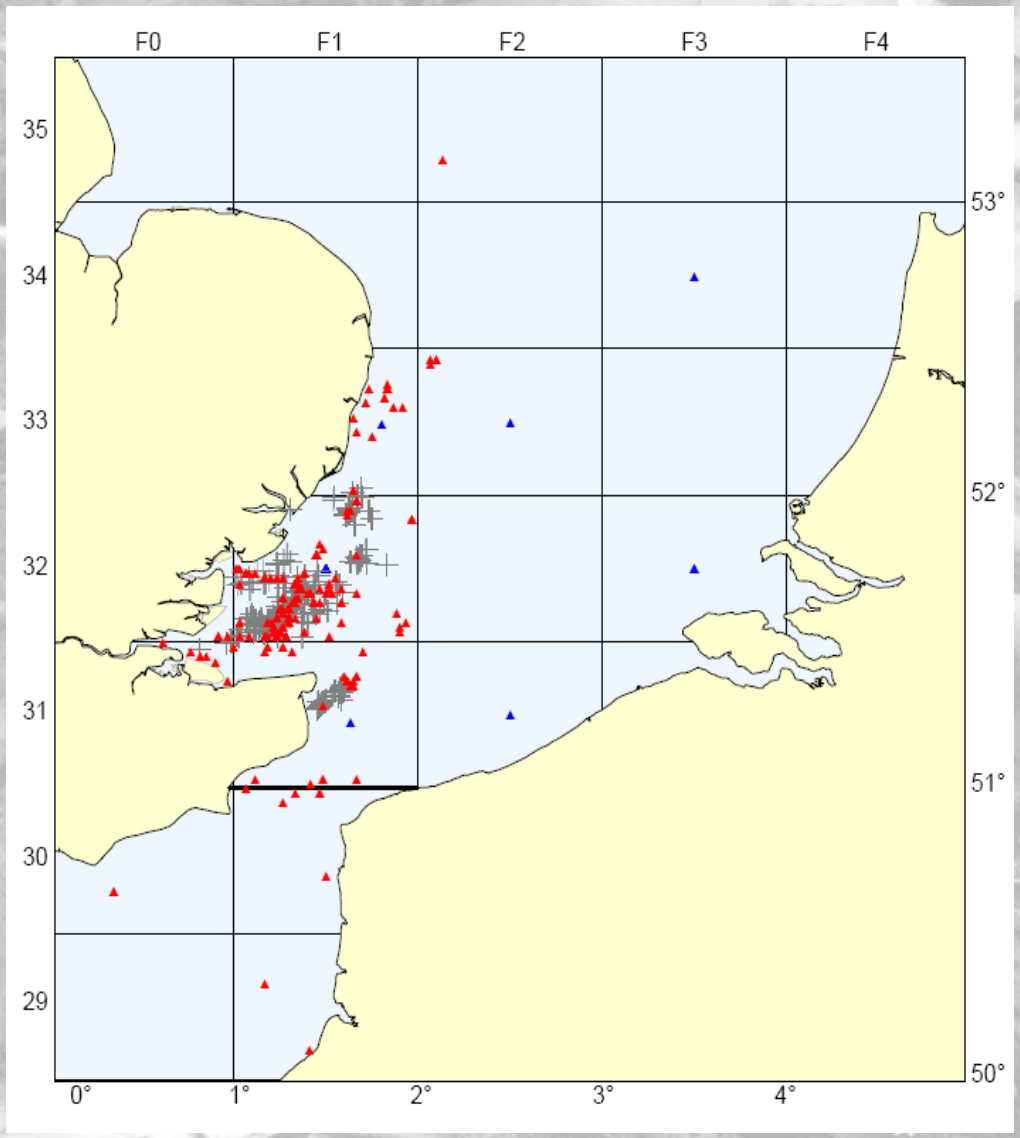



Return rates of tagged fish of similar magnitude to earlier tagging studies

Vessel	Gear	Released (No.)	Recaptured	
			No.	%
Vessel A	Twin-rig trawl	517	124	24.0
Vessel B	Triple-rig trawl	1304	168	12.9
Vessel C	Twin-rig trawl	660	102	15.5
Vessel C	Longline	110	27	24.5
Vessel D	Longline	649	145	22.3
Vessel D	Gillnet	479	119	24.8
Vessel E	Gillnet	433	41	9.5

- Earlier studies tagging skates in this area with Petersen discs reported return rates of 21-28% (Walker *et al.*, 1997)
- Skates can survive, but survival **not** quantified

Walker, P., Howlett, G. and Millner, R. (1997) Distribution, movement and stock structure of three ray species in the North Sea and eastern English Channel. *ICES Journal of Marine Science* **54**: 797–808.
Ellis, J. R., Burt, G. J., Cox, L. P. N., Kulka, D. W, and Payne, A. I. L. (2008). The status and management of thornback ray *Raja clavata* in the south-western North Sea. ICES CM 2008/K:13, 45 pp.


F0
F1
F2
F3
F4
35
34
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32
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30
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51°
50°
0°
1°
2°
3°
4°

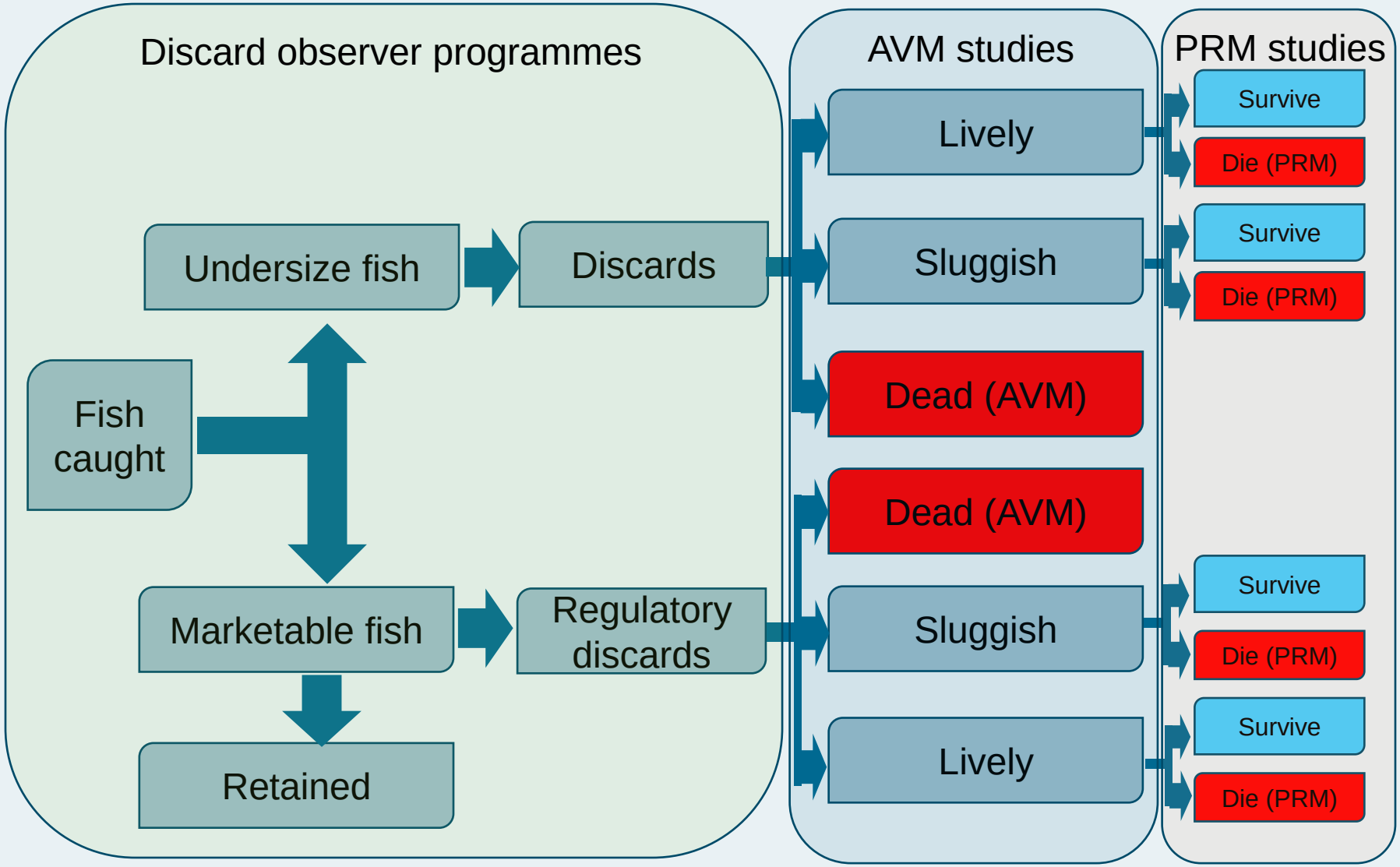
Low at-vessel mortality of skates in inshore Channel fisheries

Gear	Species	Lively		Sluggish		Dead	
		No.	%	No.	%	No.	%
Set nets	*R. clavata*	161	59.6	102	37.8	7	2.6
	R. montagui	31	67.4	12	26.1	3	6.5
	R. undulata	42	93.3	3	6.7	0	0.0
	Total Rajidae	238	64.5	121	32.8	10	2.7
Longline	*R. brachyura*	10	62.5	6	37.5	0	0.0
	R. undulata	6	100.0	0	0.0	0	0.0
	Total Rajidae	16	72.7	6	27.3	0	0.0
Trawl	*R. brachyura*	37	20.3	144	79.1	1	0.5
	R. undulata	65	48.5	68	50.7	1	0.7
	Total Rajidae	104	32.3	216	67.1	2	0.6

BUT WHAT PROPORTION SURVIVE DISCARDING?

Centre for Environment Fisheries & Aquaculture Science

Cefas



Silva, J. F., Ellis, J. R. and Catchpole, T.L. (2012). Species composition of skates (Rajidae) in commercial fisheries around the British Isles, and their discarding patterns. *Journal of Fish Biology*, 80: 1678–1703.

Data and knowledge gaps

- Improved time series for status of blonde ray (RJH)
- Improved time series for offshore species (RJI, RJF) and coastal species (RJE)
- Improved delineation of stocks and degree of mixing
- Need to achieve F_{MSY} targets by 2020: proxies to be developed, e.g. length-based methods
- Improved estimates of catch (analyses of discards data)
- Discard survival
- Improved delineation of any ‘critical habitat’