Irish Sea cod tagging project

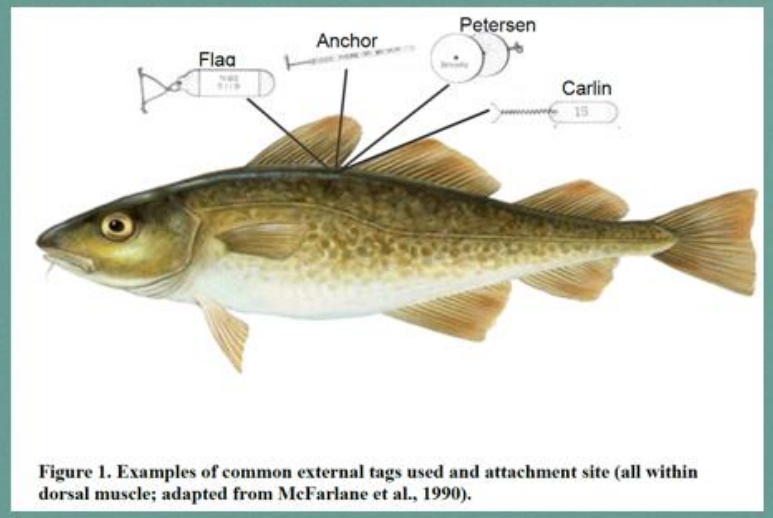
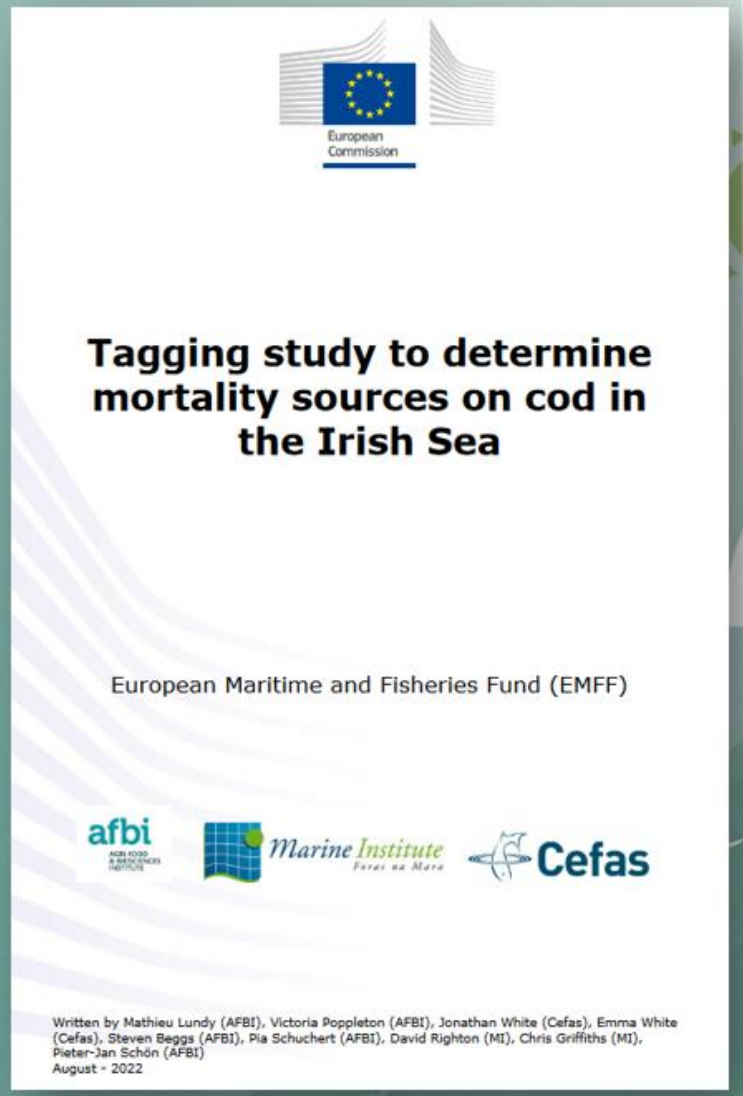


Figure 1. Examples of common external tags used and attachment site (all within dorsal muscle; adapted from McFarlane et al., 1990).

Jonathan White
FEAS – Marine Institute
1st July, 2024


European Commission

Tagging study to determine mortality sources on cod in the Irish Sea

European Maritime and Fisheries Fund (EMFF)

afbi Marine Institute Cefas

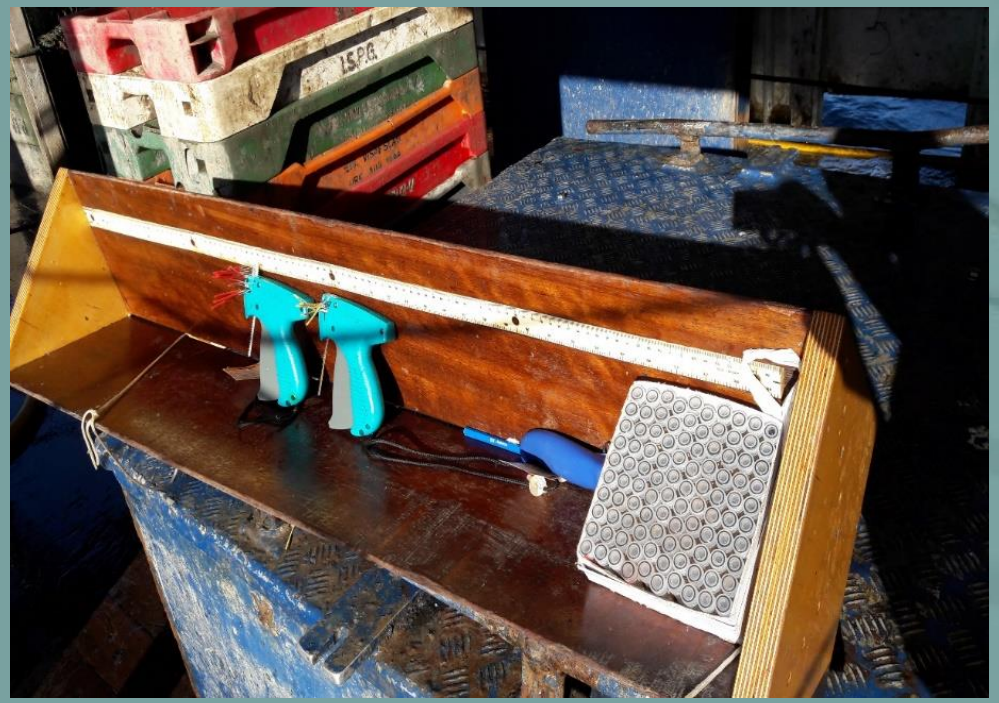
Written by Mathieu Lundy (AFBI), Victoria Poppleton (AFBI), Jonathan White (Cefas), Emma White (Cefas), Steven Beggs (AFBI), Pia Schuchert (AFBI), David Righton (MI), Chris Griffiths (MI), Pieter-Jan Schön (AFBI)
August - 2022

https://op.europa.eu/en/publication-detail/-/publication/c8a63ce2-1f6c-11ed-8fa0-01aa75ed71a1

Foras na Mara Marine Institute

2016 - 2018

Irish Sea Cod Tagging Project



SUMMARY for WKESIG/WKCELTIC – February 2019

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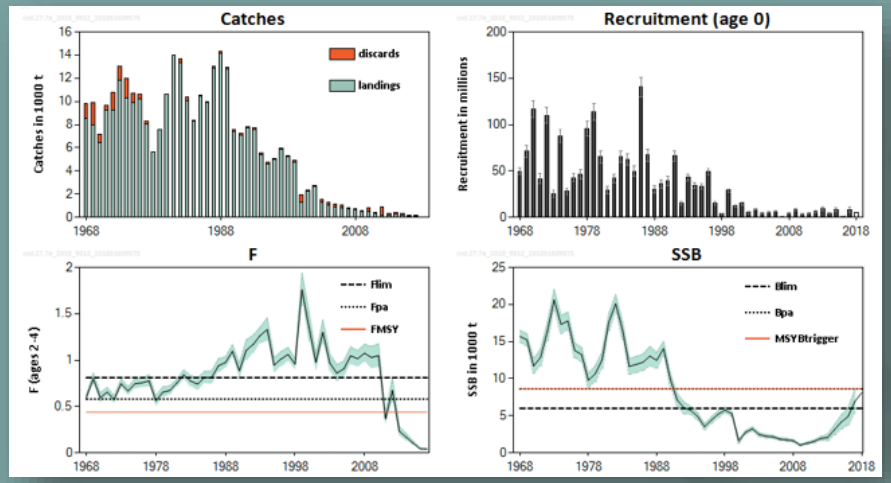
European Commission EASME Executive Agency for SMEs

Marine Institute Foras na Mara

State of the stock Irish Sea at time of study – ICES 2018 (WGCSE)

2018 – first advised TAC >0 since 1999 2023 – zero again

ICES 2017, for 2018



ICES 2024

Year	ICES advice, with single-stock exploitation boundaries since 2004	Catch corresponding to advice	Agreed TAC	Official landings	ICES landings ***	ICES discards
2016	No directed fisheries, minimize bycatch and discards	0	146	122	82	60
2017	MSY approach	0	146	103	84	59
2018	MSY approach	≤ 1073	695	235	215	42
2019	MSY approach	≤ 807	807	205†	295	7
2020	Precautionary approach	≤ 116	257	252	181	25
2021	Precautionary approach	≤ 93	206	184*	133	4
2022	Precautionary approach	≤ 74	206	128*	98	27
2023	MSY approach and precautionary considerations	0	165			
2024	MSY approach and precautionary considerations	0				

ICES 2024, for 2025

Fishing pressure on the stock is below F_{MSY}, and spawning-stock size is below MSY $B_{trigger}$ and between B_{pa} and B_{lim}.

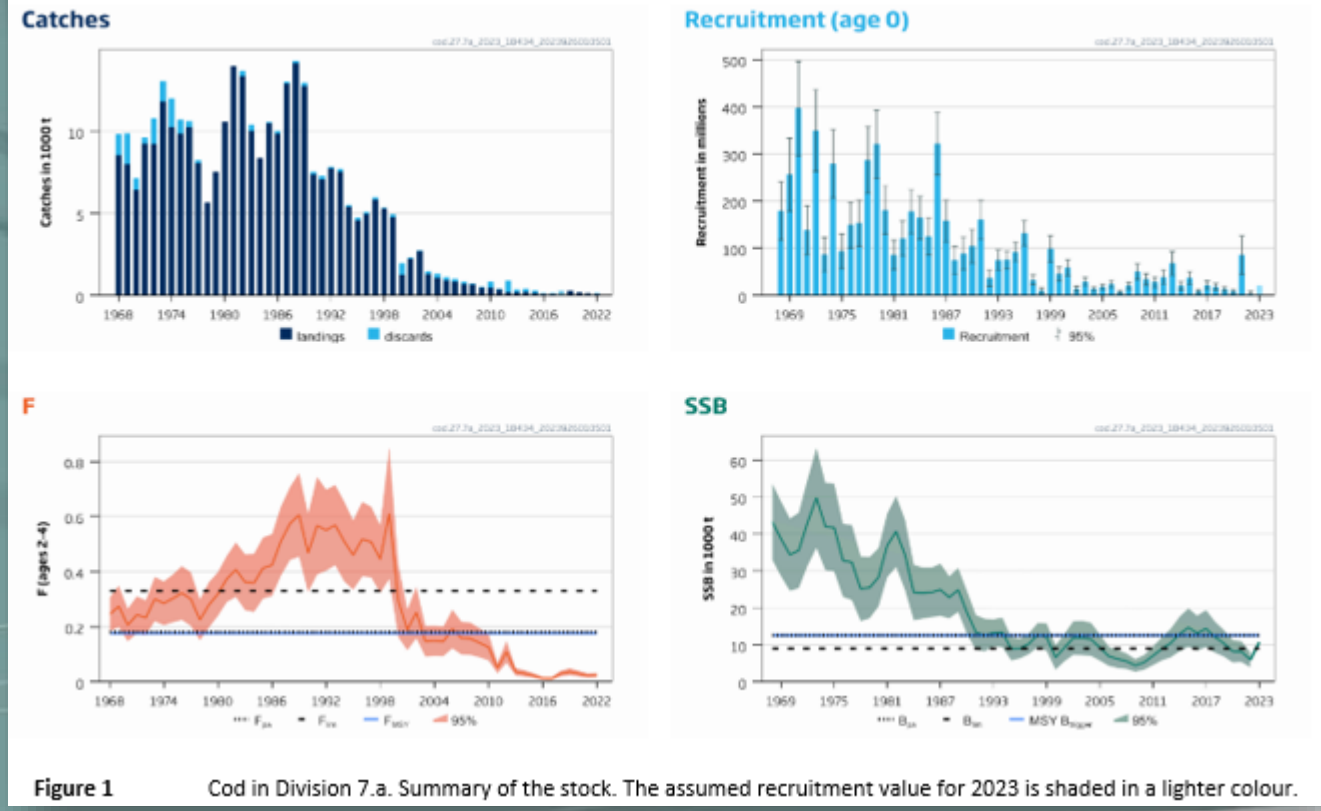


Figure 1 Cod in Division 7.a. Summary of the stock. The assumed recruitment value for 2023 is shaded in a lighter colour.

The Project:

- Review
- Outreach
- Tagging
- Recaptures
- Analysis

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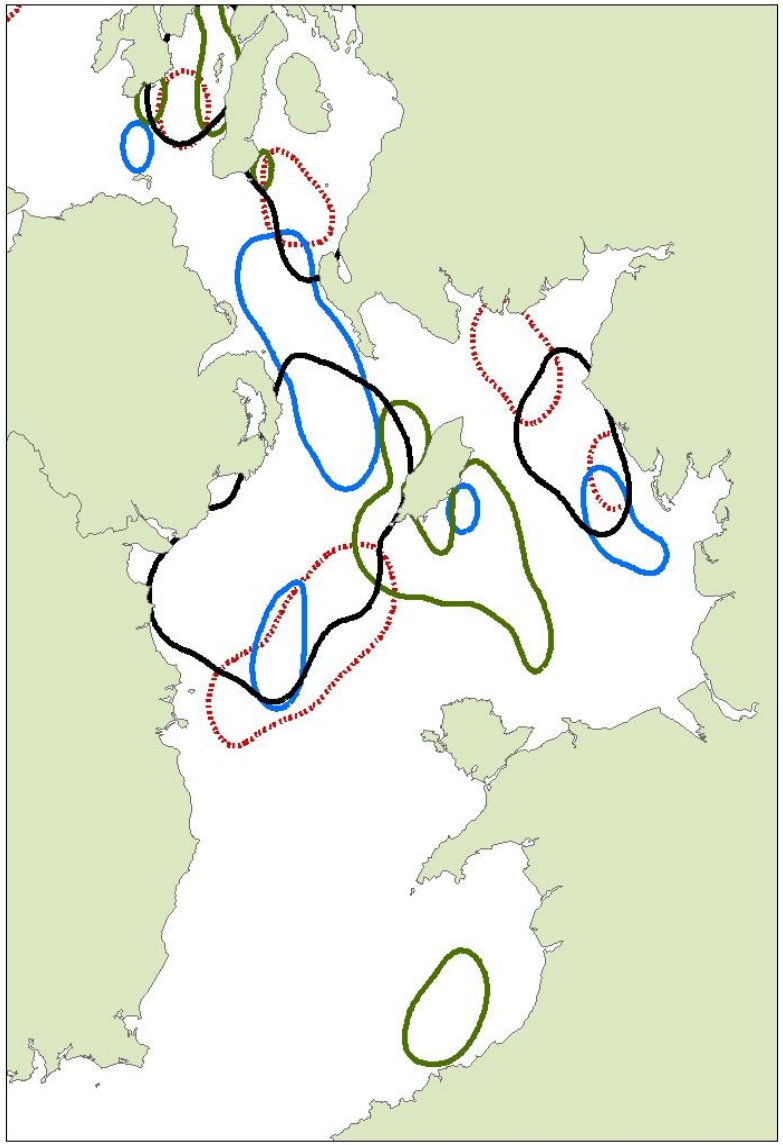


Overview of core fishing areas in the Irish Sea by gear type

Nephrops – black,

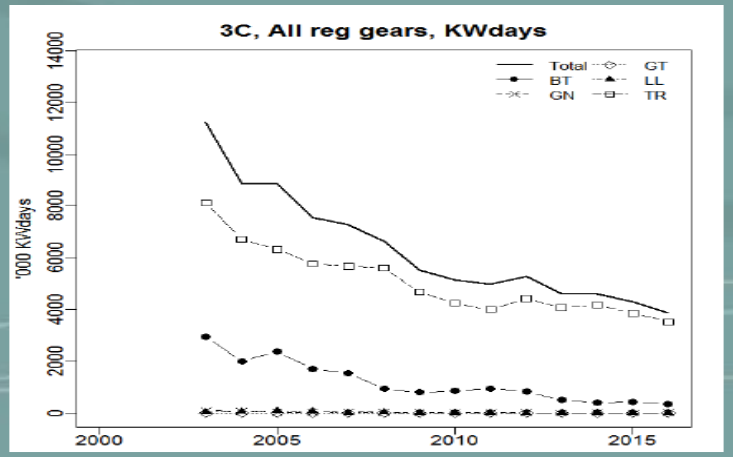
Dredging – green,

Seine – red dashed

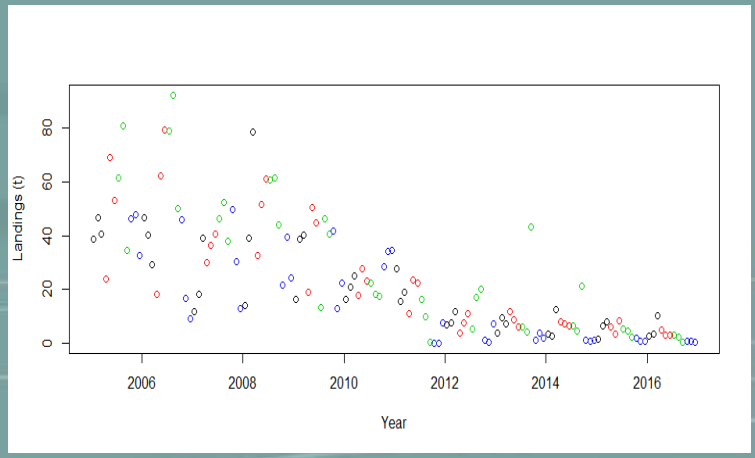
Demersal (cod/haddock/hake) – blue.

Defined from kernel density analysis of Vessel Monitoring System (VMS) data using gear information from logbooks for the UK fishing fleet (2007 – 2016).

Effort



Landings



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Review – Recoveries by release areas – previous studies:

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6a

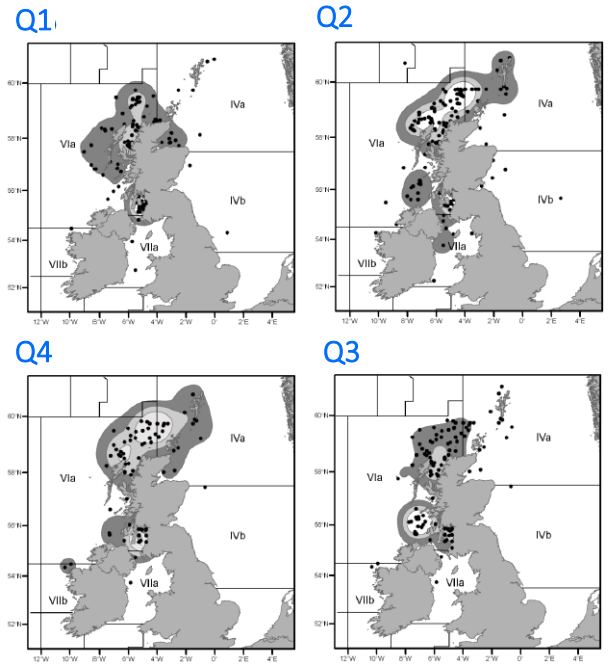


Figure 4. Mark recovery tag recapture positions of cod released in ICES area 6a (Scottish waters). Solid symbols show exact recapture locations, while shading shows the probability density surfaces for 50% (centre white), 75% (mid grey) and 95% (dark grey) of the recaptures. Data shown are for 'adults' recaptured during seasonal quarters (a) Quarter 1; (b) Quarter 2; (c) Quarter 3; and d) Quarter 4.

7a

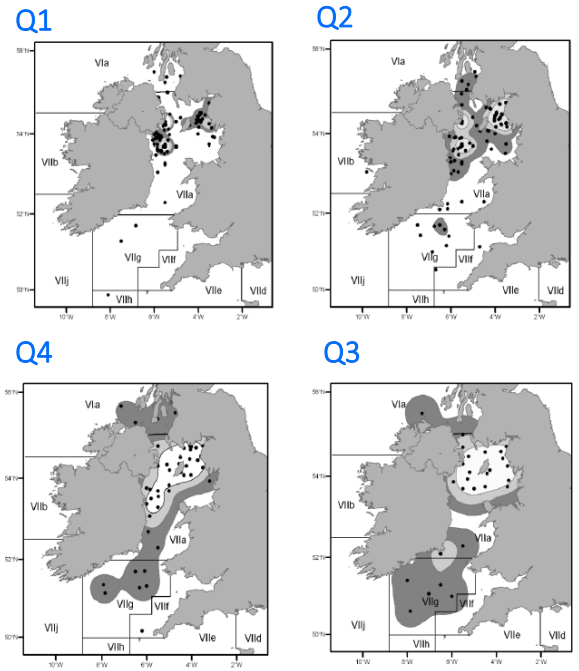


Figure 5. Mark recovery tag recapture positions of cod released in ICES area 7a (Irish Sea). Solid symbols show exact recapture locations, while shading shows the probability density surfaces for 50% (centre white), 75% (mid grey) and 95% (dark grey) of the recaptures. Data shown are for 'adults' recaptured during seasonal quarters (a) Quarter 1; (b) Quarter 2; (c) Quarter 3; and d) Quarter 4.

7e & 7f

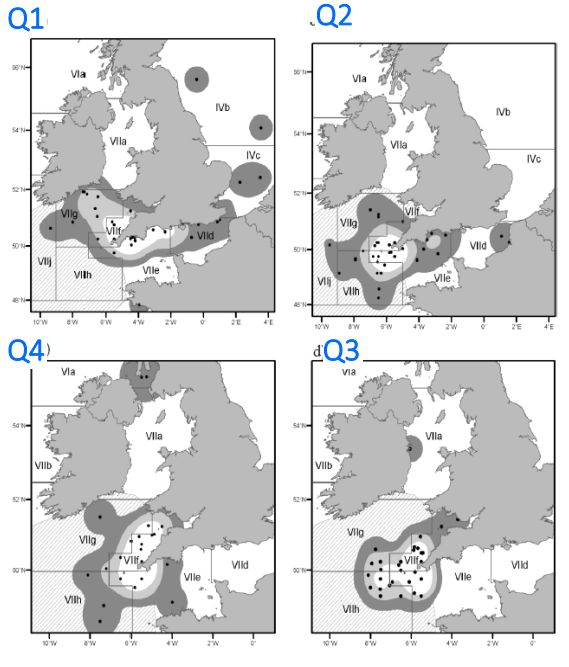


Figure 6. Mark recovery tag recapture positions of cod released in ICES area 7e & 7f (Celtic Sea). Solid symbols show exact recapture locations, while shading shows the probability density surfaces for 50% (hollow white), 75% (mid grey) and 95% (dark grey) of the recaptures. Data shown are for (a) 7e cod recaptured during combined Q4 & Q1 autumn and winter quarters; (b) 7e cod recaptured during combined Q2 & Q3 spring and summer quarters; (c) 7f cod recaptured during combined Q4 & Q1 quarters; (d) 7f cod recaptured during combined Q2 & Q3 quarters.

7g

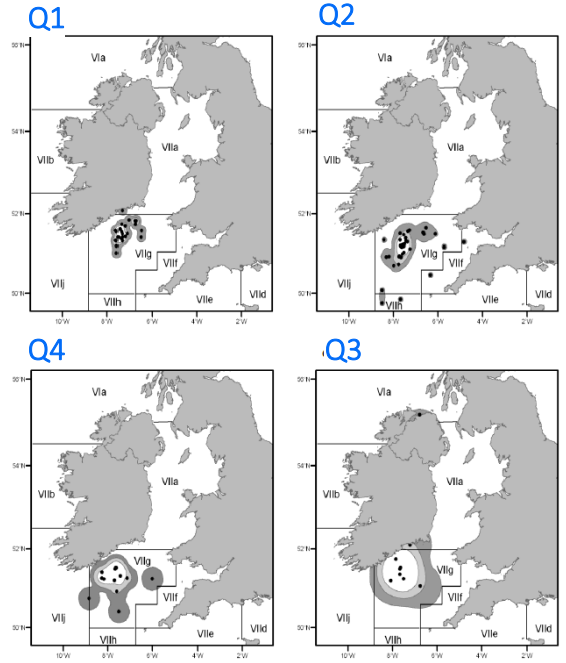


Figure 7. Mark recovery tag recapture positions of cod released in ICES area 7g (Celtic Sea). Solid symbols show exact recapture locations, while shading shows the probability density surfaces for 50% (centre white), 75% (mid grey) and 95% (dark grey) of the recaptures. Data shown are for 'adults' recaptured during seasonal quarters (a) Quarter 1; (b) Quarter 2; (c) Quarter 3; and d) Quarter 4.

Recapture:

- location
- 50% probability density
- 75% probability density
- 95% probability density

spatial & temporal tagging considerations

Review – Recoveries by release areas – previous studies:

Foras na Mara
Marine Institute

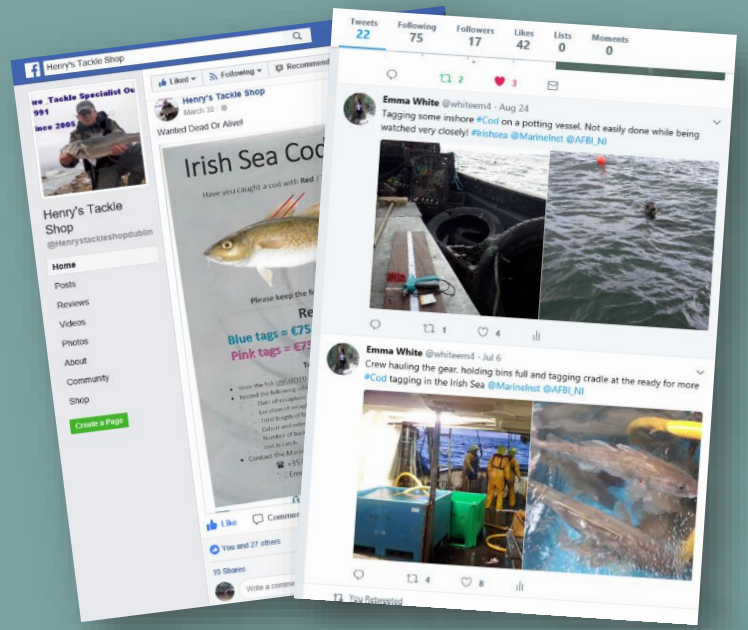
Inter – area tag recovery between ICES management areas

Release area	Recapture area										
Q1	5b	4a	6a	7a	7d	7e	7f	7g	7h/7j	4b/4c	Tags
6a		0.10	0.86	0.03	0.00	0.00	0.00	0.00	0.00	0.01	144
7a		0.00	0.02	0.97	0.00	0.00	0.00	0.01	0.00	0.01	404
7e		0.00	0.00	0.00	0.15	0.32	0.21	0.24	0.00	0.08	34
7f		0.00	0.09	0.00	0.00	0.25	0.52	0.09	0.05	0.00	21
7g		0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	27
Q2	5b	4a	6a	7a	7d	7e	7f	7g	7h/7j	4b/4c	Tags
6a	0.01	0.16	0.76	0.05	0.00	0.00	0.00	0.00	0.00	0.02	250
7a	0.00	0.00	0.03	0.91	0.00	0.00	0.01	0.05	0.00	0.00	239
7e	0.00	0.00	0.04	0.00	0.08	0.48	0.16	0.08	0.16	0.00	25
7f	0.00	0.00	0.05	0.05	0.00	0.10	0.60	0.05	0.15	0.00	20
7g	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.89	0.04	0.00	44

Release area	Recapture area										
Q3	5b	4a	6a	7a	7d	7e	7f	7g	7h/7j	4b/4c	Tags
6a	0.02	0.28	0.68	0.02	0.00	0.00	0.00	0.00	0.00	0.00	109
7a	0.00	0.01	0.05	0.82	0.00	0.00	0.01	0.08	0.00	0.00	69
7e	0.00	0.00	0.00	0.00	0.00	0.41	0.24	0.06	0.29	0.00	17
7f	0.00	0.00	0.00	0.00	0.00	0.42	0.10	0.16	0.32	0.00	19
7g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	14
Q4	5b	4a	6a	7a	7d	7e	7f	7g	7h/7j	4b/4c	Tags
6a		0.05	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59
7a		0.00	0.06	0.76	0.00	0.00	0.00	0.18	0.00	0.00	34
7e		0.00	0.00	0.00	0.00	0.64	0.18	0.00	0.09	0.09	11
7f		0.00	0.00	0.00	0.00	0.45	0.22	0.11	0.22	0.00	9
7g		0.00	0.00	0.011	0.00	0.00	0.00	0.89	0.00	0.00	9

– Proportion of recaptures in area of release

Outreach



Social Media

Trade Press

Webpage

Posters

E-mails
Phone calls
Informal discussions
Presentations

Contact

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The Project

Project Partners

This project is a collaboration between three marine research agencies; AFBI, Northern Ireland, Marine Institute, Ireland and Cefas, UK and is funded by the EU.

EASME
Executive Agency for SMEs

Huge industry and recreational stakeholder collaboration is needed for tagging and reporting recaptured tagged cod.

For Further information

Please visit our websites:

https://www.afbini.gov.uk/articles/cod-tagging-project-irish-sea

www.marine.ie/codtagging

We would like the cod and the tags…

Please record:

- date of capture
- position of capture (Lat & Long)
- total length (cm) of fish
- tag number and colour
- Number of baskets& size details (Small/Medium/Large) of other cod in catch

Store the fish UNGUTTED on ice/frozen and we will arrange collection.

Please report tagged cod to:

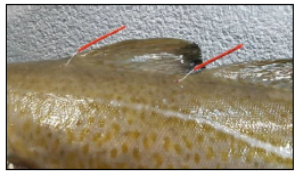
- **Phone AFBI: +44 (0)7771801301**
- **Phone MI: +353 87 9201448**
- **E-mail: fishtagging@afbini.gov.uk**

In exchange for a whole tagged cod and required information, we would like to offer the following reward;

€25	●	Red tag
€75	●	Yellow tag
€75	●	Pink tag
€75	●	Blue tag

For every **20th** cod returned:
€1000

Celtic Seas Cod Tagging Programme



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April 2018

Project aims

Previous tagging studies have helped scientists understand the movement of fish species, growth rates, population size, survival rates and mortality rates. This information is important for fisheries managers so that these parameters can be considered in the management process of fisheries in different areas.

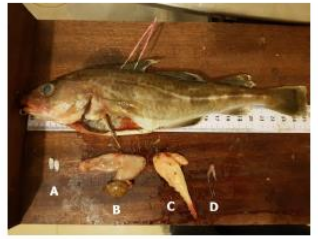
This project aims to increase our biological understanding of cod in the Irish Sea – including estimating a mortality rate and growth rate of cod, analyse cod movements and migration patterns in the Irish Sea and neighbouring areas.

Why is this project important to stakeholders?

- Improved information on cod in the Irish Sea.
- Contribute to evidence based decisions on stock quotas.
- Align the perception of cod stock numbers between scientists and stakeholders involved in cod fishing.

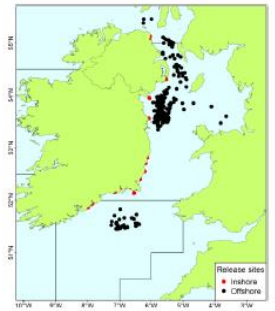
Tag and Recapture

A tagging gun is used to attach the floy tag at the base of the dorsal fin. Cod are double tagged to give an estimate of tag loss.

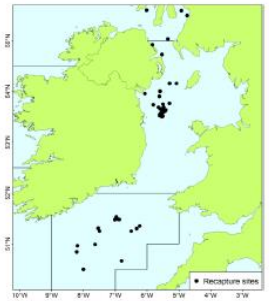


Recaptured tagged cod are dissected for:
A) Otoliths – Age
B) Stomach contents – Diet analysis
C) Liver – Condition
D) Gonads – Sex and maturity stage

Some release and recapture sites so far…



Cod have been tagged by AFBI and the Marine Institute onboard chartered commercial vessels, potting vessels, angling vessels and shore fishing since Spring 2016.



Mid Project review process

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The Tagging

- 10 dedicated tagging charters
- Angling competitions/anglers
- Commercial Observers

- 4,759 tagged cod released to date.
- 166 recapture records (as of January 2019).

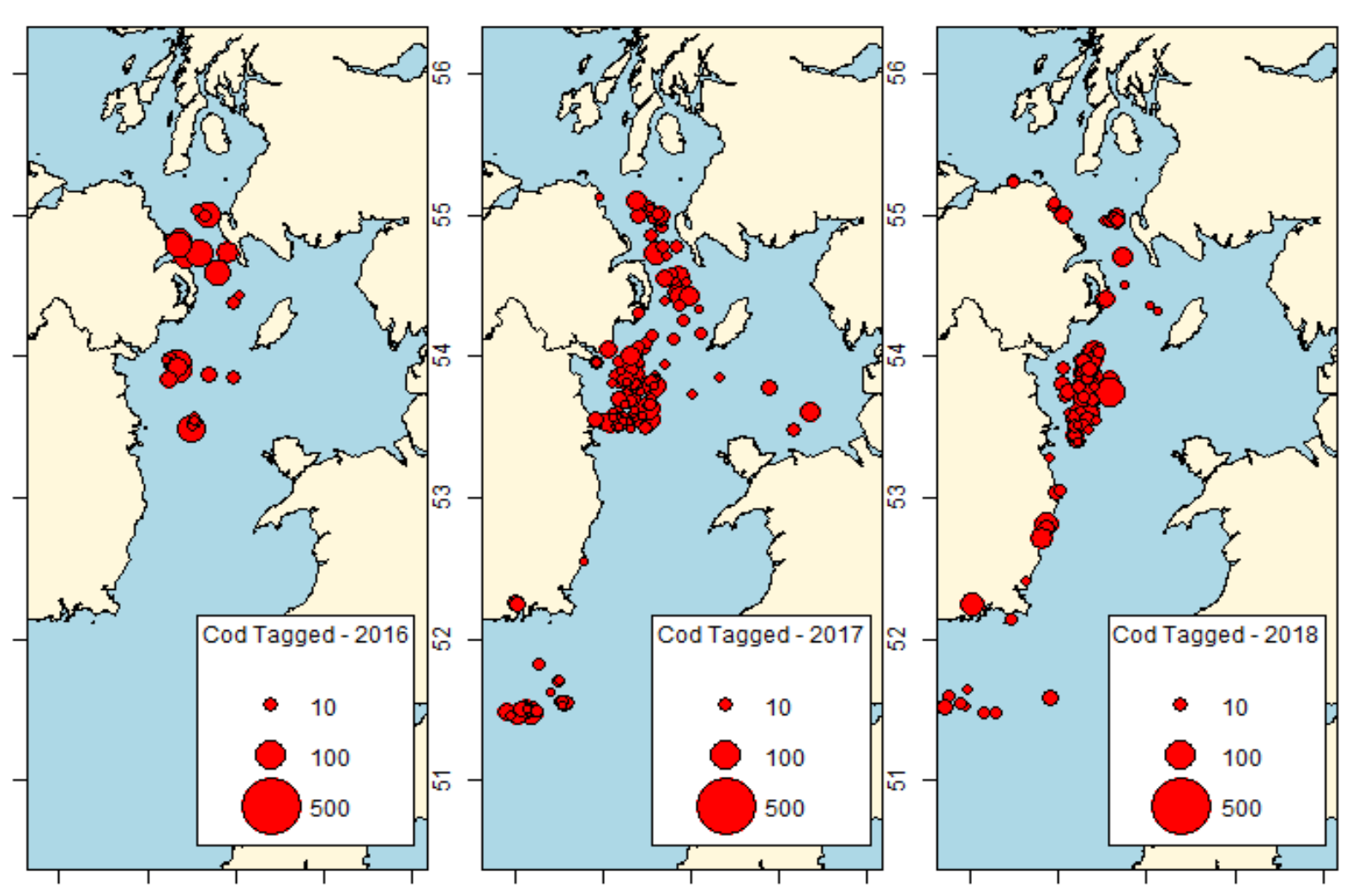
Tagging by method by year

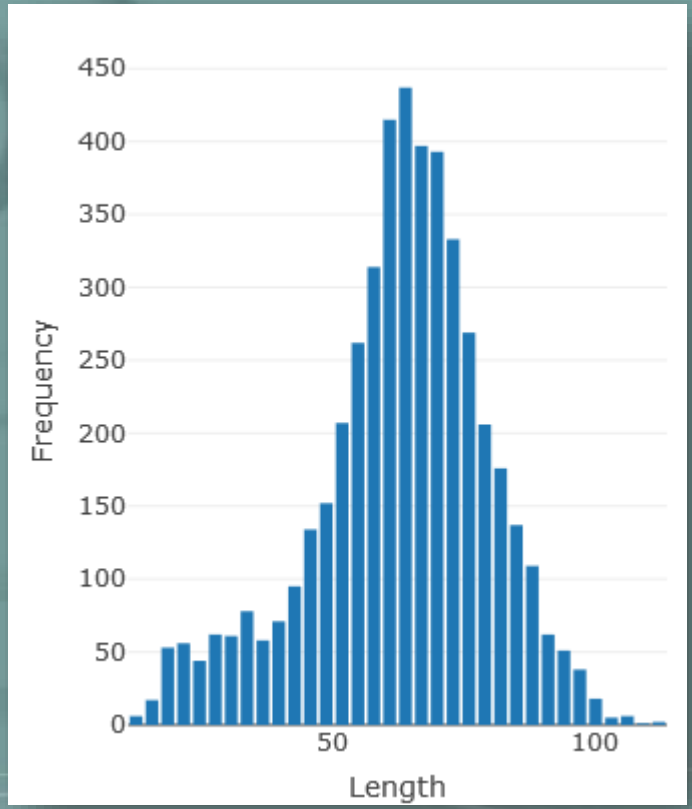
Year	Charter	Shore / Sea Angling	Scientific Survey	Other
2016	963	0	0	12
2017	1470	103	58	12
2018	1698	230	131	60
Total	4131	333	189	84

Tagging by area by year

Year	6A	7A	7G
2016	332	618	
2017	89	1378	176
2018	115	1984	38
Total	536	3980	214

The Tagging





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The Tagging

Tagging campaign

Offshore
Shore based Exploring inshore population and tagging of smaller part of the population (below MCRS)

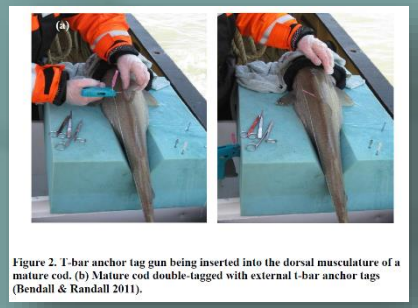
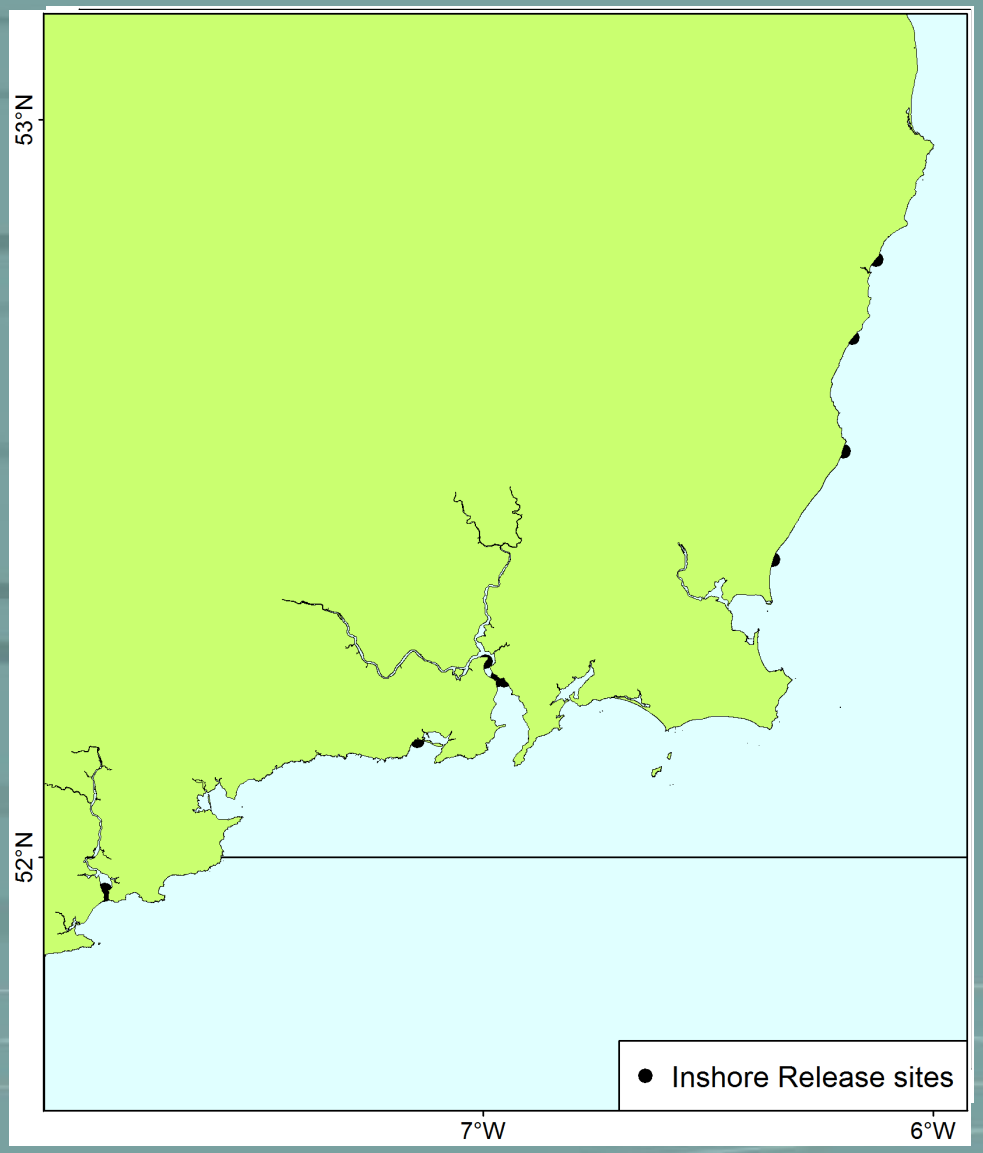


Figure 2. T-bar anchor tag gun being inserted into the dorsal musculature of a mature cod. (b) Mature cod double-tagged with external t-bar anchor tags (Bendall & Randall 2011).



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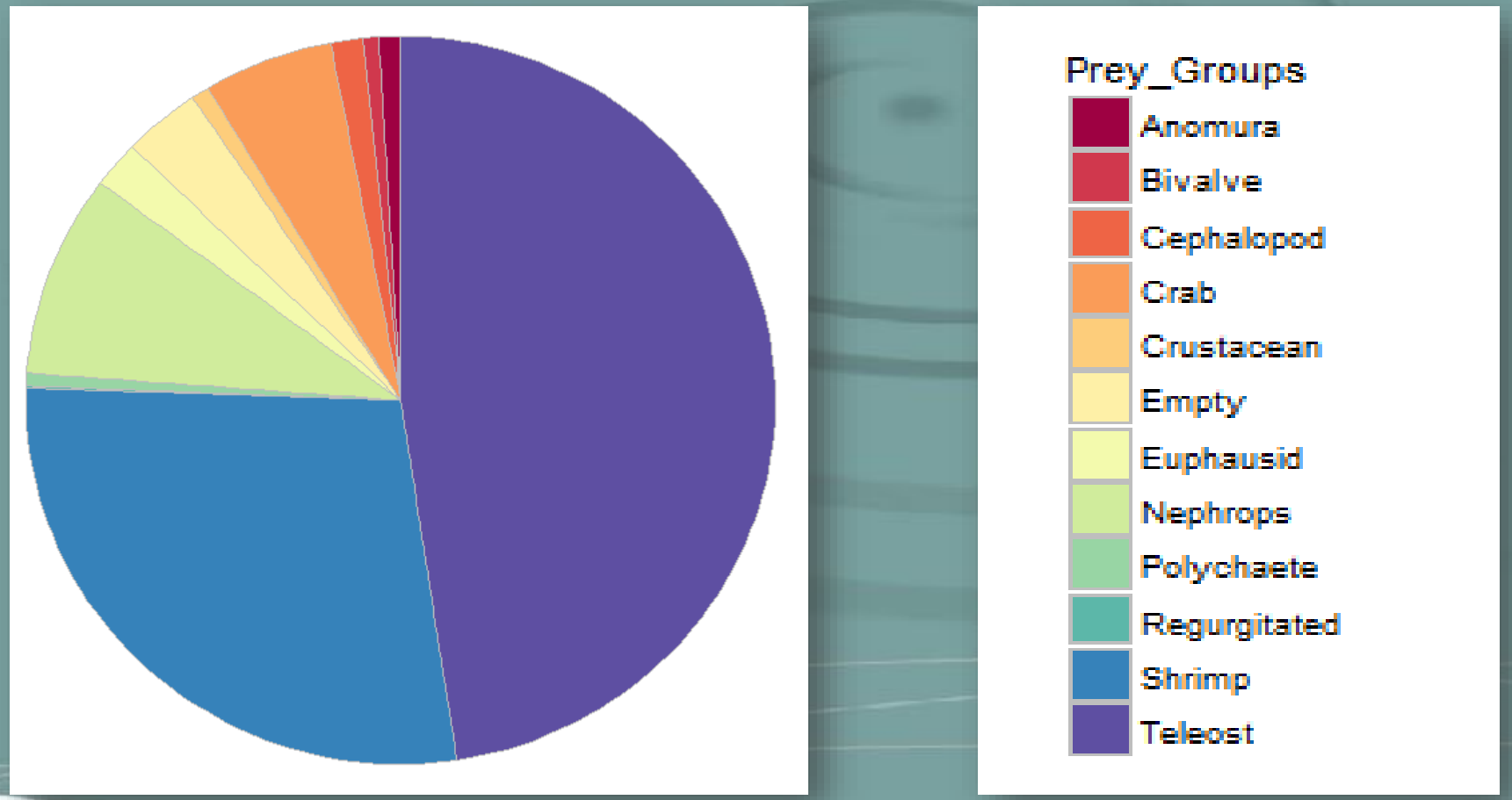
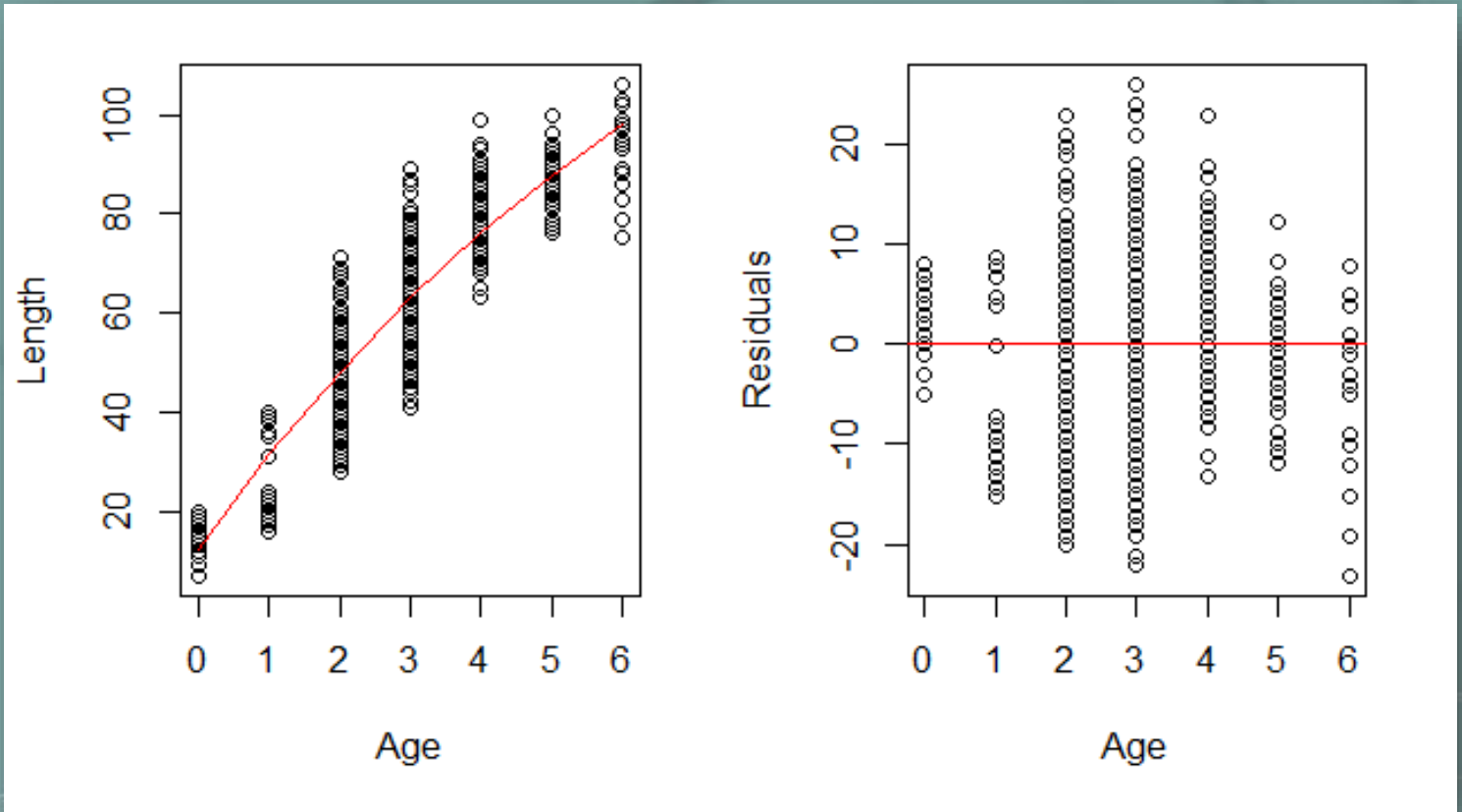
The Recaptures

Composition of prey groups by number in cod stomach contents



The Recaptures

Von Bertalanffly plot (growth curve) for 2017

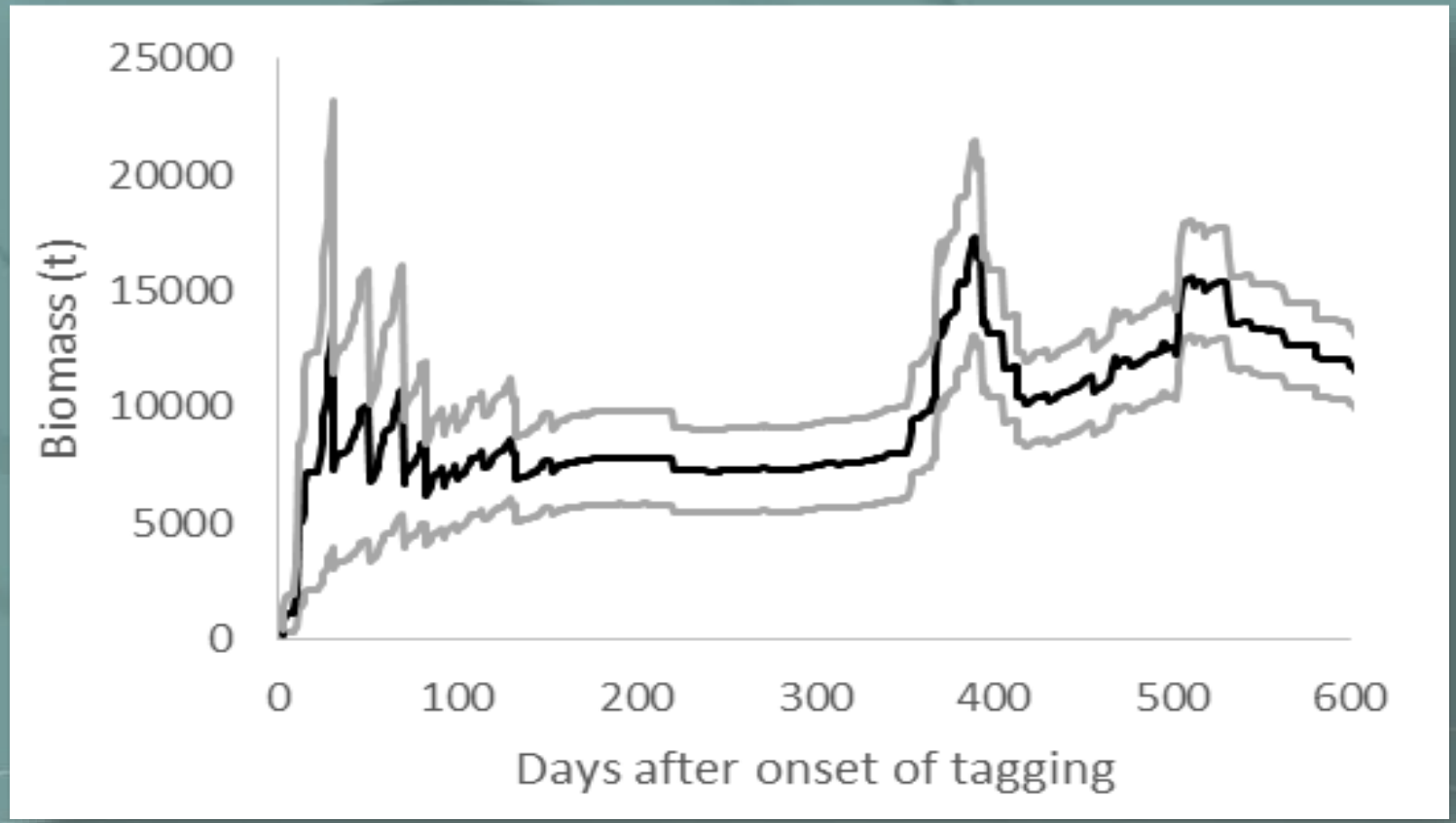


The Recaptures

Mark-Recapture population size estimates: 2017

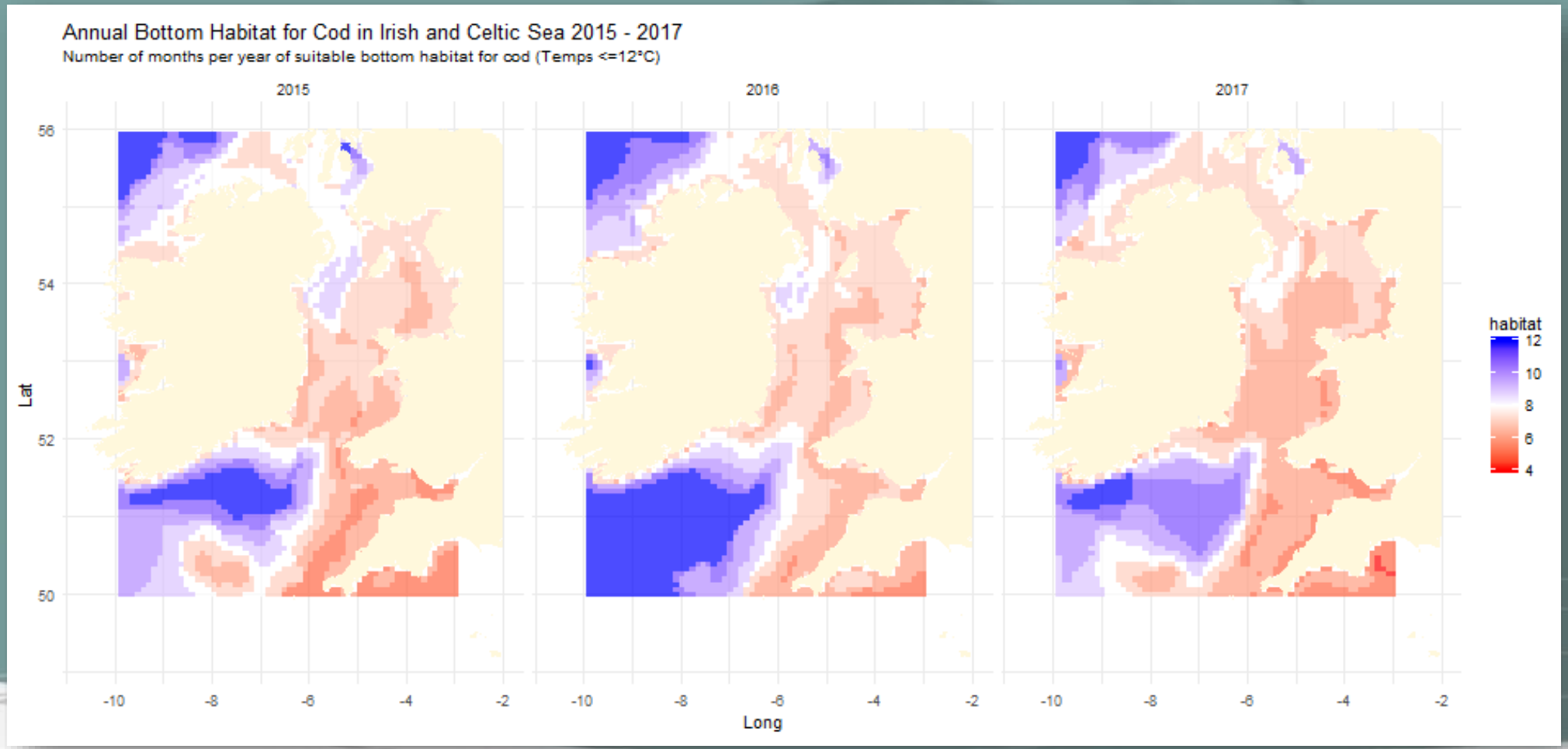
Biomass estimate (biomass of fish vulnerable to capture), on day 200, of 7,829t can be compared to the ICES assessment estimate of Spawning Stock Biomass (SSB) in 2016 of 7,173t.

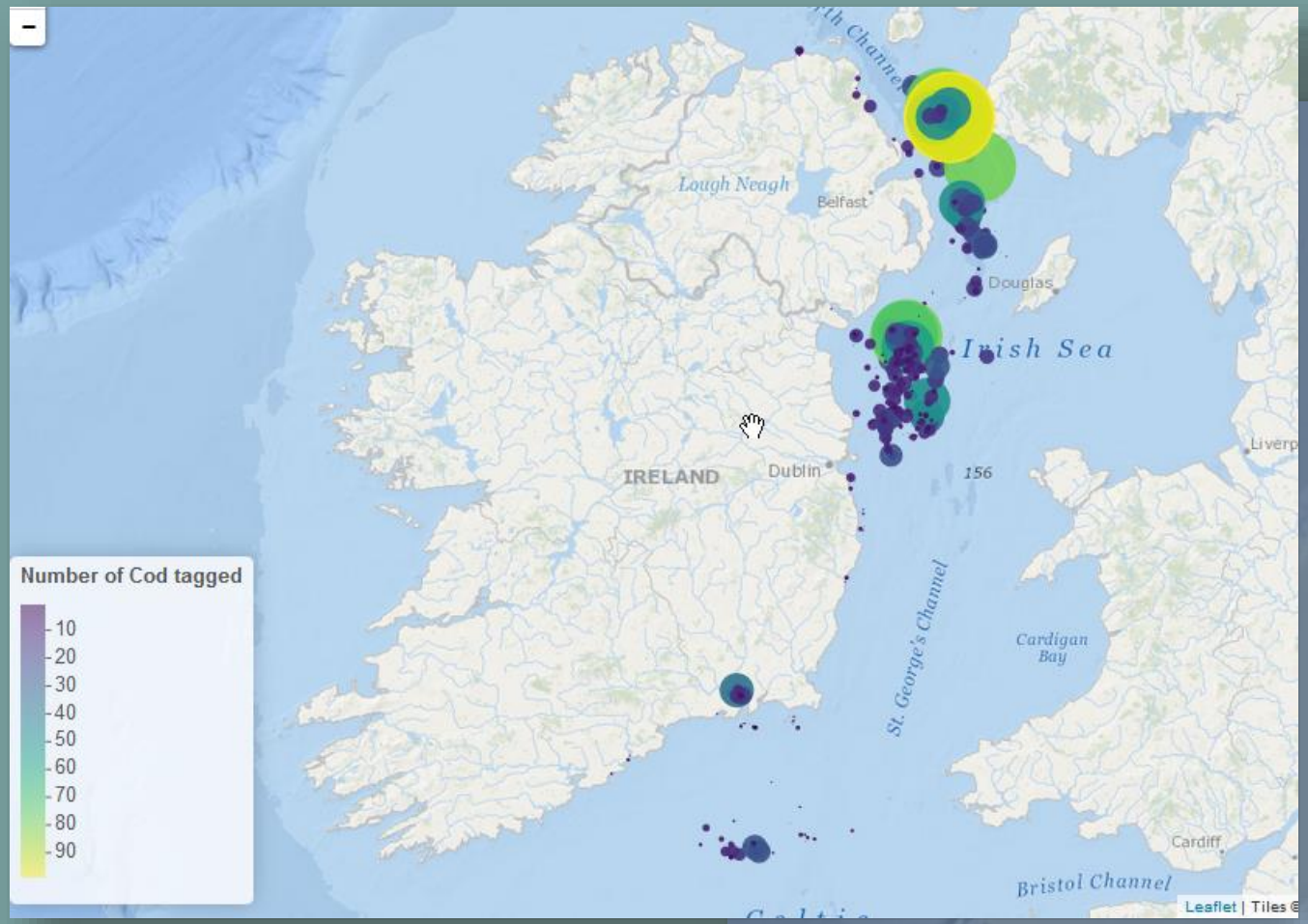
The ICES estimate of SSB for 2017: 11,002t compared to the final estimated biomass of 11,472t.



Thermal Habitat

Annual variation in mean monthly thermal habitat (bottom temperatures <=12°C), study area 2015-2017. Habitat scale represents sum of months where thermal habitat was <=12°C.





Migratory Category (from distance travelled)

- Under 50nm
- 50-80nm
- 80-140nm
- Migrators >140nm

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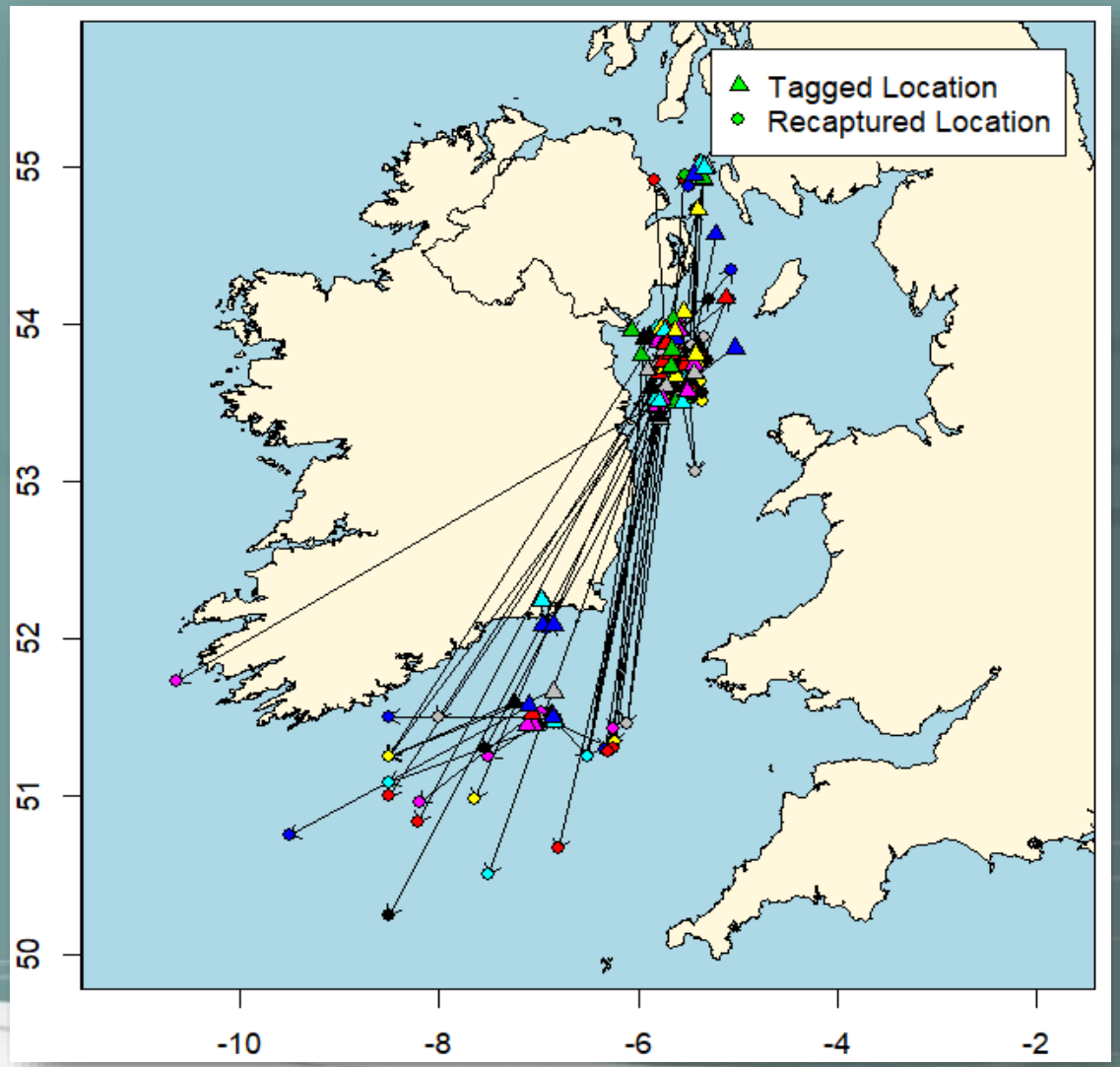
Release and recapture positions of all recaptured cod reported to October 2018.



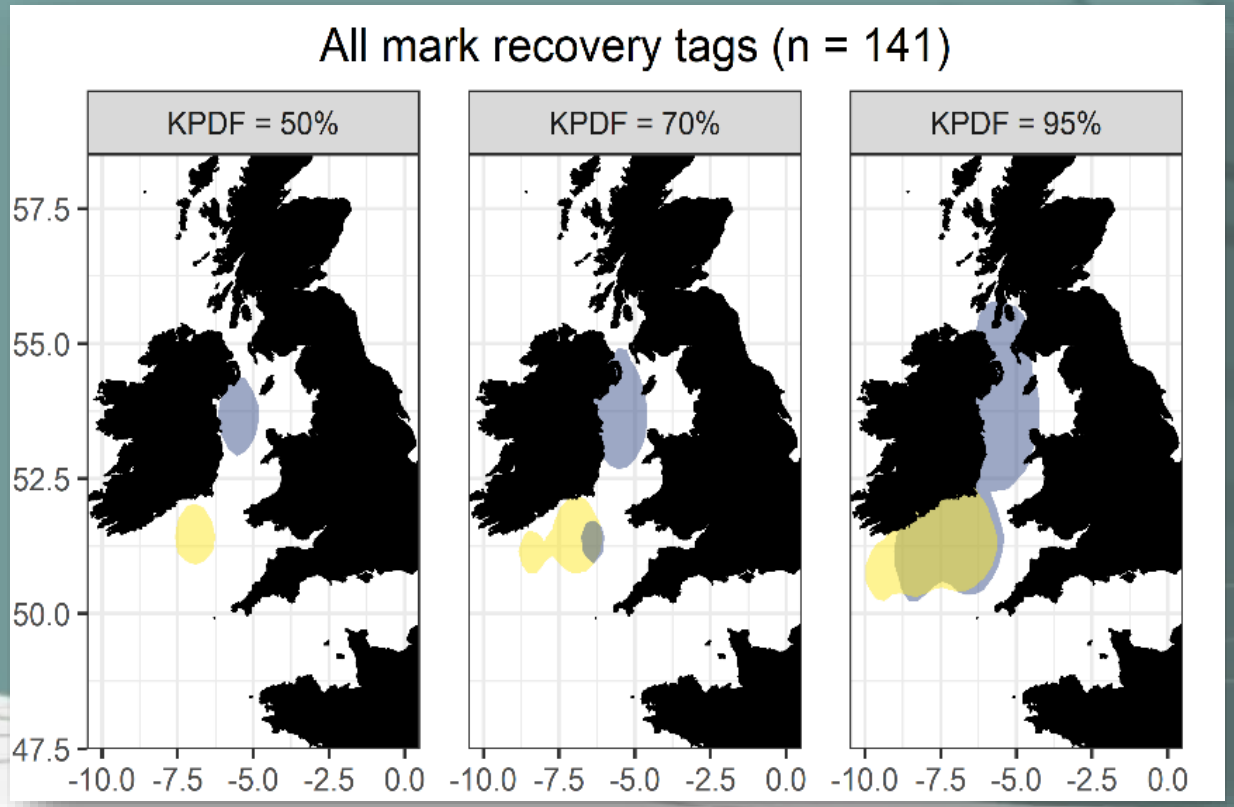
Triangle symbols denote tagging location with circles indicating recapture sites.

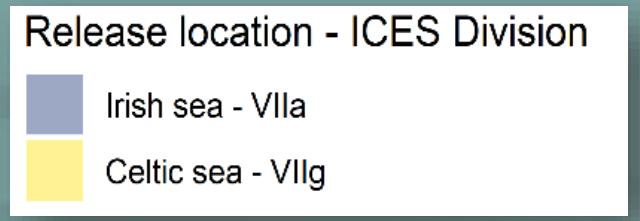
Movement

Year	Total recaptured	Release area n	Mean Time at liberty (days)	Remain in 7a	Remain in 7g	7a to 7g	7a to 6a	Mean Distance travelled (km)
All	166	7a = 145 7g = 21	7a = 160.9 7g = 87.4	118 fish (81%)	21 fish (100%)	24 fish (17%)	3 fish (2%)	7a = 80.3 7g = 43.9
2016	13	7a = 13	7a = 171.8	7 fish (54%)	-	3 fish (23%)	3 fish (23%)	7a = 105.3
2017	35	7a = 23 7g = 12	7a = 218.3 7g = 77.6	18 fish (78%)	12 fish (100%)	5 fish (22%)	-	7a = 57.6 7g = 18.7
2018	118	7a = 109 7g = 9	7a = 114.9 7g = 115.0	93 fish (85%)	9 fish (100%)	16 fish (15%)	-	7a = 91.4 7g = 114.5

Mature (> 60 cm) migration

- **Irish Sea** Released - **Irish Sea** Recaptured (81.4 % : 105 out of 129 fish)
- **Irish Sea** Released - **west coast of Scotland** Recaptured (<1 % : 1 out of 129 fish)
- **Irish Sea** Released - **Celtic Sea** Recaptured (17.8 % : 23 out of 129 fish)
- **Celtic Sea** Released - **Celtic Sea** Recaptured (100 % : 9 out of 9 fish).





Kernel Probability Density Function:
an estimate of the extent of geographical range

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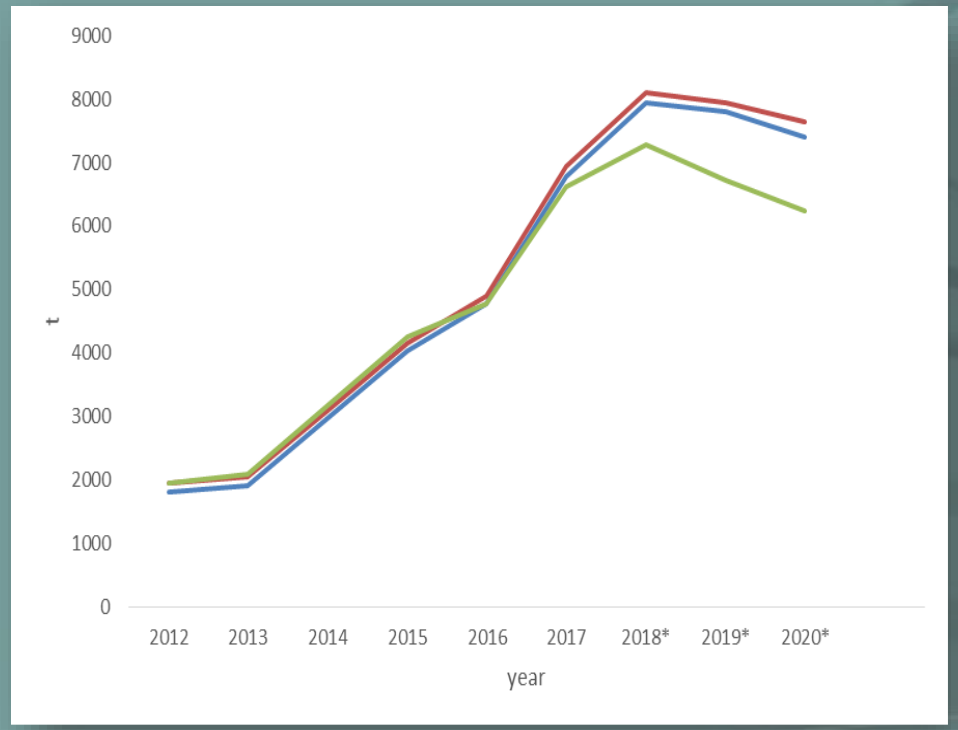
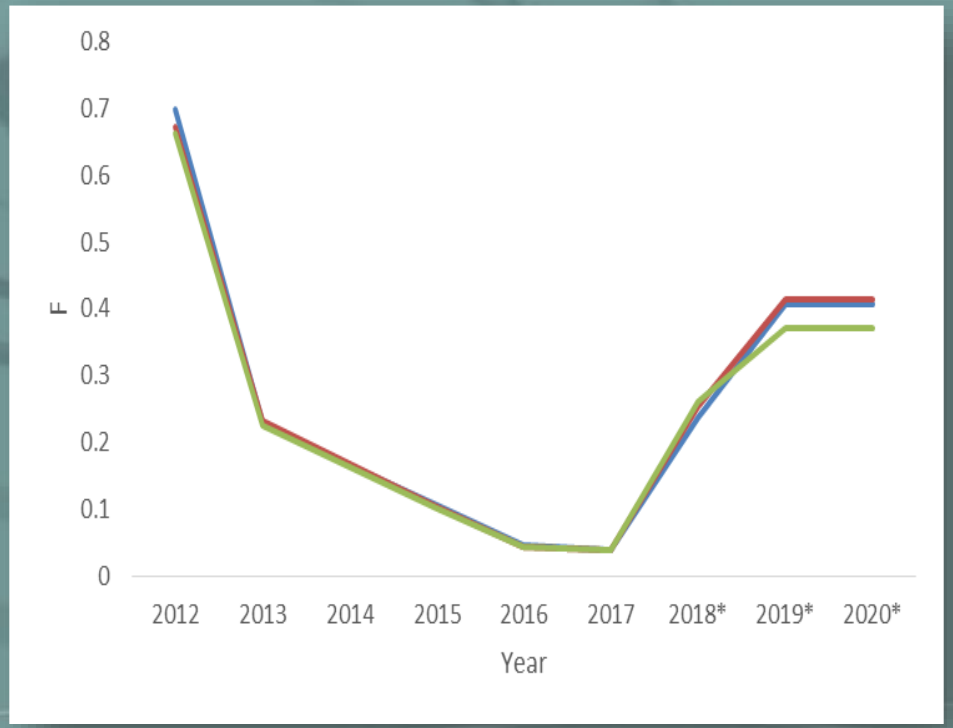
Spawning Stock Biomass (SSB) and Fishing mortality (F) under two different hypotheses compared with the model used at WGCSE 2018 (ICES 2018). Migration included in the 3 most recent years (2015-2017).





Red - WGCSE baseline (stock assessment without considering migration).
Hypothesis 1 - **Blue**: Migratory stock that returns to spawning sites in 7a (taking into account catches of 4+ year old fish in are 7g)
Hypothesis 2 - **Green**: Emigration out of 7a (adjusted M)

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Future work – AFBI

- Tag individual cod with DS-tags to further understanding of migratory behaviour
- Use of otolith trace element analysis to elucidate population structure
    - Project re-captured cod
    - Commercially caught cod in 7g and 7a recent & historic
- Use of proto-type pop-up satellite tags on cod to understand migratory behaviour
- Genetics – elucidate spawning origins
- Possible parasite composition