

Cruise report

Irish Beam trawl Ecosystem Survey 2017



Marine Institute
Foras na Mara



Hans Gerritsen and Sara Jane Moore, Fisheries Ecosystems Advisory Services,

Marine Institute, Rinville, Oranmore, Galway, Ireland, H91R673.



Clár Chistí Eorpacha Struchtúrtha
agus Infheistíochta na hÉireann
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agus ag an Aontas Eorpach



Department of
**Agriculture,
Food and the Marine**
An Roinn
**Talmhaíochta,
Bia agus Mara**



EUROPEAN MARITIME
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Introduction

The second annual Irish Beam trawl Ecosystem (IBES) took place from 7-16th March 2017 on RV *Celtic Explorer* in the western Celtic sea.

The main objective of the survey is to connect the Irish Anglerfish and Megrim Survey (IAMS) to the UK beam trawl surveys in the Celtic Sea, English Channel and Irish Sea, with the purpose of providing a swept-area biomass estimate for anglerfish (*Lophius piscatorius* and *L. budegassa*) in area VII.

Secondary objectives are to collect data on the distribution and relative abundance of commercially exploited species as well as invertebrates and by-catch species, particularly vulnerable and indicator species. The survey also collects maturity and other biological information for commercial fish species in the western Celtic Sea.

The IBES survey uses the same gear, methods and stratification as the CEFAS Q1 South-west Ecosystem Survey (Q1SWECOS).

The IBES survey is formally coordinated by the ICES Working Group on Beam Trawl Surveys

Methods

Stratification

An ecosystem-based spatial stratification for the Celtic Sea and western Channel was developed by WGMSFDEMO (2015). These strata are used by IBES as well as Q1SWECOS which covers the area as far west as stratum G (Figure 1). The IBES was designed to cover strata Ia, Ib, IV and A as well as stratum G to allow a comparison between the IBES and Q1SWECOS. Two additional stations were completed in stratum I at the request of CEFAS, as they were not sure they would be able to reach those stations themselves.

Station selection

Each stratum is divided into 15 hexagons. Random hexagons are selected sequentially in each stratum. Inside each hexagon a random station position is then selected. The sequence in which the station is selected will be considered the priority of the station; so if the target number of stations in a stratum was 5, then only the first 5 randomly selected stations would be sampled. If, during the survey, it becomes clear that the targets will not be met (e.g. due to bad weather) then the stations with the highest sequence numbers will be dropped first. For example in a stratum with 5 stations, only the first 4 will be sampled (where feasible).

The target number of stations in each of the strata is given in Table 1. A tow track was picked to go through the randomly selected points. Where it was impossible to do so (e.g. underwater cables, passive gear, unsuitable bottom) it was attempted to find a tow track that came within 1nm of the selected point. Because this is the first time this area is surveyed using a beam trawl, there was little information to optimise the sampling design and the target number of stations in each stratum was chosen to be proportional to the stratum area.

Four to six weeks prior to the departure a Marine Notice was issued (www.dttas.ie) to advise seafarers and fishermen about the proposed work. This document included a brief description of the survey methods and objectives including a list and map location of the proposed stations.

Fishing operations

Two steel 4m beam trawls are towed directly from the warps off the stern of the vessel. The beam trawls are similar to those used by the fishing industry and identical to those used by the CEFAS Q1 South-west Ecosystem Survey (Q1SWECOS). The trawls are fitted with a chain mat and single flip-up rope and 80mm mesh size in the cod-end. The starboard trawl was fitted with a 40mm cod-end liner. Further gear specifications are given in the 2016 cruise report.

The gear was trawled at 4kn over a distance of 2nm (approx. 30min). The warp to depth ratio was 3/1. On very soft or hard ground the warp may be shortened a bit to make the gear lighter on the bottom. No trawl sensors are used; the fishing master judges from the speed of the vessel when the gear is on the bottom.

The gear was inspected on daily basis by suspending it from the A-frame. The gear was checked for any missing linker chains, worn fly meshes (which tie the net to the fishing line), the shape (too slack or tight) of the chain mat, footrope, fishing line and flip-up as well as any other damage.

Fishing operations took place 24h per day.

Wetlab protocol

The catches from the (starboard) trawl with the 40mm liner are sorted first. All fish and invertebrate species are sorted and weighed. All fish and squid species as well as *Nephrops* and *Cancer pagurus* are measured and biological data are collected for the species listed in the table below. The catches from the (port) trawl without the liner are treated in the same way except for the invertebrate species, which are only weighed if they do not occur in the catches from the first trawl.

	Species	Sort by sex	OTO box	Catch weight	Can you subsample	Bio target	Live weight	Sex	Mat	Age	Gutted weight	
Aged demersal species	COD	U	100-149	yes	yes	1pcm	yes	yes	yes	yes	yes	
	HAD	U	150-249	yes	yes	100%	yes	yes	yes	yes	no	
	LIN	U	250-299	yes	yes	1pcm	yes	yes	yes	yes	no	
	MEG	F/M	300-349 / 350-399	yes	yes	1pcm	yes	yes	yes	yes	yes	
	MON*	U	400-499	yes	never	100%	yes	yes	yes	yes	yes	
	WAF*	U	500-599	yes	never	100%	yes	yes	yes	yes	yes	
	PLE	F/M	600-649 / 650-699	yes	yes	1pcm	yes	yes	yes	yes	no	
	POK	U	700-749	yes	yes	1pcm	yes	yes	yes	yes	no	
	POL	U	750-799	yes	yes	1pcm	yes	yes	yes	yes	no	
	SOL	F/M	800-849 / 850-899	yes	yes	1pcm	yes	yes	yes	yes	no	
WHG	U	900-989	yes	yes	100%	yes	yes	yes	yes	no		
Biological teleo	BLL	F/M	wkstn	yes	yes	1pcm	yes	yes	yes	no	no	
	HKE	U	wkstn	yes	yes	1pcm	yes	yes	yes	no	no	
	JOD	U	wkstn	yes	yes	1pcm	yes	yes	yes	no	no	
	LBI	F/M	990-999	yes	yes	1pcm	yes	yes	yes	no	yes	
	LEM	F/M	wkstn	yes	yes	1pcm	yes	yes	yes	no	no	
	TUR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes	no	no	
	WIT	F/M	wkstn	yes	yes	1pcm	yes	yes	yes	no	no	
Bio elasmobranchs	BLR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no	
	CUR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no	
	DGS	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no	
	DFL	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no	
	DII	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no	
	SDR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no	
	THR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no	
	NEP	U	-	yes	nemesys	nemesys	nemesys	nemesys	nemesys	no	no	
Others	All other demersal fish species			yes	Yes	none	no	no	no	no	no	
	All pelagic fish species and squid			yes	No length or biological samples							
	Invertebrates: Corals, sea fans, sea pens, fan mussels, Arctica islandica			Count & weight. If unsure about ID, take pic or freeze with haul label. For coral and A. islandica include comment on whether dead or alive								
	Other invertebrates			Total weight in comment field								
	Rubbish			As IGFS								
	CTD			As IGFS								

Key

- Sex F/M: record catch weight by sex (flatfish and elasmobranchs); U: do not sort by sex.
- wkstn use workstation number when prompted for otolith box
- subsample these species can be subsampled for length and biological data, if necessary
- e
- 1pcm biological sampling target of one fish per cm size class (otolith target 1)
- 100% biological sampling target set per length group, i.e. targets vary by size class (otolith target 100%)
- * any monk <20cm that is not clearly black should be id'd using dorsal fin ray counts: WAF 9-10; MON 11-12
- ** only determine the maturity of female elasmobranchs if they are already dead, otherwise record as stage 9.

Data collection and storage

Station positions, heading and bottom depth were recorded at the moment the gear settled on the bottom and when the gear was hauled back. Tide and wind direction and speed, barometric pressure, heave, pitch and roll were recorded at the mid-point in the tow. Bottom depth and GPS position are also recorded in a SQL database at intervals of approximately 1 per second.

Catch weights, length frequency distributions and biological data were captured using the CEFAS Electronic Data Capture (EDC) system and stored into local Access '97 databases before being imported into a central SQL database. The CEFAS software FSS (Fishing Survey System) was used to enter station data and import catch data.

Estimation

The capture probability for a fish in tow i in stratum s , (p_{is}) is given as:

$$p_{is} = \frac{v_i I_s}{A_s}$$

v_i is the swept area of tow i in stratum s .

I_s is the number of tows in stratum s .

A_s is the surface area of stratum s .

The estimated number of fish (\hat{N}) or biomass (B) in the survey area is then:

$$\hat{N} = \sum_{i \in I} \frac{n_i}{p_{lis}} \quad \hat{B} = \sum_{i \in I} \frac{n_i w_i}{p_{lis}}$$

n_i is the catch numbers-at-length in tow i

w_i is the mean weight-at-length, obtained from the length-weight relationship for the whole survey.

Because this estimate is based on the assumption that catchability is 100%, it can be treated as a lower bound of the actual abundance.

Changes in gear, protocols or estimation

No changes since the previous survey.

Results

Cruise narrative

A total of 49 valid tows were completed (out of a target of 51), as well as 4 additional tows (these had not been randomly selected but were sampled opportunistically). There was one foul haul but gear damage. The weather was good for most of the survey.

Cruise narrative

Date	Comments
Tue 07/03/17	Scientific crew changeover. Beam trawls taken onboard; Jackson trawls unloaded. Departed midnight.
Wed 08/03/17	1 test tow and 4 valid hauls completed. Good weather

Thu 09/03/17	8 valid tows completed. Good weather
Fri 10/03/17	8 valid tows completed. Good weather
Sat 11/03/17	6 valid tows and 2 additional tows completed. The additional tows were outside the survey area (Stratum I) on request by CEFAS as these stations would have been quite far out of their way. Good weather
Sun 12/03/17	Wind increased during the day; lost 5 hours due to bad weather. 6 valid hauls completed
Mon 12/03/17	7 valid tows and 1 invalid tow (hauled early to avoid static gear). Weather good again.
Tue 13/03/17	9 valid tows and 1 invalid tow (came fast – no damage)
Wed 14/03/17	6 valid tows and 2 additional tows completed. The additional tows were added into the area where plaice and sole occur with the aim to build up an abundance index for these stocks (using a different stratification – hence these stations will not be used for anglerfish / megrim index calculations).
Thu 15/03/17	Multinet sampling for Nephrops larvae on the Aran grounds , in on 19h tide
Fri 16/03/17	Returned to Galway

Downtime, damage

Weather downtime	5hrs
Technical downtime	None
Gear damage	None

Summary statistics

Target and achieved number of stations per stratum

Stratum name	Target	Achieved	Area (km ²)	Swept area (km ²)	Swept area (%)
Stratum A	5	2	6832	0.058	0.0009%
Stratum_la	2	5	2502	0.151	0.0060%
Stratum_lb	16	15	20065	0.446	0.0022%
Stratum_IV	14	13	17970	0.384	0.0021%
Stratum G	14	14	17309	0.417	0.0024%
Total	51	49	64675	0.058	0.0009%

Catch rates of target species

Species	CatchNum	CatchNumHr	CatchWtKgHr
Megrim	4466	182.0	13.35
Black bellied angler	802	32.7	13.39
Four-spot megrim	572	23.3	1.21
White-bellied angler	130	5.3	7.56

Catch rates of the top 10 species (by number); 57 species of fish were caught.

Species	CatchNum	CatchNumHr	CatchWtKgHr
Megrim	4466	182.0	13.35
Black bellied angler	802	32.7	13.39
Four-spot megrim	572	23.3	1.21
Grey gurnards	349	14.2	1.12
Scaldfish	319	13.0	0.22
Hake	304	12.4	4.58
Poor cod	293	11.9	0.75
Witch	183	7.5	0.65
Lesser spotted dogfish	168	6.8	1.26
Imperial scaldfish	155	6.3	0.20

Catch weights of the top 10 invertebrates (by occurrence); 134 species and genera of invertebrates were caught.

Species	CatchWtKg	NumHauls
<i>Eledone cirrhosa</i>	80.1	56
<i>Actinauge richardi</i>	73.7	50
<i>Astropecten irregularis</i>	7.7	49
<i>Stichastrella rosea</i>	4.0	47
<i>Luidia sarsi</i>	11.5	45
<i>Pandalus spp</i>	1.5	43
<i>Porania pulvillus</i>	6.8	39
<i>Hyalinoecia tubicola</i>	0.6	37
<i>Liocarcinus depurator</i>	2.3	35
<i>Aphrodite Aculeata</i>	70	32

Number of biological samples taken.

	Species ¹	Sex ²	Sex/Mat	Age
Aged demersal species	COD	U	3	3
	HAD	U	73	73
	LIN	U	1	1
	MEG	F/M	1292	1292
	MON	U	160	160
	WAF	U	594	594
	PLE	F/M	66	66
	POK	U	1	1
	POL	U	3	3
	SOL	F/M	78	78
	WHG	U	52	52
Biological teleo	BLL	F/M	7	
	HKE	U	256	
	JOD	U	34	
	LBI	F/M	200	
	LEM	F/M	38	
	TUR	F/M	2	
	WIT	F/M	137	
Bio elasm	BLR	F/M	0	
	CUR	F/M	63	
	DGS	F/M	0	
	DFL	F/M	18	
	DII	F/M	14	
	SDR	F/M	1	
THR	F/M	6		

Figures

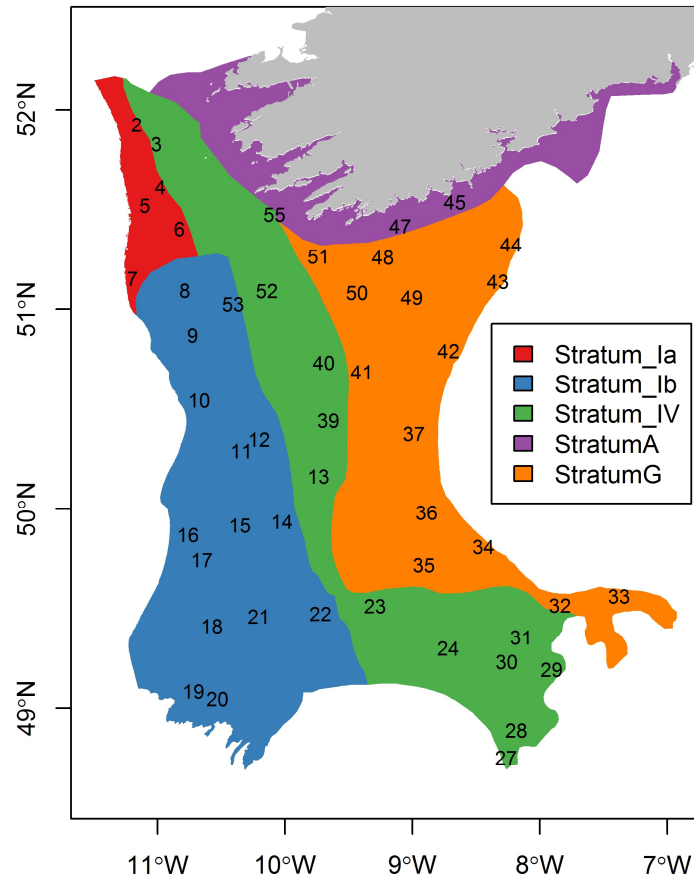


Figure 1. Valid tow positions, the numbers refer to the haul number.

Species Composition

Pelagic species and large gadoids omitted

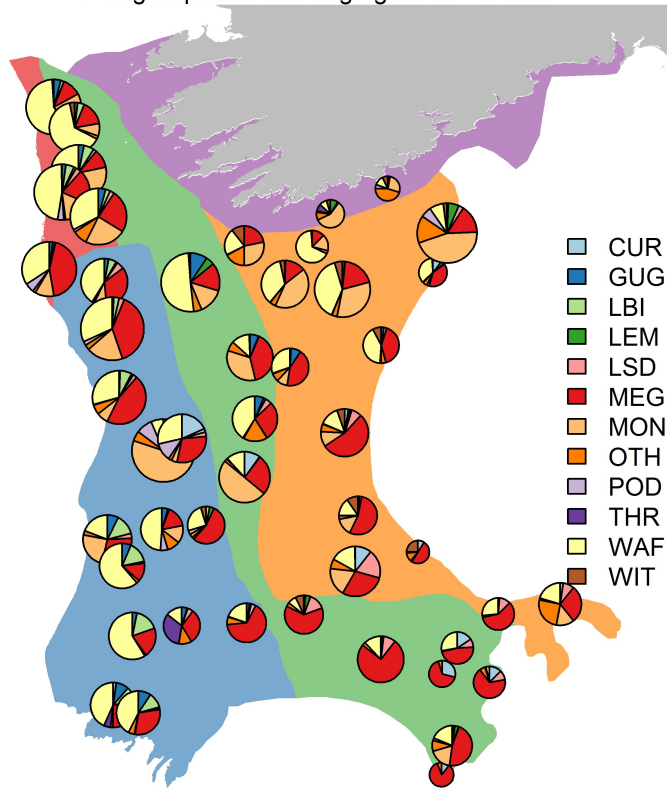


Figure 2. Fish species composition of the catches. The size of the pies is proportional to the catch weight per km² swept area. Pelagic species and gadoids were removed.

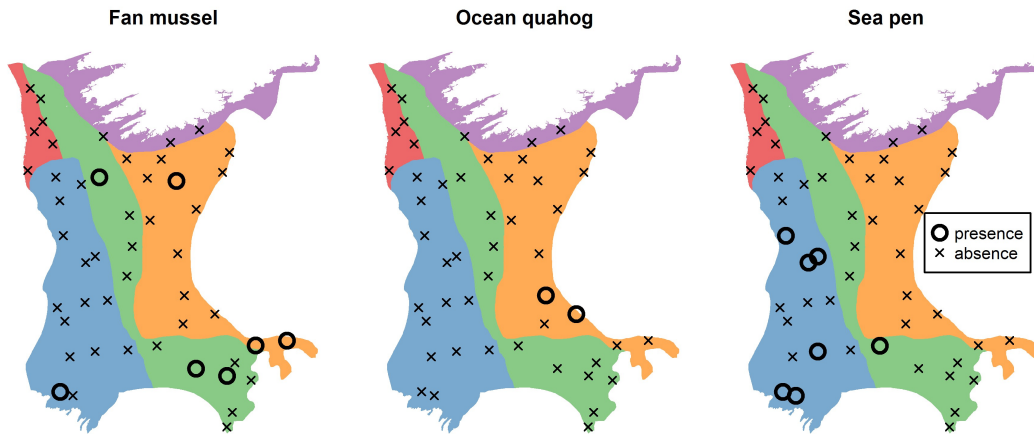


Figure 3. Presence/absence of vulnerable and sentinel species.

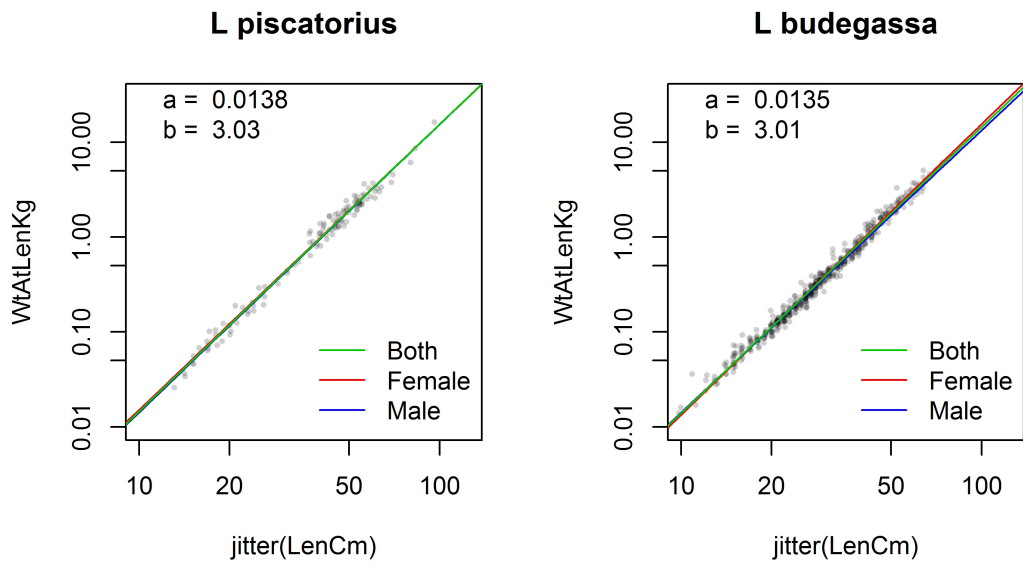


Figure 4. Length-weight parameters for *L. piscatorius* and *L. budegassa*.

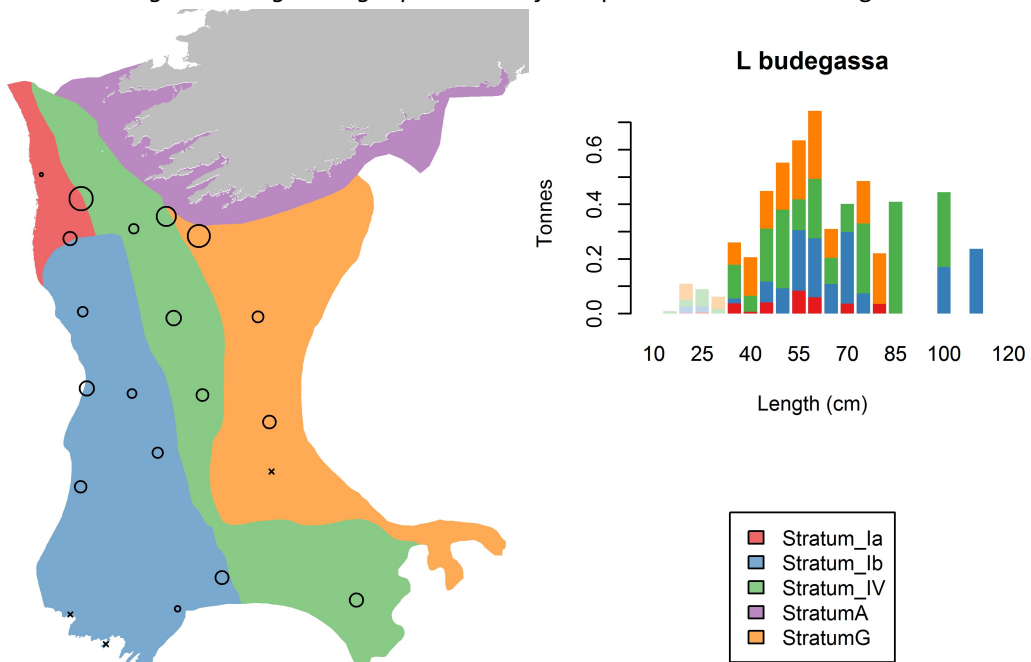


Figure 5. Bubble size is proportional to the biomass of *L. piscatorius* per swept area at each sampling station (left; >500g fish only) and biomass per size class and stratum (right; fish <500g in pale shades).

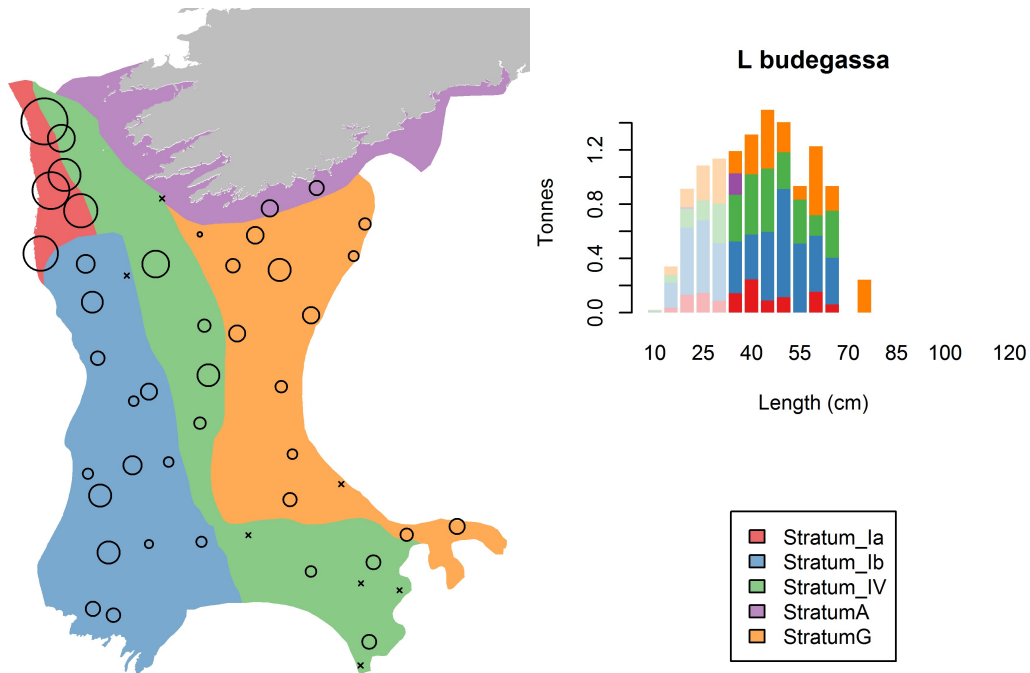


Figure 6. Bubble size is proportional to the biomass of *L. budegassa* per swept area at each sampling station (left; >500g fish only) and biomass per size class and stratum (right; fish <500g in pale shades).

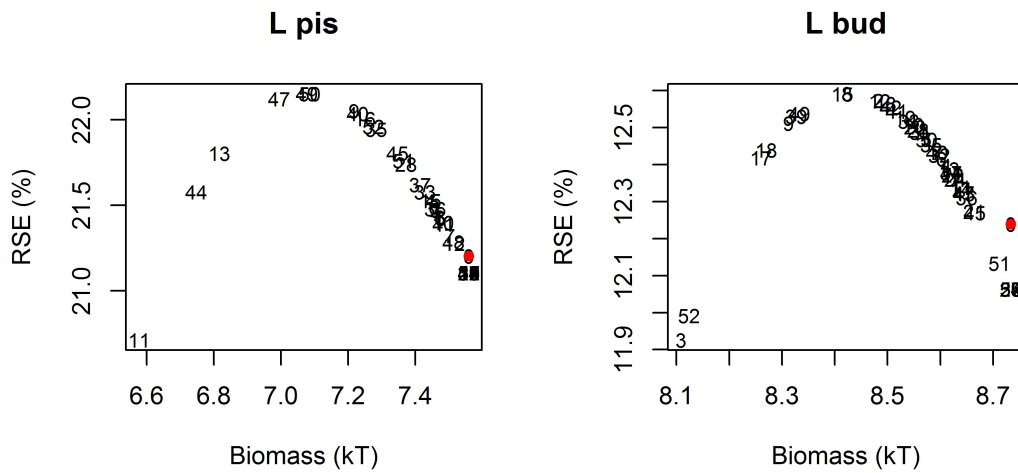


Figure 7. Influence that each tow had on the final biomass estimate (excluding fish <500g). Estimates were obtained by sequentially removing each of the tows from the analysis. The left figure shows that without haul 7 or 46 the biomass estimate of *L. piscatorius* would have been considerably lower.

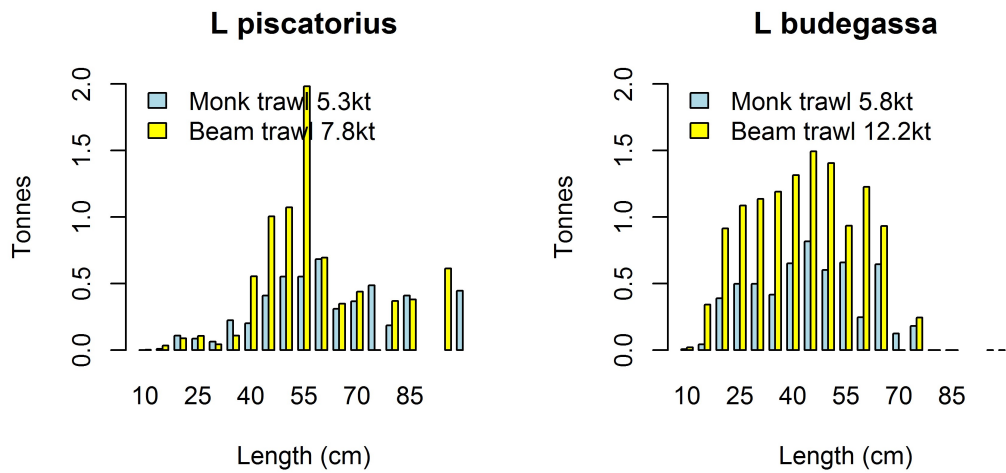


Figure 8. Comparison between the biomass estimates-at-length of the beam trawl and Irish Anglerfish and Megrim Survey (IAMS) 2016 in the area where the two overlapped. The AIMS survey took place in January and used a commercial anglerfish trawl.

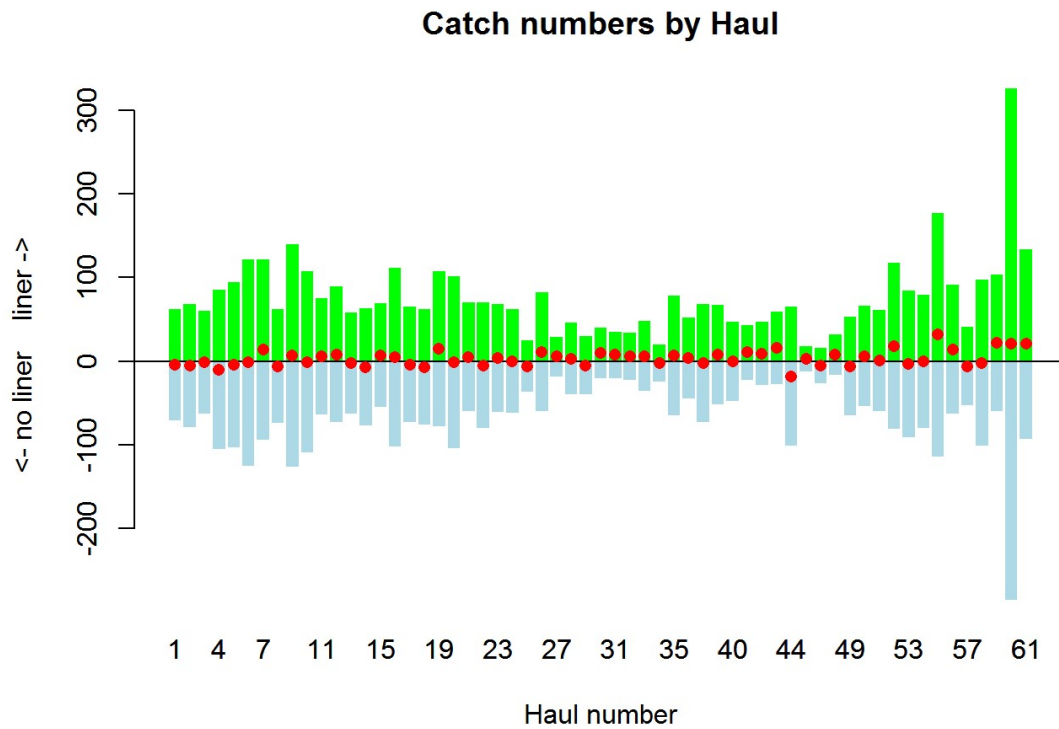


Figure 9a. Comparison between the catch numbers in the trawl with the liner (green) and without the liner (blue). The red dots signify the difference between the two trawls.

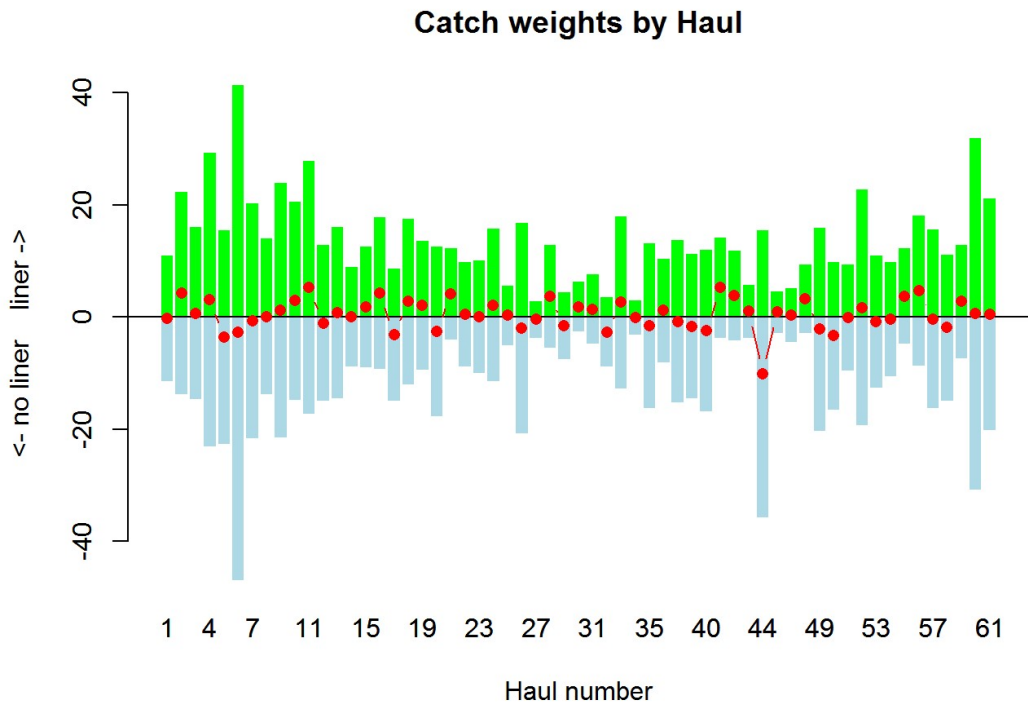


Figure 9b. Comparison between the catch weights in the trawl with the liner (green) and without the liner (blue). The red dots signify the difference between the two trawls.

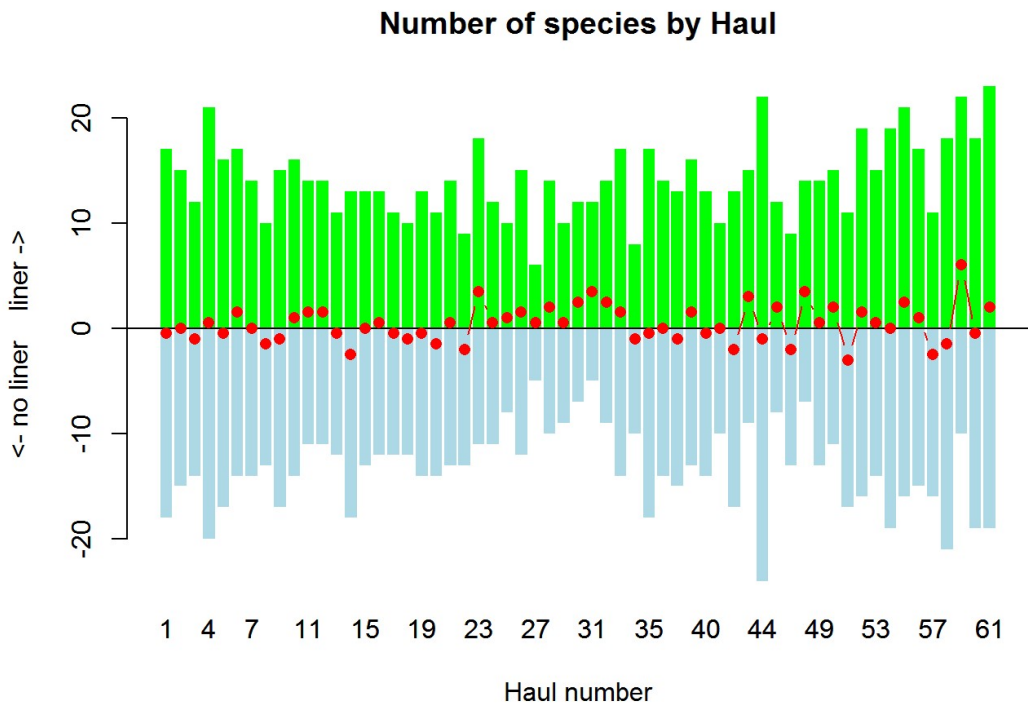


Figure 9c. Comparison between number of fish species in the trawl with the liner (green) and without the liner (blue). The red dots signify the difference between the two trawls.

References

WGMSFDemo 2015. Interim Report of the Working Group to Demonstrate a Celtic Seas wide approach to the application of fisheries related science to the implementation of the Marine Strategy Framework Directive (WGMSFDemo), 28-30 April 2015, Dublin, Ireland. ICES CM 2015\SSGIEA:12. 32 pp.

List of survey staff

Name	Organisation	Role
Sara-Jane Moore	Marine Institute	Scientist In Charge
Hans Gerritsen	Marine Institute	Scientist In Charge
Sean O'Connor	Marine Institute	Wetlab Deckmaster
Dermot Fee	Marine Institute	Wetlab Deckmaster
Turloch Smith	Marine Institute	Wetlab Assistant
Dave Tully	Marine Institute	Wetlab Assistant
Macdara Ó Cuaig	Marine Institute	Wetlab Assistant
Zara Cleere	Survey Contractor	Wetlab Assistant
Meadhbh Quinn	IWDG	Wetlab Assistant
Denise O'Sullivan	Aquafact	Wetlab Assistant
Jonathan White	Marine Institute	Wetlab Assistant
Ryan McGeady	NUIG	Wetlab Assistant
Ger Dougal	Survey Contractor	Technical Consultant