

# Do cetaceans respond to changes in their prey availability and environmental conditions?

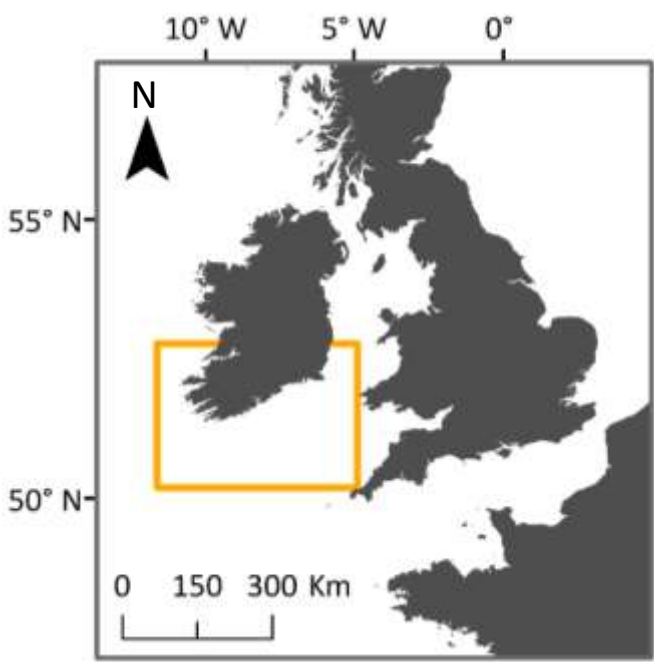


Andrea Fariñas Bermejo\*<sup>1</sup>, Simon Berrow <sup>1,3</sup>, Vasilis Valavanis <sup>2</sup>, Dave Wall <sup>3</sup>, Graham John Pierce <sup>4</sup>

\*Corresponding author:  
Andrea Fariñas Bermejo  
(andreaferinasbermejo@gmail.com)

1. Galway-Mayo Institute of Technology (Ireland); 2. Marine Geographic Information Systems Laboratory, Institute of Marine Biological Resources and Inland Waters, Hellenic Centre for Marine Research (Greece); 3. Irish Whale and Dolphin Group (Ireland); 4. Instituto de Investigaci3n Mariñas - Consejo Superior de Investigaciones Científicas (Spain)

## Once upon a time...



Map of the study area highlighted in orange.

In 2013, the Celtic herring stock which is the most important pelagic fishery for Ireland<sup>1,2</sup>, collapsed<sup>3</sup>. The area where this stock is mainly concentrated (the southern Irish coast), is also important for the Celtic sprat stock<sup>4</sup>. These two pelagic species are part of the menu of the most abundant cetaceans among the 25 species recorded in these waters<sup>5,6</sup>: common dolphins and specially, whales<sup>7</sup>.

## Scientists started wondering...

Did the herring crash have an effect on cetaceans? Which is the influence of sprat and environmental conditions?

## Let’s look for any clue...

**Data** (October 2005-2018): Celtic Sea Herring Acoustic Surveys<sup>8</sup>, Satellite images and ArcGIS

**Hurdle Generalized Additive Models**<sup>9</sup>

- 1<sup>st</sup> : Presence or absence (binomial models)
- 2<sup>nd</sup> : Abundance, with presence-given data (negative binomial models)

Common dolphins n= 410  
Fin whales n=83  
All whales n= 160  
Total km on effort analysed = 13750

Explanatory variables	Response variables: total number of sighted individuals					
	Common dolphins		Fin whales		All whales	
	Presence	Abundance	Presence	Abundance	Presence	Abundance
<b>Detectability variables</b>						
Sea state	↘		↘		↘	
Visibility						
Effort applied	↗	↘	↗		↗	↗
<b>Prey variables</b>						
Herring		~			↗	~
Sprat			↗		↗	
<b>Spatiotemporal components</b>						
Year	~				↗	
Latitude & Longitude	~		~		~	
<b>Environmental conditions</b>						
Depth	↗					
Distance to coast						
Sea surface temperature (SST)		~				~
Chlorophyll concentration (CHL)						
Photosynthetically Available Radiation (PAR)		↗				
Euphotic Depth (ZEU)	↘					

The table above highlights the trend of partial effect of the variables resulted significant in the optimum GAM to explain each of the response variables: direct positive (↗), direct negative (↘) or complex (~) partial effect.

## What does this mean?

**Common dolphins** tend to be present towards the coast, at intermediate depths and areas with an euphotic layer around 30m. Where this species is present, it is more abundant in zones with higher herring density, the coldest and warmest SST and high PAR.

In comparison, sprat influences positively the presence of **every whale species**. The differences found between the studied groups, suggested that **minke, humpback and unidentified whales** are also affected by herring, besides SST.

## Why is this important?

The obtained results provide information for:

- The development of MFSO Descriptors 1, 3 and 4.

Besides, this study emphasises the importance of:

- Implementing Ecosystem-Based Management approaches for the assessment of individual species.
- Integrative surveys, sharing data and multidisciplinary teams.

Common dolphins are affected by herring density and environmental conditions, while sprat density is the main influence on whales.

Do you want a copy or contacts?  
Don't be shy, follow the code!

QR code

1. Gerritsen, H. D., & Lordon, C. (2014). Atlas of Commercial Fisheries around Ireland, Marine Insitute, Ireland. Retrieved from <http://hdl.handle.net/10793/958>  
2. ICES (2018). Herring (Clupea harengus) in divisions 7.a South of 52°30'N, 7.g-h, and 7.j-k (Irish Sea, Celtic Sea, and southwest of Ireland). In Report of the ICES Advisory Committee, 2018. ICES Advice 2018 Her.27.Iris.  
3. Nichols, J., Huntington, T., Park, Q. B., & Street, M. (2018). Marine Stewardship Council Re-Assessment Public Certification Report For The CSHMAC Celtic Sea Herring Fishery.  
4. Marine Institute (2013). The Stock Book 2013: Annual Review of Fish Stocks in 2013 with Management Advice for 2014. Marine Institute, Rinville, Oranmore, Ireland.  
5. Berrow, S.D. (2001). Biological diversity of cetaceans (whales, dolphin and porpoises) in Irish waters. In J.D. Nunn (ed.), *Marine biodiversity in Ireland and adjacent waters. Proceedings of a conference 26-27 April, 2001*, 115-119. Belfast.

**Acknowledgments:** I would like to thank the collaborators of this study: the Marine Institute, the Irish Whale and Dolphin Group and Vasilis Valavanis for providing such interesting data; the ICES Working Group on Ecosystem Assessment of Western European Shelf Seas for their advice and Simon for giving me the opportunity of developing this research topic. Specially I am grateful to Graham Pierce for his unconditional support, help and everything he taught me, to the Fisheries Ecology Group at IIM-CSIC, family and friends for encouraging me.