DEEPFISHMAN

Management and monitoring of deep-sea fisheries and stocks

EU FP7 project

grant No 227390

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Deepfishman

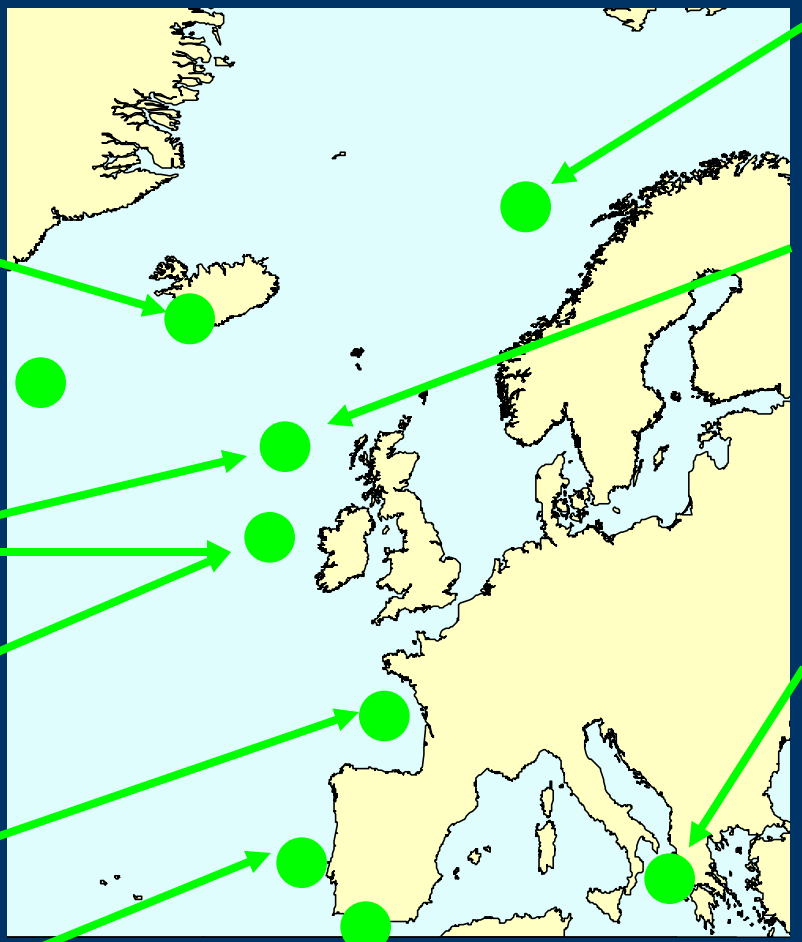
DEEPFISHMAN project

- 13 partners from 9 countries
- 3 millions Euros EC contribution
- April 2009 - September 2012

General aims

Stock assessment methods
Biological reference points (BRPs)
Harvest control rules (HCRs)
Managements strategies
Monitoring requirements

DEEPFISHMAN Case studies



Redfish

Redfish

Blue ling

Greenland halibut (NAFO area)

Mixed species trawl fishery

Orange roughy

Blackspot sea bream

Black scabbardfish

Blackspot sea bream

Blackspot sea bream

Orange roughy

(Namibia)

Todays debate: deepsea trawling phase out

a few perspective extracted from DEEPFISHMAN work

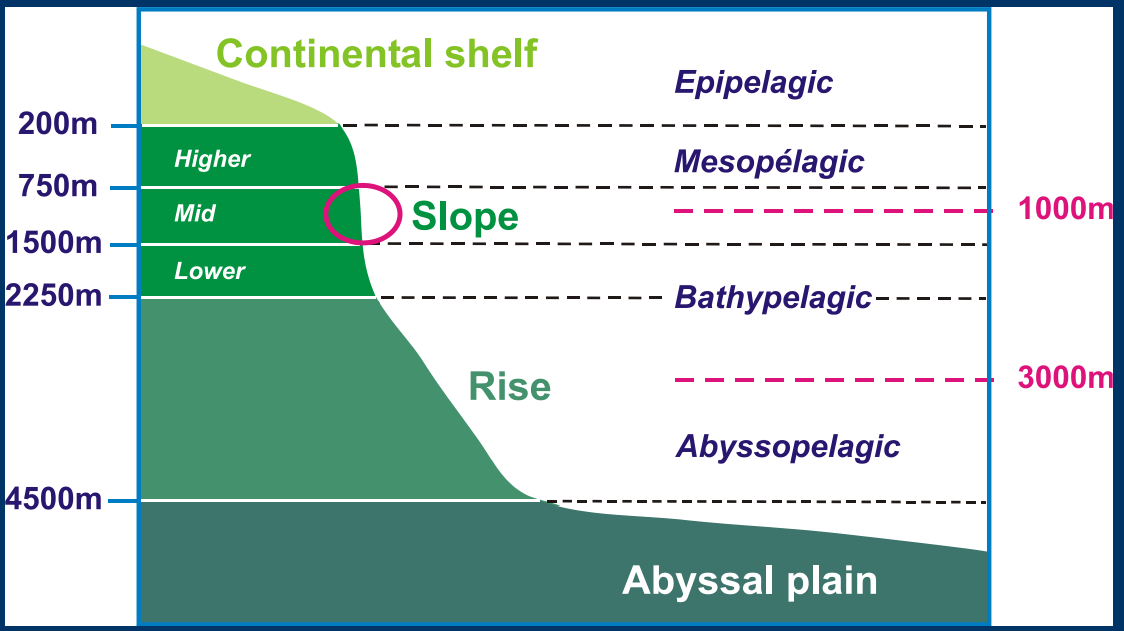
Objective of phasing out deepsea trawling: protect deepsea VMEs

Deepsea trawling = trawling for species subject to EU regulation 2347/2002

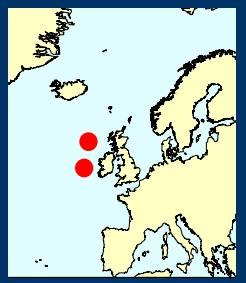
Definition of deep-water species and environments

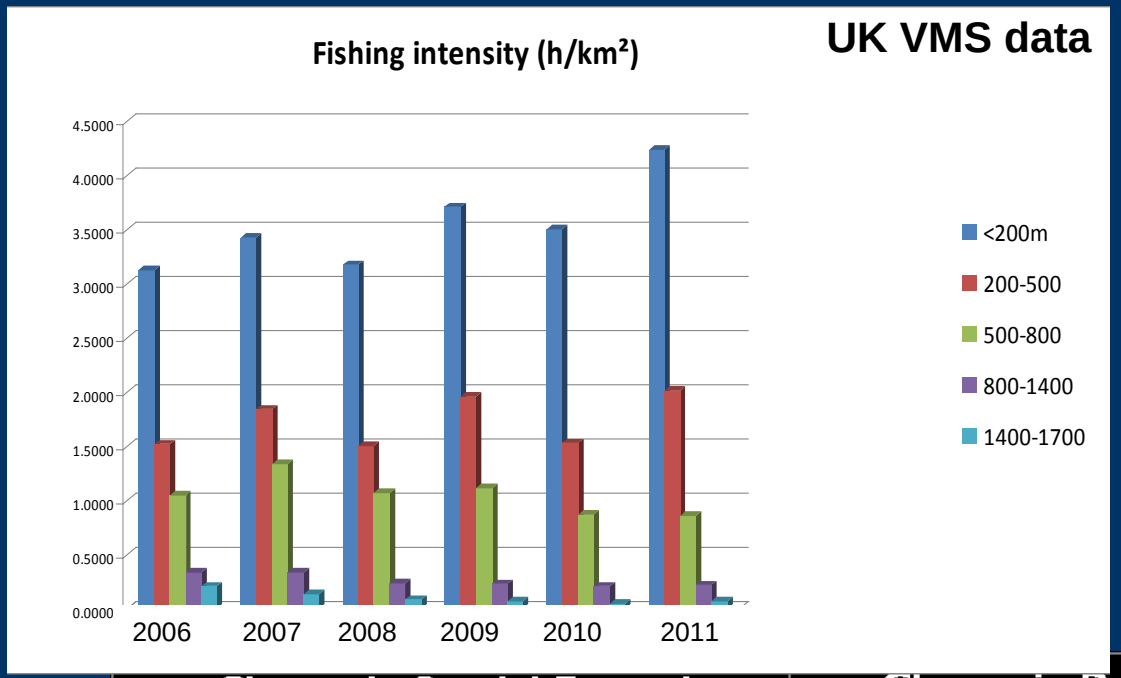
DEEPFISHMAN proposal

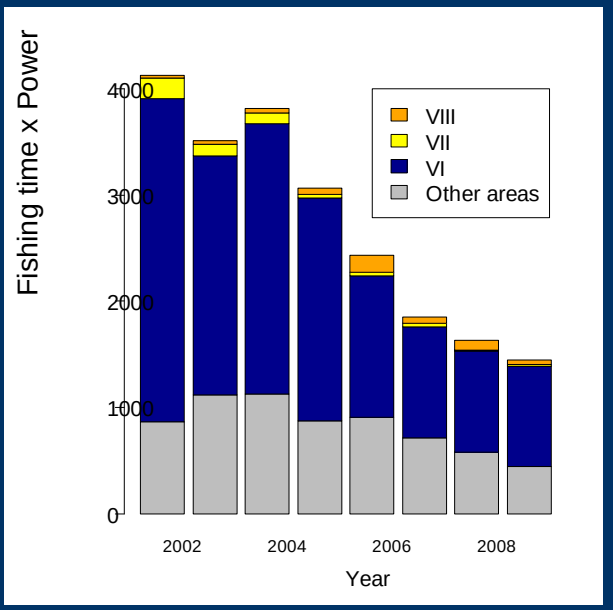
- Deep-water habitat: below 200 m
- Deep-water fish species: species with more than 50% of the biomass distributed deeper than 200 m
- EU vessel licensing: combination of annex I and II with some adjustment (e.g. including Greenland halibut and beaked redfish)



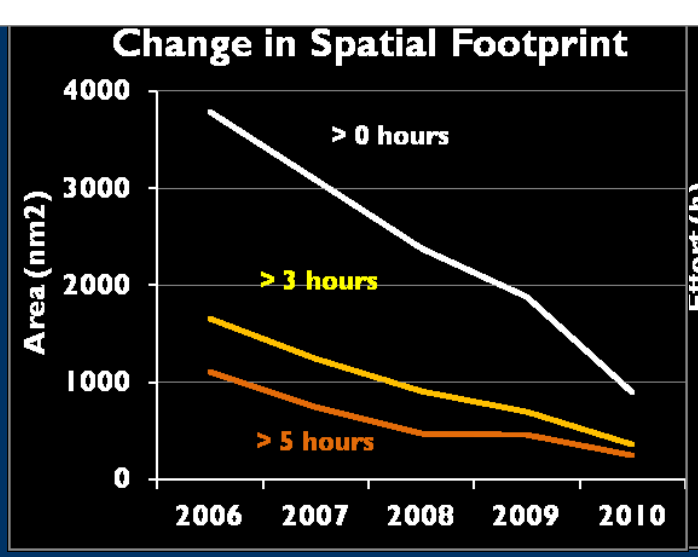
Definition of deep-water fishing effort

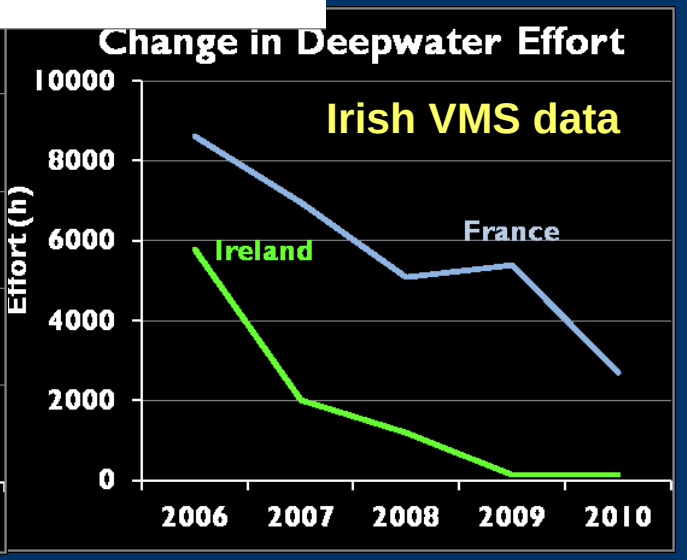




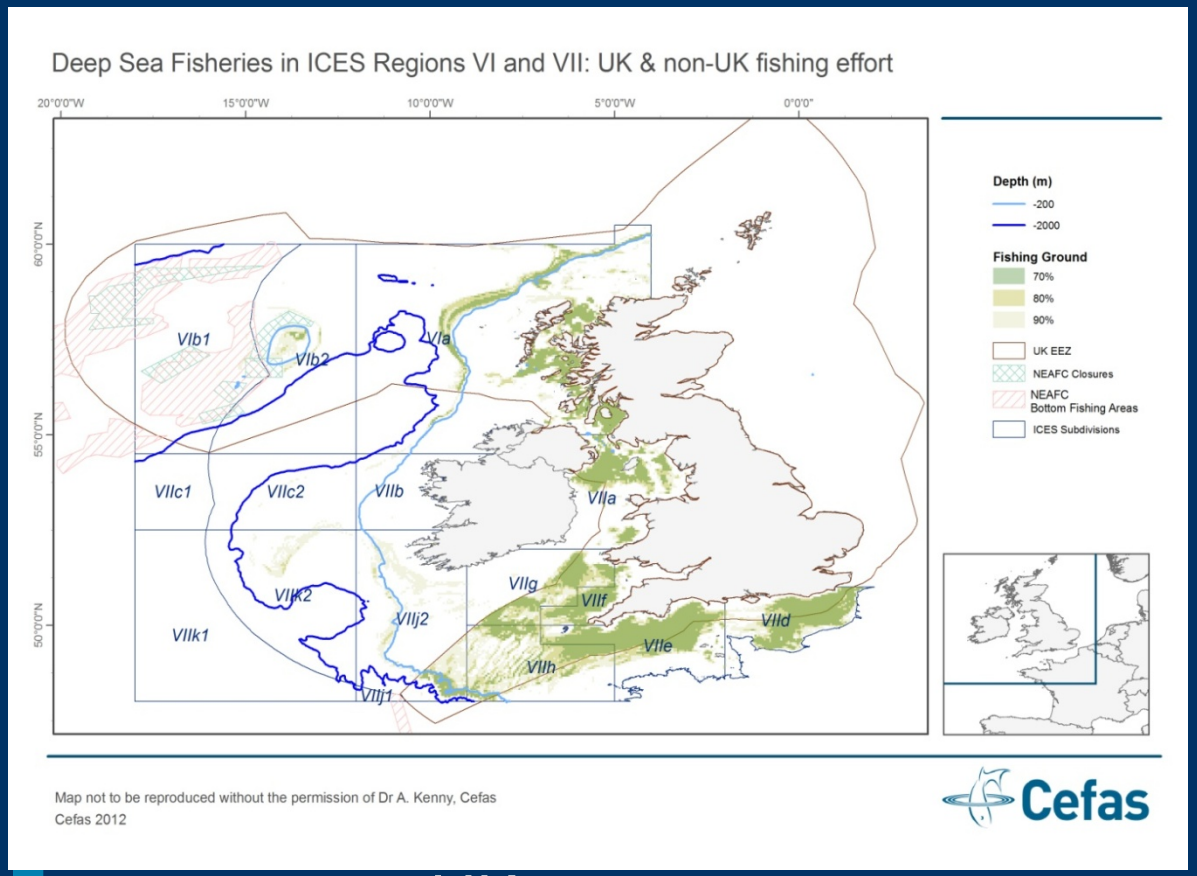


French deep-water fleet >800 m

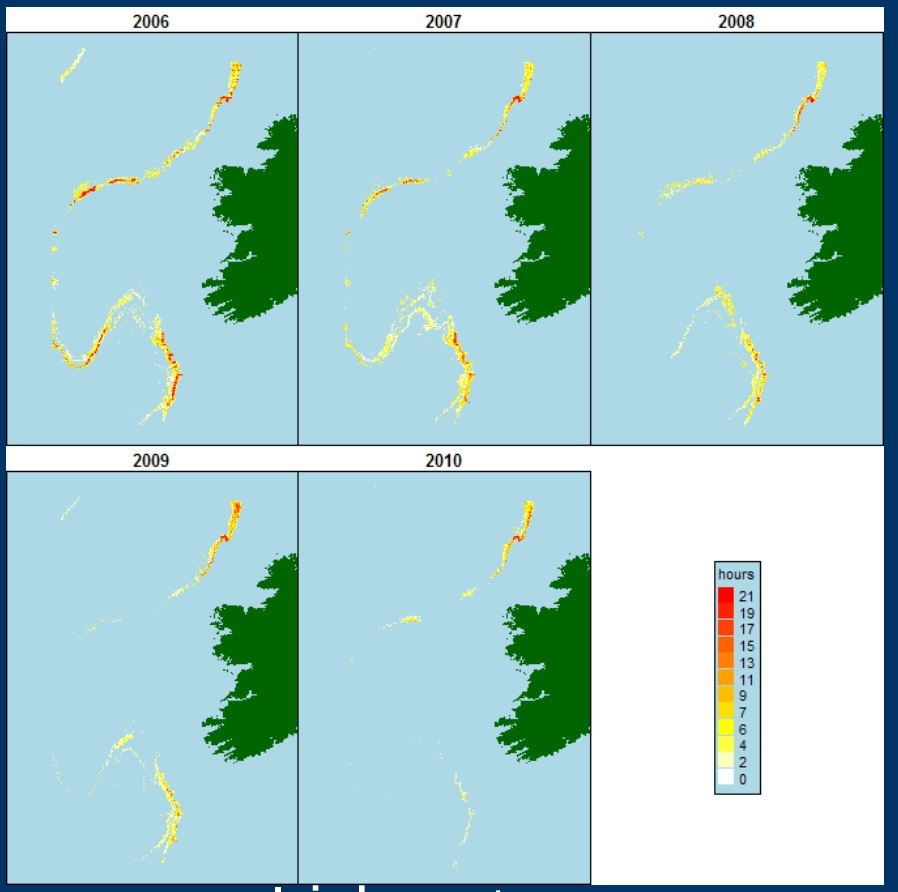




Spatial and temporal distribution of deep-water fishing from VMS



UK waters



Irish waters

DEEPFISHMAN new methods

Stock assessment methods

- Multi-annual year class curves (age based)
- Bayesian state space model of black scabbardfish and deep-sea sharks (two-stages)
- Bayesian production model for roundnose grenadier
- GADGET toolbox for Icelandic blue ling
- Simulation testing of new and traditional assessment methods for data poor situations

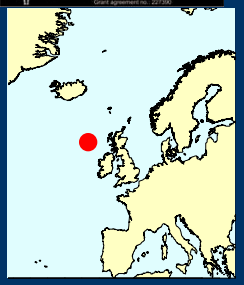
Indicator based assessment

- Standardizing CPUEs using GAMs
- Likelihood method for identifying joint time trends in multiple time series
- Spatial density modelling
- Spatial indicators
- Community level size-based indicators
- Productivity susceptibility Analysis (PSA) of orange roughy

Management

- Mono-specific Management Strategy Evaluation (MSE)
- Spatially explicit MSE
- Qualitative MSE
- Trade-off analysis

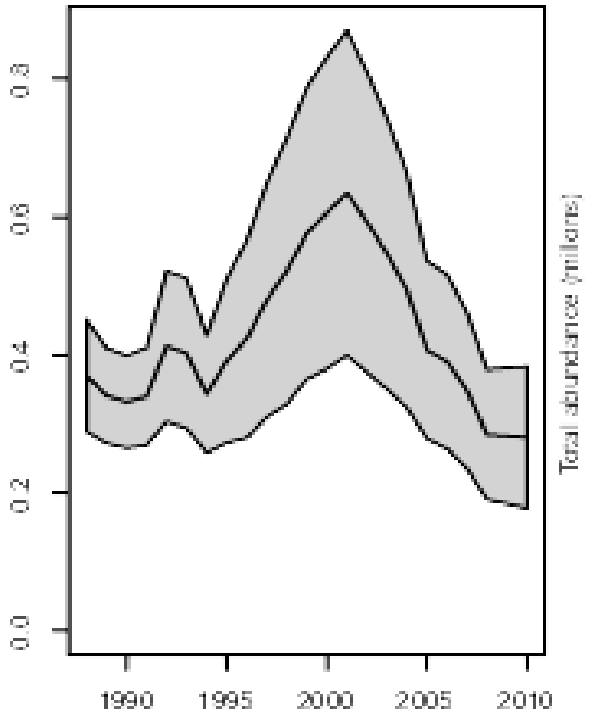
MYCC: application to blue ling



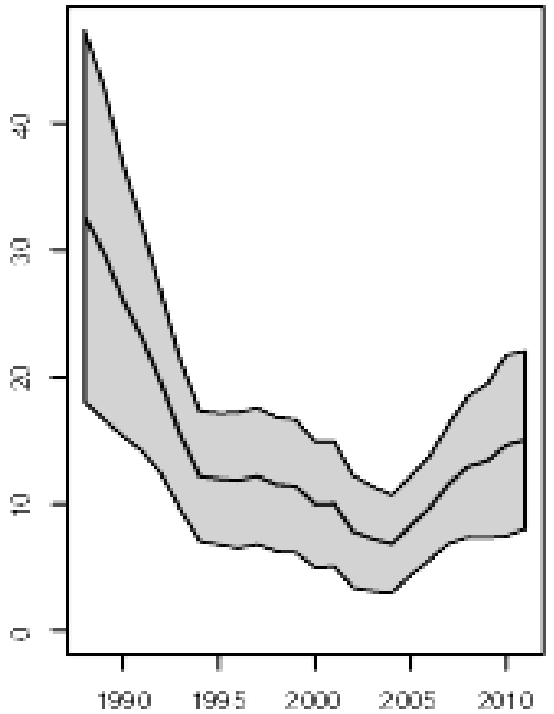
Data from commercial fishery

- Total catch (t) 1988 - 2011
- Numbers-at-length sample data (missing years)
- Age-length sample data (missing years)

Total mortality



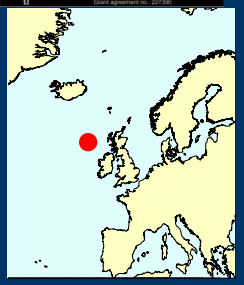
Abundance



Assumptions

- constant catchability ages 9 - 19+
- CV(catch) = 0.01

Spatial density modelling
Investigating spatial time trends: local depletion?

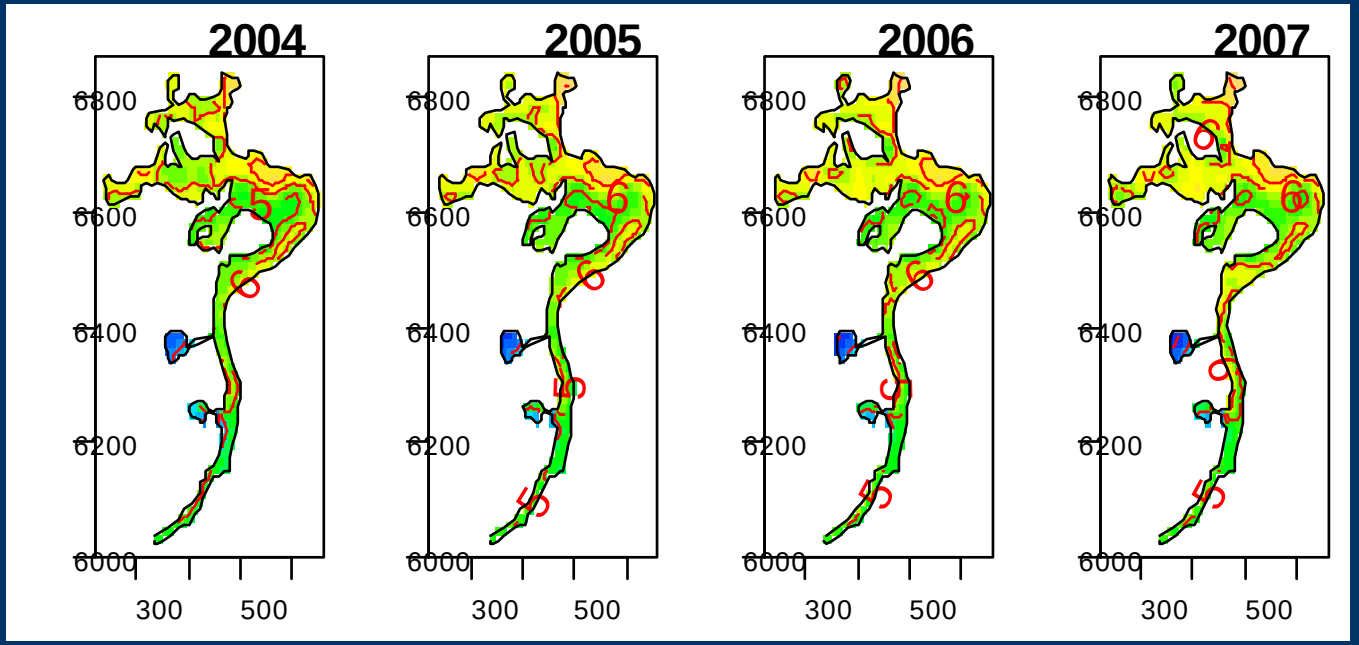


Model: landings per haul

log(E[landings]) = s(duration) + s(depth) + s(month) +
soap(eastings, northings, year) + s(depth,month) + s(depth, year)

3D soap smoother

landings~Tweedie(μ, Φ $\mu^{1.5}$)



Blue ling

Augustin, N. H., Trenkel, V. M., Wood, S. N., Lorance, P. (2013). Space-time modelling for blue ling using soap film smoothers. Environmetrics 24, 109-119.

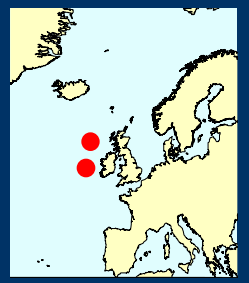
Summary of DEEPFISHMAN assessment methods

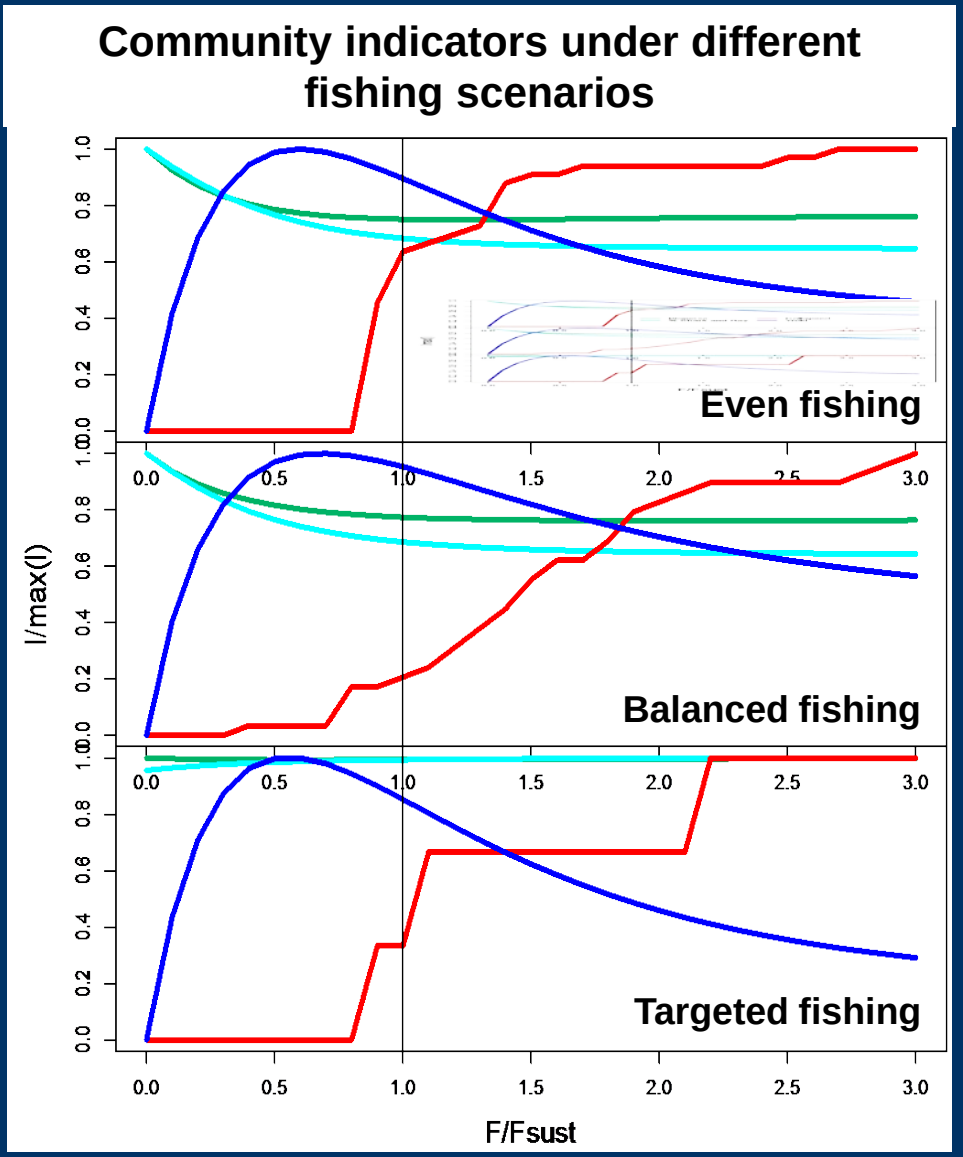
Method		Application test	Stock assessment
Multi-annual year class curves	**	Blue ling Roundnose grenadier	BLI West of B.I. (WGDEEP 2012)
State-space life-stage model	*	Black scabbardfish Deep-sea sharks	BSF (WGDEEP 2012)
Reconstructed time series of recruitment	**	Beaked redfish	RED (WKRED 2012; AFWG 2012)
Account of discards Bayesian production model	** *	Roundnose grenadier	RNG West of B.I. (WGDEEP)
Test of assessment methods	*	BLI, RNG, BSF, SBR	
GADGET toolbox		Icelandic blue ling	BLI Iceland (WGDEEP 2012)
Seasonal events in abundance	**	Greater forkbear	
Productivity susceptibility Analysis (PSA)	**	Orange roughy	(WGDEEP 2013)
Standardizing CPUEs using GAMs	**	BLI, BSF, RNG	W. of B.I. (WGDEEP)
Likelihood method for identifying joint time trends in multiple time series	*	Blue ling, B. scabbardfish, R. grenadier sharks	
Spatial density modelling	**	Blue ling	(WGDEEP 2013)
Community level size-based indicators	*	Deep-sea W of B.I.	

Comments on assessment methods

- Deep-water stocks are no longer all data-poor
- Several methods were developed or adapted for DEEPFISHMAN case studies: already used for ICES advice for 5 stocks
- DEEPFISHMAN assessment methods provide estimates of fishing mortality and absolute biomass for 4 stocks
- Spatial analysis complement stock assessment
- Survey data are not required by all assessment methods

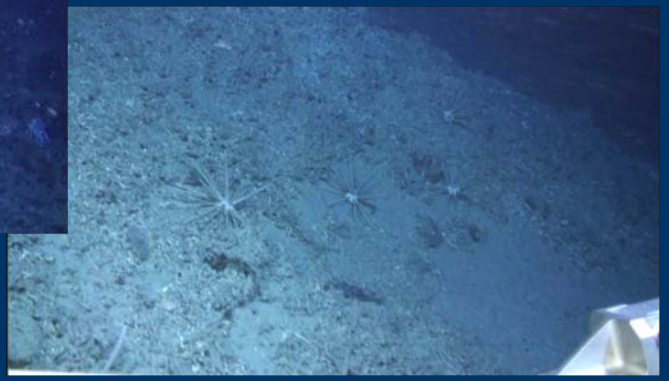
Towards an ecosystem approach: multi-species sustainability indicators

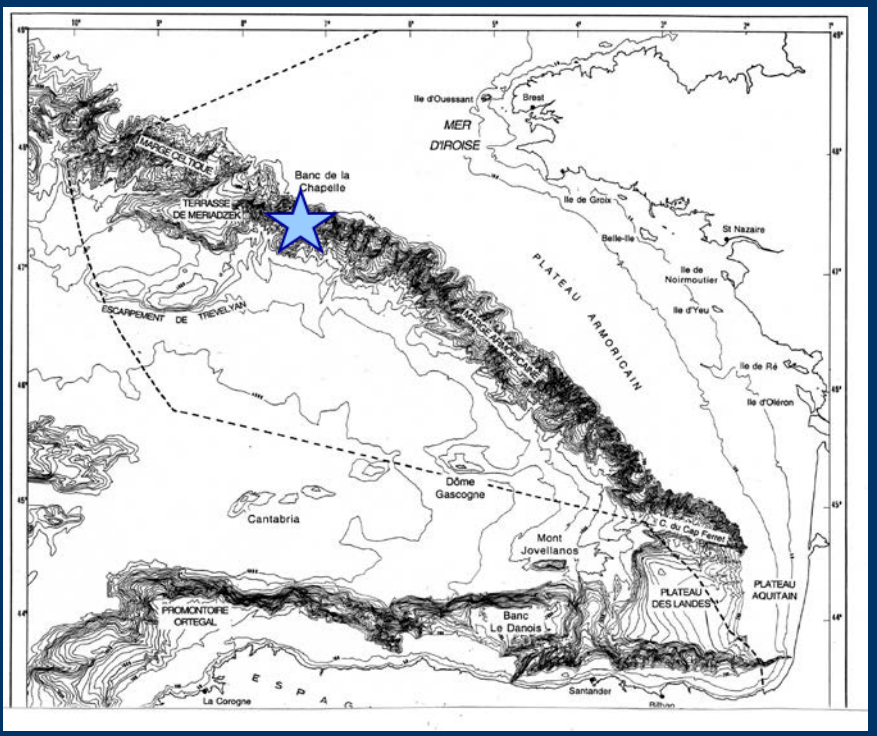




Blanchard, J.L., Trenkel, V.M., Scott, F., Lorance, P., (in prep.) Assessing the impacts of fisheries on deep-sea target and non-target species: insights from a trait-based multi-species model

Vulnerable Marine Habitats (VMEs) and fishing





Example of the Bay of Biscay

- Depth range 160-500 m : coral habitats remain only as coral rubbles (ICES WGDEC 2010, 2011)
- Deepsea fisheries (sensus 2347/2002 regulation) almost non-existent in the Bay of Biscay

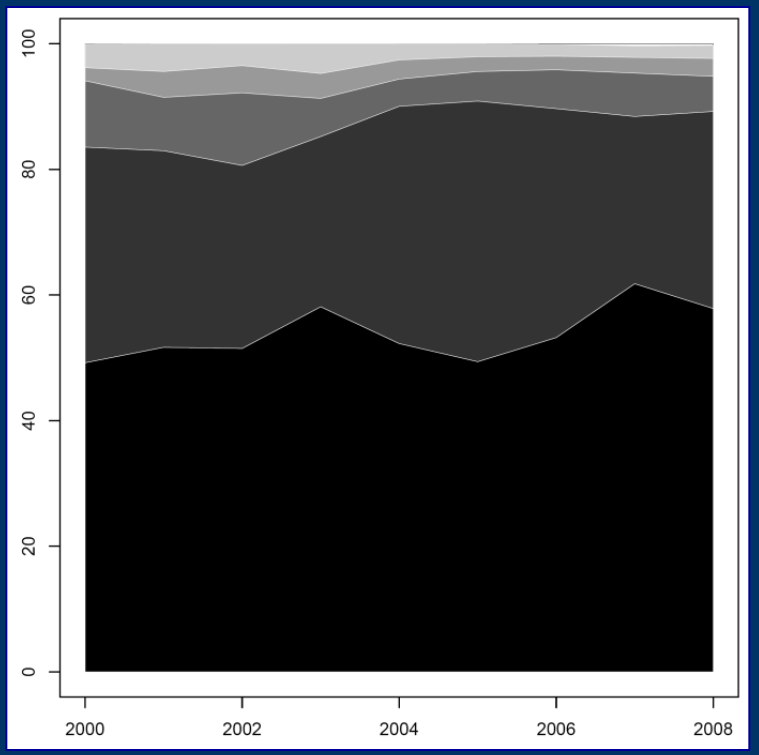
Laffargue P. & Lorance P. (2012). Interaction of fisheries and benthic habitats in the Bay of Biscay margin with a special focus on cold water corals. Ecosystem based management and monitoring in the deep Mediterranean & Atlantic, Galway, 28-31 August 2012

Upper-slope fisheries in the Bay of Biscay

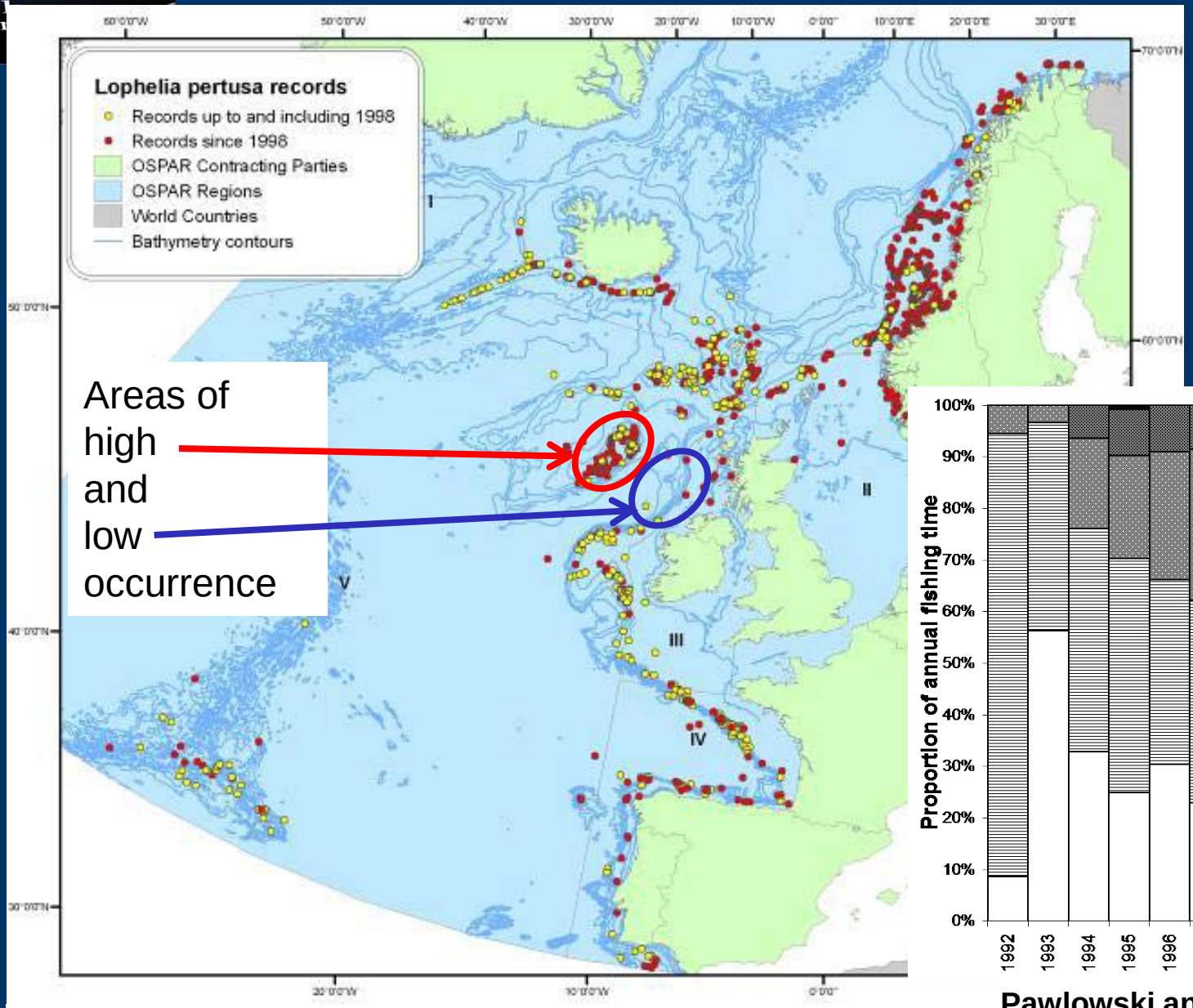
- upper slope fisheries in the Bay of Biscay are for monkfish, hake and megrims

2005-2011 Mean landings of deep-water species

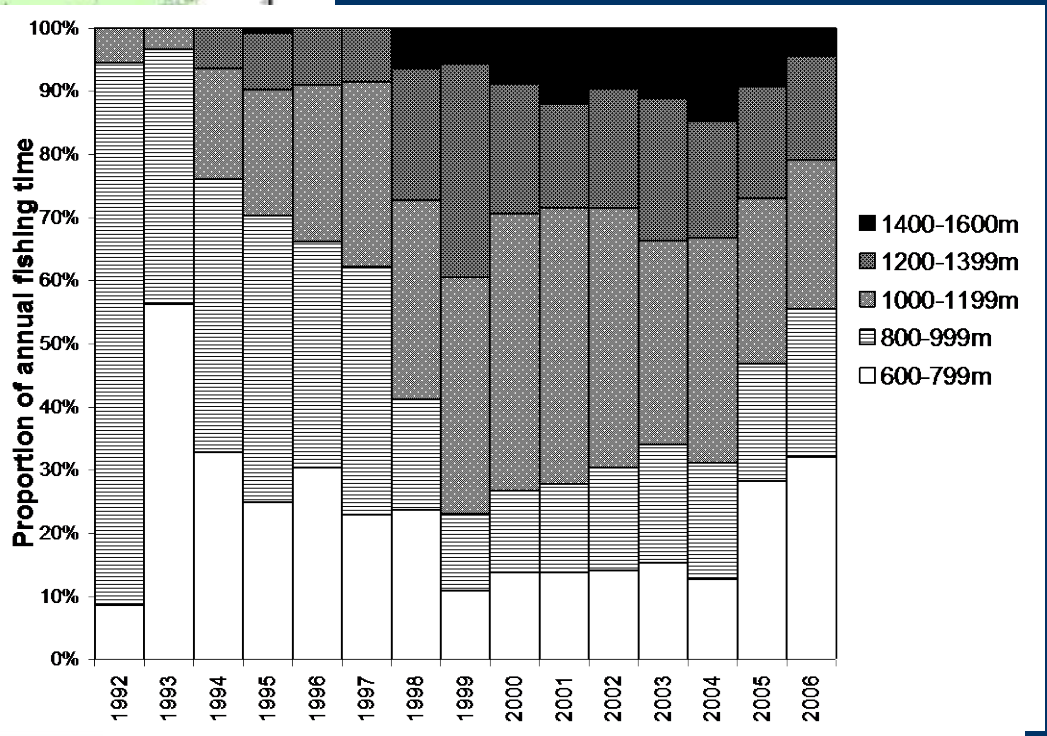
Beryx: 90 t
Argentines: 40
Greater forkbeard:
Roundnose grenadier 8
Orange roughy 15



VME distribution



”of the 1407 *L.pertusa* records that give precise depth information for the OSPAR area, 75% are from 190 – 880 m depth”

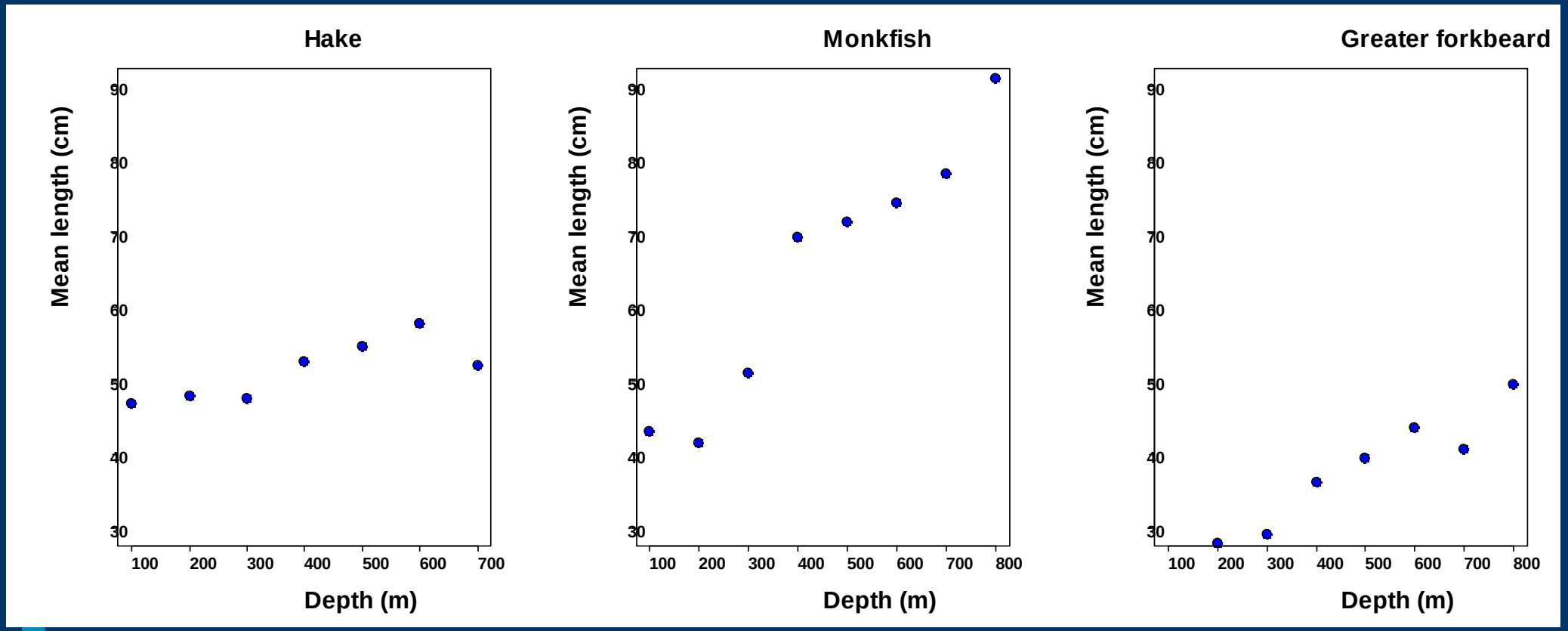


OSPAR Commission, (2009). Background Document for *Lophelia pertusa* reefs, Biodiversity series, 32 pp.

Pawlowski and Lorance, (2009). Aquatic Living Resources, 22(4), 573-582

Advantages of fishing deep

- Although small deep-water species provide a contribution to EU landings in EU waters
- Bigger-deeper trend in most species



French On-board observations, Bay of Biscay and Celtic Sea

Longline compared to trawl

- Over exploitation of target stock also occurs in longline fisheries
- Several studies have show high shark bycatch in deep-water longlines fisheries
- Comparison of longline and trawl to the west of Ireland and Scotland have show a higher proprotion of sharks in longline catch
- The same found in CoralFISH experiments (?)
- Several longline fisheries have disappeared following the decline of closure of dogfish (*Squalus acanthias*), tope shark (*Galeorhinus galeus*) and porgeagle (*Lamna nasus*)
- Problem with the gear change: DEEPSEA SHARKS

Bordalo-Machado, P., Figueiredo, I. (2009). The fishery for black scabbardfish (Aphanopus carbo Lowe, 1839) in the Portuguese continental slope. Reviews in Fish Biology and Fisheries 19(1), 49-67.
Connolly, P. L., Kelly, C. J. (1996). Catch and discards from experimental trawl and longline fishing in the deep water of the Rockall Trough. Journal of Fish Biology 49, supplement A, 132-144.
Figueiredo, I., Machado, P. B., Gordo, L. S. (2005). Deep-water sharks fisheries off the Portuguese continental coast. J. Northwest Atl. Fish. Sci. 35, 291-298.
Pajuelo, J. G., Gonzalez, J. A., Santana, J. I. (2010). Bycatch and incidental catch of the black scabbardfish (Aphanopus spp) fishery off the Canary Islands. Fisheries Research 106(3), 448-453.

Impact on deep-water VMEs

- Not generated only by «fisheries that account for about 1% of fish landed from the North-East Atlantic »

- Impacting fisheries include larger fisheries for major stock in EU waters, e.g. hake, monkfishes, megrims

- VMEs may be abundant on the upper slope and of the shelf
  - Mingulay reef complex, surveys recently with lived corals by 120-190 m west of Scotland (Roberts et al. 2009)
  - past *Lophelia* records shallower than 200 m in the Bay of Biscay (Joubin, 1922, Reveillaud et al., 2008)

Joubin, M. L. (1922). Les coraux de mer profonde nuisibles aux chalutiers. Office Scientifique et Technique des Peches Maritimes, Notes et Memoires 18, 5-16.

Roberts et al. (2009). Mingulay reef complex: an interdisciplinary study of cold-water coral habitat, hydrography and biodiversity. Marine Ecology Progress Series 397, 139-151.

Reveillaud, J., Freiwald, A., Van Rooij, D., Le Guilloux, E., Altuna, A., Foubert, A., Vanreusel, A., Olu-Le Roy, K., Henriet, J.-P. (2008). The distribution of scleractinian corals in the Bay of Biscay, NE Atlantic. Facies 54(3), 317-331.

Conclusion

- EU management at stock level, since 2003, has been efficient
- Stock assessment has improved owing to DCF, development done in DEEPFISHMAN and other projects, stocks no longer all DATA POOR
- Accumulation of DCF data is likely to allow further improvements
- Fishing on the slope allows to target larger individuals of several species
- VMEs occur also on the upper slope where major fisheries operate and at shelf depths
- Impact on VMEs are generate by several fisheries, much larger than only deep-sea (2347/2002) fisheries
- Changes in fishing gear may imply changing the ecological component impacted by fishing (impacting sharks instead of benthic VMEs)
- Management needs to a combine the management of exploited stock and spatial management, applicable to all fisheries