DEEPFISHMAN
Management and monitoring of deep-sea fisheries and stocks
EU FP7 project
grant No 227390

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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
Redfish Greenland halibut (NAFO area) Mixed species trawl fishery Orange roughy Blackspot sea bream Black scabbardfish

Blackspot sea bream (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)

[Diagram of ocean layers: Continental shelf, Epipelagic, Mesopelagic, Bathypelagic, Abyssopelagic]

Inter-RAC joint seminar on the management of deep-sea species, 15 and 16 May 2013, Edinburgh, Scotland, UK
Definition of deep-water fishing effort

French deep-water fleet >800 m

UK VMS data

Irish VMS data

Inter-RAC joint seminar on the management of deep-sea species, 15 and 16 May 2013, Edinburgh, Scotland, UK
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)

Assumptions
- constant catchability ages 9 - 19+
- $CV(\text{catch}) = 0.01$
Spatial density modelling
Investigating spatial time trends: local depletion?

Model: landings per haul
\[
\log(\mathbb{E}[\text{landings}]) = s(\text{duration}) + s(\text{depth}) + s(\text{month}) + s(\text{landings}) + s(\text{depth}, \text{month}) + s(\text{depth}, \text{year})
\]

3D soap smoother
landings~Tweedie(\mu, \Phi \mu^{1.5})

## Summary of DEEPFISHMAN assessment methods

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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


Community indicators under different fishing scenarios

Blanchard-RAC joint seminar on the management of deep-sea species, 15 and 16 May 2013, Edinburgh, Scotland, UK
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

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


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

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

![Graphs of Hake, Monkfish, and Greater forkbeard showing mean length vs depth.](image)

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 proportion 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 porbeagle (*Lamna nasus*)

- **Problem with the gear change: DEEPSEA SHARKS**


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)


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.

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 generated 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 combine the management of exploited stock and spatial management, applicable to all fisheries
Acknowledgements

- Presentation uses material from all DEEPFISHMAN partners and the stakeholder consultation process
- Thanks to stakeholders contributing to workshops and responding to questionnaires
- Project material on http://deepfishman.hafro.is/
Future research needs (1/2)

**Ecosystem impacts and seafood production**

- Spatial data repository for VMEs and fishing ground (VMS data) distributions (need for an internationally coordinated data system) - FAO database-

- Ecosystem management taking account of trade-offs, e.g. between conservation and fishery management
  - For the same total blue ling catch (1) by-catch of deep-water sharks and swept area are smaller when blue ling is caught from spawning aggregation(*)

- Assessment of deepsea sharks
  - Development of model underway
  - Main conservation question in the deep-water fish community
  - High catchability to longlines

Future research needs (2/2)

**Ecosystem impacts and seafood production**

- **Food supply chain analysis**

  To compare deep-water fisheries:
  - Environmental impacts
  - Energy intensity
  - Economic efficiency
  to other seafood productions (capture and aquaculture)

**Mediterranean blue and red deep-sea shrimp:**
- Impact on bottom habitat

**Tropical shrimp ponds:**
- Impact on mangrove

Puig et al., (2012)

Photos courtesy Jorge Keller / www.buceo-virtual.com

Photos Sebastien Blanc/AFP/Getty Images

RAC joint seminar on the management of deep-sea species, 15 and 16 May 2013, Edinburgh, Scotland, UK