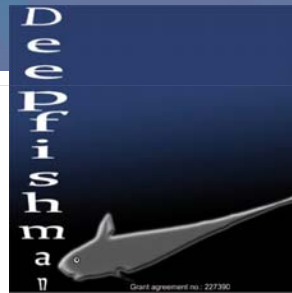


Continental slope fisheries and conservation of vulnerable fish species and deep-water benthic communities

-- Implications for management

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Context

Fishery for deep-water species west of Scotland

- Main species exploited by deep-water trawls



roundnose grenadier



black scabbardfish



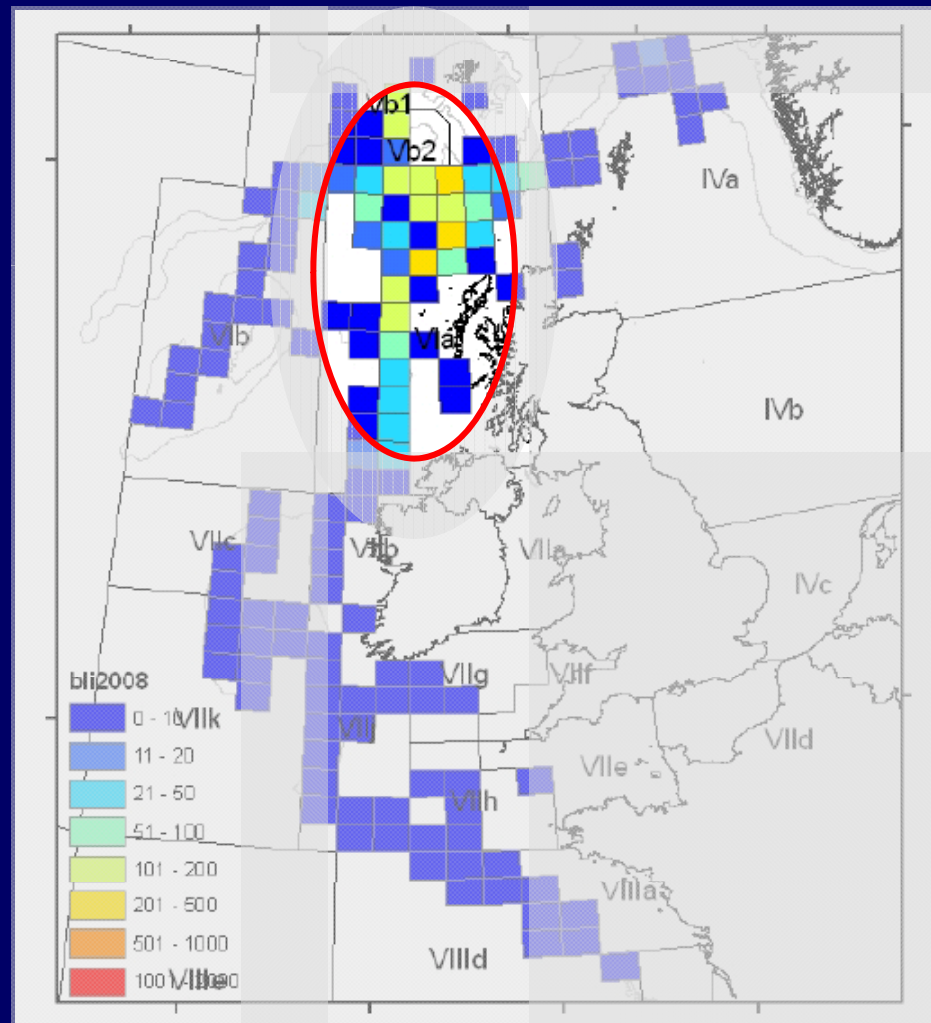
blue ling

- Bycatch, including sharks



Case study: blue ling fishery

Distribution of international landings in 2008 (ICES, 2010)



Two consequences of blue ling fishing

Seafloor disturbance

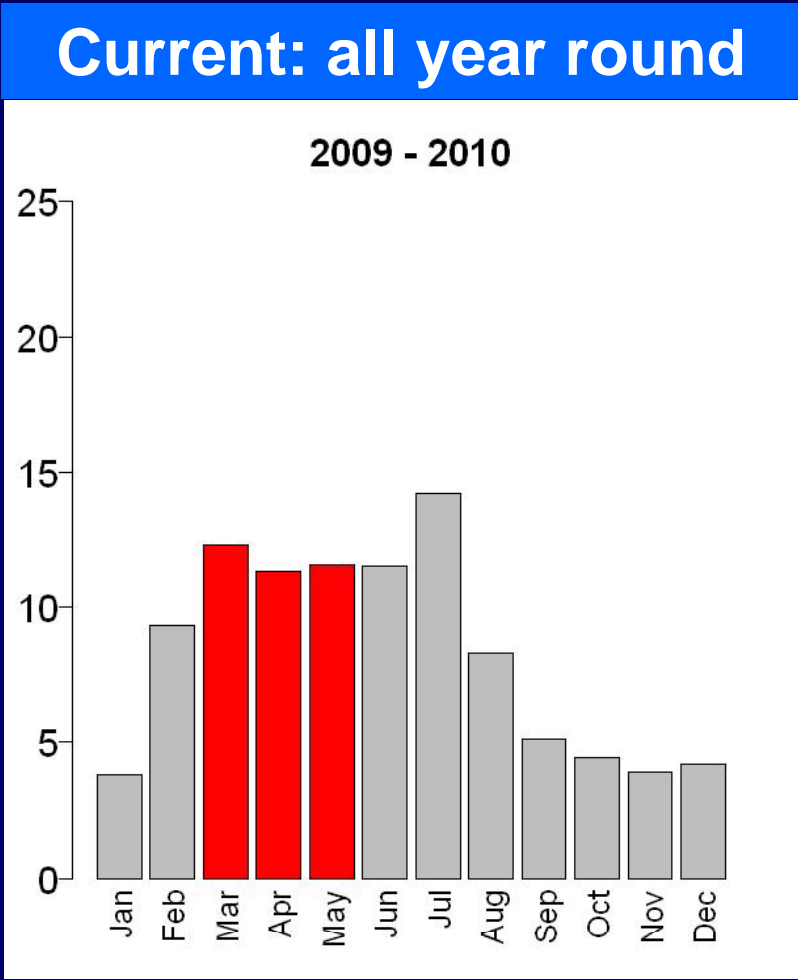
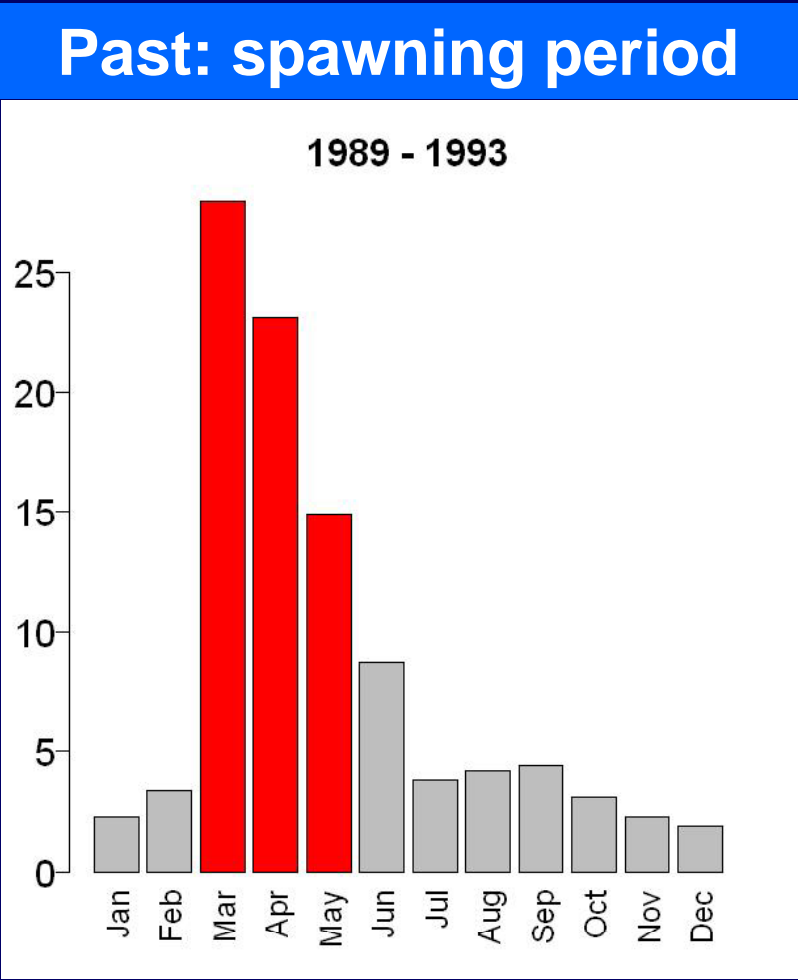


Sharks bycatch



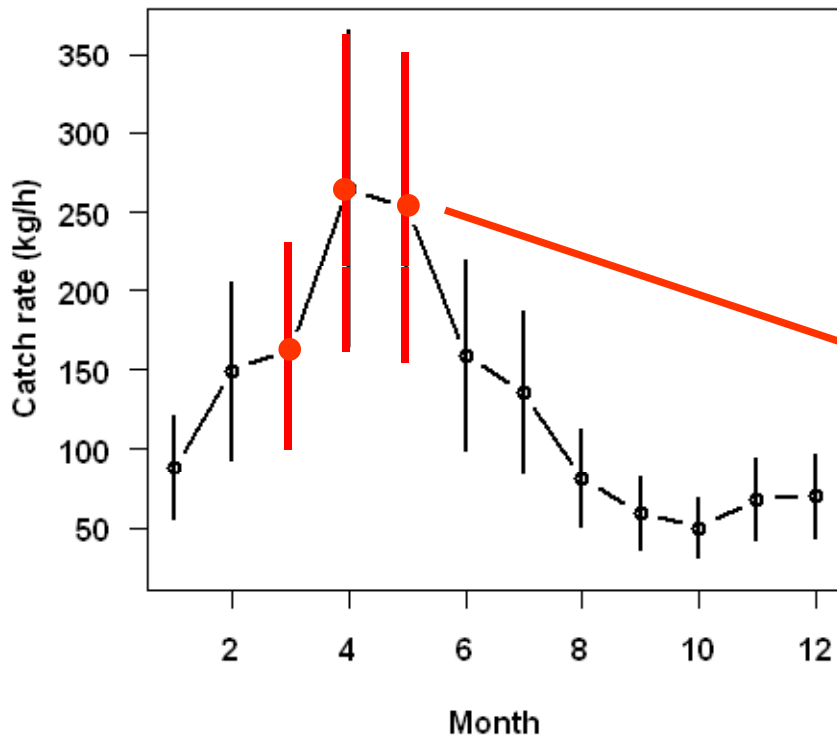
Monthly distribution of blue ling landings

Proportion of annual landings



Past catch rates by month

Predicted catch rate



Mean monthly catch rate of French trawlers 2000-2008 from haul-by-haul data; predicted at 700 m for a 44 m trawler

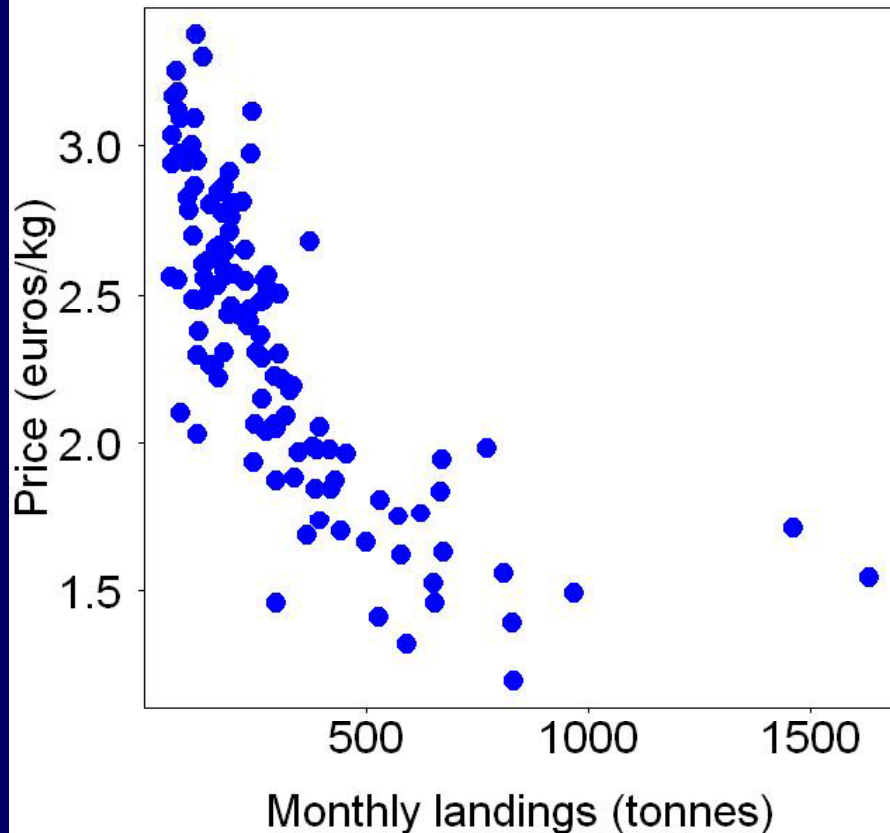
Total swept area to catch the French 2012 quota

Spawning season	1246
All year	2253

Fishing only at spawning time nearly halves swept area and fishing time (thus costs)

Prices per month

Price vs landings



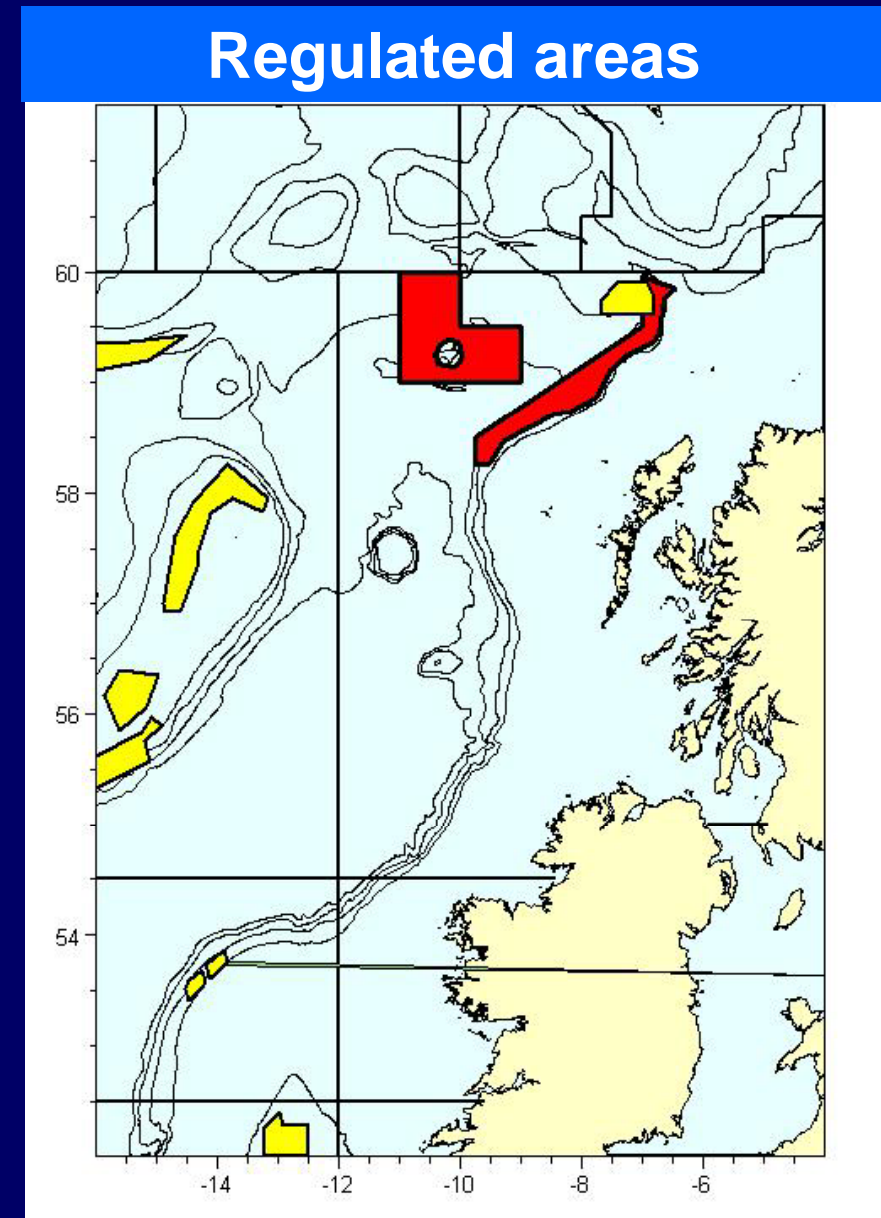
Mean price of blue ling landings in French ports, 2000-2008

Lower prices with increasing landings may have driven the fishery to exploit throughout the year

Fishing only at spawning time would decrease value of landings

Management of blue ling fishery

- TAC from 2003
- TAC decreased 2003 to 2012
- Regulation of fishing in **spawning areas** (March-May) from 2009
- Sharks landings banned since 2010
- **VME areas** closed to bottom fishing



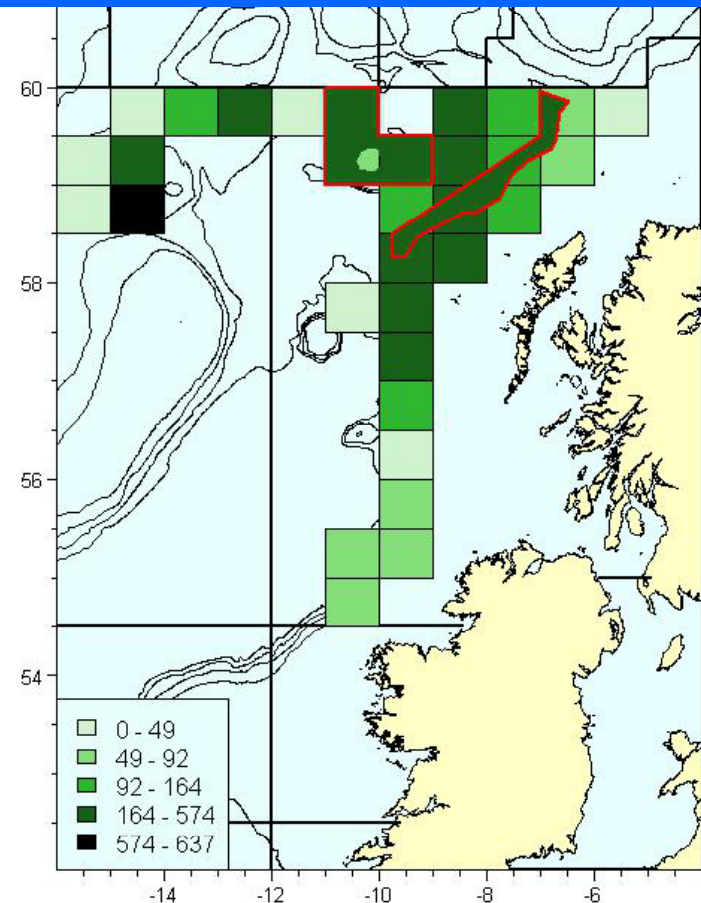
Spatial distribution of blue ling

CPUE predite par GAM

$\text{Log}(E[\text{landings}]) \sim s(\text{duree}) + s(\text{prof}) + \text{bateau} + \text{mois} + \text{rect}$

Regulated areas are amongst those with high catch rate for blue ling

Predicted catch rates in spawning season



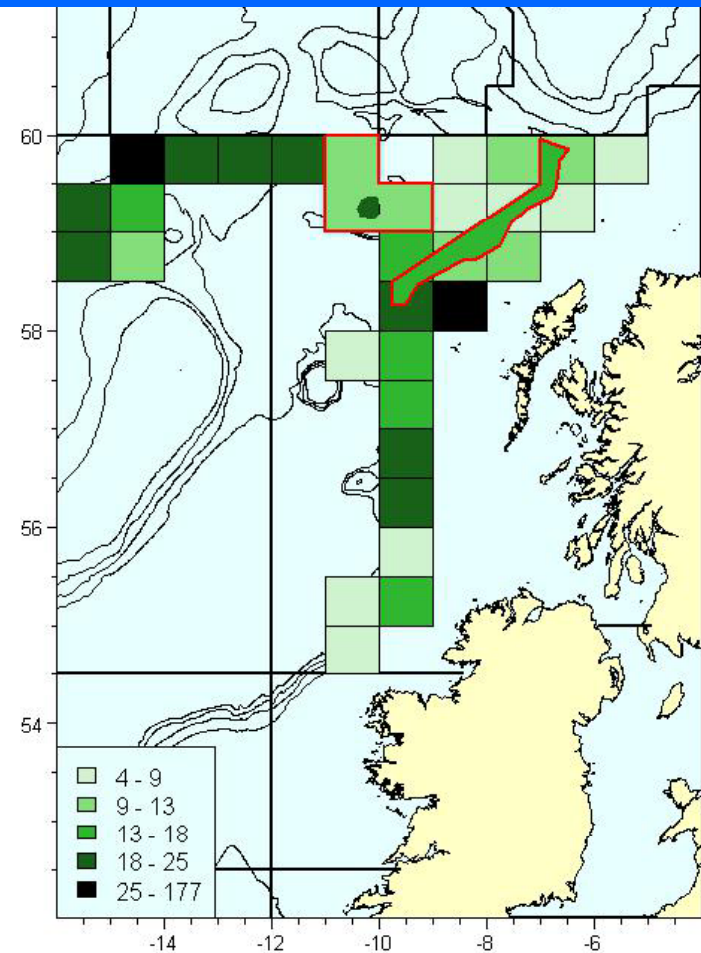
Spatial distribution of sharks

Same prediction for deep-water sharks

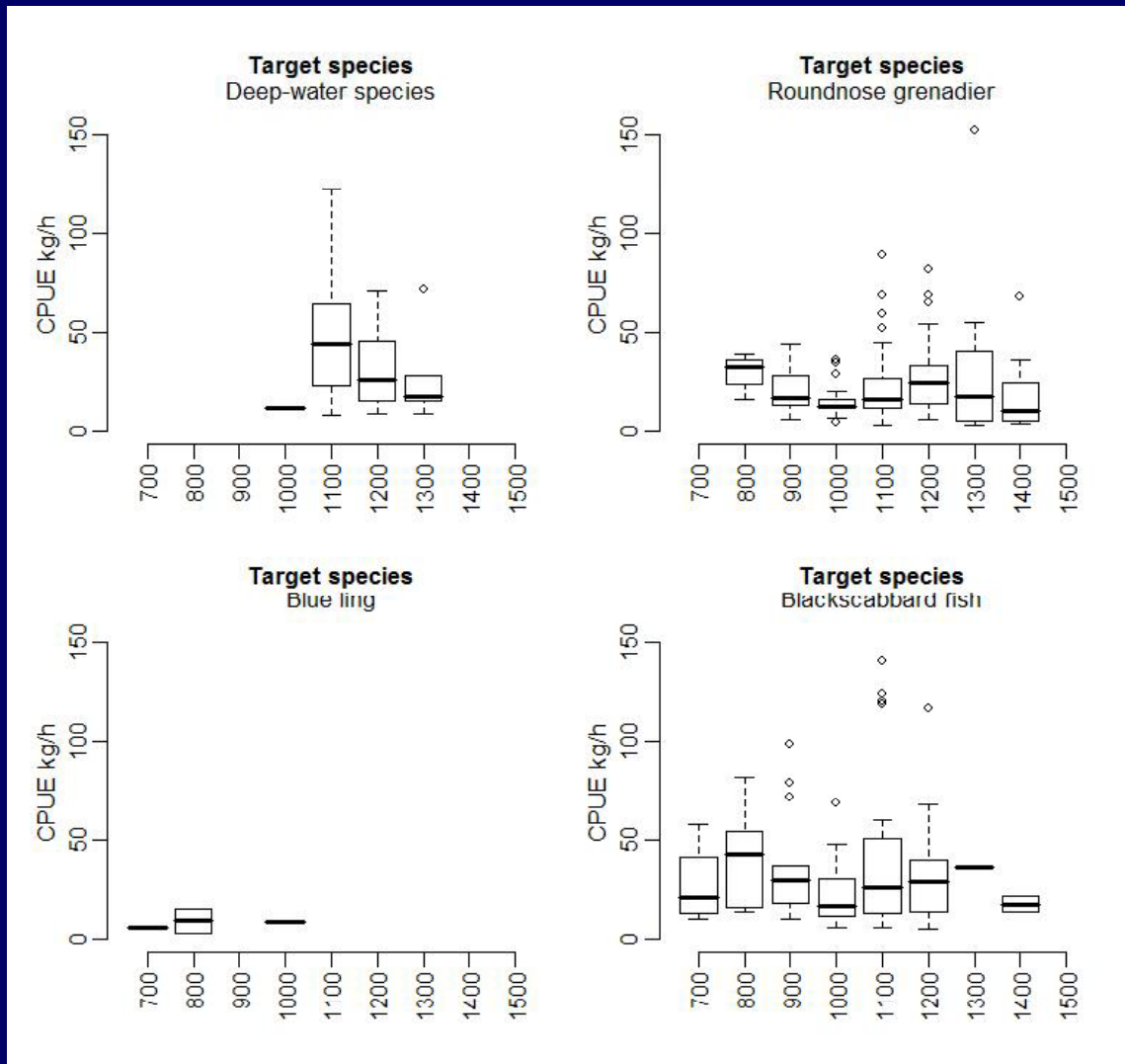
Regulated areas have low predicted catch rates for sharks

Implementation of regulated areas may have increased shark bycatch

Predicted catch rates in blue ling spawning season



On-board observations data to assess sharks bycatch



Deep-water sharks CPUE depending on the target species

Trade-offs in blue ling fishery management

Objective	Management measure	Trade-off
Exploit target stocks at MSY	TAC	Mixed fisheries
Protect vulnerable or depleted species	Ban sharks landings	
Prevent overfishing	Seasonal closure of spawning areas	Swept area Sharks discards
Minimise the effect of bottom fishing on the seafloor	Sedimentary seafloor: None VMEs: spatial closure	Catch rates and benthic production

Trade-off between fishing strategy, costs and revenue

Further to do

- Investigate where similar tradeoffs occur in other fisheries
- Use VMS data to estimate the swept areas accounting for repeated tows on same tracks

Conclusion

- **trade-offs between ecological objectives**
 - **the regulation for harvesting one stock have different effects on other species and benthic communities**
 - **a precautionary regulation for one species can have unwanted effects on other ecological components**
- **Ecology and economy**
 - **revenue obtained from a stock and associated costs are impacted by regulation**

Acknowledgements

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