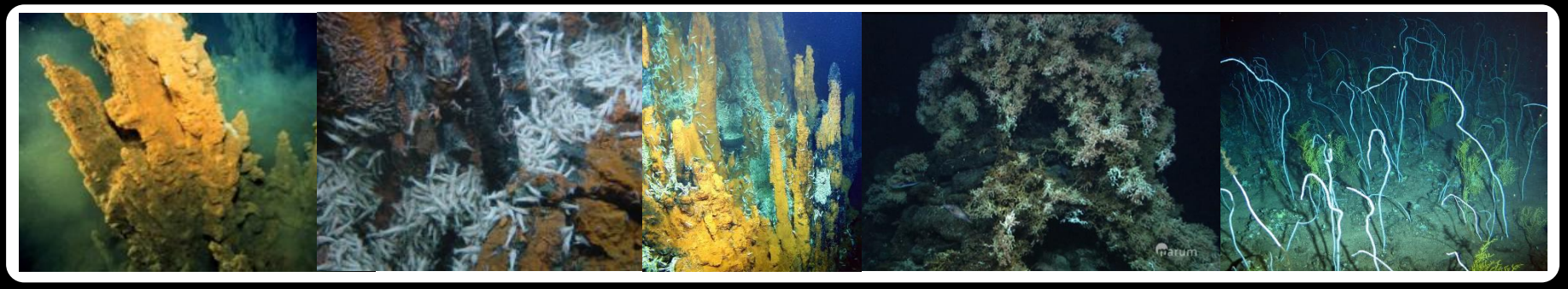

The impact of deep-sea bottom longline and handline on Vulnerable Marine Ecosystems

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IMAR / Universidade dos Açores, DOP, Portugal

Photo credits: Seahma, Deepfun, Ifremer-MoMARSAT, EMEPC, ImagDOP, UAz

Achieving sustainability of deep-sea fisheries

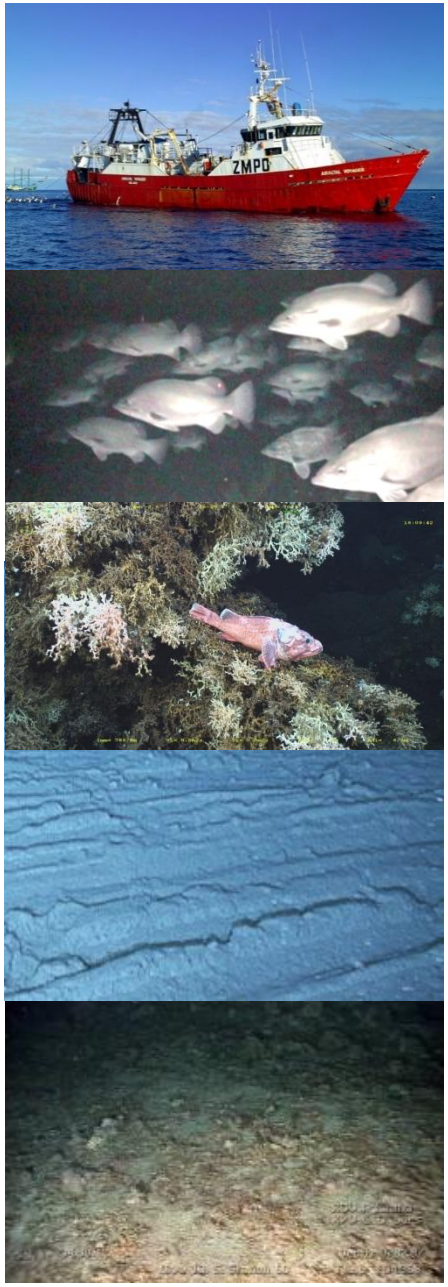
Deep-sea fishing

Deep-sea bottom trawling is the most common form of deep-sea fishing (1,2)

Modifies seafloor morphology and physical properties (3)

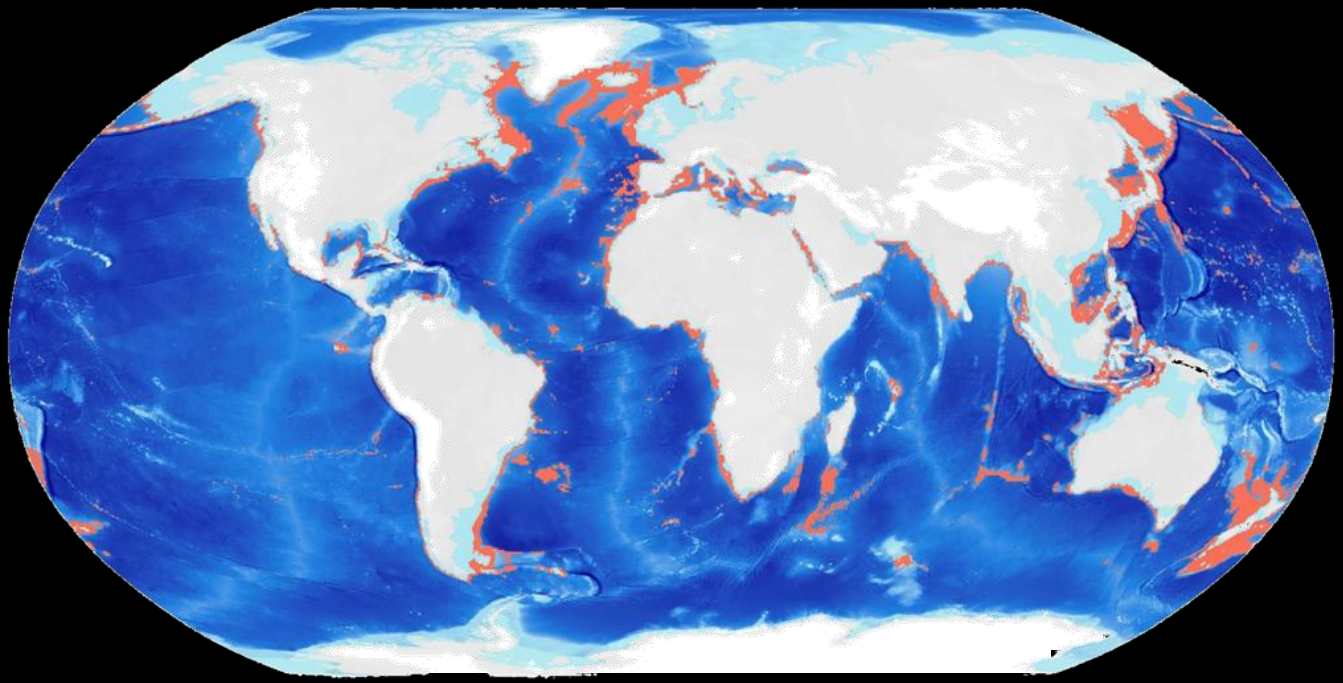
Impacts benthic communities including Vulnerable Marine Ecosystems (VME) (4,5)

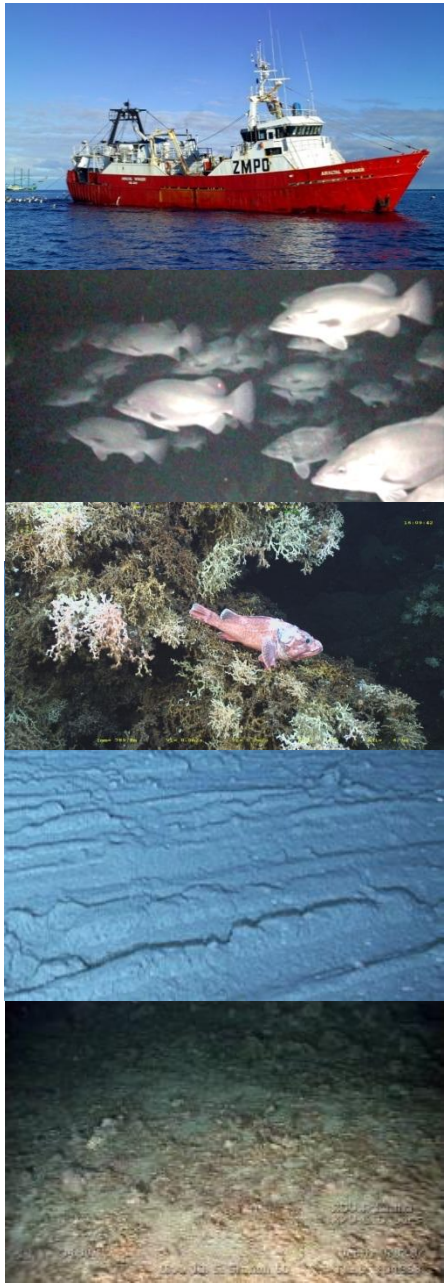
It's an issue of global concern



1- Watling 2013; 2- Watson et al. 2006; 3- Puig et al. 2012; 4 Hall-Spencer et al. 2002; 5- Watling & Norse 1998

Achieving sustainability of deep-sea fisheries





Global map of VME impacted by deep-sea bottom trawling

Areas in red illustrate the global extent of deep-sea (>200 m) bottom trawling (1) on areas of predicted deep-sea VME (2,3)

1- Watson et al. 2006; 2- Yesson et al. 2012; 3- Davies & Guinotte 2011

Achieving sustainability of deep-sea fisheries

Deep-sea fishing

Conservation of VMEs is a global priority (1)

Increasing pressure to regulate bottom trawling in the deep sea (2)

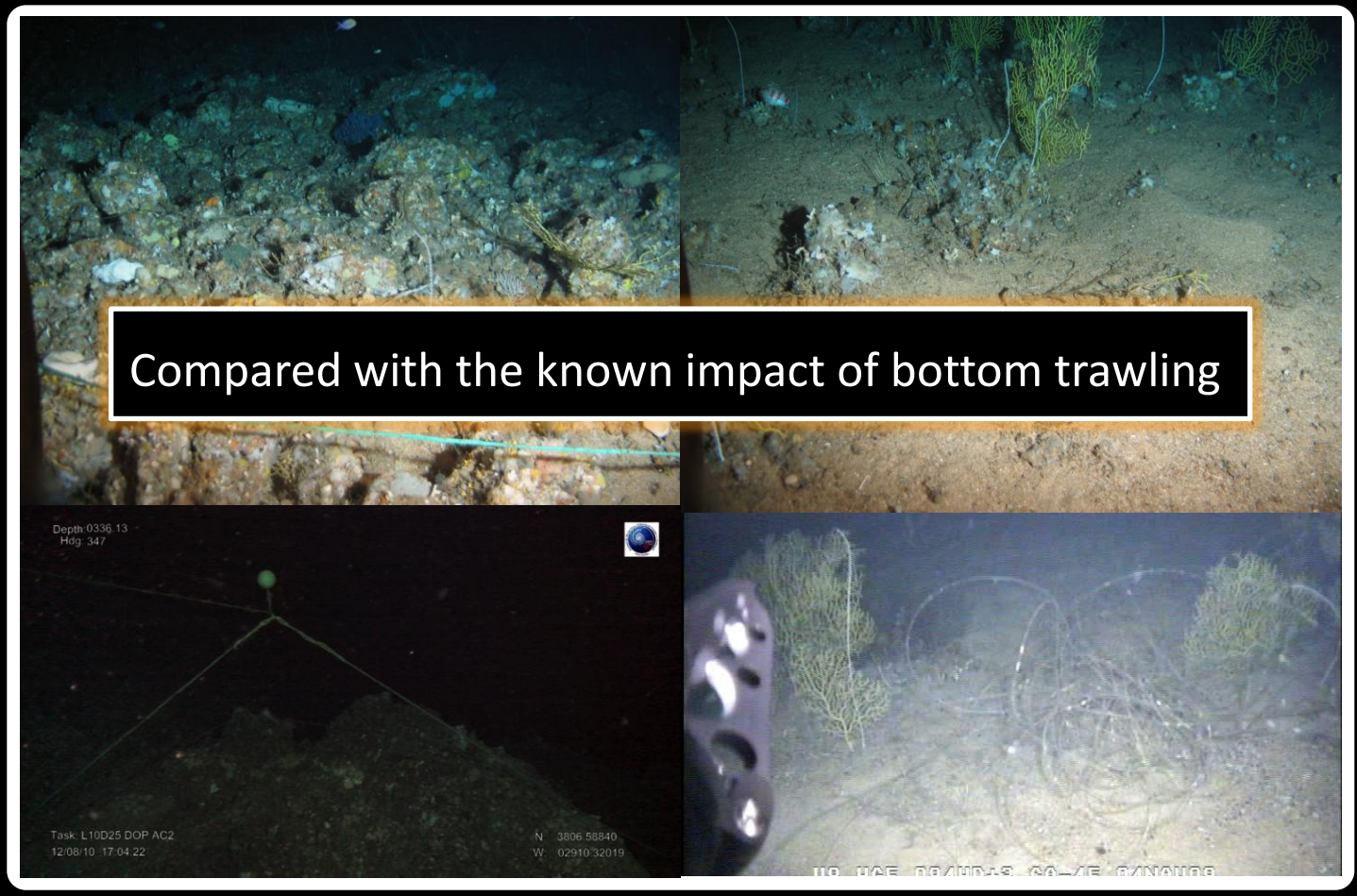
Future of deep-sea fishing relies on alternative techniques that maintain the health of deep-sea ecosystems and tolerate appropriate human uses (3)

1- FAO 2009; 2- Watling 2013; 3 Auster et al. 2011

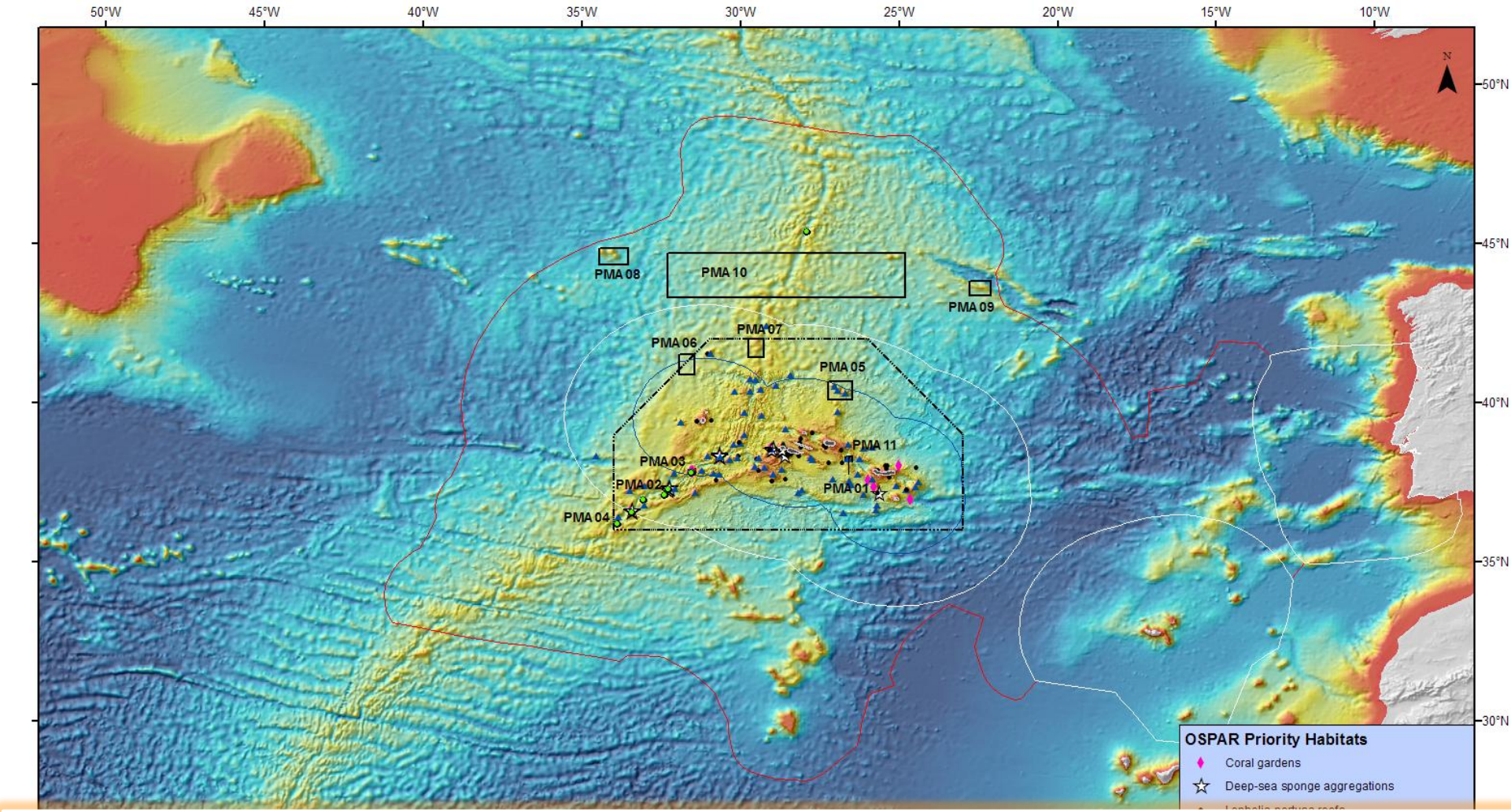
Achieving sustainability of deep-sea fisheries

Objectives: Assess the impact of bottom longline fisheries on CWC

- Quantifying the **by-catch**
- ***in situ*** damages through video analysis



Pham, … & Morato, 2014



Study area: the Azores

Fishing takes place on seamounts with depth between 300 and 600 meters

CWC are common at those depths and fishing grounds (1)

Creating a unique opportunity to assess the impact of hook and line gear on VMEs

Achieving sustainability of deep-sea fisheries

Bycatch data:

Collected by observers onboard commercial vessels (389 LL and 550 HL sets)

Experimental fishing surveys (107 LL sets 2007-2011)

General Additive Models were used to standardize bycatch levels

In situ video analysis from ROV Luso and ROV SP:

Densities of all CWC were estimated close to lost longline

The physical state of each CWC was recorded : intact, bent, minor damage, major structural damage, displaced or dead

Achieving sustainability of deep-sea fisheries

Assess level of by-catch of CWC in the bottom longline

Standardized mean by-catch (n / 1000 hooks)

GEAR	TOTAL	CWC	SPONGES	OTHER	ROCKS
Handline	0.08	0.01	0.03	0	0.03
Longlines	0.41	0.32	0.06	0.004	0.03

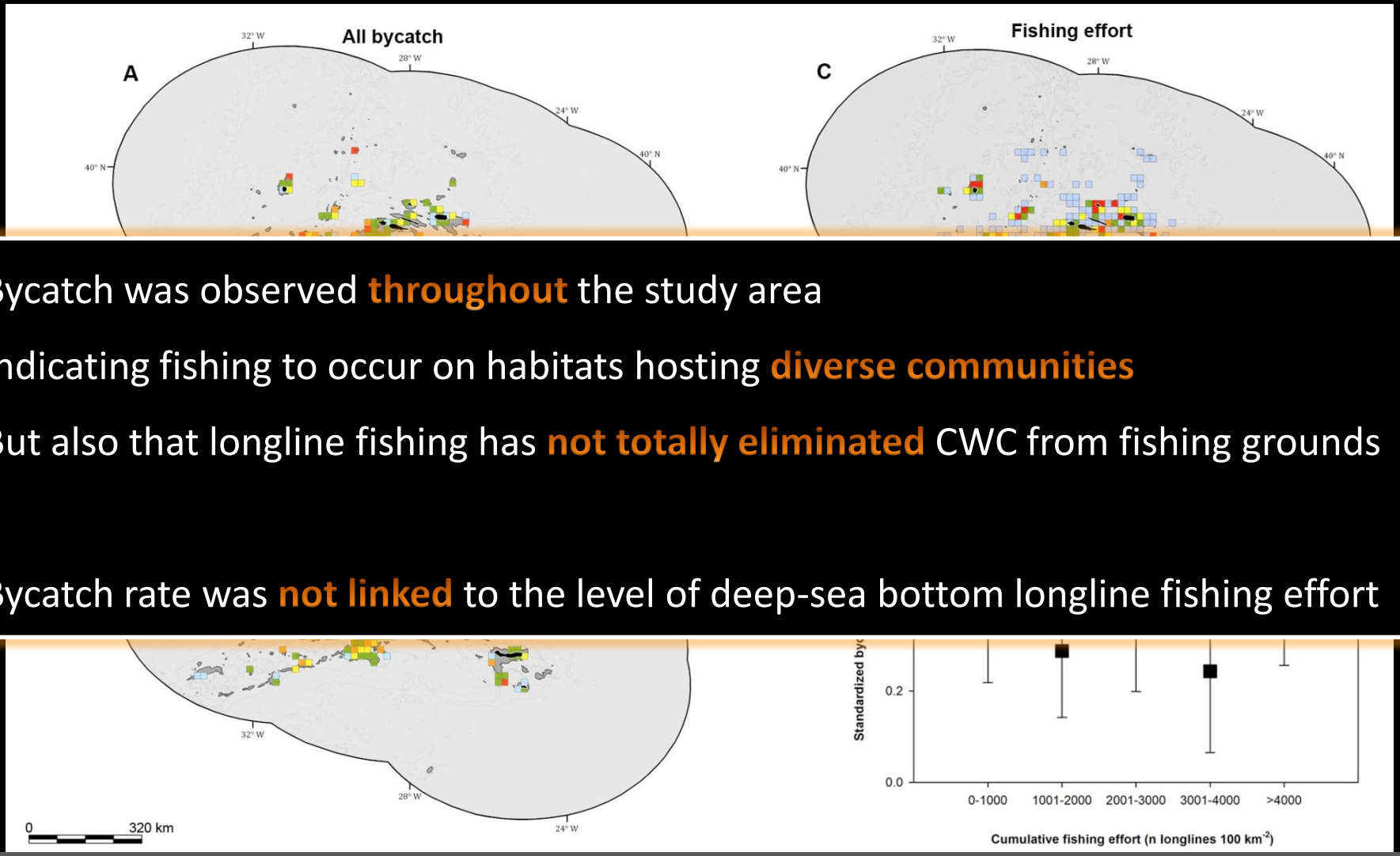
Handline has **no impact** on sessile organisms

A typical **longline** set has **low by-catch** of CWC (3,000 hooks - 1 CWC)

Pham, … & Morato, 2014

Achieving sustainability of deep-sea fisheries

Assess level of by-catch of CWC in the bottom longline



Bycatch was observed **throughout** the study area

Indicating fishing to occur on habitats hosting **diverse communities**

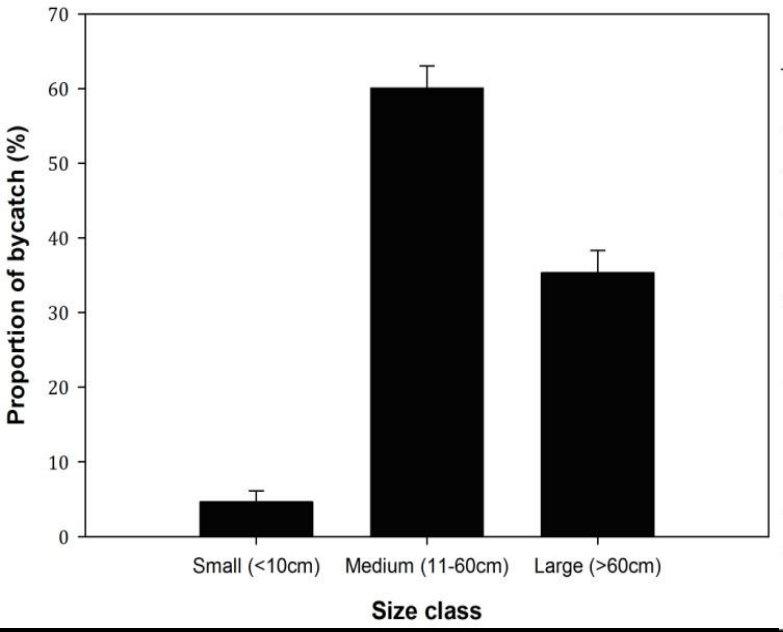
But also that longline fishing has **not totally eliminated** CWC from fishing grounds

Bycatch rate was **not linked** to the level of deep-sea bottom longline fishing effort

Pham, … & Morato, 2014

Achieving sustainability of deep-sea fisheries

Assess level of by-catch of CWC in the bottom longline



Group	Primary bycatch				Secondary bycatch			
	N of genera	Percent occurrence*	Size	Complexity	N of genera	Percent occurrence*	Size	Complexity
Porifera	n.a.	18.8	M	H	n.a.	23.5	S	H
Actiniaria	n.a.	0.4	M	H	n.a.	9.4	S	L
Alcyonacea	18	40.7	L	H	18	11.7	S	L
Antipatharia	5	4.1	L	H	1	0.5	M	H
Scleractinia	8	7.8	M	H	6	6.8	S	H
Zoantharia	?	0.2	S	L	n.a.	2.3	S	n.a.
Leptothecata	4	14.1	M	H	10	28.0	S	L
Stylasteridae	3	5.2	M	H	2	0.9	M	H
Bryozoa	n.a.	0.8	n.a.	n.a.	n.a.	12.6	S	L
Bivalvia					n.a.	1.2	S	L
Cirripedia					n.a.	1.3	S	L
Crinoidea					n.a.	0.3	n.a.	n.a.
Foraminifera					1	0.4	S	n.a.

Longline mostly impact **large organisms with a complex** morphology (91%)

Having therefore an **unbalanced** impact on the ecosystem

Pham, … & Morato, 2014

Achieving sustainability of deep-sea fisheries

Bottom trawling impact in CWC areas in Norway	Bottom longline impact in CWC areas in the Azores
	

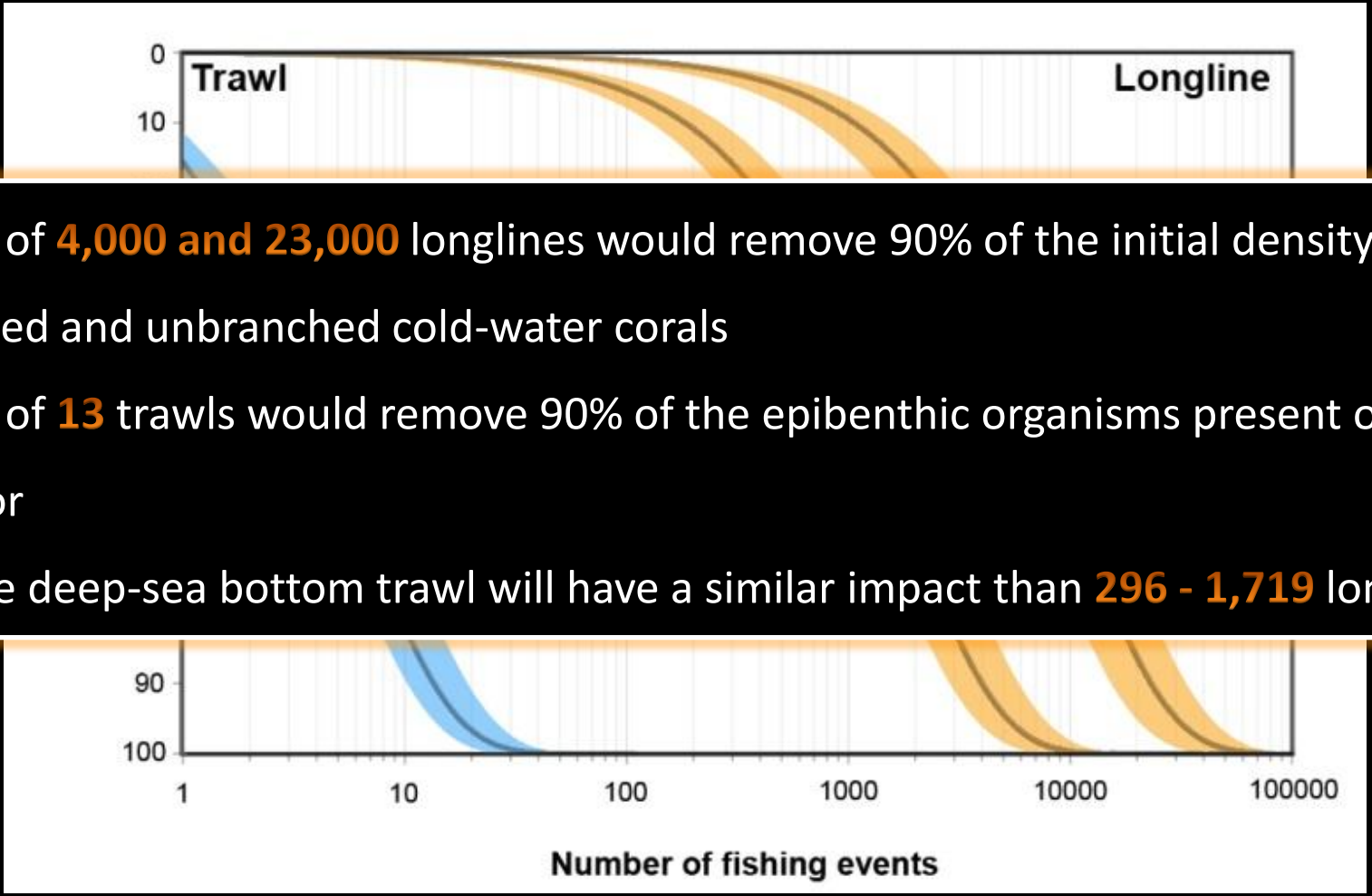
Bycatch levels on a seamount previously surveyed by ROV, showed that a longline impact **0.03% of CWC** present (0.01% low and 0.06% high complexity)

Depending on trawl design and fishing depth, macrobenthos removal rate per tow averages **15.8%** (13.8%-89%)

Pham, … & Morato, 2014

Achieving sustainability of deep-sea fisheries

Compared with the known impact of bottom trawling



A total of **4,000 and 23,000** longlines would remove 90% of the initial density of branched and unbranched cold-water corals

A total of **13** trawls would remove 90% of the epibenthic organisms present on the seafloor

A single deep-sea bottom trawl will have a similar impact than **296 - 1,719** longlines

Pham, … & Morato, 2014

Achieving sustainability of deep-sea fisheries

- The **oldest** continuously **living organisms** on the planet
- Place of Birth: Azores
- Year of Birth: **-1392 c.e.** (common era)
- Year of Death: + 2008 c.e.
- Age: **3400 years**

Carreiro-Silva et al., 2013

Achieving sustainability of deep-sea fisheries

Compared with the known impact of bottom trawling

Towards sustainability of deep-sea fisheries

Longliners have lower energy consumption per tonne of fish catch (1)

Discards rates are much lower for longliners than for bottom trawling (2)

Bottom longline are particularly hazardous for seabird (18) and deep-sea shark (3, 4)

1- P. Suuronen et al. 2012; 2- Kelleher 2005, 3- Muñoz et al. 2011, 4- Coelho et al. 2003

Achieving sustainability of deep-sea fisheries

Location	Fishing gear	Target spp	Depth (m)	% DW Sharks	Source data	Reference
Azores	Bottom Longline	Blackspot seabream	300-750	2.56%	Obs, commercial fishing	Pham et al., 2013
Azores	Handline	Blackspot seabream	100-500	0.02%	Obs, commercial fishing	Pham et al., 2013
Azores	DW Trawl	Orange roughy	850-1300	2.90%	Obs, commercial fishing	Melo & Menezes, 2002
Reykjanes Ridge (B)	DW Longline	not known	500-1700	37.20%	Survey	Hareide and Garnes, 2001
Hecate Seamount	DW Longline	not known	500-1800	22.15%	Survey	Hareide and Garnes, 2001
North of the Azores	DW Longline	not known	500-1300	63.23%	Survey	Hareide and Garnes, 2001
Rockall Trough	DW Longline	not known	600-1400	58.76%	Survey	Clarke et al., 2002
Rockall Trough	DW Trawl	not known	600-1200	22.45%	Survey	Clarke et al., 2002

Trawls and longlines catch different deep-sea **shark species and size** frequencies in different locations (1)

Their bycatch levels are in **same order of magnitude**

However, in many locations bycatch of deep-sea sharks **in trawls is lower** than for longlines but post catch **survival is likely to be higher** in longlining (2)

Many solutions have been developed to **overcome the bycatch** of seabirds (3) and deep-sea sharks (1)

Achieving sustainability of deep-sea fisheries

Conclusion:

Deep-sea bottom longline has **reduced impact on VMEs**, reducing bycatch of CWC and limiting additional damage to benthic communities

We found that slow-growing vulnerable species are **still common** in areas subject to more than 20 years of longlining activity

When comparing with the overall impact of deep-sea bottom trawls in other parts of the world the **differences are striking**

Achieving sustainability of deep-sea fisheries

Conclusion:

Given the pronounced differences in the magnitude of disturbances

Coupled with its **selectivity** and lower **fuel consumption**

We suggest that **regulated** deep-sea longlining can be an alternative to deep-sea bottom trawling in many parts of the world's oceans

And can help achieving **sustainability** of deep-sea fisheries

Thanks

AZORES TEAM

Alexandra Rosa, Andreia B. Henriques, António Godinho, Arquipélago Crew, Bogdan Glogovac, Christopher Pham, Diana Catarina, Eva Giacomello, Fernando Tempera, Filipe Porteiro, Frederic Vandeperre, Gui Menezes, Hugo Diogo, Hugo Parra, Íris Sampaio, João Gil Pereira, João Monteiro, João Santos, José Nuno Pereira, Marina Carreiro Silva, Paulo Martins, Pedro Ribeiro, Renato Bettencourt, Ricardo Medeiros, Ricardo Serrão Santos, Rogério Ferraz, Telmo Morato, Tiago Bento, Valentina Matos, Victor Rosa, Victor Slof