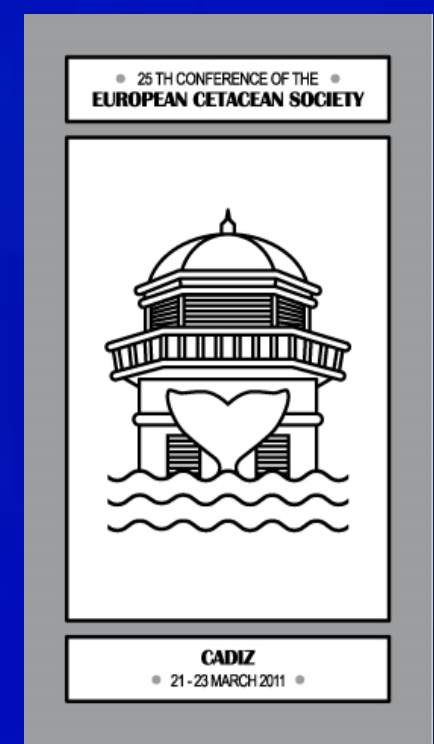




Trophic resources of Blainville's beaked whales (*Mesoplodon densirostris*) and Cuvier's beaked whales (*Ziphius cavirostris*) in El Hierro, Canary Islands.



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Mesoplodon densirostris

Trophic resources of Blainville's and Cuvier's beaked whales (*Mesoplodon densirostris*, *Ziphius cavirostris*) are little known, with data in the Canary Islands coming from stomach contents of a few stranded specimens. Studying foraging ecology and prey selection of top-predators requires knowledge on the availability of different types of potential prey. Here we present results from fresh floating remains of fishes and cephalopods found in the area of residence of the beaked whales off El Hierro, and from mesopelagic fishing trawls performed in the same area. The main organisms found (available prey) were cephalopods (Histioteuthis, Mastigoteuthis, Brachioteuthis, Chiroteuthis, Discoteuthis, Leachia and Tremoctopus) and fishes (Myctophidae, Sternoptychinae, Macrouridae and Gonostomatidae).



Ziphius cavirostris

METHODS

POTENCIAL PREYS INFERRED FROM FLOATING REMAINS

During beaked whale photo ID surveys off El Hierro performed from 2004 to 2011 we found fresh remains of 8 specimens of cephalopods and 15 fishes. 68% of them near diving groups of beaked whales.



Class	Order	Species	beaked whale
Cephalopoda		Cephalopod no id.*	Zc
		Cephalopod no Id.	Zc
		Cephalopod no id.*	-
Teuthida		<i>Histioteuthis</i> spp.	Zc
		<i>Histioteuthis</i> spp.*	Zc.
		<i>Mastigoteuthis</i> spp.	Md
		<i>Mastigoteuthis</i> spp.	-
		Cranchiid no id.	Z. ini.
		<i>Leachia atlantica</i>	Zc
		<i>Discoteuthis</i> spp.	Md
Octopoda		Octopod no id.	Md
		<i>Tremoctopus violaceus</i> *	-
Actinopterygii		Fish no Id.	Zc
Gadiformes		<i>Coelorinchus</i> spp.*	-
Stomiiformes		<i>Sternoptyx diaphana</i>	Zc
		<i>Sternoptyx</i> spp.	Zc
		<i>Argyropelecus aculeatus</i> *	-
		Sternoptychinae no Id.	-
		<i>Argyropelecus aculeatus</i>	Md
		<i>Sternoptyx</i> spp.	Md
		<i>Argyropelecus aculeatus</i>	-
		<i>Sternoptyx</i> spp.	Md
		<i>Sternoptyx</i> spp.	Zc
		<i>Sternoptyx</i> spp.	Md
		<i>Gonostomatido</i> *	Zc/Md
Mictiiformes		<i>Diaphus</i> spp.	-
		<i>Neoscopelus</i> spp.*	-
		<i>Neoscopelus</i> spp.*	Zc

Table 1: Taxonomic ID of fish and cephalopod floating remains found in El Hierro

➤ Cephalopods: Mesopelagic: *Histioteuthis* spp., *Leachia* spp. and *Mastigoteuthis* spp. Epipelagic octopod: *Tremoctopus violaceus*

➤ Fish. Mesopelagic: the hatchetfish *Argyropelecus* spp., *Sternoptyx* spp. and lanternfish *Diaphus* spp. Benthopelagic: *Neoscopelus* spp. and *Coelorinchus* spp.

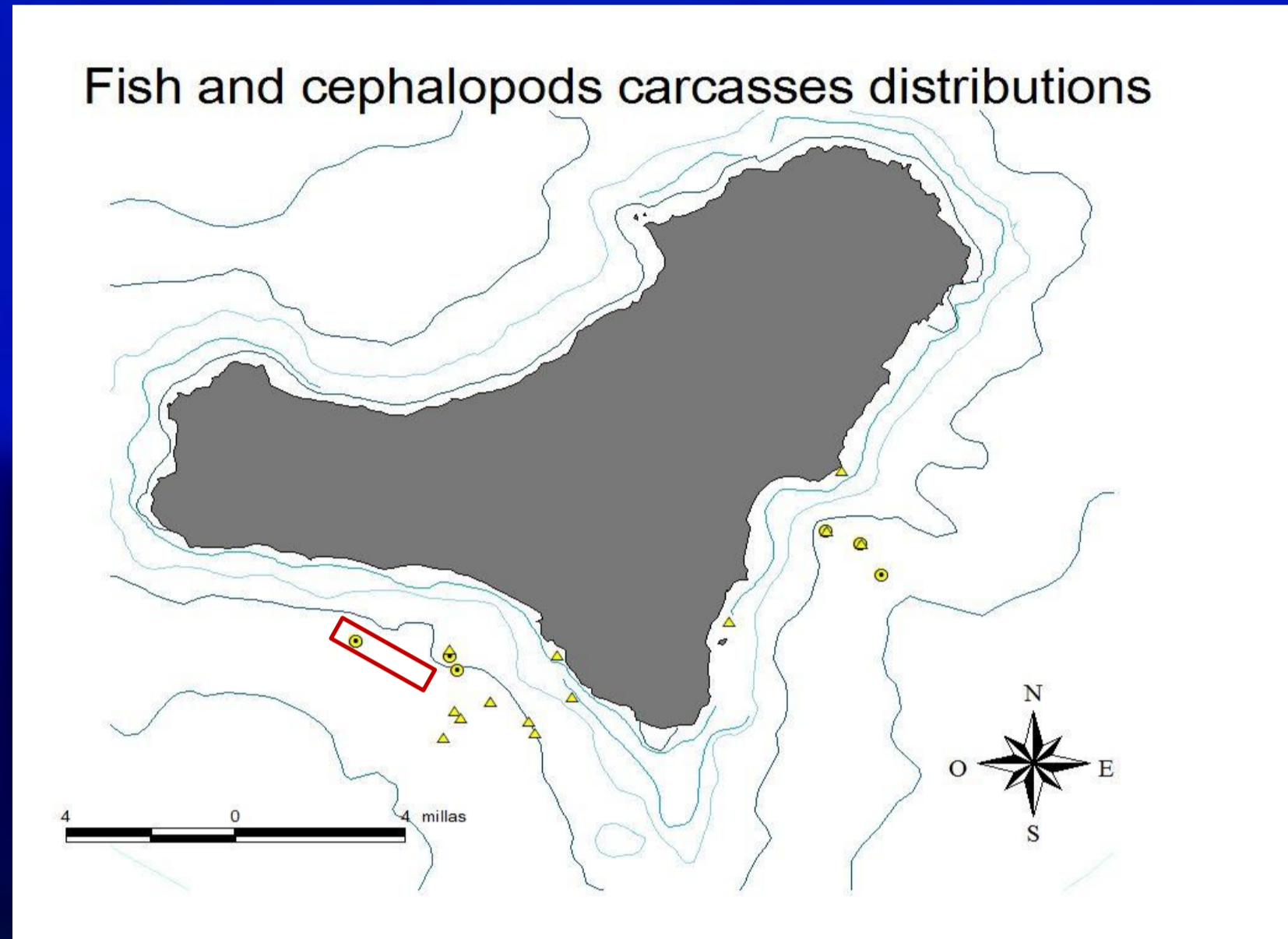


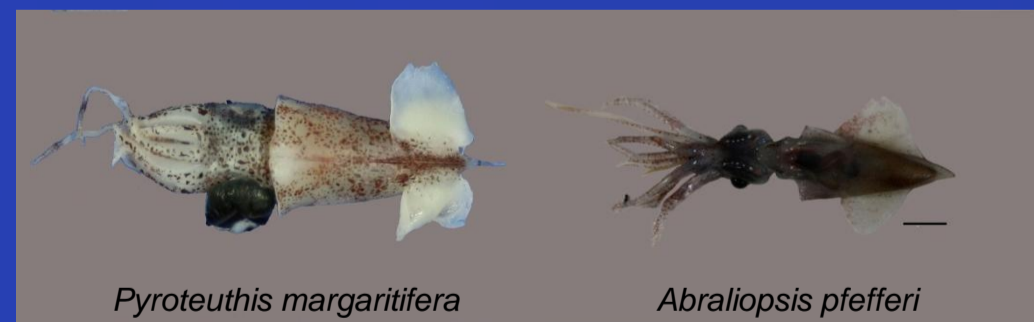
Fig.1. Map of the island of El Hierro. Red Rectangle Indicates fishing area. Fish carcasses ▲: Cephalopods carcasses: ●

CEPHALOPODS GENERA CAUGHT IN MESOPELAGIC TRAWLS IN EL HIERRO.

Genera	N	%
Abraliopsis*	113	51,1
Argonauta*	2	0,9
Bathotauma	1	0,5
Brachioteuthis	7	3,2
Chiroteuthis	6	2,7
Eneploteuthis*	12	5,4
Heteroteuthis*	8	3,6
Histioteuthis	27	12,2
Japetella*	1	0,5
Liguriella	1	0,5
Mastigoteuthis	11	5,0
Pterygioteuthis*	13	5,9
Pyroteuthis*	13	5,9
Spirula*	2	0,9
Taonius	1	0,5
Todarodes	3	1,4
Total	221	100

*: species below 50 mm DML

➤ Cephalopods were abundant in the captures: 32 species belonging to 16 genera were identified. The most abundant genus in the catches were Abraliopsis, Pterygioteuthis, Pyroteuthis and Eneploteuthis. Squids with a dorsal mantle length (DLM) below 50 mm were not considered potential prey of beaked whales. These squid comprised 74% of the cephalopods captured in the trawls.



Pyroteuthis margaritifera *Abraliopsis pfefferi*

MESOPELAGIC TRAWLS

During the cruise "Zifical-I" in June 2009, ten mesopelagic trawls were carried out over the slope SW of El Hierro (Fig.1) from the research vessel "La Bocaina" (Fig.2). We used a commercial pelagic net with an opening of 160 m² and 60 m in length, modified with 10 mm cod-end mesh size. The net was towed horizontally during day and night in three stratified depths (shallow: 200m; medium: 600m; deep: 800m) according to the foraging habits of beaked whales (Johnson et al. 2004, Tyack et al. 2006, Aguilar de Soto, 2006) and the migration of the deep scattering layer.(Fig.3)

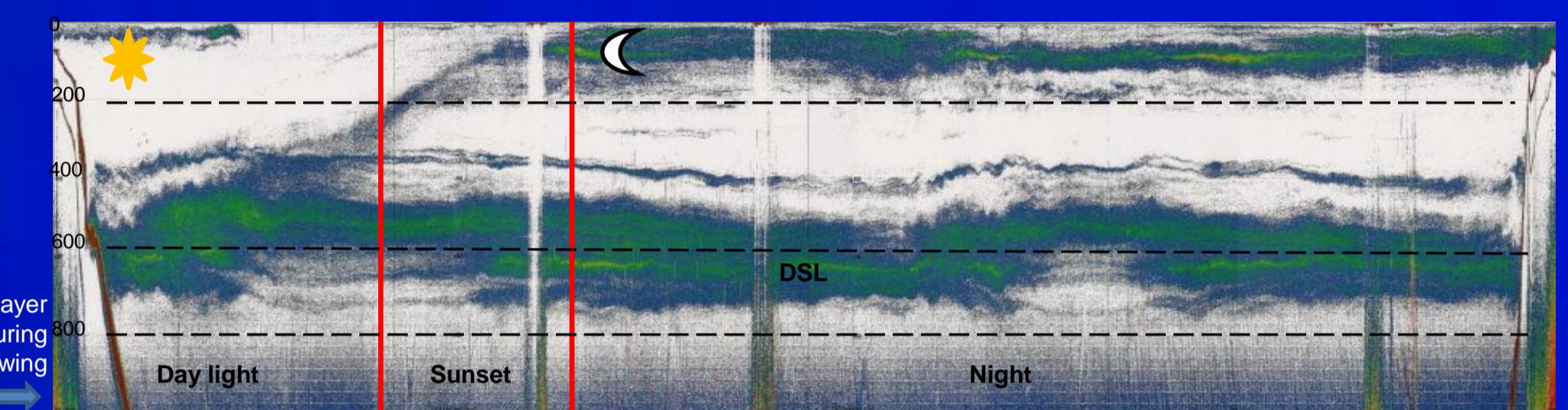


Fig.3: Deep scattering layer in El Hierro island during Zifical-I surveys, showing fishing depths.

CEPHALOPODS "POTENTIAL PREYS" CAUGHT IN EL HIERRO ISLAND.

Genera	N	%
Histioteuthis	27	46,55
Mastigoteuthis	11	18,97
Brachioteuthis	7	12,07
Chiroteuthis	6	10,34
Todarodes	3	5,17
Bathotauma	1	1,72
Japetella	1	1,72
Liguriella	1	1,72
Taonius	1	1,72
Total	58	100

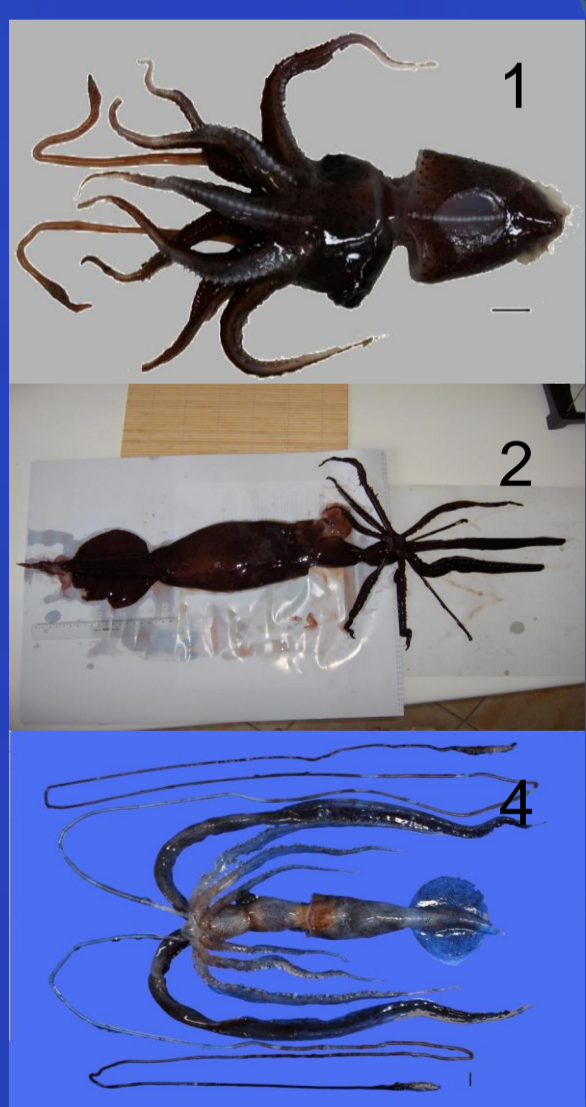


Fig.2: Vessel "La Bocaina" during trawling

➤ Of the remaining 26% of the cephalopods, 88% were grouped in only 4 genera:

➤ Large or highly mobile species were not captured, suggesting that they may have avoided the fishing net. This limits our ability to characterize the all potential beaked whale prey.

1. Histioteuthis 46%
2. Mastigoteuthis 19%
3. Brachioteuthis 12%
4. Chiroteuthis 10%



➤ Deep water specimens collected floating in the surface coincide with the most common species in the stomach contents of beaked whales (Santos et al. 2007). We speculate that they may have escaped from foraging beaked whales. Occurrence of prey remains is common in areas with high density of sightings of beaked whales as Bahamas, Hawaii, Ligurian Sea (Pelagos sanctuary) and the Canary Islands (Moulin et al., 2007; Hickmott, 2005; Baird com. pers.). In addition it is supported, because the cephalopods found floating in these areas.

The occurrence of benthopelagic species as *Neoscopelus* spp. (Myctophidae) and *Coelorinchus* spp. (Macrouridae) may indicate foraging near the sea-floor. This is supported by the presence of remains of benthopelagic fish such as Hakes and Silver scabbardfish (*Lepidopus caudatus*) in the stomachs of the few beaked whales stranded in the world (MacLeod et al. 2003) and acoustic data recorded in DTAGs on Blainville's beaked whales tagging in El Hierro. (Arranz et al. 2008).

➤ The waters off El Hierro show a high diversity of cephalopod species. However, many of the captured small size species are not represented in the stomach contents of Cuvier's and Blainville's beaked whales stranded in the Canary Islands or elsewhere. This implies that beaked whales are actively choosing prey and not targeting the most abundant prey available.

➤ Medium-large size Histioteuthis spp., Mastigoteuthis spp., Brachioteuthis spp., and Chiroteuthis spp. were abundant in the samples and have been found in the stomach contents of Cuvier's and Blainville's beaked whales stranded in Canary Islands and other areas of the world (MacLeod et al., 2003; Santos et al., 2001, 2007). Therefore, these species could constitute important preys for Beaked whales in El Hierro.

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