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**By-catch of cold-water corals from an Experimental Trawl Survey in three seamounts within NAFO  
Regulatory Area (Divs. 6EFG) during year 2004**

by

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**ABSTRACT**

By-catch of cold-water corals from a Trawl Experimental Survey developed during 2004 in three NAFO seamounts was examined. Three hauls were carried out over two peaks located in Divs. 6EF. In this area, catches of commercial resources were negligible and by-catch of corals was recorded (degraded pieces of dead *Enallopsammia* sp and *Keratoisis* sp and few alive corals like *Solenosmilia variabilis*, *Metallogorgia melanotrichos*, *Paragorgia johnsoni*, etc.), showing some interaction between fishing and vulnerable habitats and that trawl fishing in the area is unfeasible. Ninety-two hauls were carried out over one peak located in Div. 6G, with big catches of alfonsino (*Beryx splendens*), but only six hauls showing coral records (*Enallopsammia rostrata*, *Solenosmilia variabilis*, *Madrepora oculata*, *Acanella eburnea* and *Placogorgia terceira*) and in less quantities in comparison with Divs. 6EF. The low by-catch of corals in the Div. 6G peak could be related with their less rough bottom feature and with the previous alteration of sessile epifauna due to intense fishing activity developed during the last decades of XX Century. The results of the Experimental Survey indicate that the impact of trawling on seamounts could be important and that the closed area agreed in 2007 to protect the bottom habitats of the seamounts within NAFO Regulatory Area (Divs. 6EFG) should be maintained and improved.

**Key words:** NAFO Regulatory Area, North-west Atlantic Ocean, seamount, trawl, cold-water corals, by-catch.

**INTRODUCTION**

Seamounts provide a unique deep-sea environment due to the topographically-enhanced currents in their vicinity (Roden, 1986) and benthic environment is also distinct from that found on the surrounding seafloor, and may be disturbed to anthropogenic activities like bottom fishing. Due to the enhanced currents, the benthic communities around seamounts are typically dominated by corals and other suspension feeders (Rogers, 1994). Seamounts are widely recognized as areas of high productivity, and the focus of important commercial fisheries based on fish species that form large aggregation in association with them (Clark and O'Driscoll, 2002). However, by-catch of vulnerable benthic invertebrates in seamount commercial fisheries is generally poorly studied (Waller *et al.*, 2007).

Following the United Nations General Assembly Resolutions (UNGA, 2005; UNGA, 2007), several management measures in order to protect vulnerable ecosystems in the high seas, are being implemented by Regional Fisheries Management Organizations. In this way, in year 2007, several seamounts located in North-west Atlantic, including New England and Corner Rise Seamounts, were closed by NAFO to all fishing activities involving demersal fishing gears (NAFO, 2006).

In year 2004, before the aforementioned closure enforcement, an Experimental Trawl Survey was carried out in fishing grounds (NAFO Regulatory Area: Div. 6EFGH & 4XWVs) considered non-habitual for the NW Atlantic Spanish fleet. This kind of cooperative surveys (Durán Muñoz and Román, 2000) are research initiatives carried out in collaboration with the fishing industry, with the aim to obtain data on distribution and biology of fisheries resources and to study the interactions between commercial fishing, gears and habitats (Durán Muñoz *et al.*, 2007).

Results from the 2004 Experimental Trawl Survey were presented to the 2005 NAFO Scientific Council Meeting (Durán Muñoz *et al.*, 2005) focused on fish resources and including brief results on benthic invertebrate by-catch. In addition, in this Working Document, we present a detailed review of the cold-water coral by-catch information collected during the expedition, in order to make this data available to the new NAFO-WGEA, and to contribute to improve the knowledge on the effects of fishing in the seamounts within NAFO regulatory Area.

## MATERIAL AND METHODS

During last Quarter of year 2004, a two month Experimental Survey was carried out in NAFO Regulatory Area (Div. 6EFGH & 4XWVs) and adjacent international waters, with one polyvalent trawler, using “*Gloria*” pelagic trawl gear and “*Pedreira*” trawl gear. A scientific observer was on board. Among other information, location, time, depth, catch and discards (paying special attention to invertebrate by-catch) were noted by the observer, haul by haul. Biological samples were made, according with IEO methods. Invertebrates samples were preserved as vouchers for subsequent definitive identification in the laboratory.

A total of 126 hauls were carried out during the survey, which 119 were valid hauls: 95 short duration hauls with “*Pedreira*” gear, just over seamounts and 31 long duration hauls using “*Gloria*” gear far away from bottom features, between 600-1400 m and 200-800 m depth approx., respectively. In this document we analyze all the hauls (valid+null), because null hauls also could contain corals by-catch. Nine seamounts were explored by means of echo-sounder (SIMRAD ES-380), spending 106’5 hours, but only in three of them, fishing operations using “*Pedreira*” gear were carried out just over the peaks. The “cucharada” fishing technique (Gonzalez-Costas and Lorenzo, 2006) was used in order to avoid gear damage and minimize the contact with the bottom. Map of Figure 1 shows the location of the peaks where this gear and technique was employed.

## RESULTS

Table 1 shows the number of hauls with coral by-catches. Coral records did not occur in any fishing operations carried out by means “*Gloria*” gear. On the other hand, corals were recorded in 9 hauls using “*Pedreira*” gear just over three peaks located in New England and Corner Rise Seamount Complexes. In the remainder 86 hauls carried out with this gear over peaks, no coral by-catch was observed.

### NAFO Divs. 6EF (New England Seamount Complex)

In the Divs. 6EF, a total of three short hauls were carried out with “*Pedreira*” gear just over two peaks. Fishing operations were very difficult, because extremely rough bottom features were found. On the other hand, catches of main commercial fish species were negligible (Durán Muñoz *et al.*, 2005) and some by-catch of corals was recorded (Table 1). The most common coral by-catch recorded in Div. 6F was the colonial scleractinian *Enallopsammia* sp (Table 2). Most of the by-catch of this specie corresponded to pieces of degraded dead skeletons (like sub-fossil), though several fragments presented recent scars showing that they could belong to a coral structure. Also the base of a big *Keratoisis* sp like sub-fossil was caught. Another records of live corals, include the scleractinian *Solenosmilia variabilis*, gorgonians (*Metallogorgia melanotrichos*, *Paragorgia johnsoni* and *Lepidisis* sp.) and antipatharians. In Div 6E (Table 2), by-catch of corals was less important. Corals observed were the scleractinian *Solenosmilia variabilis* (dead) and the gorgonian *Thouarella grasshoffi*.

### NAFO Div. 6G (Corner Rise Seamount Complex)

On the Div. 6G, fishing operations using “*Pedreira*” gear were carried out over one peak exclusively. The peak showed a rough feature. Nevertheless, trawl fishing over the summit were less difficult than in Divs. 6EF, and

catches of alfonsino (*Beryx splendens*) were considerable. In this seamount, 92 short hauls using “*Pedreira*” gear were carried out, and only in 6 of them slight amount of corals were recorded. Corals observed were a piece of *Enallopsamia rostrata*, *Solenosmia variabilis*, *Madrepora oculata*, *Acanella eburnea*, *Placogorgia terceira* and antipatharians (Table 2).

Lost pots in good conservation state were found entangled in the gear in two hauls, indicating recent bottom fishing activity in this seamount.

## DISCUSSION

The results of the 2004 Trawl Exploratory Survey show that in two peaks located in New England Complex, trawl fishing operations is unfeasible, due to catches of commercial resources were negligible and by-catch of corals occurred, indicating some interaction between fishing and vulnerable habitats. On the other hand, in one peak of Corner Rise Complex, despite the intense fishing activity directed to alfonsino along the last decades of XX Century in the area (Vinnichenko, 1997), high CPUE’s of this fish species were obtained, but in the 7% of the fishing operations, by-catch of cold-water corals was recorded. The less by-catch of corals recorded (in comparison with New England Complex), could be related both with the more friendly bottom feature of the peak (and the consequent success of the “*cucharada*” fishing technique), and/or with the previous alteration of sessile epifauna due to the intense fishing activity developed in the past (Vinnichenko, 1997). Moreover, Waller et al. (2007) using a remotely operated vehicle (ROV) documented evidence of large-scale trawling damage on Div. 6G.

Generally coral by-catch obtained in seamounts during the 2004 trawl experiment, corresponded to dead skeletons. It is accepted, that the degradation of coral reefs could be due to either natural or anthropogenic factors (Mortensen et al., 2007). Nevertheless, coral rubble provides appropriate substrate to epifauna and this is very relevant in terms of an associate biodiversity that is necessary to protect (Duran Muñoz et al., 2008). Fishing technique used over seamounts is totally different from the technique used in sedimentary seabed in continental slope. Multidisciplinary studies show that the habitat in the sedimentary seabed is generally very different also from the habitats observed in hard substrate seabed. Consequently, is expected a different kind of interaction between gears and habitats.

In seamount fisheries, obviously, fishing techniques have been designed to minimize bottom contact, with the objective to avoid gear damage and to increase the catches of fish aggregations, located generally no very close to the bottom of the summit. Nevertheless, result difficult to achieve a total success in this objective and in certain number of hauls (depends on several factors like the skipper experience and ability, the fishing technique used, etc.), trawl gear could contact with the bottom, and corals could be damaged. Despite that the aforementioned technical factors and the fishermen experience could be improved, results of this trawl experiment supported by the evidence of bottom seamount habitat alteration documented by means ROV, indicate that the impact of trawling on seamount complex could be important, with the coral substrate and associated community removed from the most heavily fished seamounts (Koslow et al., 2001). This seems that the closed area agreed in 2007 to protect the bottom habitats of the seamounts within NAFO Regulatory Area (Divs. 6EFG) should be maintained and improved.

On the other hand, the presence of lost pots observed in this area, could indicate the existence of some other kind of bottom fishing activity in Division 6G, which effects have not still been documented.

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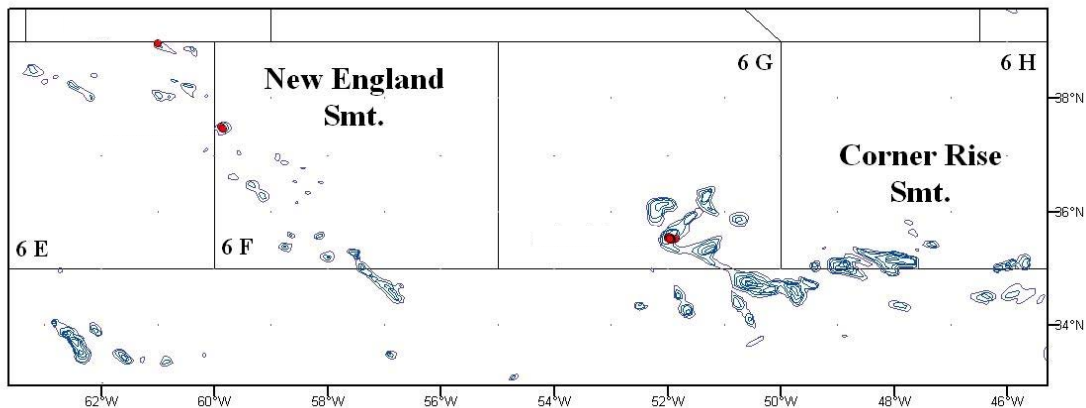
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**Table 1.** - 2004 Trawl Experimental Survey. *Pedreira hauls* carried out in New England and Corner Rise Seamount Complex: Total hauls and hauls with cold-water coral presence.

	New England Smt. Complex		Corner Rise Smt. Complex
	Div 6E	Div. 6F	Div.6G
N° of hauls carried out	1	2	92
N° of hauls with coral presence	1	2	6

**Table 2.** -2004 Trawl Experimental Survey. By-catch of cold-water corals (kg) in New England and Corner Rise Seamount Complex. (1) alive; (2) dead; (3) like sub-fossil; (4) unknown status.

Cold-water coral species	New England Smt. Complex		Corner Rise Smt. Complex
	Div 6E	Div. 6F	Div.6G
<i>Enallopsammia rostrata</i>			0.022 <sup>(1)</sup>
<i>Solenosmilia variabilis</i>	0.57 <sup>(2)</sup>	0.471 <sup>(1)</sup>	0.225 <sup>(4)</sup>
<i>Madrepora oculata</i>			0.015 <sup>(4)</sup>
<i>Enallopsammia</i> sp		70.422 <sup>(3)</sup>	
<i>Keratoisis</i> sp		2 <sup>(3)</sup>	
<i>Paragorgia johnsoni</i>		0.156 <sup>(1)</sup>	
<i>Acanella eburnea</i>			0.02 <sup>(1)</sup>
<i>Lepidisis</i> sp.		1 <sup>(1)</sup>	
<i>Placogorgia terceira</i>			0.004 <sup>(1)</sup>
<i>Thouarella grasshoffi</i>	0.011 <sup>(1)</sup>		
<i>Metallogorgia melanotrichos</i>		0.02 <sup>(1)</sup>	
Antipatharia indet. 1		0.150 <sup>(1)</sup>	
Antipatharia indet. 2			0.005 <sup>(1)</sup>



**Figure 1.** - 2004 Trawl Experimental Survey. Location of the *Pedreira hauls* carried out in New England and Corner Rise Seamounts.