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REPORT OF THE

Study Group on Cold-Water Corals

By Correspondence

May 2003

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

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1 INTRODUCTION

1.1 Participation

The following members of the Study Group on Cold-Water Corals (SGCOR) participated in producing this report (see Annex 1 for addresses):

Mark Tasker (Chair)	UK
Jan Helge Fosså	Norway
André Freiwald	Germany
Anthony Grehan	Ireland
John Gordon	UK
Tomas Lundälv	Sweden
Pål Mortensen	Canada
Jason Hall-Spencer	UK
Murray Roberts	UK
Sigmar Arnar Steingrímsson	Iceland
Ole Tendal	Denmark
Andy Wheeler	Ireland

1.2 Terms of Reference

At the 89th Statutory Meeting, the Study Group on Cold-Water Corals (SGCOR) was given two terms of reference:

a) review new information on the occurrence of cold-water corals in the Northeast Atlantic;
b) prepare a proposal for a theme session on cold water corals at ASC 2004.

1.3 Justification of Terms of Reference

The Terms of Reference are based on a standing request for advice sent by the European Commission asking ICES "to identify areas where cold-water corals may be affected by fishing." There is strong evidence of recent, permanent damage to cold-water coral features in the ICES area. Scientific advice is required to inform possible management measures to avoid further damage. In addition the European Commission has requested more precise information on the location of areas to close to protect cold water coral than was provided in 2002.

1.4 Acknowledgements

We thank Caroline Turnbull, JNCC (UK) for help with the Darwin Mounds site description.

2 NEW INFORMATION ON THE OCCURRENCE OF COLD WATER CORAL IN THE NORTHEAST ATLANTIC

2.1 Introduction

Many species of coral grow in cold water. If the terms of reference provided by the ICES process were interpreted widely, these corals occur throughout the ICES area and the entire ICES area would be identified. However, the origin of the term of reference was a request from the European Commission to help meet recent concerns about the impacts of fishing on cold water coral reefs. It is therefore assumed for the purposes of this report that cold water corals refer to those coral species that contribute to reef formation in waters less than about 20° C. In Northeast Atlantic waters these include the azooxanthellate scleractinarian corals *Desmophyllum cristagalli, Enallopsammia rostrata, Lophelia pertusa, Madrepora oculata* and *Solenosmilia variabilis*. The main reef building species is *Lophelia pertusa*. Other coral species often occur in association with *Lophelia pertusa* and none has been found forming reefs away without *Lophelia pertusa* being present. Zibrowius (1980) gave a good general review of the distribution of cold water coral in European waters.

Several publications appeared during 2002 and 2003 that have furthered knowledge of the occurrence of cold-water coral in the Northeast Atlantic from that reported in our 2002 report (ICES, 2002a). These and further unpublished information are reviewed below. In addition, following indications from the European Commission that they wished to have more precise locations of the occurrence of coral reefs described in our 2002 report (ICES, 2002a), and the extent of areas that potentially need to be closed to protect them from the impacts of fishing, detailed coordinates are given of

some occurrences in EU waters described in ICES (2002a). A database of the global occurrence of *Lophelia pertusa* is being compiled (A. Frewald, pers. comm.). Figure 2.1.1 indicates occurrences in the Northeast Atlantic.

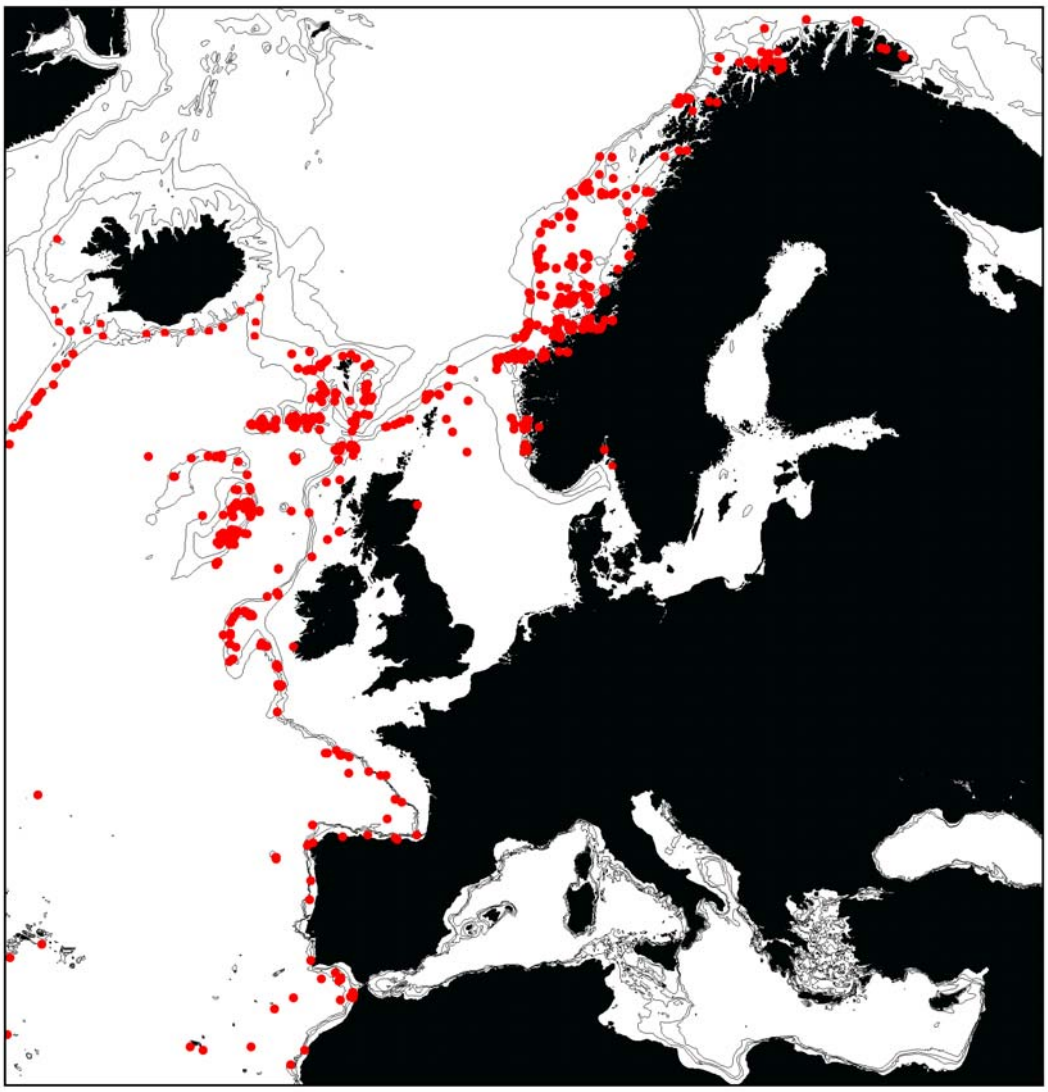

Figure 2.1.1. Distribution of *Lophelia pertusa* in the northeast Atlantic (A. Frewald, pers. comm.).

2.2 Distribution of cold water coral

2.2.1 Norway

An extensive programme using acoustic techniques to map deep-water corals is carried out every summer on Norway's continental shelf. In May 2002, a huge (initially measured at 35 km long and 3 km wide) *Lophelia* reef system was discovered mainly between 300 m and 400 m depth on a steep and rugged part of the continental break off the archipelago of Lofoten, between 67°N and 68°N (Fosså and Alvsvåg, 2003).

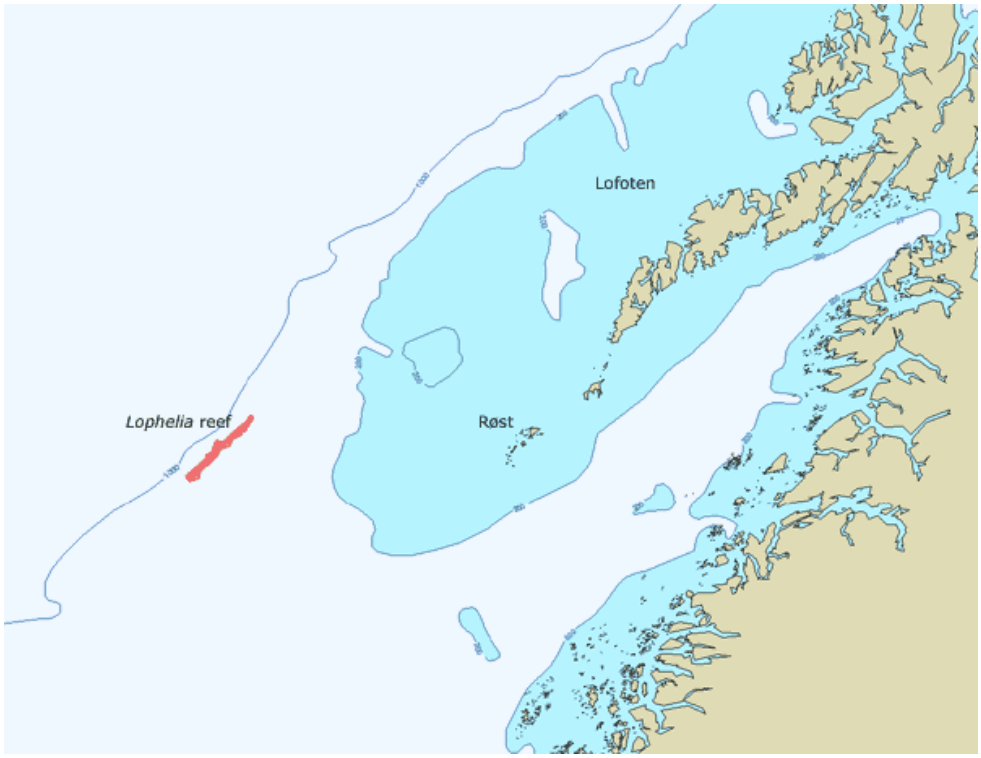

Figure 2.2.1.1. Location of the *Lophelia* reef discovered to the west of Røst, Norway in May 2002.

A coral reef at least 1.2 km long and 200 m wide was found by researchers from the Tjärnö Marine Biological Laboratory (Strömstad, Sweden), to the north of Tisler in Yttre Hvaler in Norway, close to the border to Sweden in 2002 (Lundälv and Jonsson, 2003) (Figure 2.2.1.3). Living corals were found between 74 m and 160 m depth and yellow varieties of *Lophelia pertusa* were documented for the first time. There are at least two more, yet unexplored, reefs nearby. The area of habitat that the reef was found within extends across the Swedish/Norwegian boundary (Nilsson, 1997; Lundälv and Jonsson, 2000; Jonsson and Lundälv, 2001). The eastern parts of the area (Koster-/Väderöfjorden and Singlefjorden) are situated in Swedish territorial waters and the western part (Yttre Hvaler) is situated in Norwegian territorial waters. The central position of Kosterfjorden/Yttre Hvaler is approximately 58°58.7' N and 11°01.6' E.

Fosså and Alvsvåg (2003) provided an updated map of the occurrence of *Lophelia pertusa* and reefs within Norwegian waters (Figure 2.2.1.2).

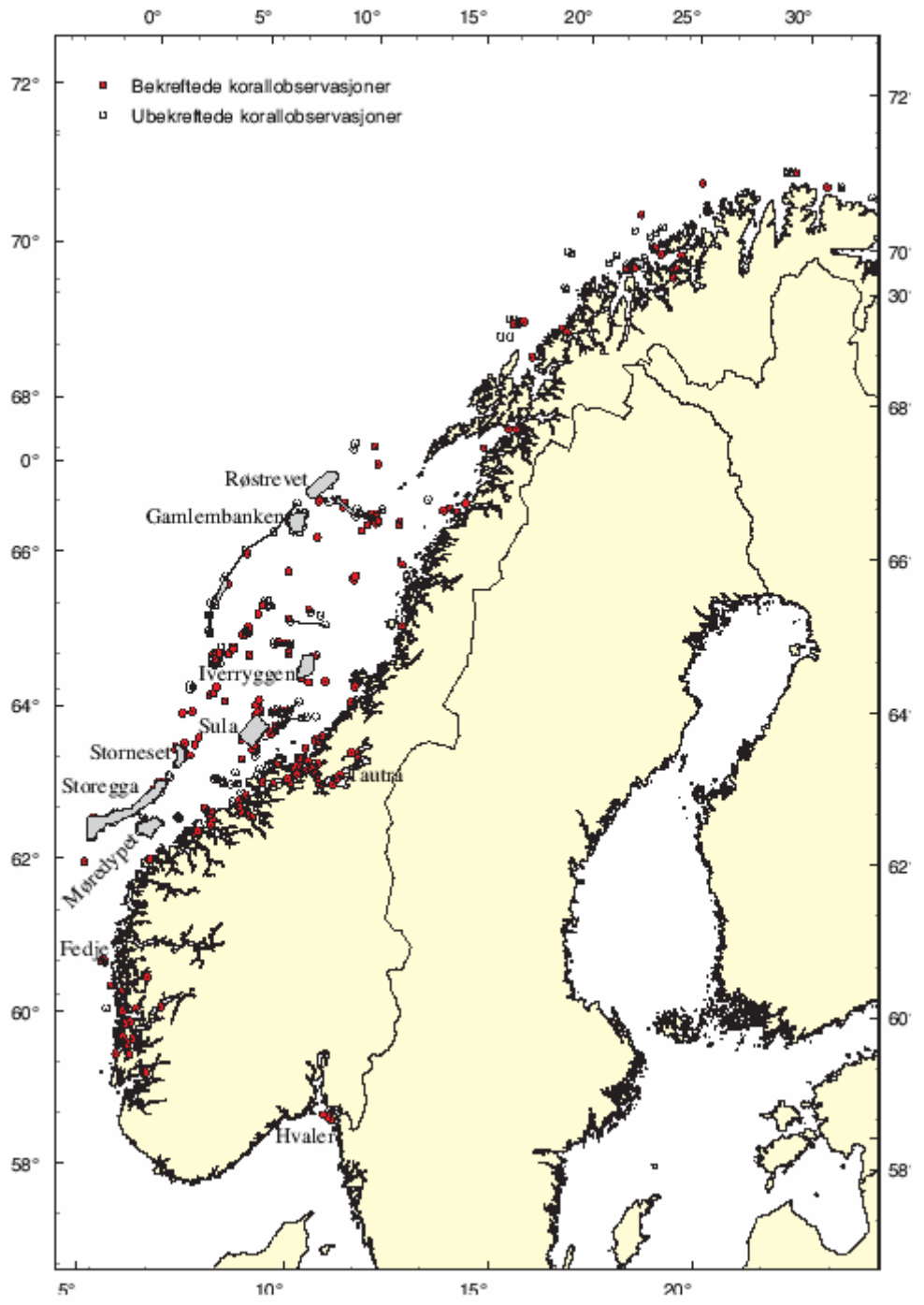

Figure 2.2.1.2. Known occurrence of *Lophelia pertusa* in Norwegian waters at the end of December 2002. Named areas are described in detail in Fosså and Alvsvåg (2003).

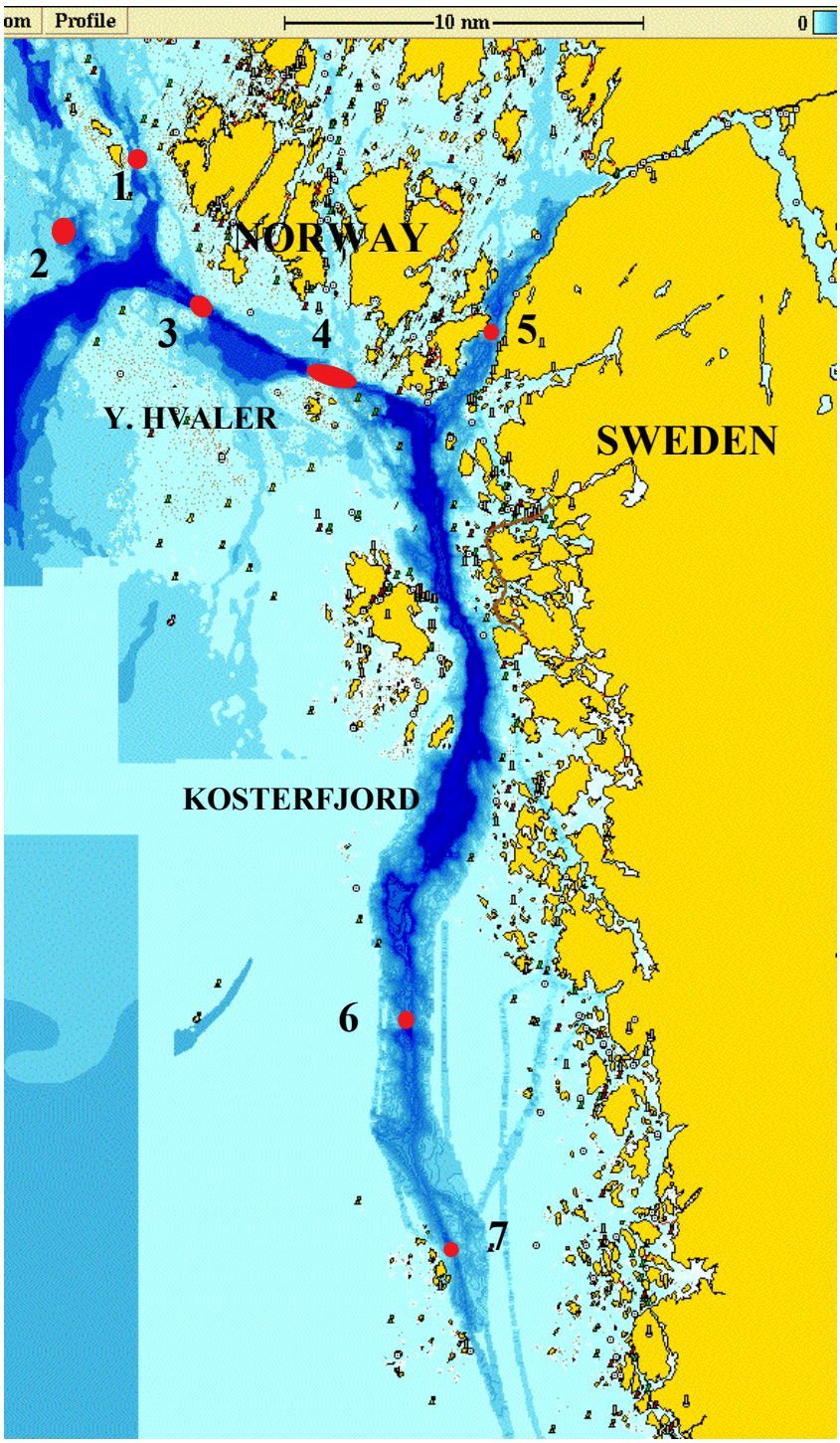

Figure 2.2.1.3. Map of known coral occurrences in the Yttre Hvaler/Kosterfjord area. Site 1 was studied with dredging techniques about 30 years ago and its present condition is unknown. Sites 2, 3 and 4 were the ones we discovered last year, and there are large living reefs in site 2 (Fjellknausene) and 4 (Tisler), while site 3 (Djupekrakk) seems to have been destroyed by trawling. Site 5 (Sacken) is a small reef that has been known since the 1920s, but is badly damaged by trawling (and perhaps also by over-enthusiastic biologists). Sites 6 and 7 contained living corals 15–20 years ago, but have since been destroyed by trawling. Small trawl exclusion areas have been created around sites 5, 6 and 7, but further damage occurred after this protection was installed. Norwegian authorities are presently considering protective measures for sites 2 and 4.

2.2.2 Sweden

Small amounts of reef occur in the Swedish Skagerrak adjacent to the Hvaler site described for Norway in Section 2.2.1.

2.2.3 Faroes

No new information was available.

2.2.4 Iceland

No directed survey work has been carried out off Iceland in 2002–2003, but further reports have been gathered from retired fishers of the location of coral reef areas around Iceland in the 1970s (Figure 2.2.4.1). The majority of these areas were to the south of Iceland, but with some to the north and west.

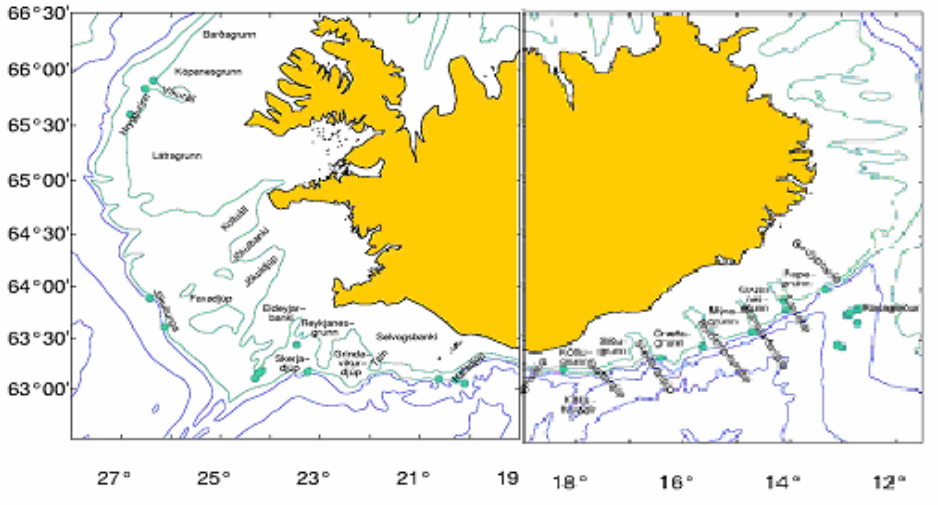

Figure 2.2.4.1. The development of the deep-sea fisheries around Iceland took place in the 1970s. This map (based on information from retired fishermen) indicates where coral grounds occurred when trawling expanded into the shelf break area around Iceland (S.A. Steingrímsson, pers. comm.).

2.2.5 United Kingdom

Information on the broad distribution of coral reefs on the Rockall Bank (Figure 2.2.5.1.) was compiled from interviews with fishermen by Hall-Spencer (pers. comm.). This information broadly agrees with that presented in Wilson (1979a) and the same author's studies reported in Wilson (1979b). There has been no recent survey of this area and this must be a priority research need.

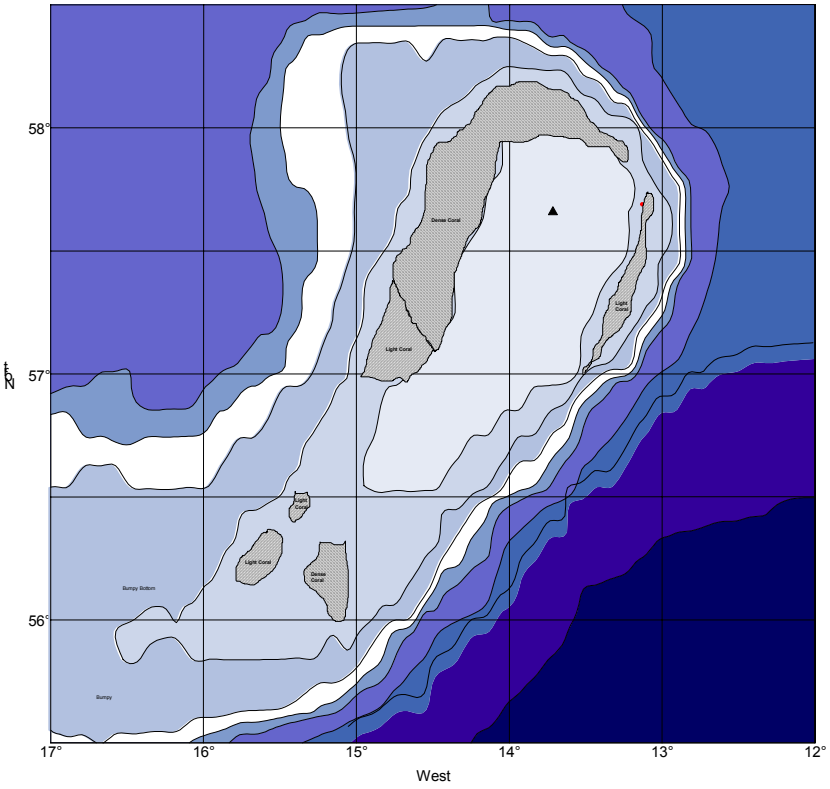

Figure 2.2.5.1. The distribution of coral reefs on Rockall Bank from fishermen's records (J. Hall-Spencer, pers comm.). The cross-hatched areas indicate presence of *Lophelia* reefs.

The best known site in UK waters remains the Darwin Mounds to the north and west of Scotland. These are located in 1000 m deep water to the south of the Wyville Thomson Ridge. The best known of these mounds were described in ICES (2002a). Further analysis (Masson *et al*., 2002) has shown mound features to extend some way beyond the two best known fields described in ICES (2002a) (Figure 2.2.5.2). This area has been heavily impacted by trawl gear with many areas typified by broken coral rubble and a reduction in biodiversity (Wheeler *et al*., in press).

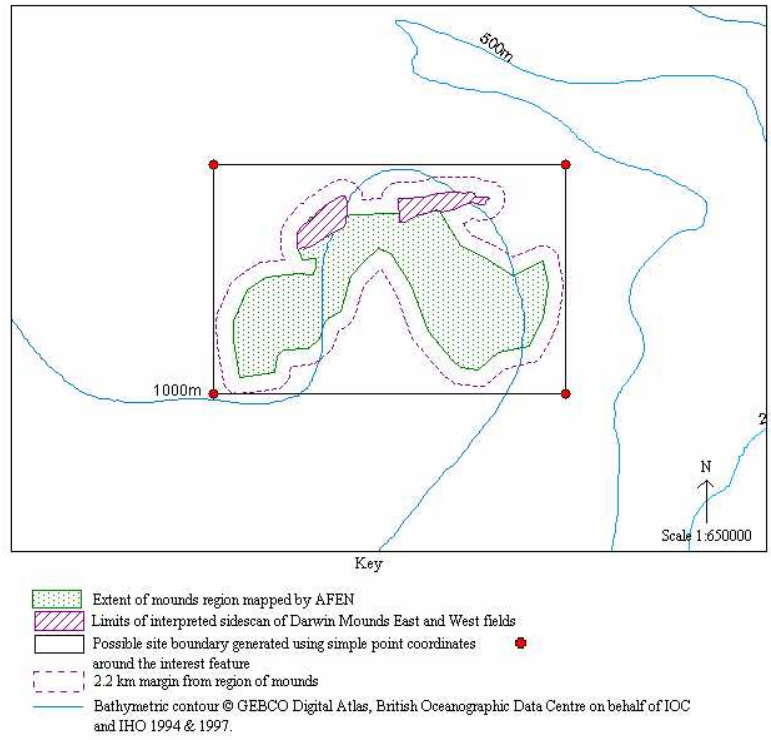

Figure 2.2.5.2. Extent of the mound features (specked area) in the Darwin Mounds, along with boundary points around the mounds. The corner points of the boundary are 59° 54' N 7° 39' W, 59° 54' N 6° 47' W, 59° 37' N 6° 47' W and 59° 37' N 7° 39' W.

Roberts *et al.* (2003) describe the distribution of *Lophelia* to the west of Scotland and the environmental controls on its occurrence.

2.2.6 Ireland

Deep-water coral reefs have been found in Irish waters associated with carbonate mounds (Hovland *et al.,* 1994; Kenyon *et al.,* 1998, 2003; Henriet *et al.,* 1998; De Mol *et al.,* 2002; Akhmetzhanov *et al*., 2003; van Weering *et al*., 2003) located to the west of Ireland (Figure 2.2.6.1). There are a number of mound clusters fringing the upper continental slope of the Rockall Trough and Porcupine Seabight (Croker and O'Loughlin, 1998). In the Porcupine Seabight two major, complex mound provinces have been identified: the "Hovland-Magellan" mound province on the northern slope of Porcupine Seabight and the "Belgica" mound province on the eastern slope of Porcupine Seabight (Figure 2.2.6.1)(De Mol *et al.,* 2002). In the Rockall Trough, two major mound clusters on the SE and SW margin have been studied: the "Pelagia" mound province on the southeast Rockall Trough and the "Logachev" mound province on the southwest Rockall Trough (Kenyon *et al.,* 2003).

These mounds occur in water depths between 500 m to 1200 m and vary from small structures of a few metres to over 300 m in height, and occur singly or in large clusters (Kenyon *et al.,* 1998; De Mol *et al.,* 2002). Extensive mapping using TOBI side-scan sonar has now been completed over all of these mounds (Figure 2.2.6.1) as well as high-resolution side-scan sonar lines on selected mounds ground-truthed by video (de Haas *et al*., 2002). Densest living coral cover occurs on the summits of mounds where current flow is generally highest. Current speeds in excess of 40 cm/s have been recorded close to mounds by moored and lander-deployed current meters (White, 2001). Temperature and salinity at these locations are typically in the range of 6 °C to 11°C and 35.2 % to 35.6 ‰, respectively (White, 2001).

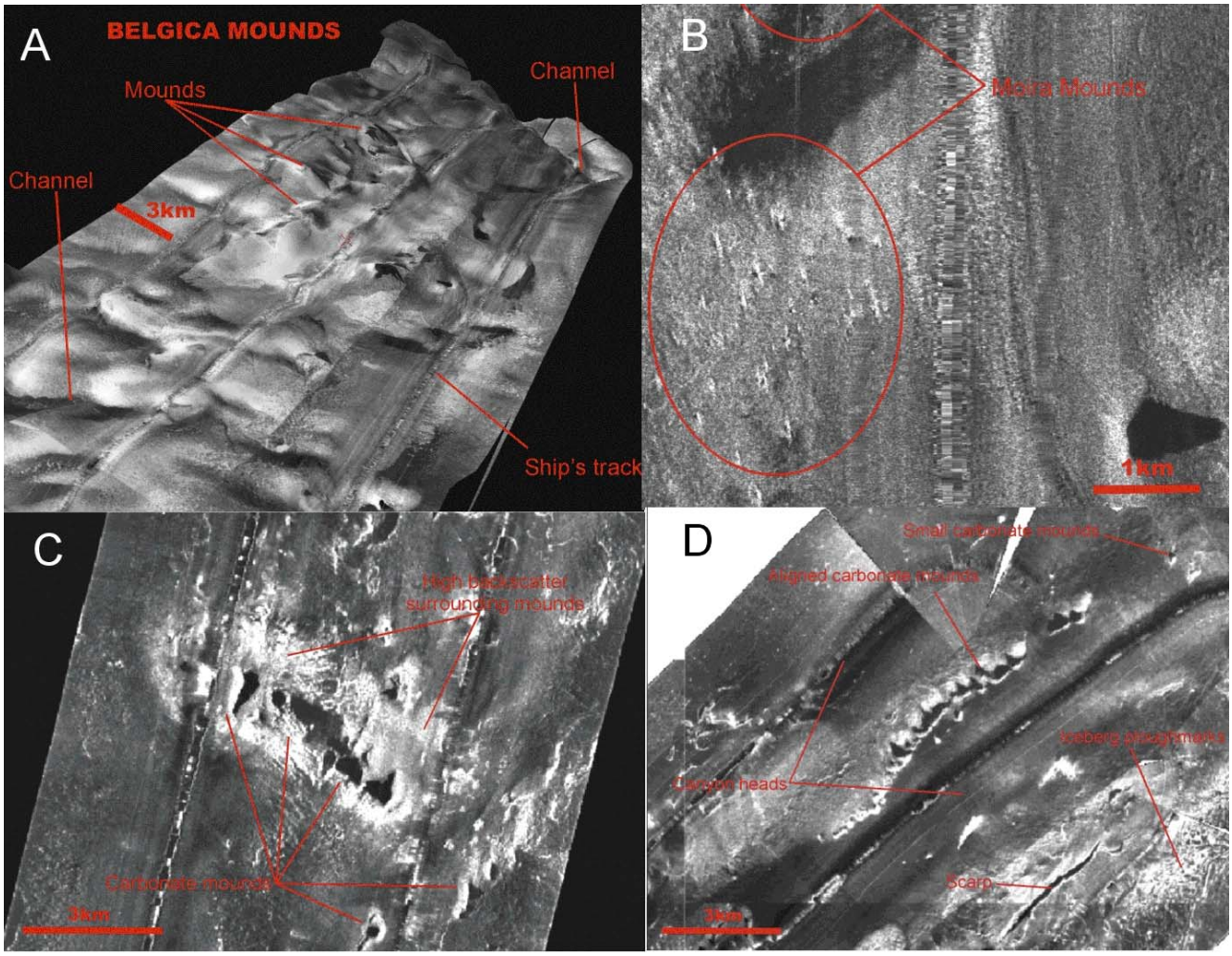

Figure 2.2.6.1. An example of TOBI side-scan sonar showing an alignment of carbonate mounds on the Porcupine Bank (de Haas *et al*., 2002). Comprehensive mapping of primary carbonate mound occurrences were mapped during this recent cruise.

A French-Irish-EU research cruise CARACOLE (Carbonate Mound and Cold Coral Research) visited five deep-water coral locations in the Porcupine Seabight and the Irish parts of the Rockall Trough in summer 2002 (Figure 2.2.6.2.). Five coral/mound locations were studied in detail during this cruise: Thérèse Mound in the Belgica Mound Province; Propellor and Perserverence Mounds in the Hovland/Magellan Mound Province; the R1 Mound complex in the Pelagia Mound Province and the R2 Mound Complex in the Logachev Mound Province.

High-resolution video and close-up digital stills were taken with the French "VICTOR" Remotely Operated Vehicle. These observations revealed exceptionally dense and rich coral communities dominated by the two framework-constructing species, *Lophelia pertusa* and *Madrepora oculata*, and other suspension feeders, especially sponges, gorgonians and crinoids. Mobile fauna included echinoderms, crustaceans and various fish species. The coral communities covered large areas at some sites (e.g., Thérèse Mound and R2) but showed a more patchy distribution and restricted area at other sites (R1, Propeller and Perseverance Mounds). Evidence of fishing activity was confined to imaging of static gears (gillnets/tangle nets) used to fish for monkfish or anglerfish (*Lophius* spp.) and hake (*Merluccius merluccius*), lost on the side of mounds. However, trawl-marks have been imaged between mounds based (on high resolution side-scan sonar) and the use of tangle-nets on the Logachev Mounds observed (A. Wheeler, pers. comm.).

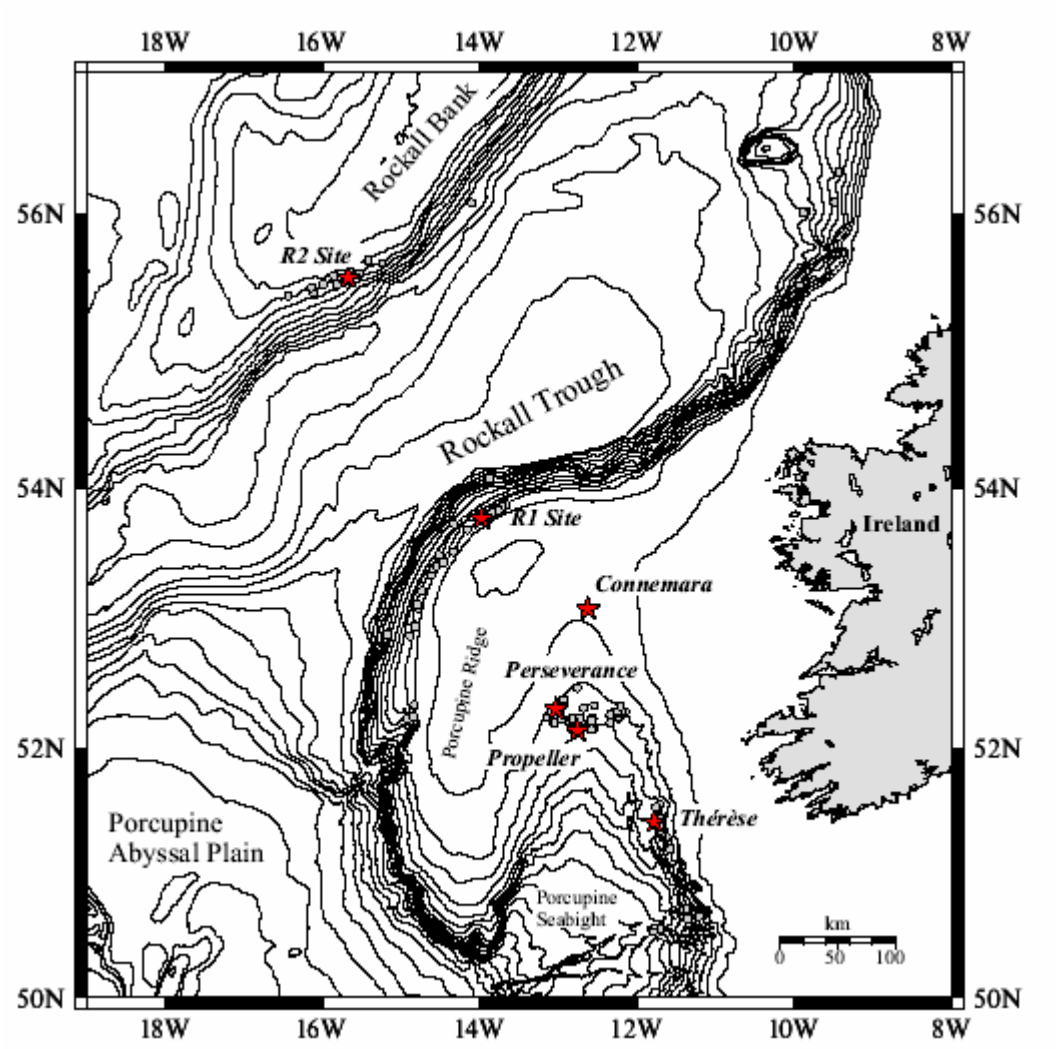

Figure 2.2.6.2. The location of carbonate mound sites investigated during the CARACOLE 2001 cruise (red stars). Circles highlight carbonate mound locations identified on the basis of seismic data (Croker and O'Loughlin, 1998). Bathymetric contour interval 500 m (Grehan *et al*., 2003).

2.2.7 France, Spain, Portugal

No new information was available.

3 NEW INFORMATION ON THE IMPACTS OF FISHING ON COLD-WATER CORALS

As noted in the 2002 report from this study group (ICES, 2002a) and in advice from ICES to the European Commission (ICES, 2002b), *Lophelia pertusa* reefs are particularly affected by mobile bottom-fishing gears and the use of such gears is widespread in areas holding *Lophelia*. Other fishing gears occur in *Lophelia* reefs but cause much less damage than mobile bottom-fishing gear.

Further evidence of the occurrence of other gears was obtained during the cruises off Ireland described above. Figure 3.1. shows a lost gillnet on the Thérèse Mound and Figure 3.2. shows a lost tangle net on the R1 site. Eight examples of lost nets were found during the video survey of the Thérèse Mound (Figure 3.3), along with evidence of previous scientific dredge surveys of the area (Grehan *et al*. 2003).

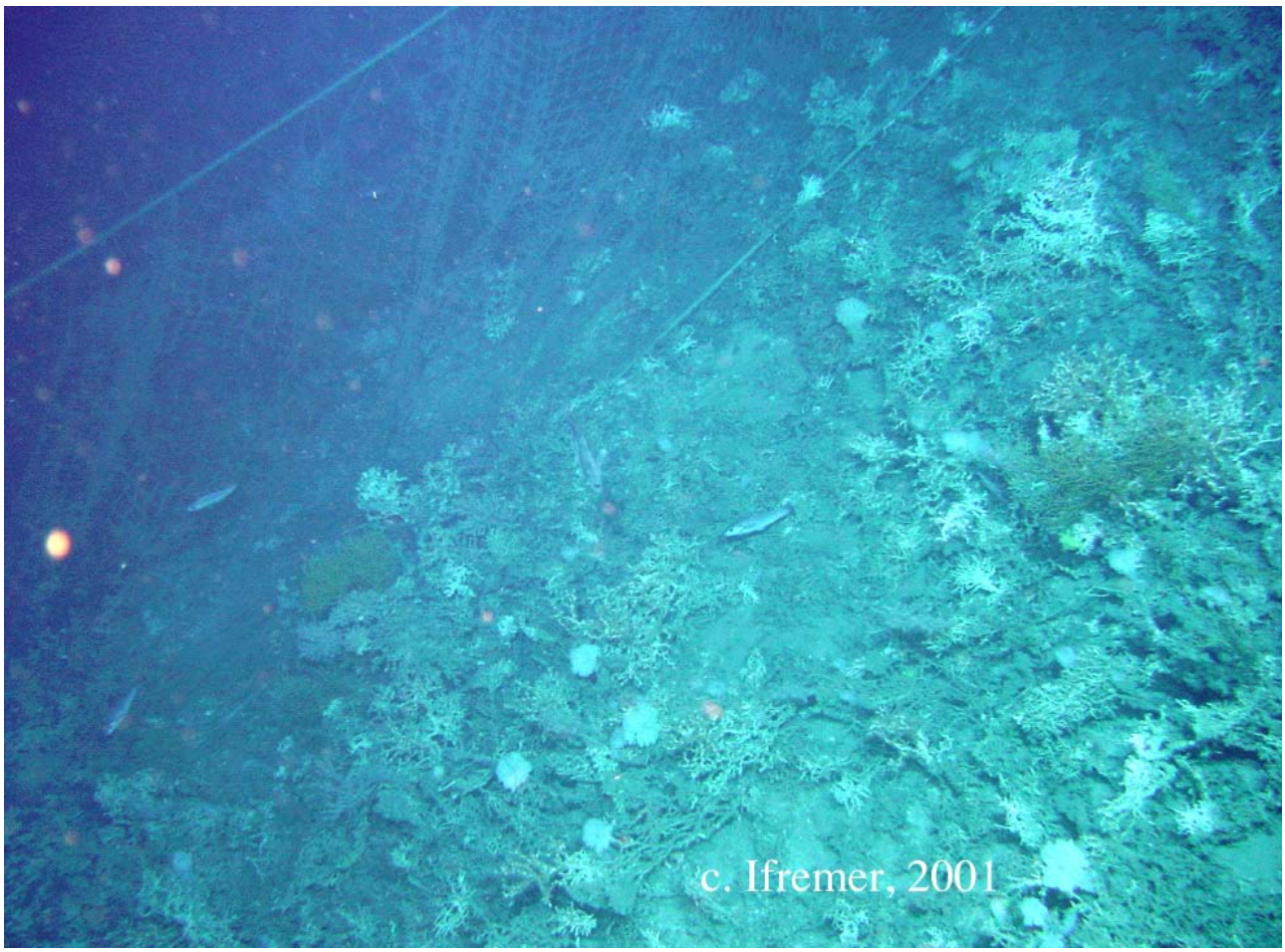

Figure 3.1. A video grab image from the forward-looking camera showing a lost gillnet on the western side of the Thérèse Mound. Note the abundant *Lophelia pertusa* colonies and large hexactinellid sponge *Aphrocallistes bocagei,* and small gadoid-like fish (Grehan *et al*., 2003). Copyright IFREMER.

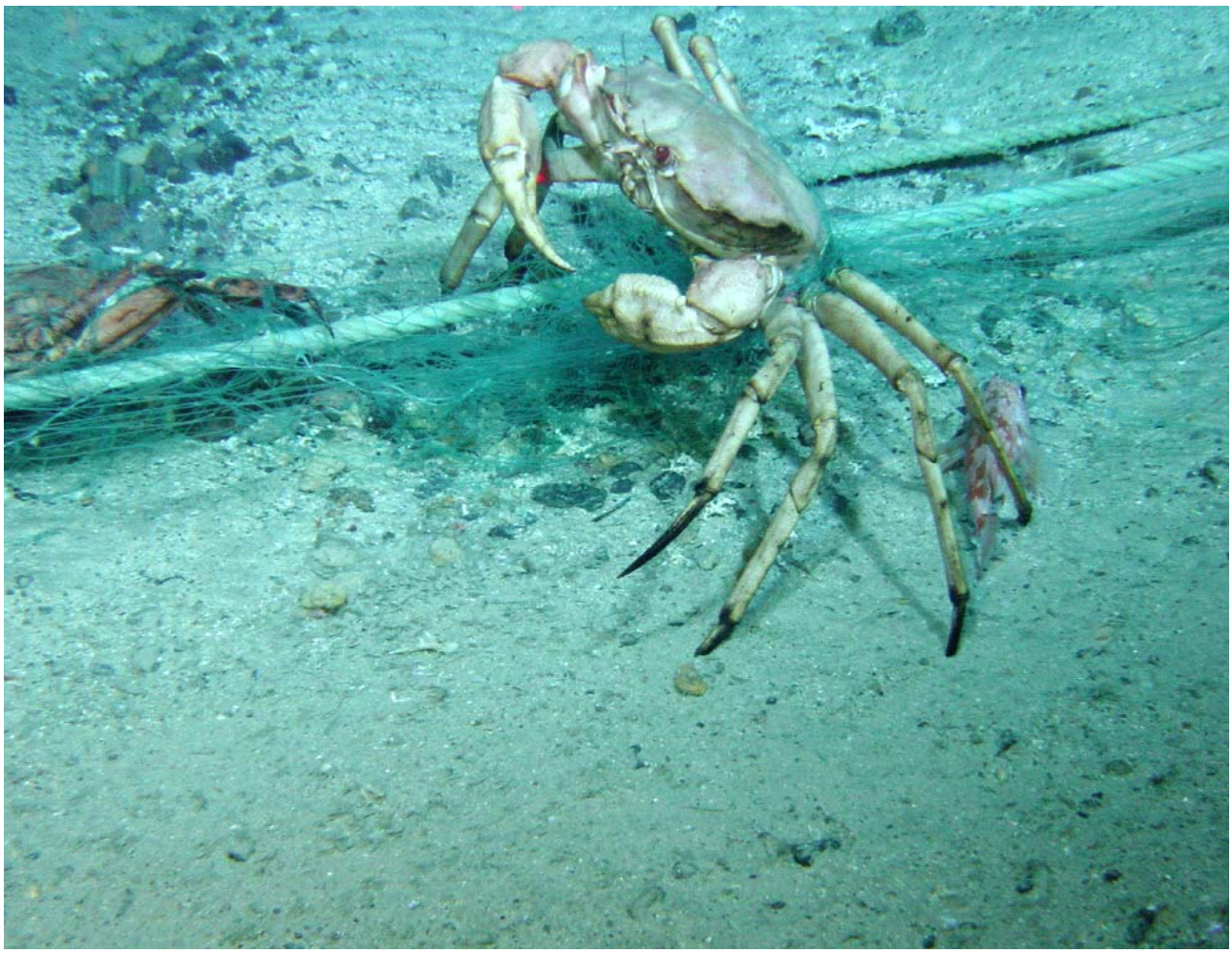

Figure 3.2 A digital still image of a lost tangle net at the R1 site, showing a pair of deep-water red crabs *Chaceon affinis*, in the process of becoming entangled as a scorpion fish (Family *Scopaenidae*) watches (Grehan *et al*., 2003).

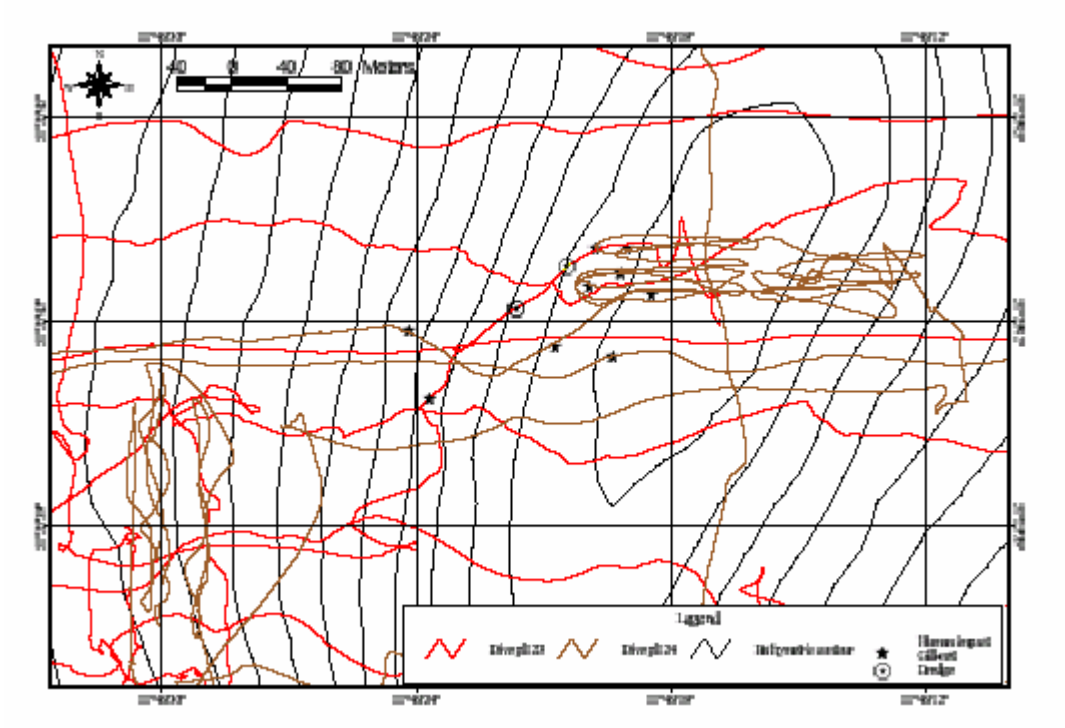

Figure 3.3. Enlarged section of the western flank of the Thérèse Mound showing the location of the gillnet (stars) observed by the downward-looking video camera (tracks in red and brown) and dredge scars (enclosed stars) (Grehan *et al*., 2003).

Grehan *et al.* (2003) describe the various fishing methods used in deep water to the west of Ireland. This includes demersal trawl fisheries for deep-water species that deploy trawls fitted with heavy rock-hopper gear spread with otter boards typically weighing in excess of 1000 kg each. The trawls are towed at 3 to 4 knots with the otter boards set ca. 60–70 m apart. Gear is worked for ca. 4 hours per haul, sweeping about 12–15 miles per haul. There are regularly 4 to 5 hauls per day so an average trip of 10 days can cover some 33 km^2 of sea floor (Hall-Spencer *et al.,* 2002).

A more robust type of bottom trawling gear has been developed for orange roughy fishing. The technique involves the sophisticated use of bottom sonar to map target pinnacles/sea mounts prior to fishing. The trawls are fitted with high-resolution headline transducers so that the actual position of the net with respect to the bottom can be constantly monitored. These vessels are also fitted with high-resolution colour sounders and many use systems such as the SIMRAD CM 60 Chart mapping system to generate topographic seabed maps in real time. Orange roughy tend to aggregate near the summit of topographical highs and fishing an acoustically identified stock involves shooting the trawl to pass close to the summit of the peak, allowing the net to sink quickly to drive the orange roughy onto the sea floor, before towing off into deep-water. This is a high-risk technique, as under-shooting the trawl during the initial pass over the summit will result in snagging of the net on the side of the pinnacle/sea-mount. Only certain tracks on each pinnacle/mount are suitable for successful operation of this technique (BIM, 2001; Andrae, 2002).

An Irish orange roughy fishery utilising the high-risk fishing technique described above has expanded rapidly since 2001. These techniques are distinctly coral unfriendly. Orange roughy fishing in the Southern Hemisphere, particularly in Australia and New Zealand, has had a major impact on seamount coral ecosystems (Probert *et al.,* 1997; Koslow *et al.,* 2000, 2001). Almost 90 % of corals have been removed in some places (Koslow *et al.,* 2001). Although, the recent introduction of Total Allowable Catches and quotas for several deep-water fish species in European Community waters (European Community, 2002) will go some way to reducing the potential damage of unregulated fishing, nevertheless, the nature of the orange roughy fishery which puts a premium on the identification and exploitation of virgin stocks, suggests that the capacity for collateral habitat damage during exploratory fishing, by itself, will remain high. In mitigation, many of the mound sites are steep-sided with slope angles in excess of 20 degrees. Successful trawling requires slope angles less than 20 degrees (Andrae, 2002) which means that the mounds themselves may confer a certain degree of "natural" protection from current trawling impacts. That said, given the fragile and ancient nature of coral reefs, even a relatively short period exposed to this type of fishing impact would be likely to be catastrophic for the long-term viability of the coral habitat in its present physical configuration.

Observations made in the northeast Skagerrak by Lundälv and Jonsson (2003) found that three of six sites containing or known to have contained coral have been destroyed by fishing activities in relatively recent times, while two of the remaining three sites with live corals were heavily impacted by trawling. The main trawl fishery in this area is for shrimps (*Pandalus borealis*). Fishermen have reported reduced catches in the areas near to corals after trawling activities.

4 LOCATION OF AREAS TO PROTECT FROM DEEP-WATER TRAWLING

4.1 Norway (and Sweden)

Norway closed the areas of the Sula Ridge and Iverryggen reefs to towed gears in 2000. On 4 January 2003, an area 43 km long and 6.8 km wide was closed by the Norwegian Minister of Fisheries to bottom-trawl gears in order to protect the newly-discovered reef to the west of Røst. The area is delineated by four coordinates: 67° 36.2' N, 009° 32.9' E; 67° 33.8' N, 009° 40.2' E; 67° 17.3' N, 008° 57.1' E and 67° 19.8' N, 008° 49.5' E.

The Worldwide Fund for Nature (WWF) has suggested that the Yttre Hvaler reef should be incorporated into a Norwegian-Swedish protected area. Some 426 km^2 of the Koster-Väderöfjorden, in the Swedish part of the area, has already been declared a Special Area of Conservation under the EU Habitats Directive. A working group, consisting of representatives from public authorities, fishing organisations and individual fishermen, has been successfully working to reduce the effects of shrimp trawling on the sensitive marine organisms in the area. Certain gear regulations have been introduced and a number of small areas within the Natura 2000 area are being identified as protected zones where trawling is forbidden. In Norway, the area is listed as a candidate area in the national marine protection plan currently under development. Under this plan, a network of MPAs will be established in Norwegian waters in 2004. The area is also being considered as a nature reserve or national park under the Norwegian Nature Conservation Act.

4.2 United Kingdom

The UK has indicated to the European Commission that it will be proposing the Darwin Mounds site as a Special Area of Conservation under the EU Habitats Directive as soon as national regulations are in place. The UK has also drawn attention to the need for the Commission to exercise its sole competency in fisheries management in EU waters in

regulating fishing in the area of the Mounds. A possible boundary for the site has been proposed (Figure 2.2.5.1), that has been kept simple to aid in fisheries monitoring and control. The boundary corner points are 59° 54' N 7° 39' W; 59° 54' N 6° 47' W; 59° 37' N 6° 47' W and 59° 37' N 7° 39' W. This margin between the Mounds and the boundary is sufficiently wide to allow for the length of towing warp between any trawler and a net being fished on the seabed in this area. Fishing vessels which are bottom trawling in the region need a minimum towline length of twice the depth of water which they are fishing in (SERAD, 2001). The Darwin Mounds are in water between approximately 1000 m and 1100 m deep and, therefore, minimum towline lengths are likely to be between 2 km and 2.2 km long. The suggested site boundary for the Darwin Mounds comprises the smallest rectangle based on whole degrees/minutes (to two decimal places), which will include the mounds area plus a margin of 2.2 km to allow for possible impacts of trawling as outlined above. The total area covered by the proposed boundary option is about 1529 km^2

However, if fisheries monitoring near the Mounds is to use the satellite-based VMS system (Hall-Spencer, 2003; Marrs and Hall-Spencer, 2003) currently in use in EU waters, then the boundary where fishing vessels should not go may need to be drawn wider still. This is because the VMS cycle rate is once every two hours. A further margin of at least the equivalent of 1–2 hours steaming time may therefore be needed to be added to the site boundary in order to ensure that fishing vessels cannot tow undetected over the site. An alternative might be to modify the VMS system to give more frequent positional updates, or to randomize the timing of positional updates such that it is impossible for any fisher considering breaking the closure to know when VMS signals might be transmitted.

4.3 Ireland

The Irish Coral Task Force has identified four areas of carbonate mounds and *Lophelia* reefs most suitable for protection in Irish offshore waters (Grehan pers. comm.). These are the R1 and R2 sites either side of the Rockall Trough, the Perserverence and Propeller Complex and the Thérèse Mounds (Figures 2.2.5.2. and 4.3.1). The Irish Coral Task Force has been formally asked by Duchas, the Irish Heritage Agency, to assist with the designation of offshore Special Areas of Conservation to protect *Lophelia* reefs under the EU Habitats Directive.

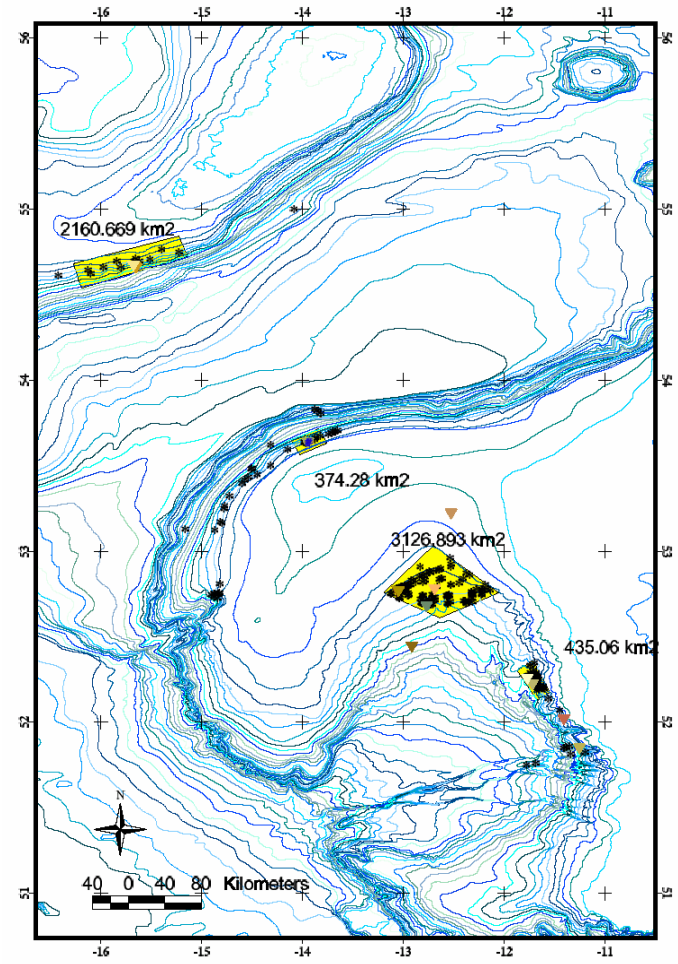

Figure 4.3.1. Four sites to the west of Ireland identified as suitable for the protection of cold-water coral reefs and carbonate mounds by the Irish Coral Task Force.

5 THEME SESSION ON COLD-WATER CORAL

The second international symposium on deep-sea corals will occur in Erlangen, Germany from 9–12 September 2003 (www.cool-corals.de). This will be a very suitable occasion ahead of the 2003 ICES Annual Science meeting to discuss and prepare a proposal for a theme session at the 2004 Annual Science meeting.

6 RECOMMENDATIONS

SGCOR has mostly considered the distribution and occurrence of *Lophelia pertusa* and other colony-forming Scleractinia so far. These are not the only long-lived habitat-forming species at risk from fishing activities in the Northeast Atlantic. We therefore recommend that distribution of, and threats to, large, slow-growing octocorals, especially *Paragorgia arborea* and *Primnoa resedaeformis*, should be considered in our work in 2003–2004.

Lophelia pertusa reefs are a habitat for hundreds of other species. We recommend that information on the importance of these reefs to other species be reviewed in 2003–2004.

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