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Strandings of NE Atlantic gorgonians

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ABSTRACT

Northeast coral gardens provide vital breeding and feeding habitats for fishes of conservation and commercial importance. Such habitats are increasingly at risk of destruction as a result of over fishing, ocean warming, acidification and marine litter.

A key cause for concern regarding the vulnerability of coral gardens to damage from any source is their slow growth rate, and thereby their ability to recover from damage. Hence protected areas are being put in place, which exclude the use of towed demersal fishing gear.

Citizen scientists observed that gorgonian coral (Pink Sea Fans) skeletons were stranding on beaches entangled in marine debris (sea fangles) across southwest England. Further, SCUBA divers reported that gorgonian corals were being caught up and damaged in lost fishing gear and other marine litter.

To determine the cause of the damage to coral gardens, sea fangles were collected and analysed.

The sea fangles were made up of a diverse range of litter from fishing and domestic sources, however, the majority comprised of fishing gear ($P < 0.05$).

Marine Protected Areas can protect coral gardens from direct fishing pressure, but risks still remain from ghost fishing pressure, demonstrating the need for sources of litter into the environment to be reduced and existing litter removed.

The EU Marine Strategy Framework Directive (MSFD) outlines targets for marine litter by 2020. This study highlights the importance of adhering to the MSFD and/or creating more ambitious regulation if the UK re-write existing legislation following BREXIT.

1. Introduction

The northeast Atlantic has a highly diverse coral fauna (Roberts et al., 2009), and historical records show that the region used to have extensive scleractinian coral reefs, as well as gardens of cold-water alcyonaceans (leather corals), antipatharians (black corals), gorgonians (sea fans) and stylasterids (hydrocorals) (Hall-Spencer et al., 2007b). Drawings by Gosse (1860) brought international attention to the beauty and abundance of anthozoans in the region and cold-water corals have long fascinated marine biologists due to the high diversity of life associated with the habitats that they create (Le Danois, 1948). In this paper, evidence of recent damage to coral gardens globally is discussed, prompted by citizen scientist reports of strandings of gorgonians in southwest England in late 2014.

In shallow waters above the thermocline there have been increasing incidences of gorgonian disease in tropical and temperate waters (Hall-Spencer et al., 2007a; Kim, 2015), and marine heat waves have caused mass mortalities in gorgonian populations (Cerrano et al., 2000). The combined effects of stressors such as over-fishing, surface ocean warming, acidification and marine litter mean that the managers of maritime activities will need to be forward-thinking to protect cold-water coral habitats (Witherell and Coon, 2000; Bo et al., 2014; Jackson et al., 2014).

Where strong currents and hard substrata are available, gorgonians can form dense stands from shallow waters down to depths of > 2000 m (coral gardens) (Yesson et al., 2012). These coral gardens increase habitat structural complexity and thereby contribute strongly to their biodiversity (Krieger and Wing, 2002; Ponti et al., 2016). Cold-water corals that are easily damaged by towed demersal fishing gear provide habitat for the feeding and breeding of commercially important fishes (Costello et al., 2005). The mounting evidence of impacts of bottom trawling on scleractinians shows that towed demersal fishing leaves behind smashed reef frameworks (Hall-Spencer et al., 2002; Clark et al., 2010). Fishing impacts on gorgonians have a less obvious legacy, although gorgonians are just as vulnerable to the use of towed demersal gear and can be a prominent component of the by-catch (Watling and Norse, 1998; Stone, 2006; Edinger et al., 2007; Bo et al., 2014). A main reason for concern over the vulnerability of coral gardens to damage

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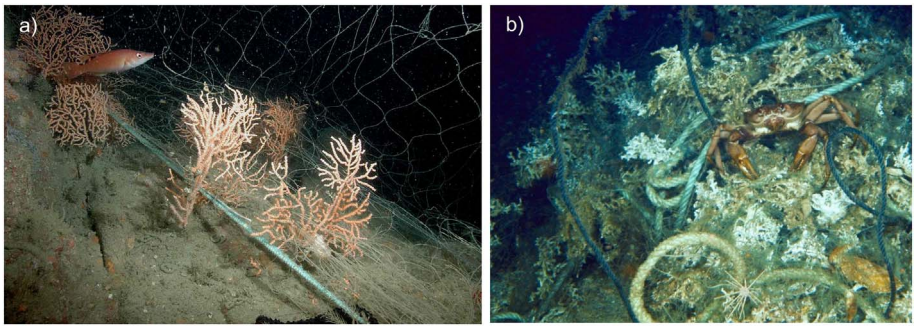

Fig. 1. a) Bottom set monofilament plastic gillnet running through a *Eunicella verrucosa* coral garden on bedrock at 20 m depth off Plymouth, southwest England with a female cuckoo wrasse *Labrus mixtus* top left (photo courtesy of Keith Hiscock) and b) a reef constructed by scleractinian and stylasterid corals damaged by non-biodegradable lost fishing gear at 1000 m depth off southwest Ireland with a crab (*Chaceon* sp.) feeding on invertebrates within the smashed-up reef (photo taken by IFREMER owned ROV Victor 2000 aboard RV Polarstern during a study by Söffker et al., 2011).

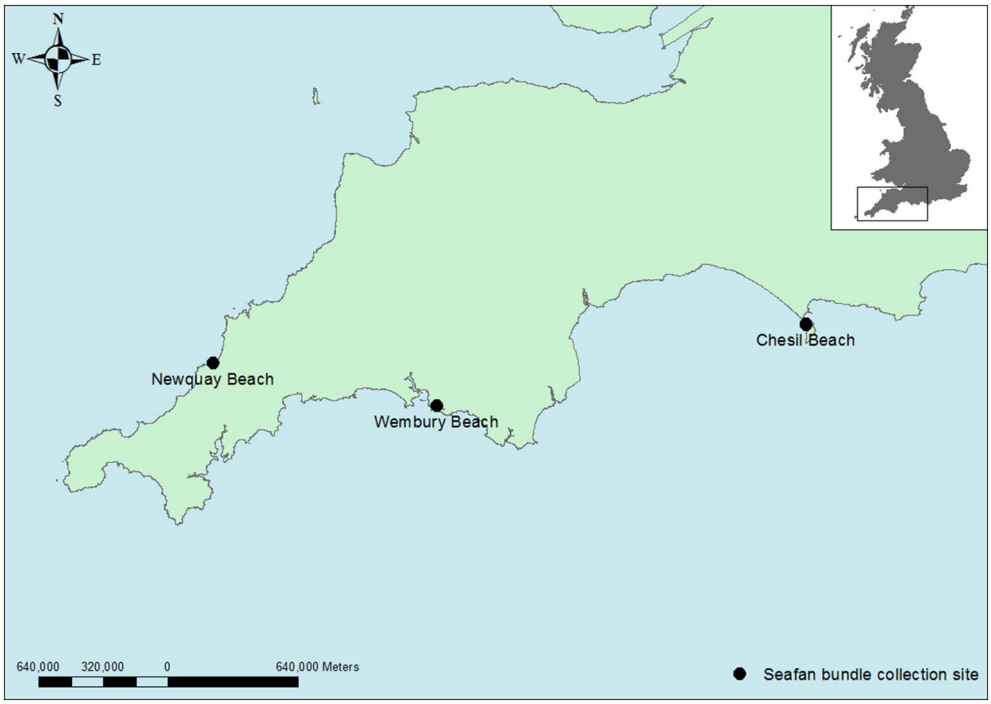

Fig. 2. Strandline survey sites at Chesil Beach, Wembury and Newquay in southwest England.

from any source is their slow rate of growth, so protected areas are being put in place, which exclude the use of towed demersal fishing gear (Althaus et al., 2009; Hall-Spencer et al., 2009; Harter et al., 2009; Sheehan et al., 2013a, b).

There are 83 species of gorgonian corals described for the NE Atlantic, but the vast majority of these live below 200 m depth (Hall-Spencer et al., 2007b). Only one species, *Eunicella verrucosa* (Pallas, 1766), occurs in shallow waters off England. It is known locally as the 'Pink Sea Fan' and large colonies may be over 50 years old: although they may grow up to 10 cm in the first year, their growth rate then slows to around 1 cm per year (Wood, 2013). This species is characteristic of rocky reefs on open coasts, although the rock substrata may not always be obvious due to a thin sediment veneer (Sheehan et al., 2013b), where it provides habitat for the rare Sea Fan Anemone *Amphianthus dohrnii* (Koch, 1878), a sea slug called *Tritonia nilsohdneri* (Marcus Ev. 1983) and the gastropod *Simnia hiscocki* (Pennant 1777) (Wood, 2013) as well as three dimensional seabed structures within which fish shelter (Fig. 1). In the 1960s–70s, *E. verrucosa* were collected for souvenirs and so this is now one of the few marine species protected from intentional damage (Wildlife and Countryside Act, 1981). It is also listed as 'Nationally Scarce' in the UK and listed as 'Vulnerable' on the International Union for Conservation of Nature and Natural Resources 'Red List' of threatened species (IUCN, 2015). Heavy demersal gear types, such as beam trawls and scallop dredges, are currently widely used in southwest England (Campbell et al., 2014) and so there have recently been localized bans on their use over coral gardens within key conservation areas of the region (Sheehan et al., 2013a, b; Pikesley et al., 2016). Eno et al. (2001) found that *E. verrucosa* were resilient to potting so this, and other forms of static gear, are currently permitted within coral gardens off southwest England.

While exclusion of demersal towed gear has benefitted Pink Sea Fan populations (Sheehan et al., 2013a, b), dead Pink Sea Fans are still stranding around southwest England, entangled in marine debris, from here on referred to as sea fangles. A 'fangle' is something newly fashioned or a foolish innovation. It is suspected that protected Pink Sea Fans are still being fished through the process of ghost fishing. Ghost fishing is the process of marine organisms becoming entangled in lost fishing gear and is most commonly associated with birds and cetaceans (Matsuoka et al., 2005; Brown and Macfadyen, 2007). It appears, however, that Pink Sea Fans are not only being ghost fished by lost fishing gear but also by domestic marine litter. The present study arose when hundreds of sea fangles were washed up on strandlines at