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Two "pillars" of cold-water coral reefs along Atlantic European margins: Prevalent association of *Madrepora oculata* with *Lophelia pertusa*, from reef to colony scale

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ABSTRACT

The scleractinian coral *Lophelia pertusa* has been the focus of deep-sea research since the recognition of the vast extent of coral reefs in North Atlantic waters two decades ago, long after their existence was mentioned by fishermen. These reefs where shown to provide habitat, concentrate biomass and act as feeding or nursery grounds for many species, including those targeted by commercial fisheries. Thus, the attention given to this cold-water coral (CWC) species from researchers and the wider public has increased. Consequently, new research programs triggered research to determine the full extent of the corals geographic distribution and ecological dynamics of "*Lophelia* reefs". The present study is based on a systematic standardised sampling design to analyze the distribution and coverage of CWC reefs along European margins from the Bay of Biscay to Iceland. Based on Remotely Operated Vehicle (ROV) image analysis, we report an almost systematic occurrence of *Madrepora oculata* in association with *L. pertusa* with similar abundances of both species within explored reefs, despite a tendency of increased abundance of *L. pertusa* compared to *M. oculata* toward higher latitudes. This systematic association occasionally reached the colony scale, with "*twin*" colonies of both species often observed growing next to each other when isolated structures were occurring *off-reefs*. Finally, several "*false chimaera*" were observed within reefs, confirming that colonial structures can be "coral bushes" formed by an accumulation of multiple colonies even at the inter-specific scale, with no need for self-recognition mechanisms. Thus, we underline the importance of the hitherto underexplored *M. oculata* in the Eastern Atlantic, re-establishing a more balanced view that both species and their yet unknown interactions are required to better elucidate the ecology, dynamics and fate of European CWC reefs in a changing environment.

1. Introduction

According to Jones' definition (Jones et al., 1994), corals are considered as autogenic engineers as they *"change the environment via their own physical structures,* i.e. *their living and dead tissues"*. The population dynamics of these engineering species is determinant for the dynamics of the communities they support and the persistence of ecosystems they belong to.

Two main species of stony corals form reefs in the East Atlantic (Fig. 1), the scleractinians *Lophelia pertusa* (Linnaeus 1758) and *Madrepora oculata* (Linnaeus 1758). Historical reports of locations of cold-water coral (CWC) reefs date back to the 18th century in Norway (Gunnerus 1768) and early 20th century in Ireland and the Bay of Biscay (Joubin, 1922a, 1922b; Le Danois, 1948) where massive formations were reported. In these reports, however, no distinction was made between *L. pertusa* and *M. oculata*, both refered to as "*white corals*". These reef-building "white corals" were opposed to the

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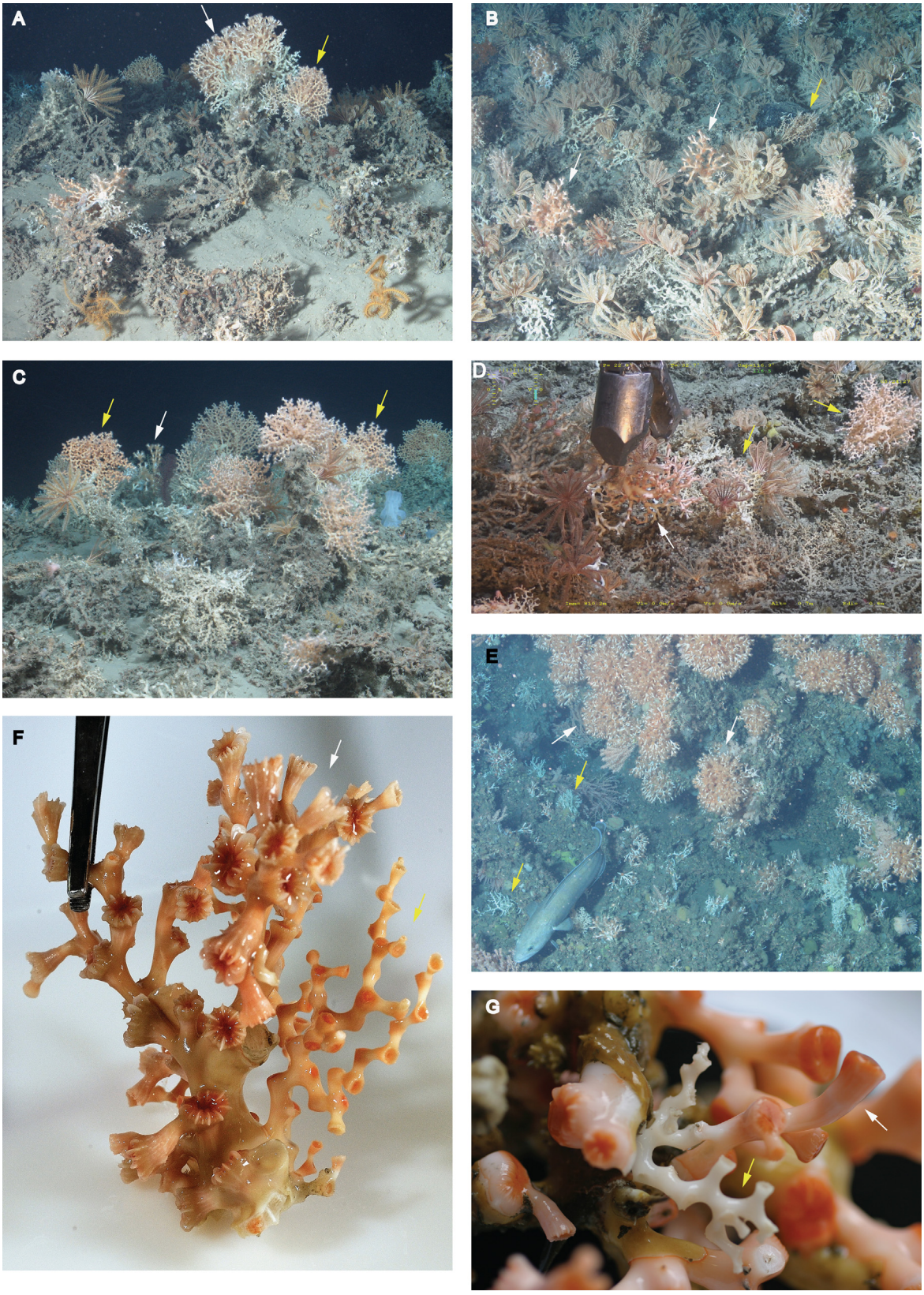

Fig. 1. Reefs showing the intermingling of both species (white arrow shows a *Lophelia pertusa* colony, yellow arrow a *Madrepora oculata* colony) in the Croisic (A), Guilvinec (B) and Petite Sole (C) canyons in the Bay of Biscay, at the Logachev Mounds region in Ireland (D) and at Hafadjúp off Iceland (E); (F, G) "*chimaera*"-like colony (white arrow shows a *Lophelia* polyp, yellow arrow a *Madrepora* polyp) sampled in the Bay of Biscay (F) and off Iceland (G).

"yellow" corals that included species from the genus *Dendrophyllia*, such as *Dendrophyllia cornigera* (Lamarck 1816). Fisheries moving to deeper areas and seabed surveys motivated by prospecting for fossil energies (oil and gas) in the past two to three decades, have indeed led to the discovery of vast CWC reefs along continental margins (Rogers, 1999). The long-standing view that cold-water scleractinians would