Deep-Water Emergent Patagonian Coral Fields

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Introduction: Deep sea reefs are often dominated by a single habitat forming species (Cairns, 1983). The stylasterid coral *Errina* spp. have been identified as key structural species in Antarctica (Post *et al*, 2010), the South West Atlantic (Bax *et al*, in prep), New Zealand's fiord's (Miller *et al*, 2004), and in southern Chile's Patagonian fiord's (Haussermann & Forsterra, 2006).

Errina antarctica is distributed throughout Patagonia and the peninsula region of Antarctica. Due to the phenomenon of Deep Water Emergence (DWE), common of fiord systems, *E. antarctica* occurs in shallow waters. The extensive abundance (±80% coverage) and maximum colony size (40 cm) is exceptionally high compared to cold-water coral accumulations elsewhere.

The closely related Antarctic *Errina* corals; *E. fissurata*, *E. laterorifa and E. gracilis* are considered circum-Antarctic, and often occur in sympatry (Cairns, 1983), in dense field-like aggregations (Bax & Miller, *in prep*), at depths greater then 450m (Post *et al*, 2010). Sampling in Antarctica is extremely challenging, sample sizes and experimental design are often less than ideal as a result. Hence, the shallow coral fields of the Patagonian fiords provide the unique opportunity to gain in-sight into the dispersal capacity of corals in more inaccessible ecosystems such as sea-mount and submarine ridges in Antarctica.

Hypothesis: Local scale isolation is expected based on the evidence to date:

Haussermann & Forsterra (2006): discovered reef-like populations of *E. antarctica* isolated to the Isla Madre de Dios area of Chilean Patagonia, with ±80% coverage across a 10,000m² area. Post *et al* (2010) documented similar reef-like abundance of *Errina* spp. coral in the Dumont d'Urville Sea, Antarctica. Genetic studies on *E. fissurata* from this region suggest that both large scale (> 2000km) ocean expanses and local scale (10- 73km) seas act as effective barriers to gene flow (Bax, 2009). These findings agree with *Errina* spp. Reproduction (self-recruiting brooders e.g. *E. novaezealandiae* (Stratford in Batson, 2002).

Methods: In February 2012 an expedition was launched to Isla Madre de Dios in Chilean Patagonia (Fig. 3). The aim of this expedition was to record, sample and ecologically assess *E. antarctica* fields in the Southern fiord region. Remote Operated Vehicle (ROV) (Fig. 1) and SCUBA (Fig. 2) were utilised to document, and collect *E. antarctica* colonies across varying depths in combination with environmental variables. Colonies were collected as shallow as 8m by SCUBA, and recorded to a maximum depth of 105m by the ROV, indicating a eurybathic distribution. The sampling latitude extended southward from 48 – 55◦ (Fig.3). Within this sampling range eight fiords were chosen, where possible 30 individual colonies were sampled per site, to increase statistical accuracy.

Results and Discussion: Of the 15 sample sites , only three had a sufficient number of *E. antarctica* colonies to be considered reef-like (±80% coverage); Isla Solar, Canal Guadalupe and Angostura (Fig 3. indicated by blue arrows). These sites were all vertical walls of *E. antarctica* in high abundance from 17m-25m in areas of strong current, with ample rocky substrate for larval attachment, suggesting that suitable habitat and nutrient availability are essential to colonisation success.

ROV and SCUBA surveys were conducted at four sites near Isla Madre de Dios, *E. antarctica* was only found at one site - Canal Copihue. Although, *E. antarctica* was evident, the field-like abundance described by Haussermann and Forsterra (2006), was no longer present. The most likely reason is collection for trade (Gunter Forsterra, *pers com*). This observation highlights the need for effective conservation management in the region.

Conservation management implications:
Cold-water corals are especially sensitive to the impending threat of climate change, the burgeoning demand of trawl fisheries, and coral trade. Corals possess vulnerable life history characteristics (e.g. slow growing, late to mature, long lived), their skeletal structure is extremely fragile and easily damaged by destructive fishing gear.

E. antarctica corals form dense aggregations, in isolated regions, with potentially no connectivity. Therefore, their ability to recover following disturbance is limited. Populations with low connectivity tend to enhance local protection through self recruitment and are, thus, more vulnerable to extinction. In contrast, populations with high larval dispersal and connectivity are more resilient to extinction and open to recruitment subsidies from neighbouring populations. Therefore, knowledge on the level of connectivity is vital to inform conservation managers, and aid in the development of effective Marine Protected Areas.

Future studies will focus on the population genetic structure of *E. antarctica* populations within and between fiord regions to evaluate connectivity on a local scale (~100m – 10km), and on a broad scale (>10 – 1000kms) linking Antarctic populations. Genetic, geographic and ecological data will be combined to better understand these important ecosystems and effectively conserve them.

Figure 1: Remote Operated Vehicle (ROV) V8 Sii from the Alfred Wagner Institute took video transect footage at each fiord sample site and recorded temperature, salinity, light, pH, O2, chlorophyll and fluoride. Samples from deep locations (35-105m) were collected if possible. Photo credit: Mathias Hune.

Figure 2: SCUBA divers collected a small portion (~1cm) of 30 individual colonies at each fiord sample site and recorded the depth at the time of collection. Photo credit: Mathias Hune.

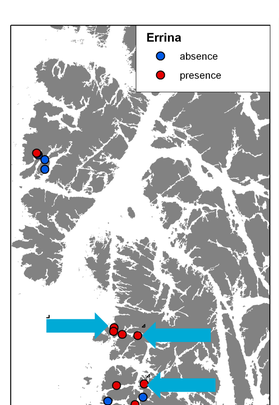

Figure 3: A) 15 Sampling sites, and presence/absence of *E. antarctica* at 8 fiords (from North to South); Canal Copihue, Isla Solar, Canal Elena, Canal Guadalupe, Passage de los Currentes, Angostura, Carmona and Grupo Dacres. The highest abundance was found at 17-25m across sites, however *E. antarctica* was found at 8-11m at *Canal Copihue* and *Angostura*. The highest abundance of *E. antarctica* colonies was at Isla Solar. Map credit: Laura Fillinger B) Wall of E. antarctica coral at 18m at Isla Solar. Photo credit: Mathias Hune C) Map of study sites in the central Patagonian zone from Haussermann & Forsterra (2006). Study sites: C1-C14 (2005) and D1-D19 (2006). *Quadrats*: study sites without stylasterids; *triangles*: squares designate study sites where *Errina antarctica* was reported.

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