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Seasonal growth of the cold-water coral *Desmophyllum dianthus* along an *in situ* aragonite saturation gradient

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Cold-water corals (CWC) are considered especially vulnerable…

…to ocean acidification(1) but *in situ* studies on the response of CWC to low aragonite saturation (Ω_{ar}) are still scarce. Comau Fjord in northern Patagonia (Chile) is naturally stratified with vertical and horizontal pH gradients and harbours high densities of the cosmopolitan CWC *Desmophyllum dianthus* at $\Omega_{ar} \leq 1$(2,3). Previous studies revealed high growth rates of *D. dianthus* in summer(4) but it is unknown if skeletal growth shows seasonal fluctuations due to changes in Ω_{ar} and/or food supply.

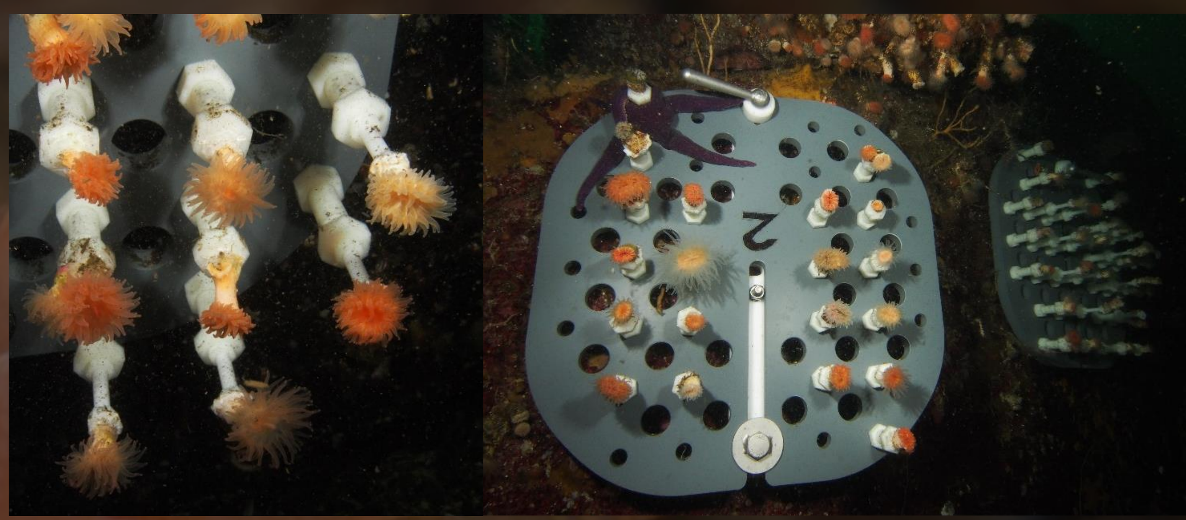

Figure 1: *D. dianthus* corals glued on plastic screws and attached to holders to re-transplant them in their natural orientation on the fjord wall.

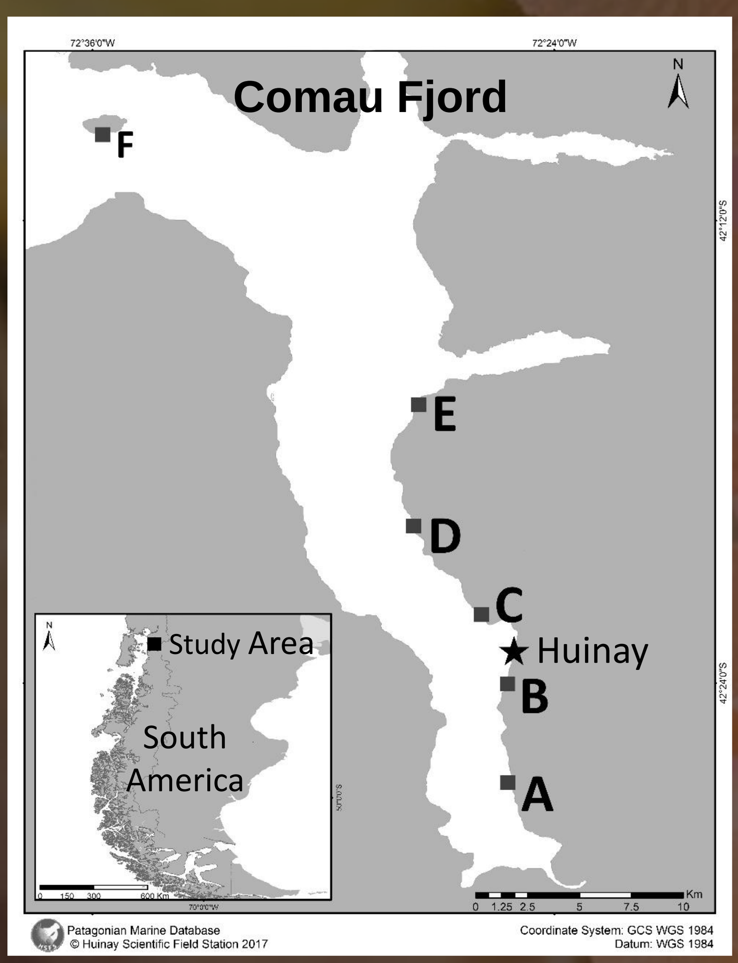

Figure 2: Study sites (A-F) of corals and water samples

Desmophyllum dianthus' growth and linear extension rates…

…(buoyant weight technique(5); calcein staining and fluorescent microscopy, Fig. 3) were compared with the physico-chemical conditions in the water column (T, Ω_{ar}) in austral summer 2016/17 and winter 2017. Water samples were collected near corals with a CTD rosette at six stations in 20m depth between the fjord's head and its mouth (Fig. 2) and analysed for TA, DIC and temperature, from which pH_T, Ω_{ar} and pCO_2 was calculated(6).

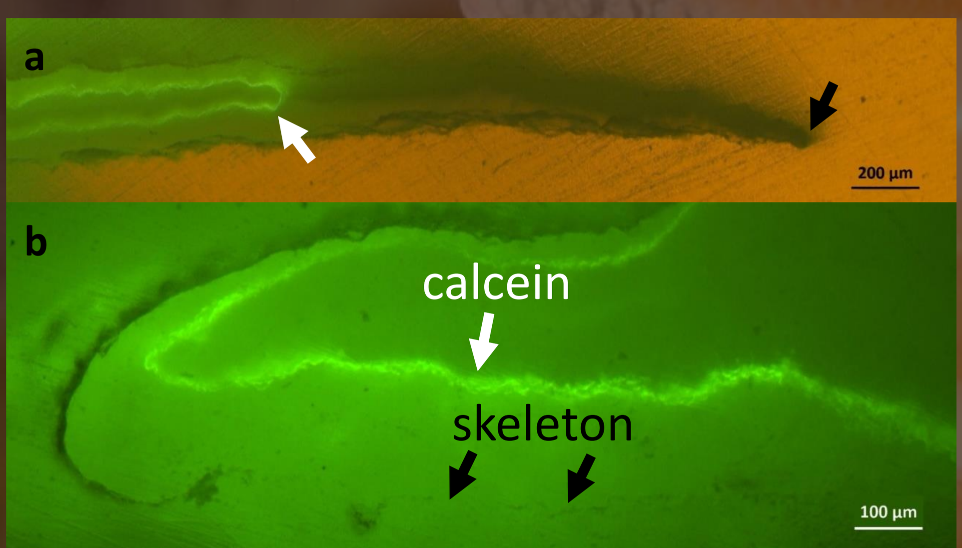

Figure 3: Calcein staining line in skeleton of *D. dianthus* after four months of growth (09/16 – 01/17); longitudinal sections of (a) septal and (b) apical and lateral (outward) extension of calyx.

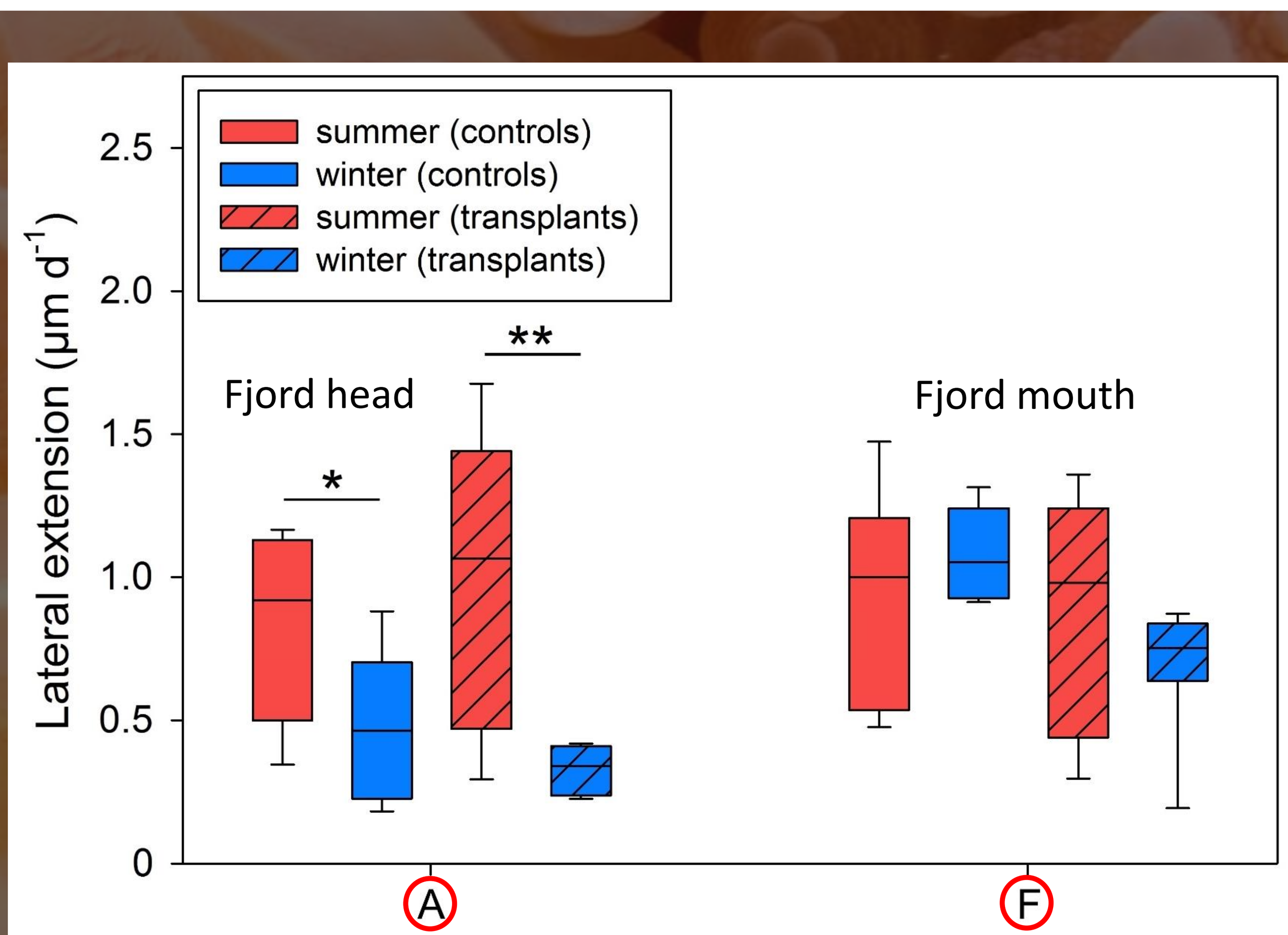

Figure 4: Lateral extension rates (fluorescent microscopy) of *D. dianthus* determined at head (A) and mouth (F) of Comau Fjord, cross-transplants between the two stations shown in striped boxes. Apical extension rates of septa and calyx did not reveal seasonal differences (not shown); N = 6-8; * $p < 0.05$, ** $p < 0.01$ (t-tests).

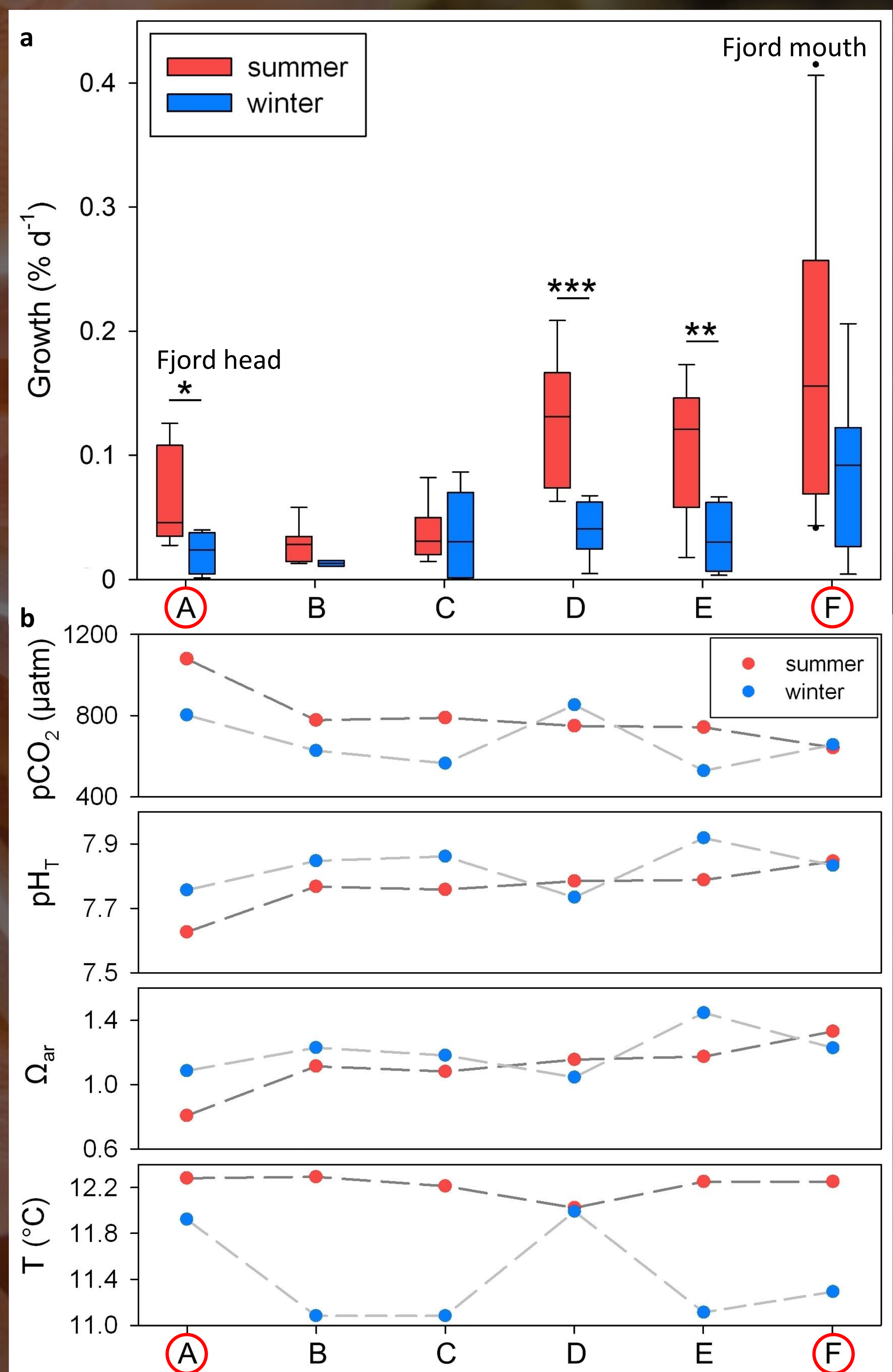

Figure 5: a) Seasonal growth (buoyant weight) of *D. dianthus* in summer ● = 09/16 – 01/17 and winter ● = 05/17 – 08/17; N = 5-10 (station B winter N = 2); * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (t-tests). b) Carbonate chemistry of Comau Fjord, calculated from total alkalinity (TA) and dissolved inorganic carbon (DIC) at stations A-F using CO2sys(6).

Growth rates of *D. dianthus* were reduced in winter…

…when water temperatures were up to 1.2 °C lower, although Ω_{ar} increased at most stations (Fig. 5).

- Undersaturation in summer ($\Omega_{ar} = 0.81$) at head of the fjord (station A) → growth rates were still higher in summer than in winter (Fig. 5a)
- Both coral controls and transplants showed seasonal differences in lateral growth of the calyx at station A (Fig. 4)
- Horizontal pH gradient in 20m water depth in austral summer and winter; summer values generally 0.1 units lower (Fig. 5b)
- Reproduction of *D. dianthus* takes place in August(7) leading to reduced growth in winter as less energy is available for growth
- Food supply (plankton availability) is assumed to be better in summer → may further explain striking difference in growth performances between summer and winter

Literature

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[7] Rhian Waller, personal communication.

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