10.7

Growth and respiration of the scleractinian cold-water coral *Tethocyathus endesa*

[YOUMARES | 6]
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A journey into the blue - Ocean research and innovation
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ALFRED-WEGENER-INSTITUT
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endesa chile
PONTIFICIA UNIVERSIDAD CATOLICA DE VALPARAISO
fundación san ignacio del huinay

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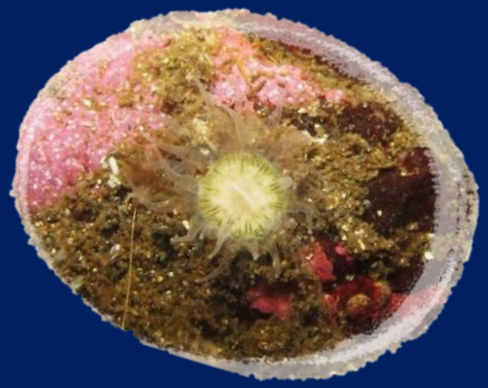
Cold-water corals

- Also ‘Deep-sea corals‘, occur usually in waters between 200m and 1500m (Freiwald *et al.,* 2004)

- > 50% of the approximately 5100 recent corals (Roberts *et al.,* 2009)



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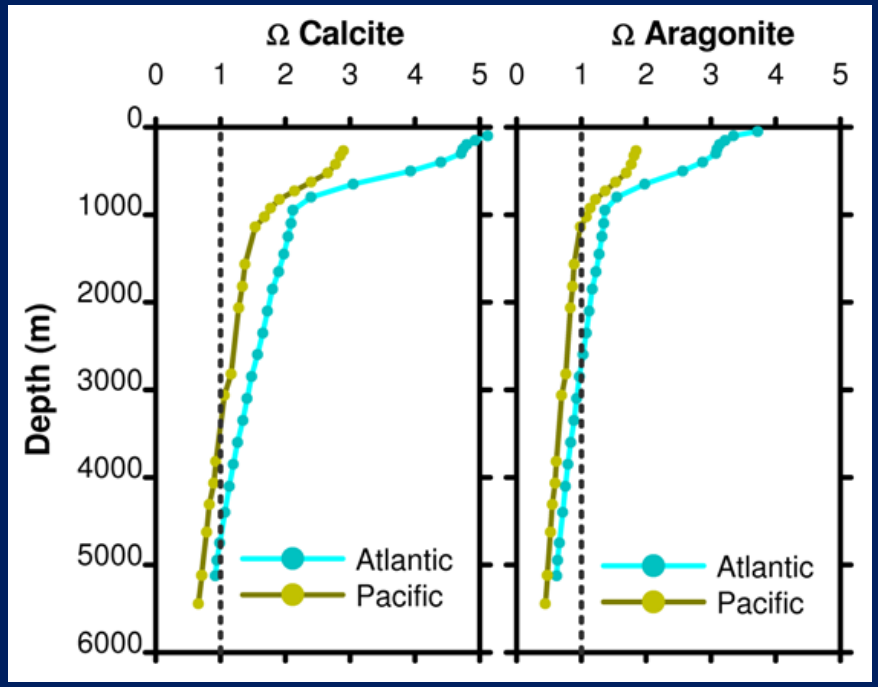
Cold-water corals

- are long living
- slow growing
- fragile, which makes them especially vulnerable to physical damage

Cold-water corals

- > 70% of CCW live in regions that will be undersaturated with respect to aragonite by the end of the century (Maier *et al.* 2013)



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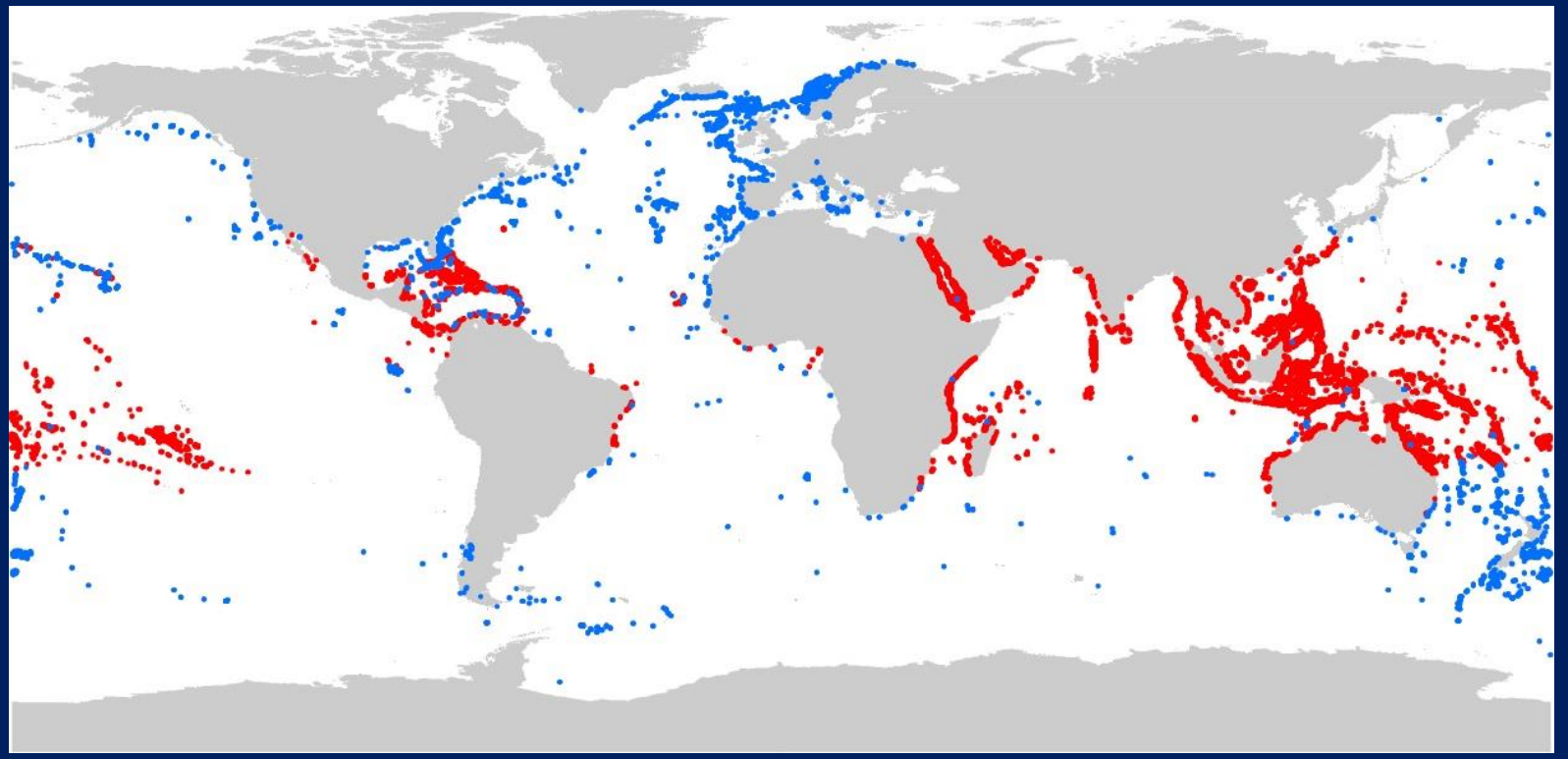
Distribution of cold-water corals



- Warm – water corals
- Cold – water corals

Data: Pörtner *et al.* 2014, IPCC 2014
Map: Laura Fillinger

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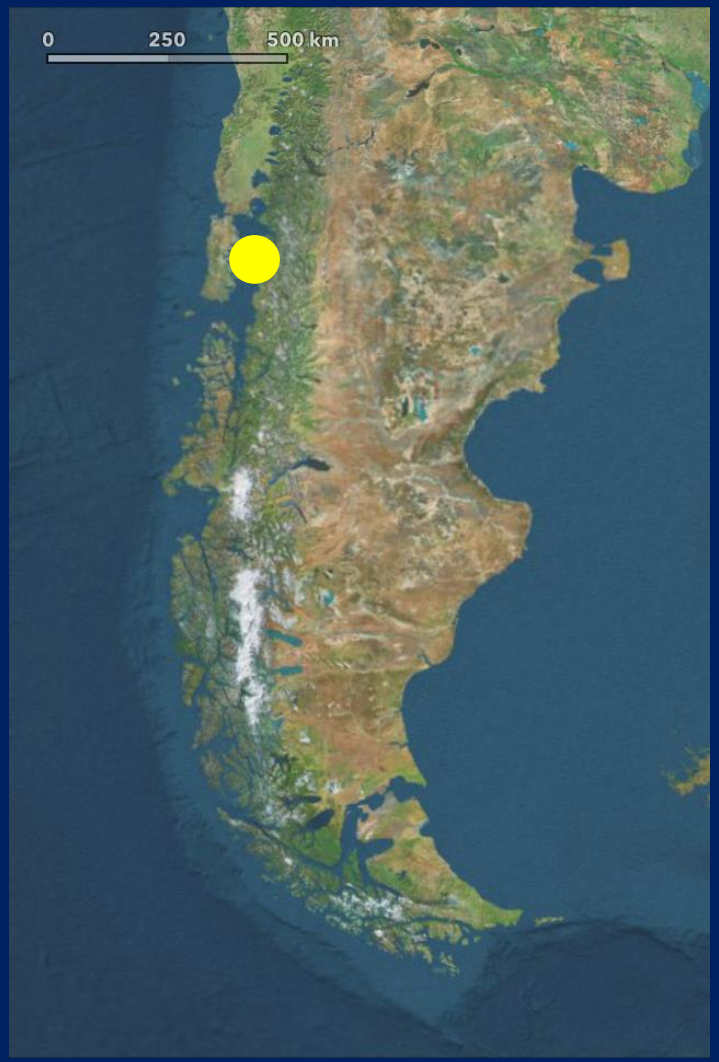
Comau fjord



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Tides at Comau fjord

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Comau fjord

Sampling stations:

High pH

pH: 7.87 ± 0.06

Low pH

pH: 7.67 ± 0.05

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Tethocyathus endesa

- Recently discovered (Cairns, Häussermann, Försterra, 2005)
- Solitary scleractinian
- Cold-water coral: ~ 12°C

Upper distribution: ~ 15m

Low: not examined yet

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Material and Methods

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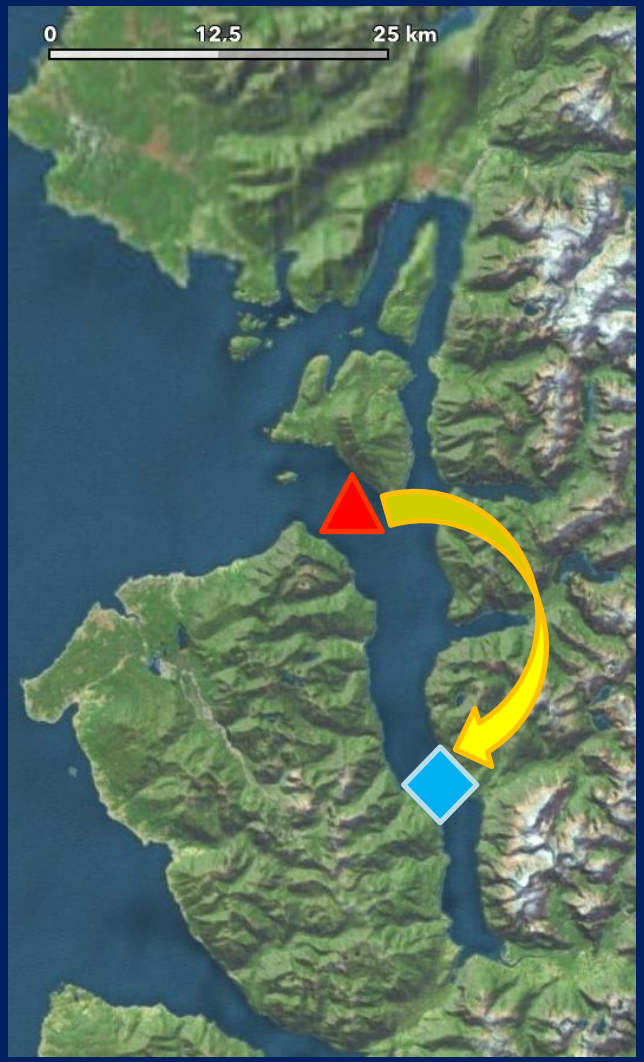
Cross-transplantation experiment

Control group:

10 corals at **high pH** location

10 corals at **low pH** location

Cross-transplantation experiment



Transplanted corals:

10 corals from **high pH** –

transplanted to **low pH**

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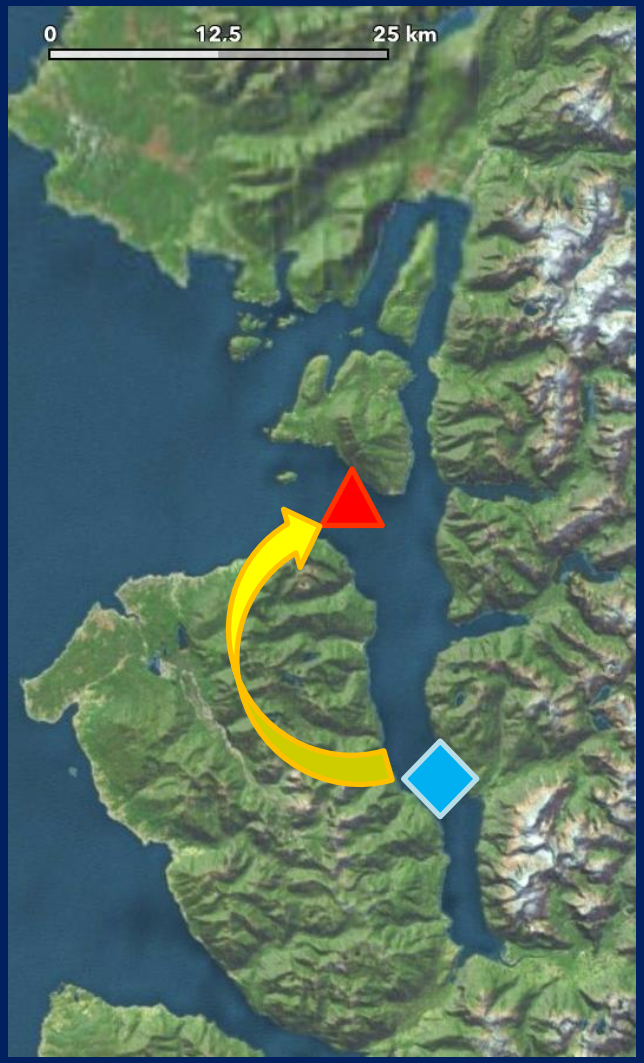
Cross-transplantation experiment



Transplanted corals:

10 corals from **high pH** – transplanted to **low pH**

10 corals from **low pH** – transplanted to **high pH**

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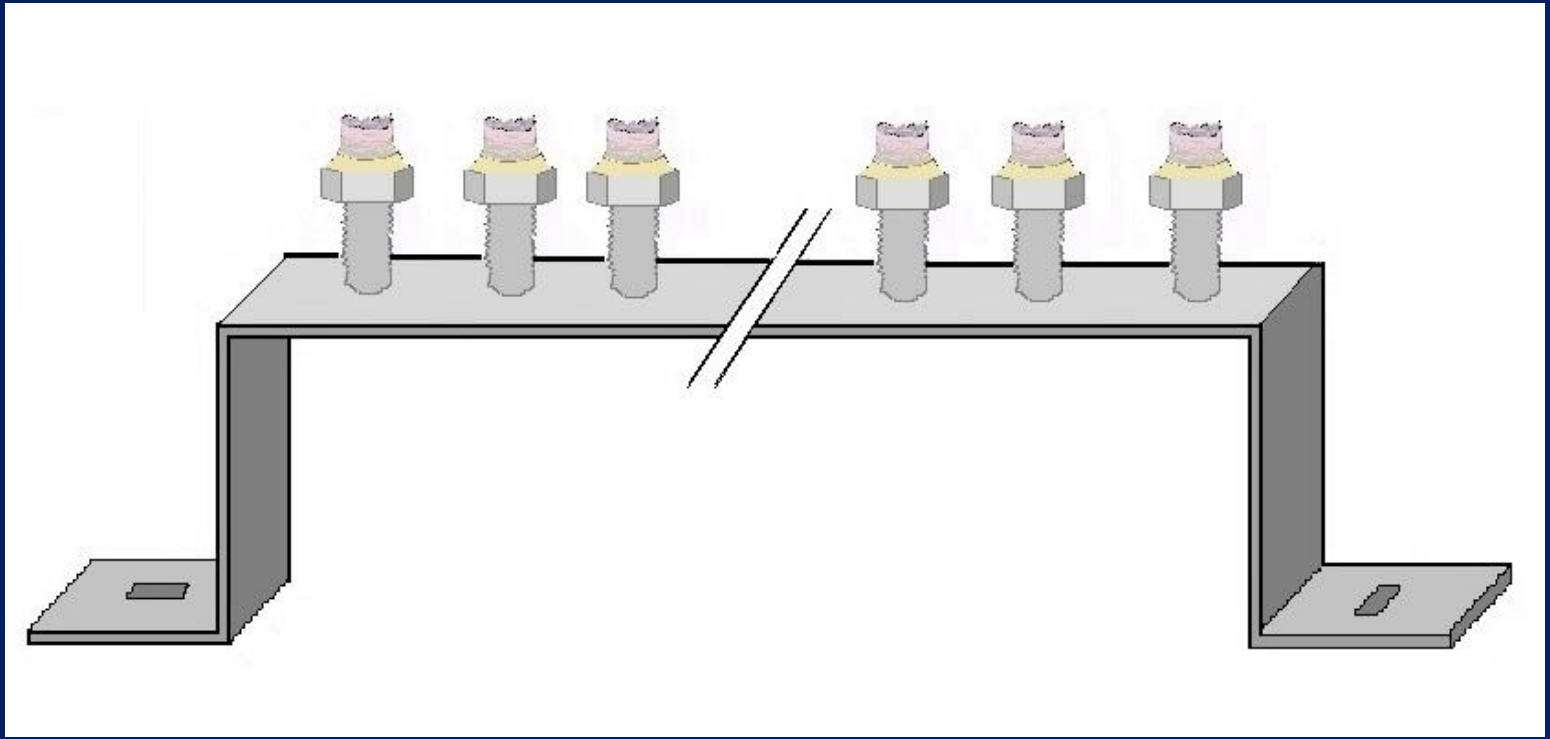
Setup

Corals holders at both stations:

- 20m depth
- 10 corals per coral holder



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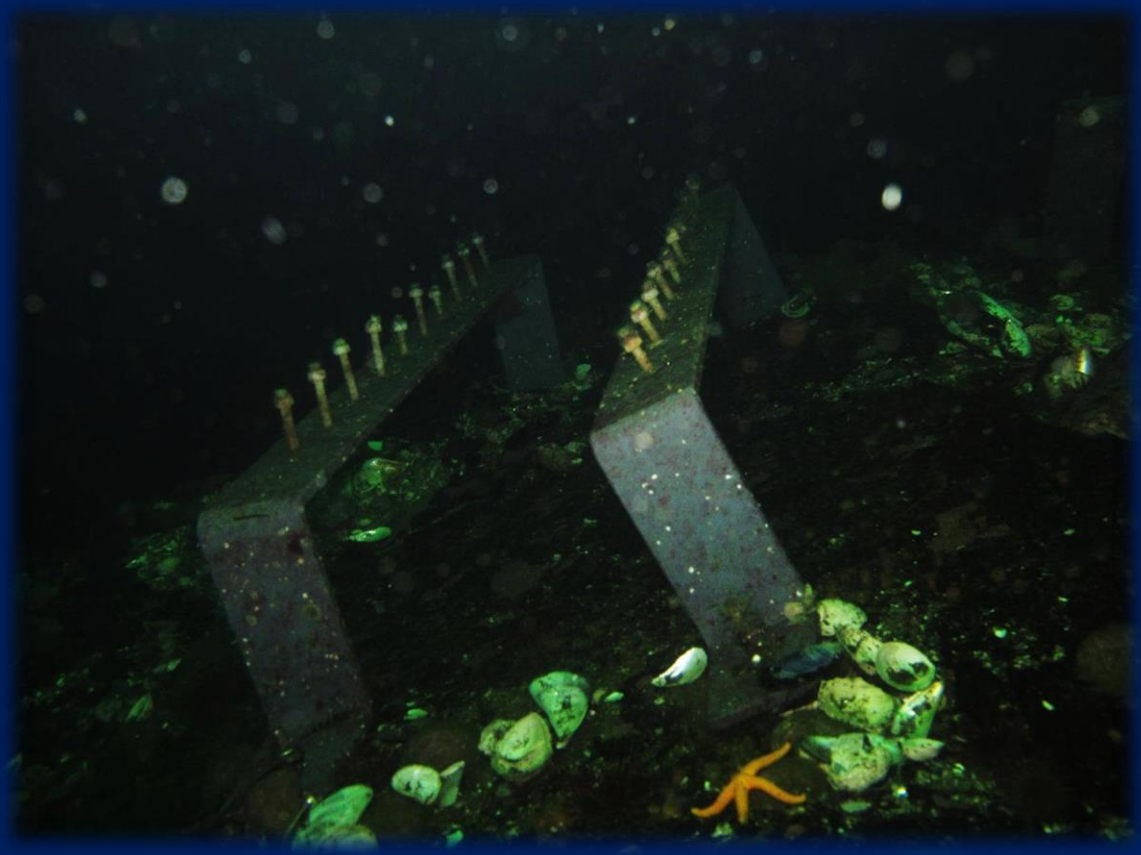
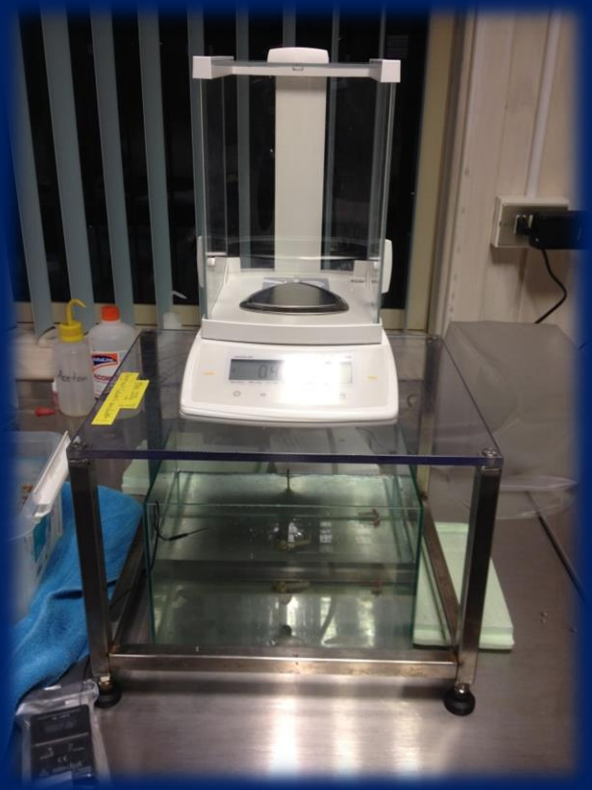
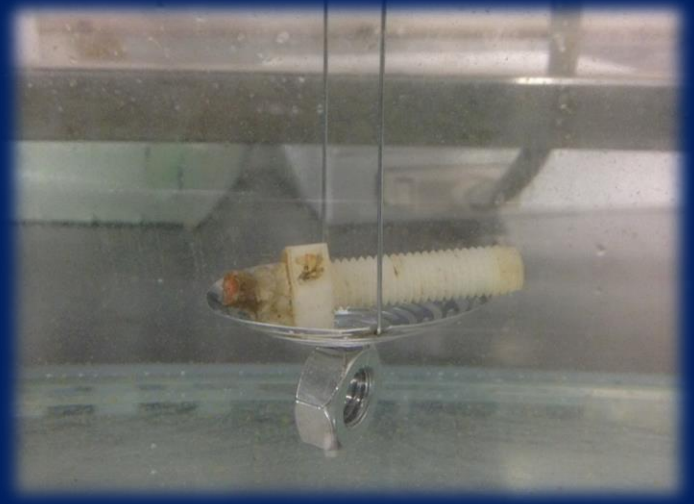
Setup



Buoyant - weighing



Archimedes' principle – theory



$$wt_{air} = wt_{water} / (1 - (\rho_{water} / \rho_{aragonite}))$$

After Davies, 1989

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Respiration rates

- ***in situ*** effects of low Seawater pH measured as ***in vitro*** respiration rates.

Increased respiration rates are an indicator for stress (Telesnicki *et al.*, 1995) **!!**

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Respiration rates

Manually method:

- Dark incubation
- Magnetic stirrer
- 12h

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Respiration rates

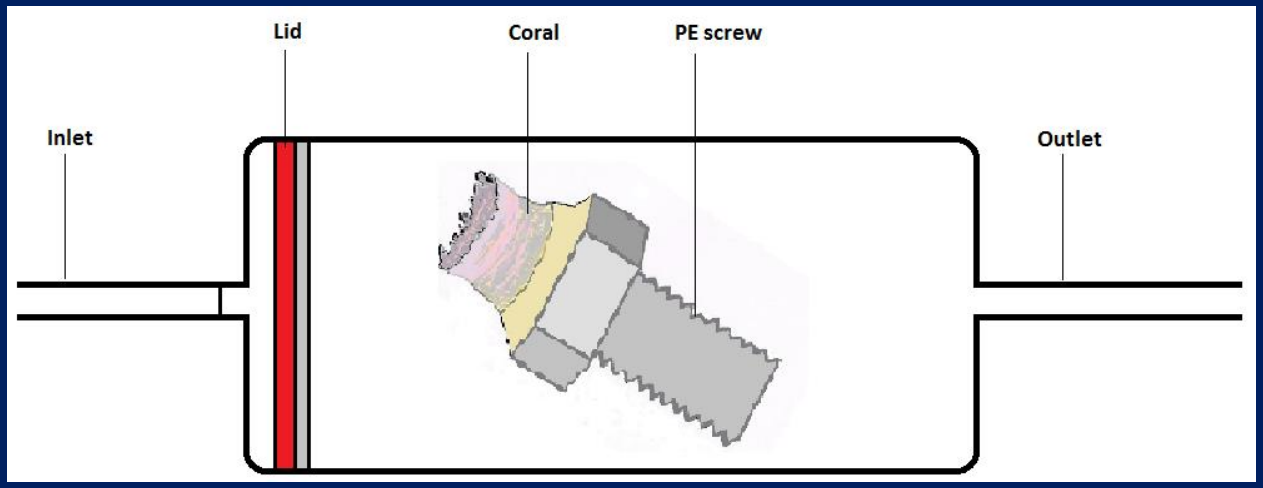
Manually method:

- handheld Luminescent/Optical Dissolved Oxygen Probe
- + one blank for bacterical background respiration

Respiration rates

Automatically method:

- Respiration chambers with flow-through system
- 12h dark – incubation
- Constant data logging



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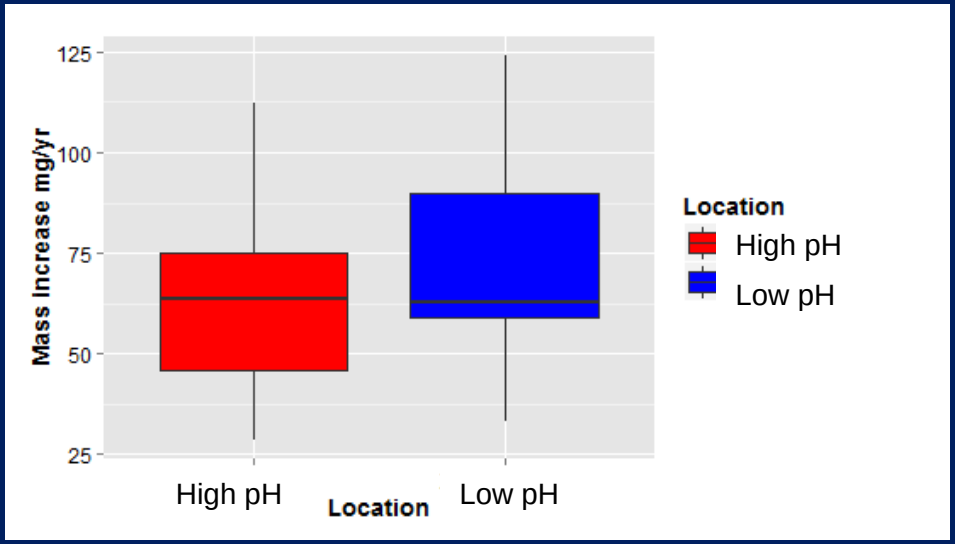
Results and Discussion

Mass increase

Controls:

High pH : 65.11 ± 25.23 mg y^{-1} (0.03 ± 0.01 $\%d^{-1}$)

Low pH : 73.55 ± 26.71 mg y^{-1} (0.03 ± 0.01 $\%d^{-1}$)



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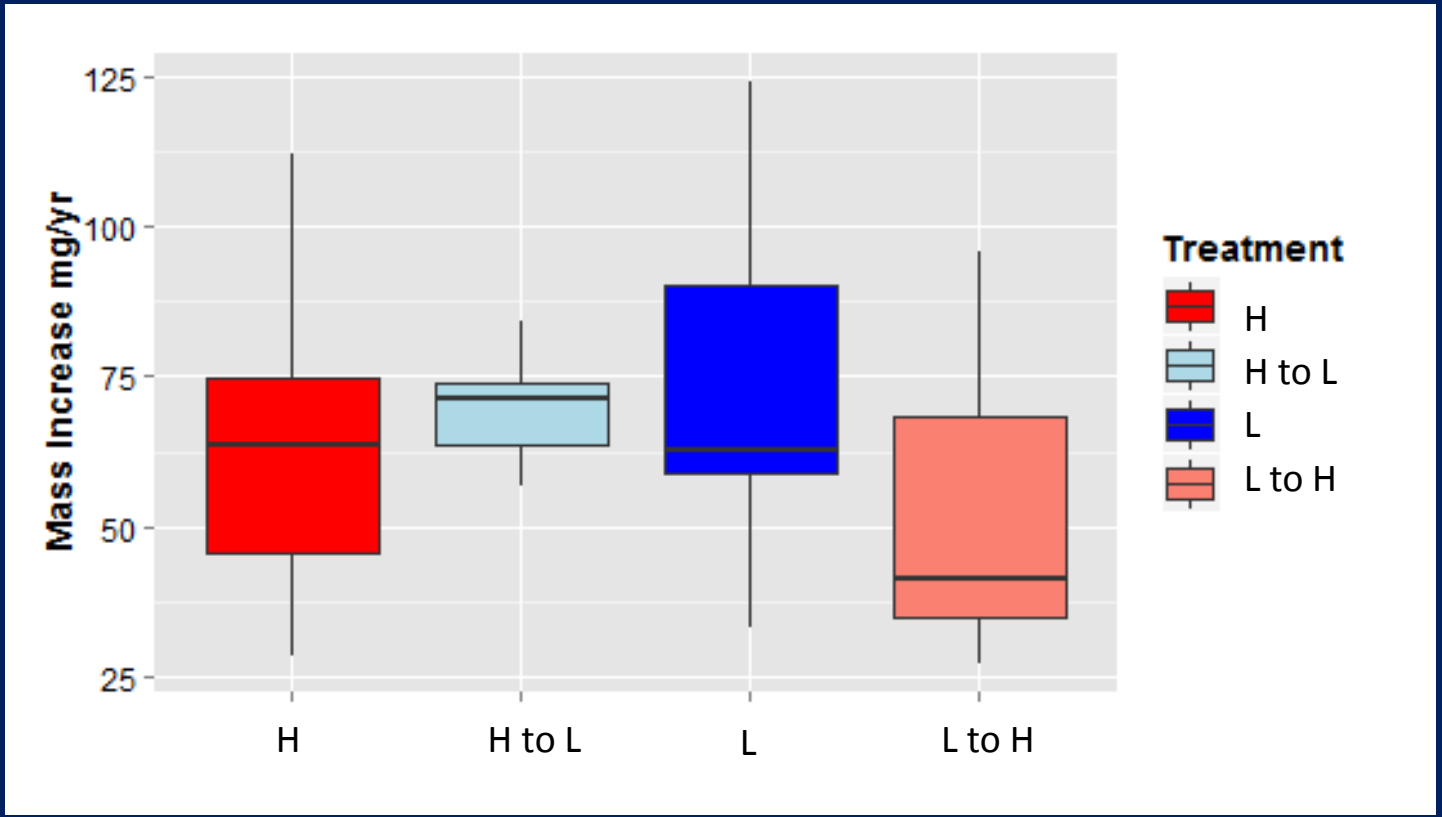
Mass increase



Mass increase

T.endesa in situ longterm mass increase:

0.03 ± 0.01 %d^{-1} (69.33 ± 25.72 mg y^{-1})

- *Caryophyllia huinayensis* (Wurz, 2014):
  0.06 ± 0.04 %d^{-1}
- *Desmophyllum dianthus* (Orejas *et al.,* 2011b):
  0.04 ± 0.02 %d^{-1}
- *Dendrophyllia cornigera* (Orejas *et al.,* 2011b):
  0.04 ± 0.02 %d^{-1}

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Mass increase

- one of first studies on *in situ* growth rates of CCW

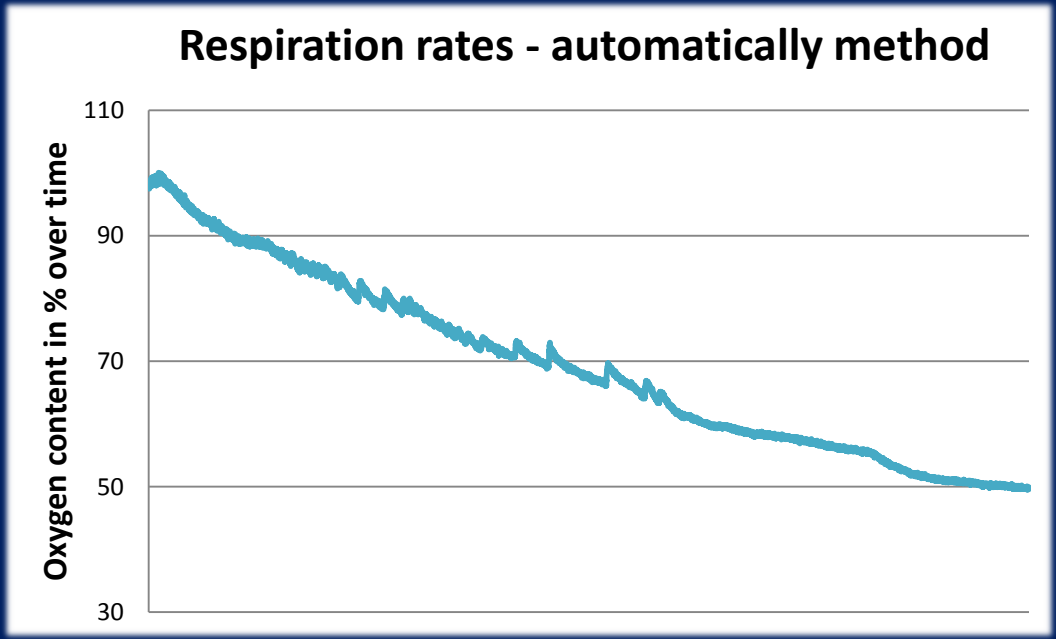
- **No significant difference** in growth rates between cross-transplanted corals of the central part of the fjord (pH 7.66) and of mouth of the fjord (7.87)

Indication for the adaptability of *T.endesa*

Respiration rates

Comparison of manually and automatically method:

- comparable values
- **Δ O_2Start – O_2End**



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Respiration rates

Comparison of manually and automatically method:

- comparable values
- **Δ O_2Start – O_2End**

Manually method is valid and much easier to implement, especially at field expeditions!

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Respiration rates – *T.endesa*

Control groups:

low pH: 7.16 ± 4.23 µMol O_2 x cm^2 x d^{-1}

High pH: 8.05 ± 2.93 µMol O_2 x cm^2 x d^{-1}

Transplants:

High to **low** pH: 9.88 ± 4.52 µMol O_2 x cm^2 x d^{-1}

Respiration rates

T.endesa	**High** to **low**	+22%
C.huinayensis	**High** vs. **low**	+144%

Indication for the adaptability of *T.endesa*

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Conclusion

Tethocyathus endesa, has the potential to colonize habitats:

- that are influenced by daily and seasonally fluctuations

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Tethocyathus endesa, has the potential to colonize habitats:

- that are influenced by daily and seasonally fluctuations
- that are foreseen to undergo more severe changes in the future

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Conclusion

T.endesa is capable to maintain its ability of calcification and stays physiologically potent in the acidified waters of Chilean fjords.

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- Fieldtrip Team Patagonia 2014 and 2015

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THANK YOU FOR THE ATTENTION!

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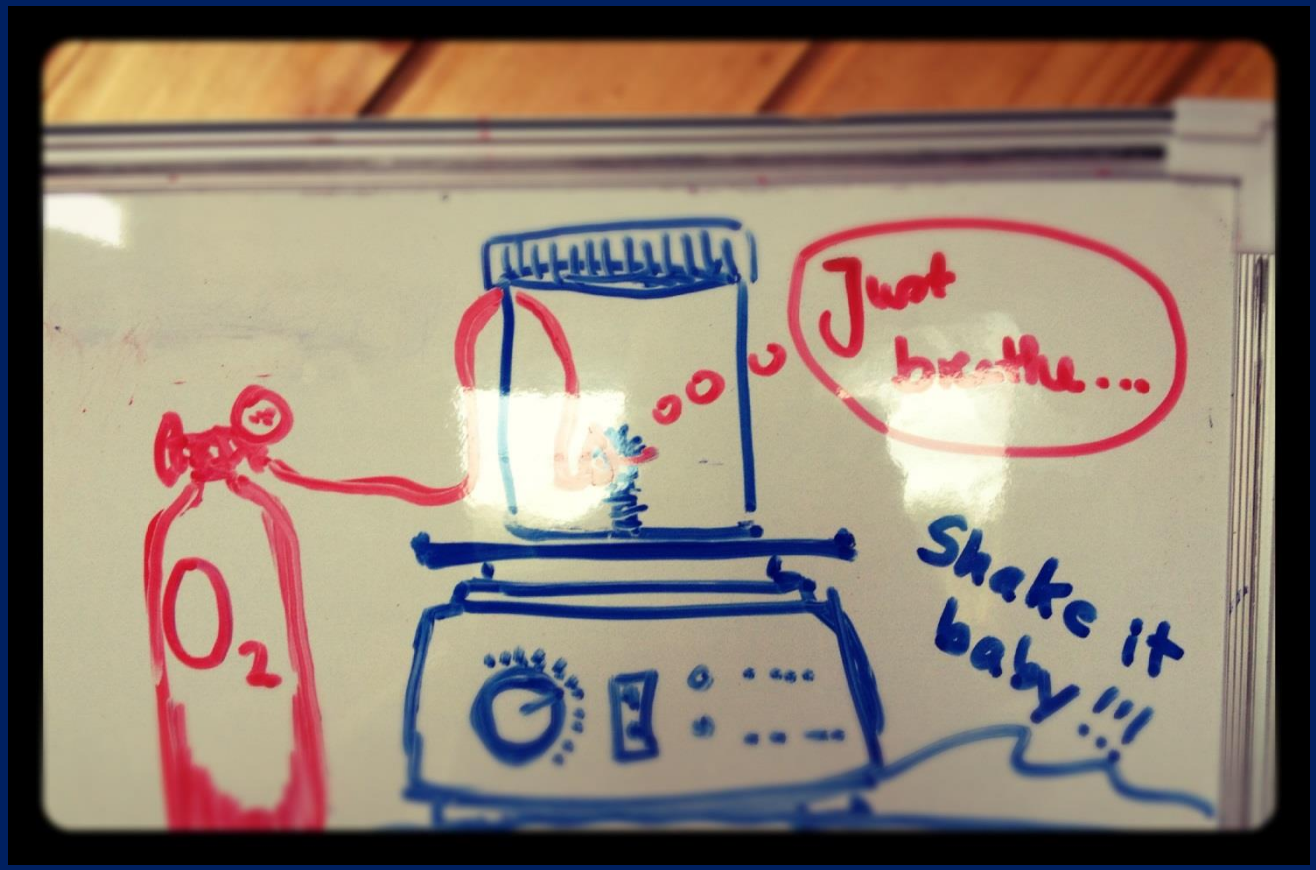

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Respiration rates

Treatment	RR [µMol O_2 x cm^2 x d^{-1}]	
	Manually	Automatically
High pH	9.20 ± 2.53	5.712 ± 2.148
High to Low pH	10.57 ± 4.10	6.793 ± 6.799
Low pH	8.23 ± 4.32	5.239 ± 3.666
Low to High pH	7.24 ± 0.74	8.916 ± 1.844

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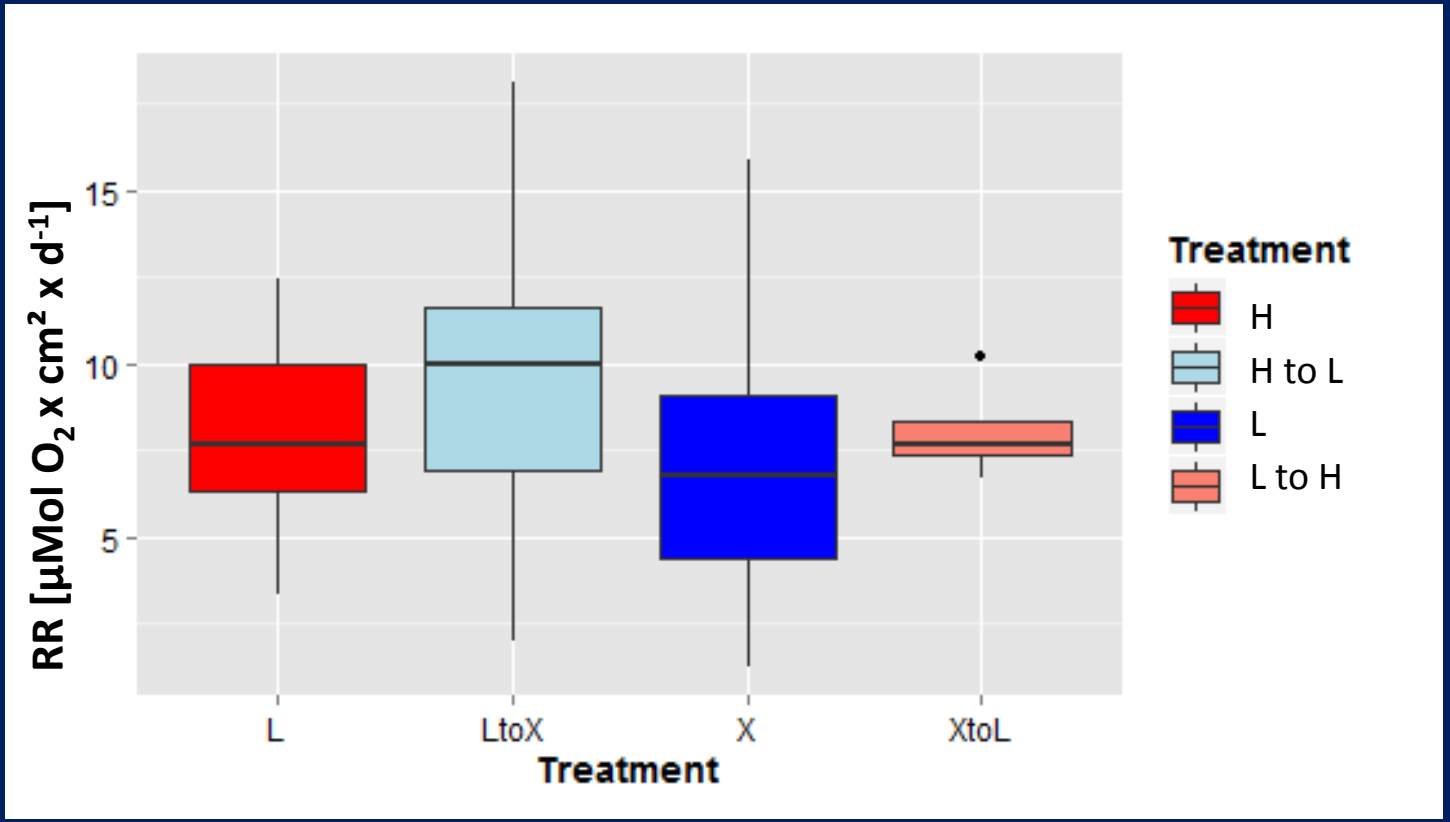
Respiration rates



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Respiration rates

	pH	RR [µMol O_2 x cm^2 x d^{-1}]
T.endesa	7.87	8.05 ± 2.93
C.huinayensis	7.8	3.69 ± 0.80
T.endesa	7.66	7.16 ± 4.23
C.huinayensis	7.6	7.24 ± 1.74