Climate Change, UV & Oil

A hot and sticky mess for corals?

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Aims

- Test the combined impacts of temperature & UV light on heavy fuel oil toxicity to coral larvae
- Determine settlement EC50 for *Acropora millepora* under different temperature & light conditions
- Assess potential interactions between temperature & light on toxicity

Background

- Information on corals' oil sensitivity remains limited[1,2]
- Coral reefs under pressure from global & local stressors[3]
- Shipping set to continue to increase[4]
- UV light ubiquitous on reefs & increases oil toxicity[5,6,7]
- Global average temperature will continue to increase[3] & may affect oil toxicity[8]

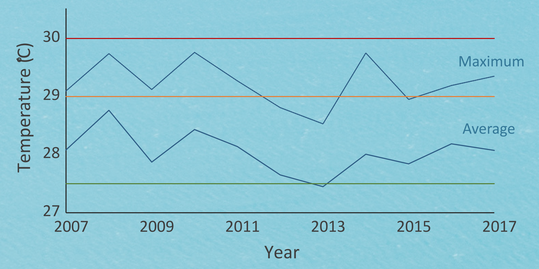

Figure 1. Average (solid line) and maximum (broken line) December water temperatures at Davies Reef, central Great Barrier Reef, between 2007-2017. Data source[9].

Methods

- *A. millepora* planula larvae from the Great Barrier Reef
- 48 h exposure
- Water soluble fractions (WSF) of an Australian heavy fuel oil
- Ecologically relevant light[5] & temperature[9] conditions

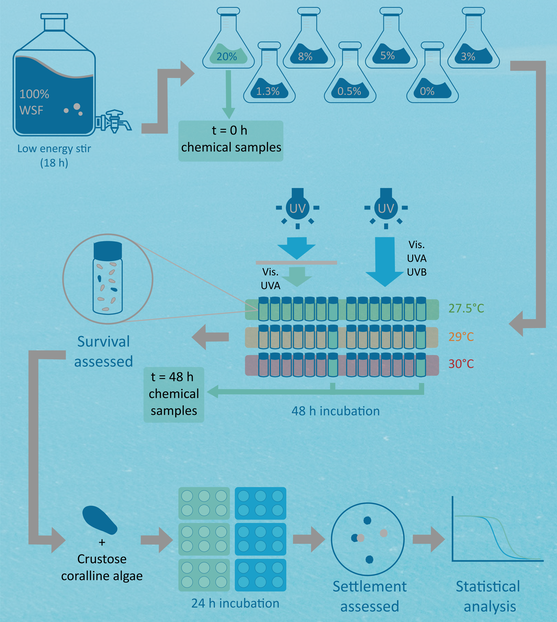

Figure 2. Experimental procedure for 48 h exposure of larval *A. millepora* to the water soluble fractions (WSF) of an Australian heavy fuel oil at three treatment temperatures (27.5, 29 or 30 °C) under two light conditions (visible, UVA and UVB or visible & low intensity UVA).

Results

- Larval survival not affected at any concentration tested
- Larval settlement severely impacted > 20 µg TPAH L^{-1}

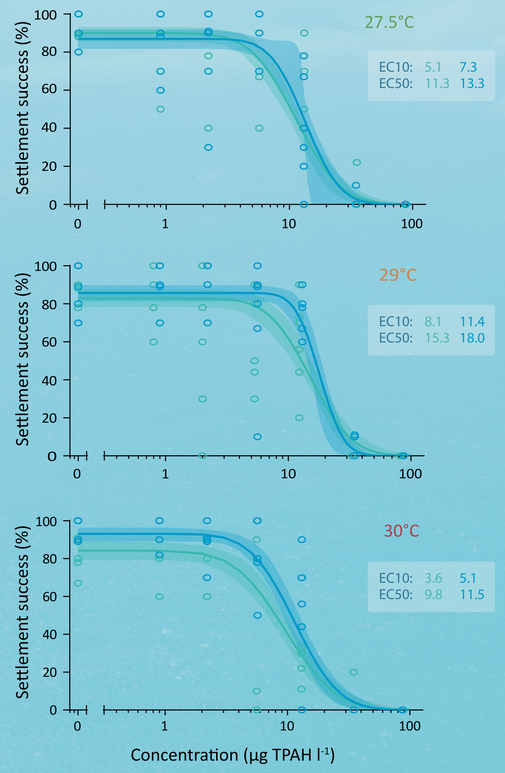

Figure 3. Settlement success of larval *A. millepora* exposed to the water soluble fractions of heavy fuel oil for 48 h at three treatment temperatures (27.5, 29 or 30 °C) under visible light & low intensity UVA (green; <0.05 mW cm^{-2} UVA) or visible light, UVA & UVB (turquoise). All concentrations time averaged total petroleum aromatic hydrocarbons (TPAH) per litre.

Conclusions

- Settlement very sensitive to heavy fuel oil exposure
- Survival not affected at concentrations tested
- Assessing interactions is logistically difficult
- Elevated temperature within this range may decrease phototoxicity

Future directions

- Re-run experiment with wider temperature treatments
- Test potential interactions for adult *A. millepora*
- Validation of predictive oil toxicity models for higher temperatures

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References
[1] Turner & Renegar (2017). Petroleum hydrocarbon toxicity to corals: A review; [2] Nordborg et al. (in review); [3] Hoegh-Guldberg et al. (2018). Chapter 3: Impacts of 1.5C global warming on natural and human systems; [4] PGM Environment (2012). GBR shipping: review of environmental implications; [5] Nordborg et al. (2018). Phototoxic effects of two common marine fuels on the settlement success of the coral *Acropora tenuis*; [6] Negri et al. (2016). Acute ecotoxicology of natural oil and gas condensate to coral reef larvae; [7] Guzman-Martinez et al. (2007). Photoinduced toxicity of the polycyclic aromatic hydrocarbon, fluoranthene, on the coral, *Porites divaricata*; [8] French-MacCay (2002). Development and application of an oil toxicity and exposure model, OilToxEx; [9] AIMS data centre (2019). https://www.aims.gov.au/docs/data-centre/seatemperatures.html.

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