



Ressources Coastal protection
Tourism Biodiversity
Subsistence fisheries
Economy Society
Ecosystems management

Acclimation of Coral Reef Fish as a Response to Global Warming

Timothy Ravasi

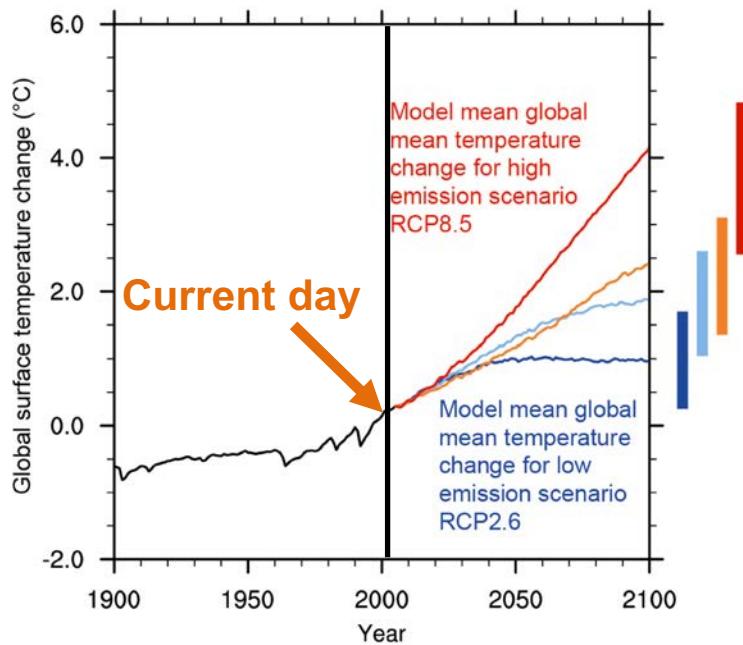
Marine Climate Change Unit

Okinawa Institute of Science and Technology (OIST)

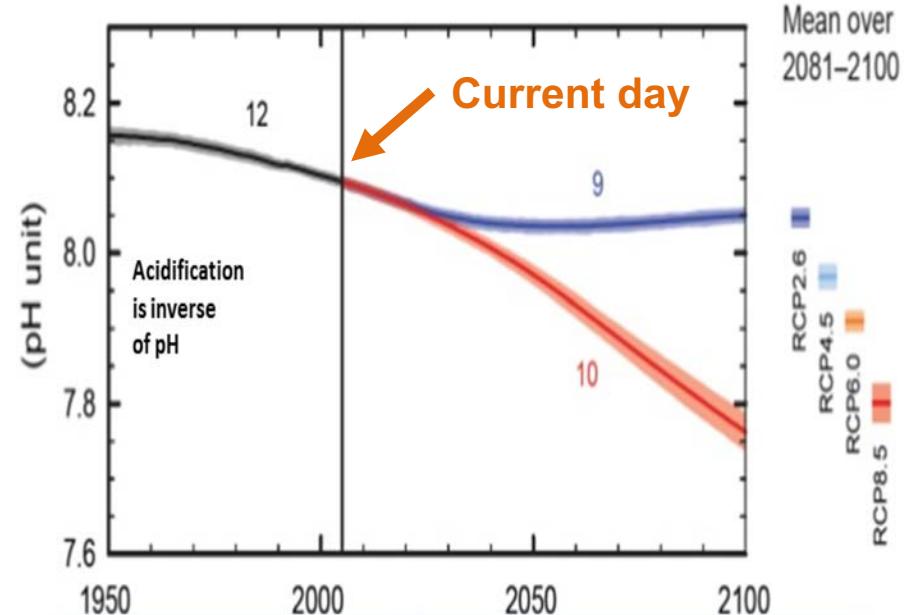


Climate projections in the Anthropocene

Oceans temperature



Oceans pH

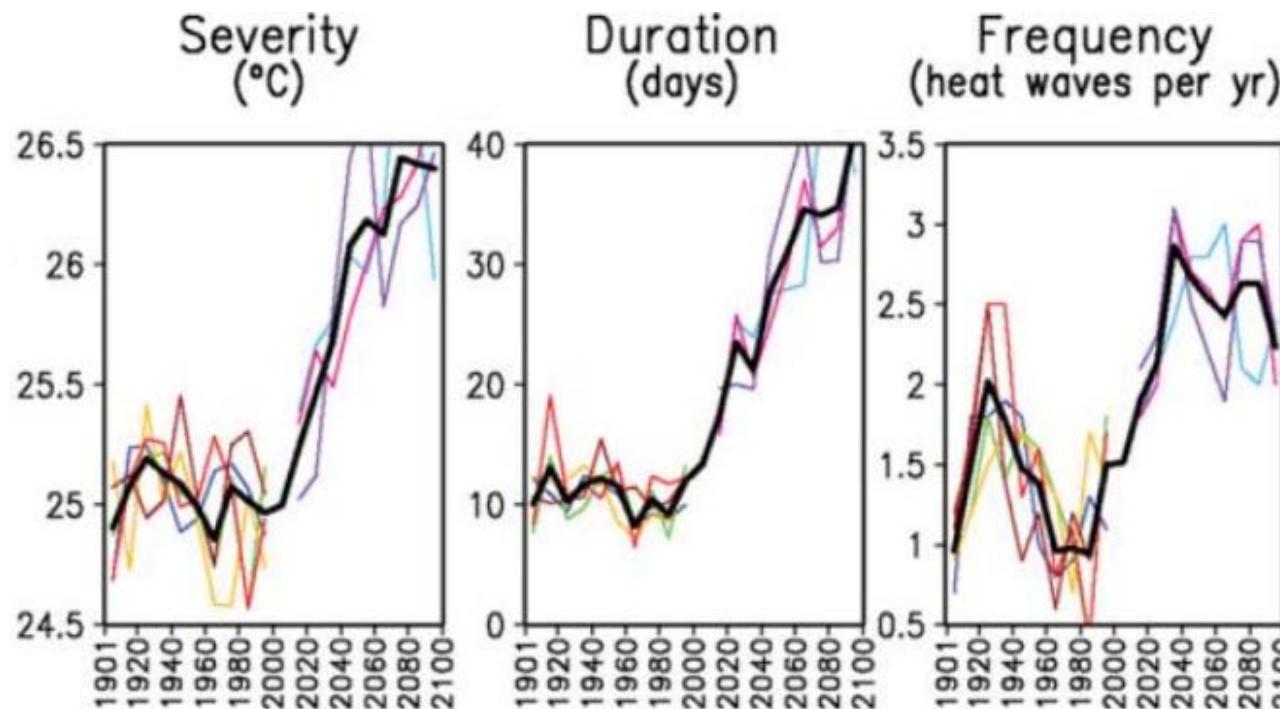


Intergovernmental Panel on Climate Change (IPCC 2019)

RCP= Representative Concentration Pathway



Increasing frequency, intensity and duration of observed global heatwaves



Unfortunately things are adding on!!

Natural disturbances

- Tropical storms
- Outbreaks of a coral predators
- Diseases
- Extended periods of elevated or low water temperatures
- Extremely low tides



Other Anthropogenic influences

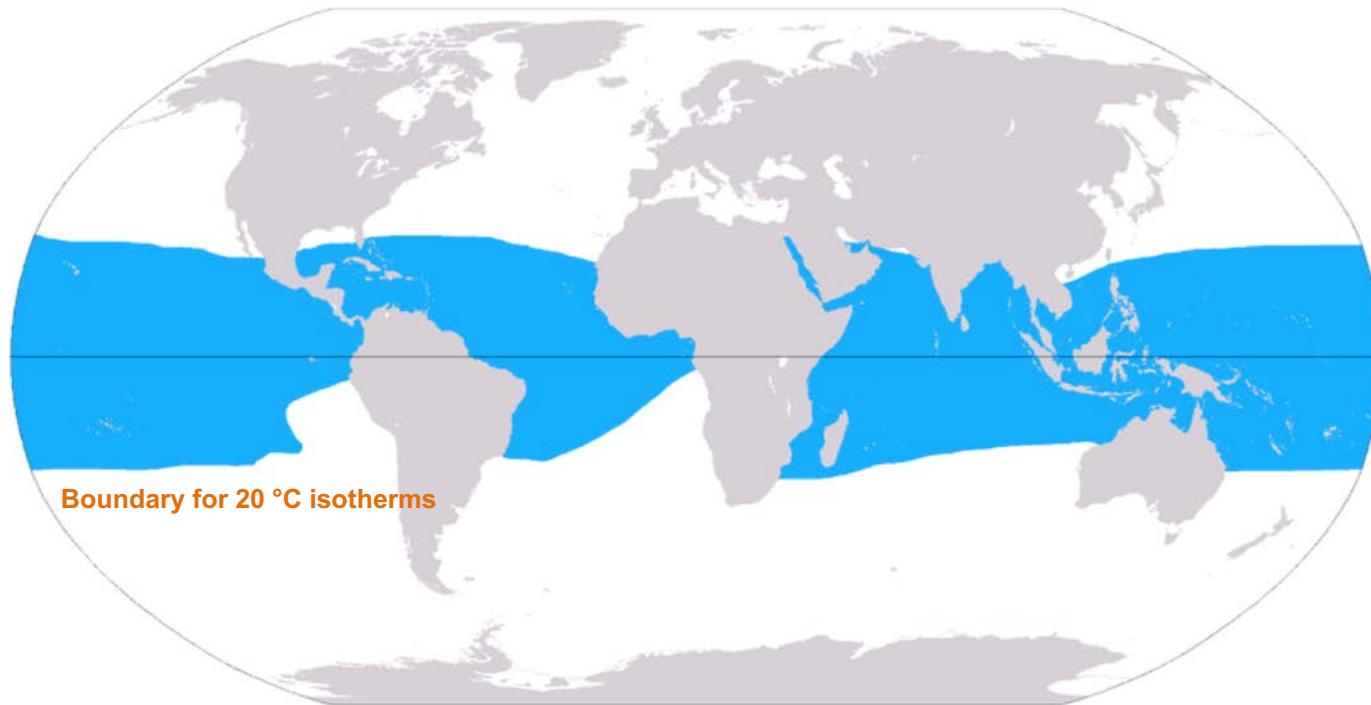
- Overfishing
- Agriculture
(freshwater runoff polluted runoff, sedimentation, and nutrient inputs)
- Urbanization
- Ocean acidification and warming
- Commercial and private vessel traffic mean the possibility of fuel leaks or spills



Coral reefs are particularly sensitive to these changes

Why?

**Reefs are ecosystems adapted to
an extreme environment**



This might have profound socio-economical implications.



In the GBR, tourism generates approximately \$5-6 billion/year.

Japan is home to a \$14 billion/year commercial fishing industry.
Fish supply can dramatically change by the end of the century!



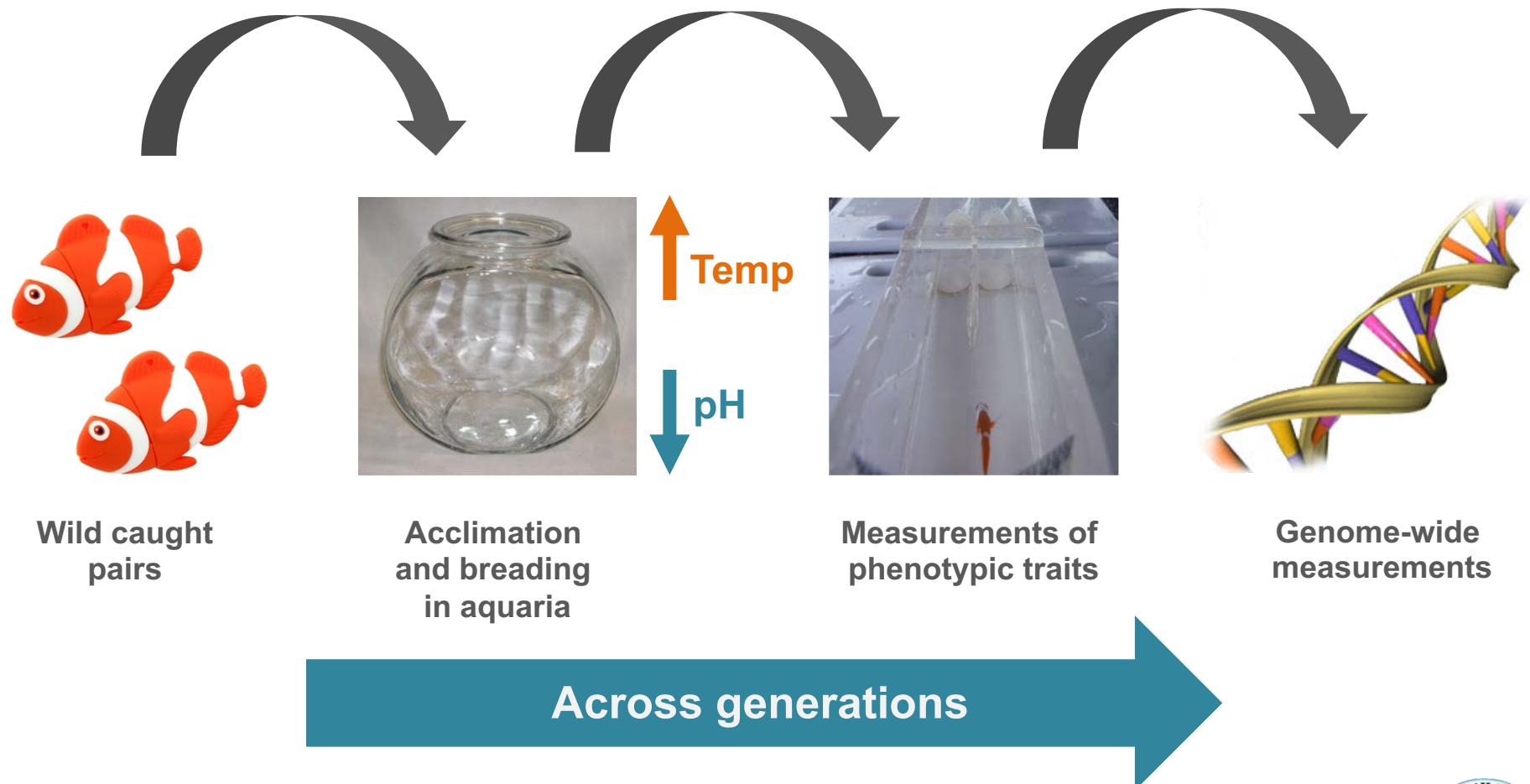
How we study the future?

- 1. By recreating it in the lab**
- 2. By exploring natural analogs of future climate**



A laboratory system to study future climate

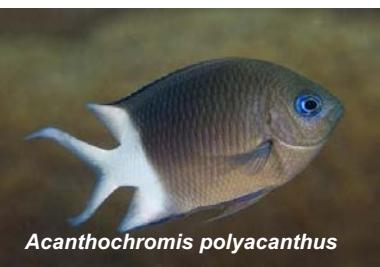
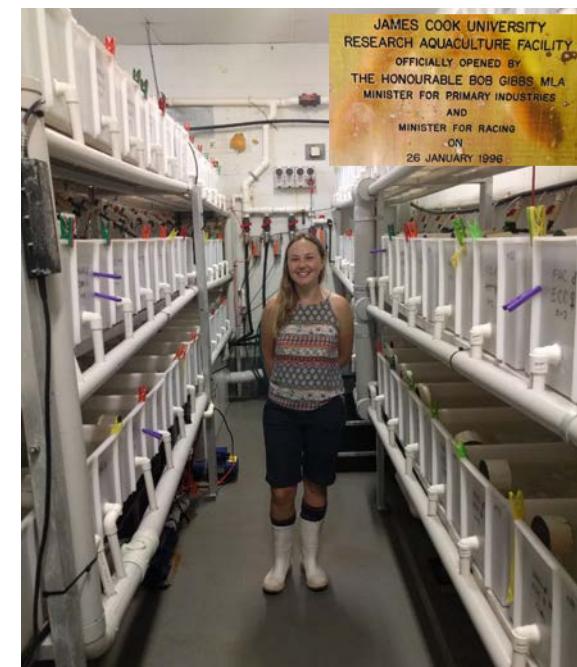
The basic idea is to:



A laboratory system to study climate change



OIST Marine Science Station



Acanthochromis polyacanthus



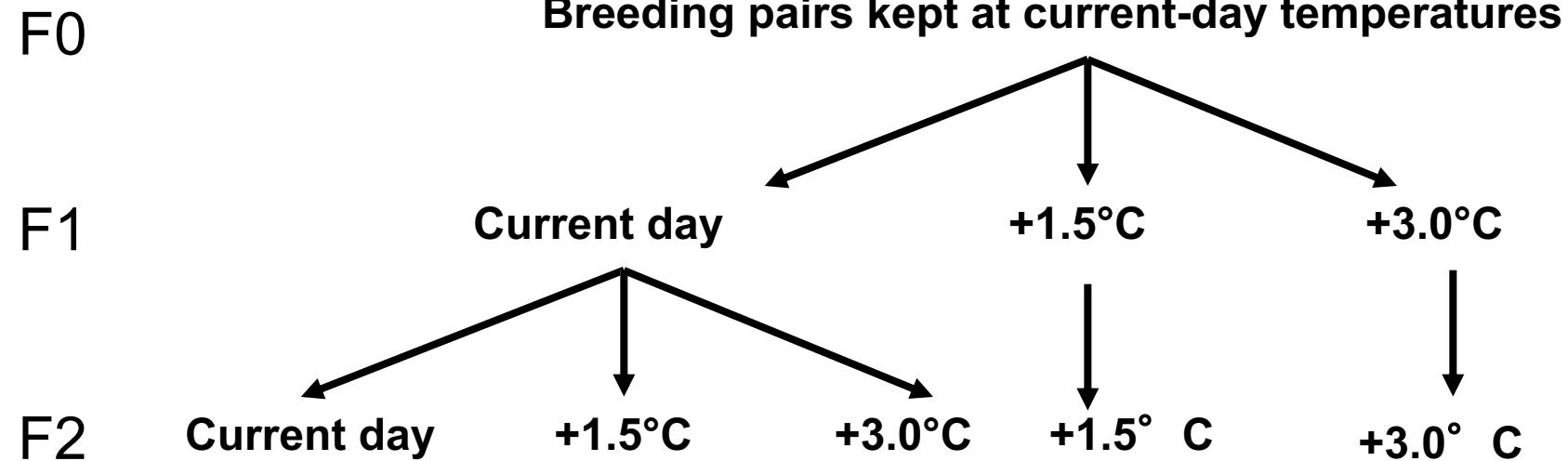
Amphiprion percula



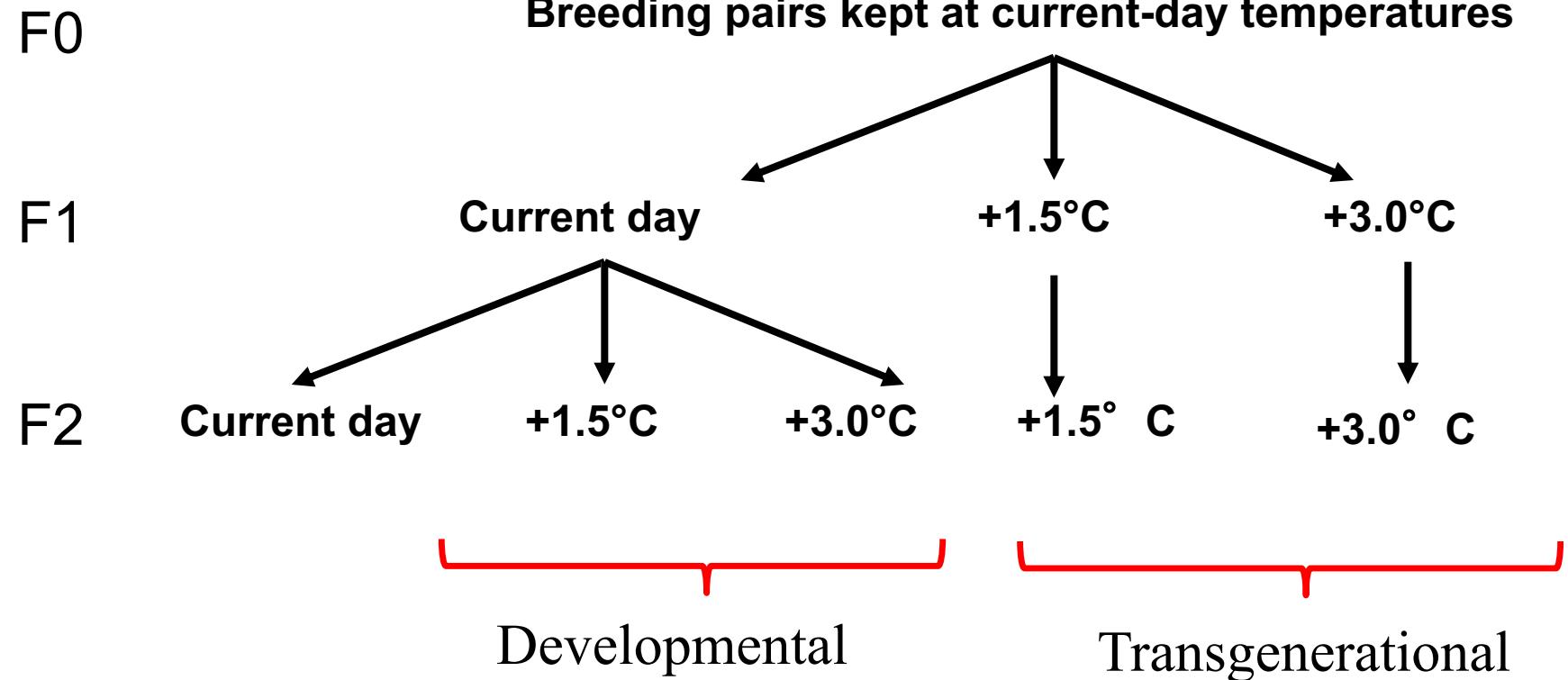
Amphiprion melanopus



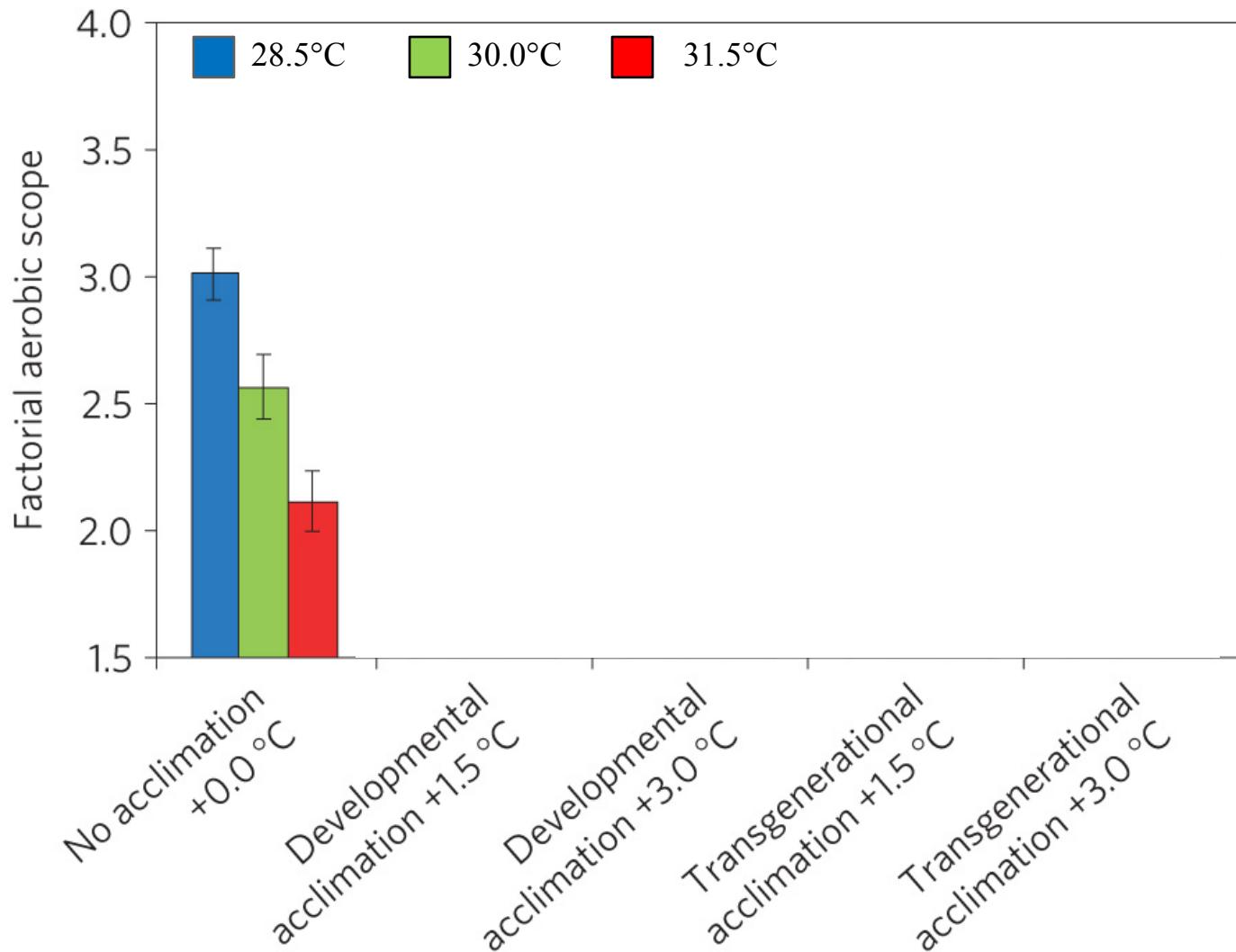
Experimental design for future ocean temperatures



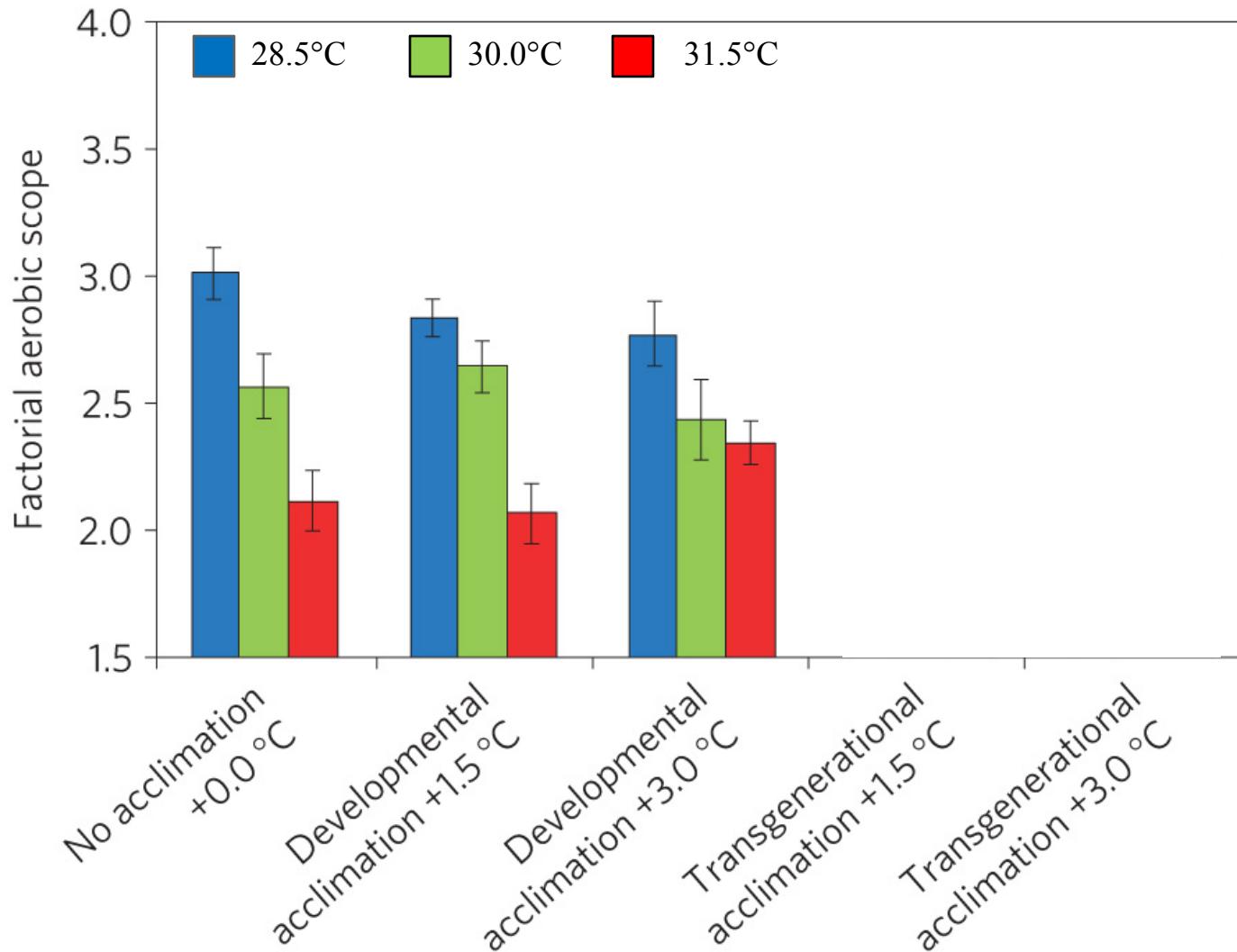
Experimental design for future ocean temperatures



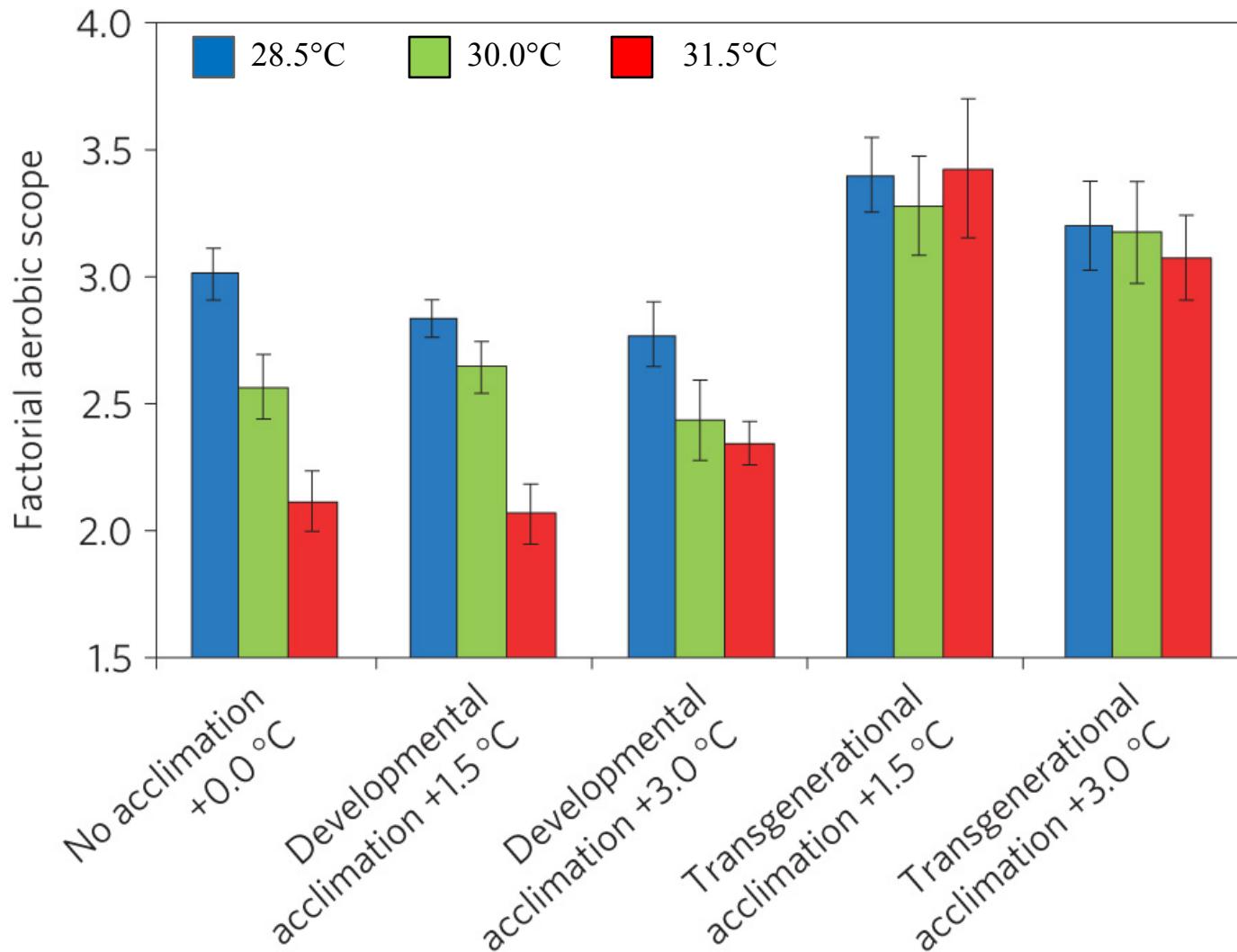
Fast transgenerational acclimation to ocean warming



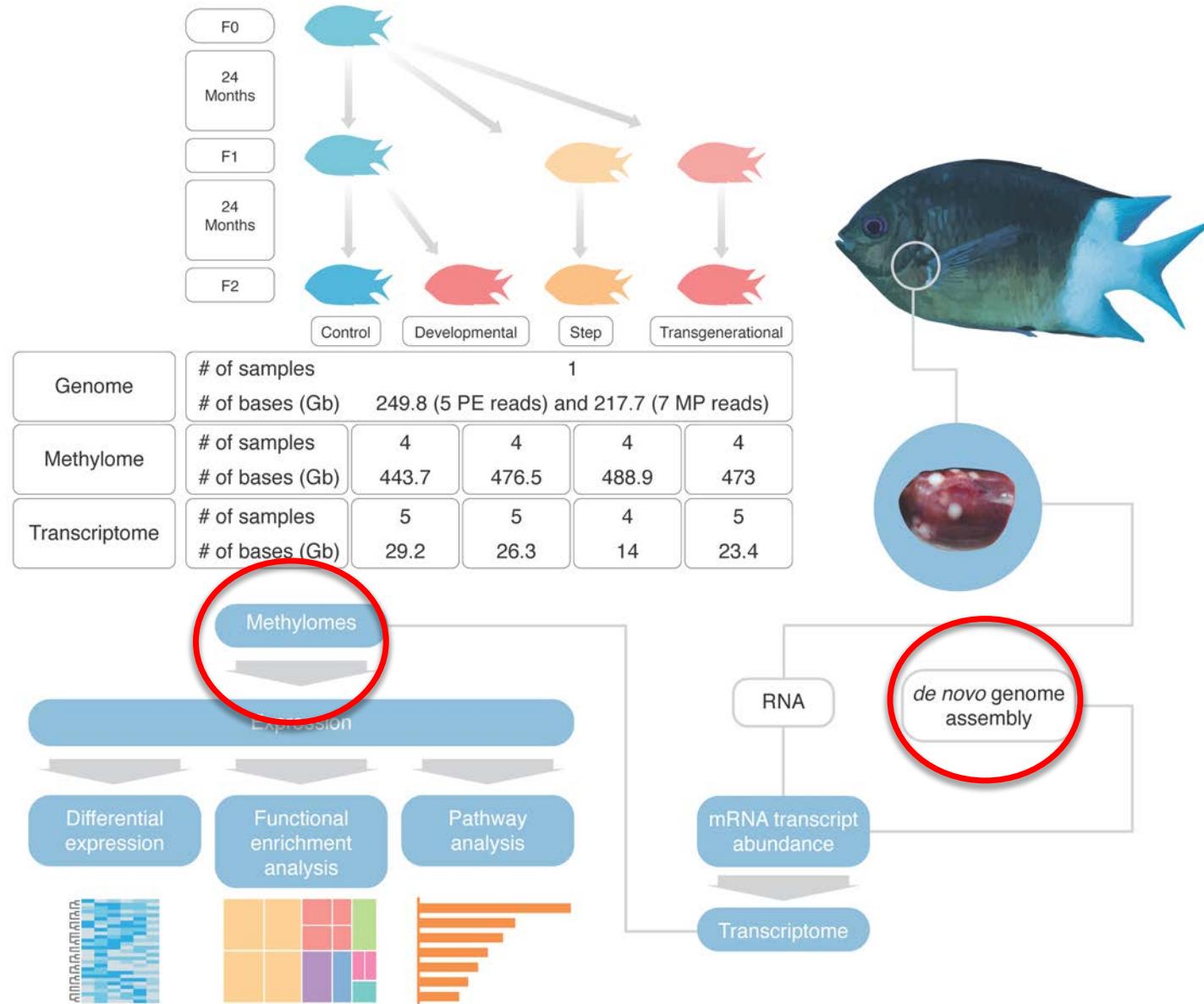
Fast transgenerational acclimation to ocean warming



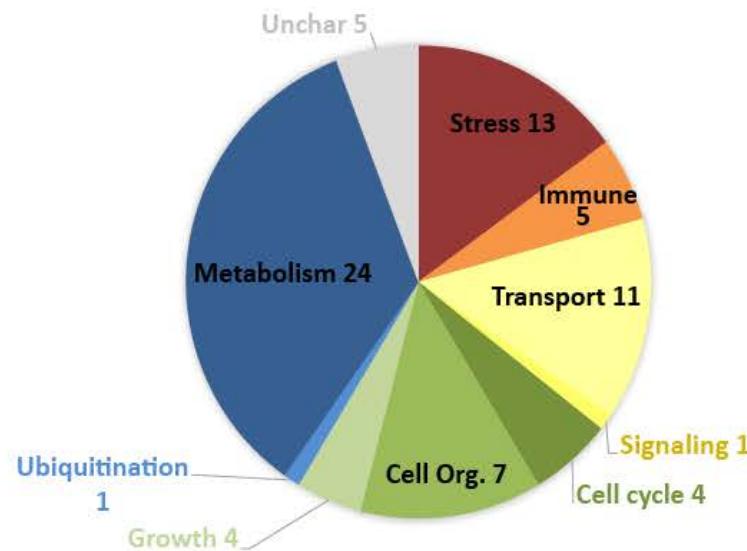
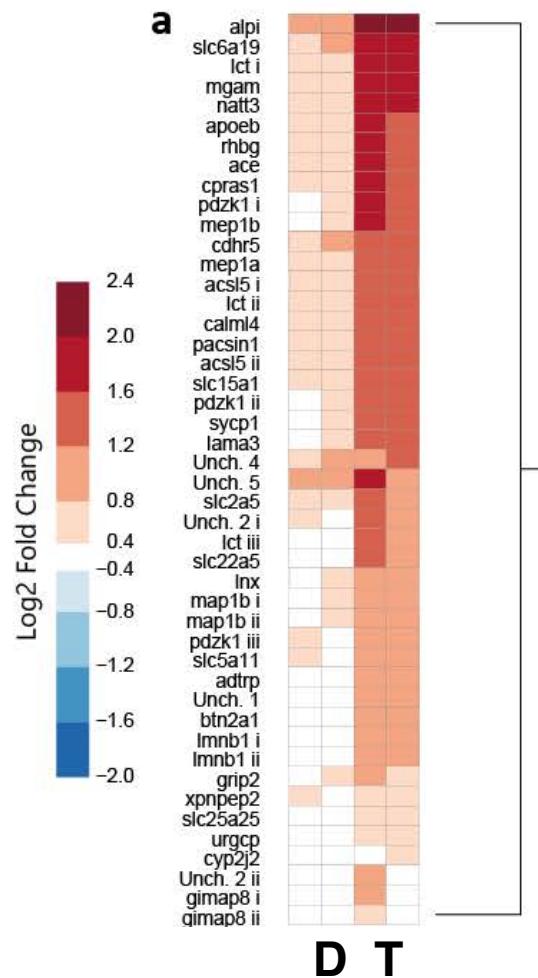
Fast transgenerational acclimation to ocean warming



A genomics approach

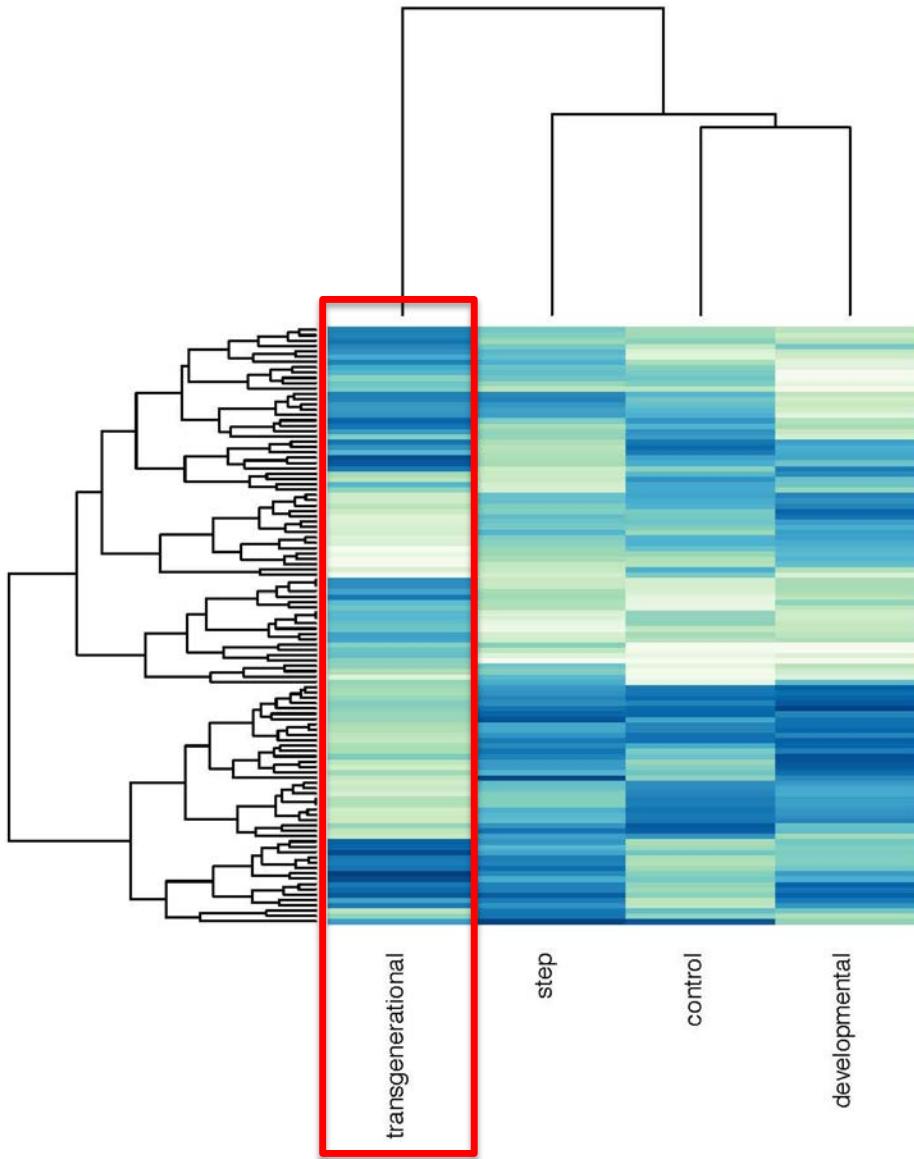
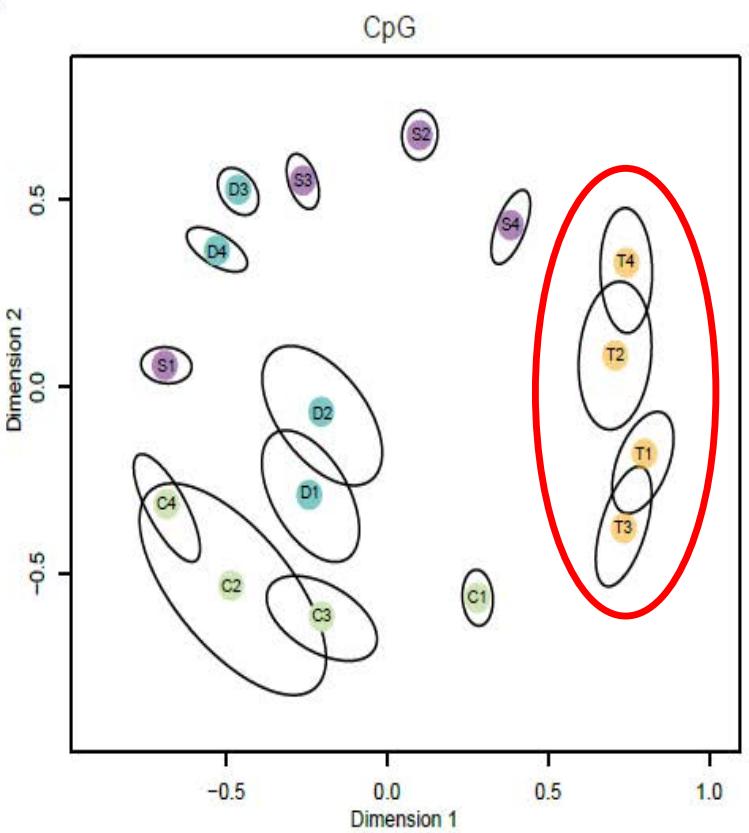


The transcriptional program in the liver correlate with metabolic phenotypes



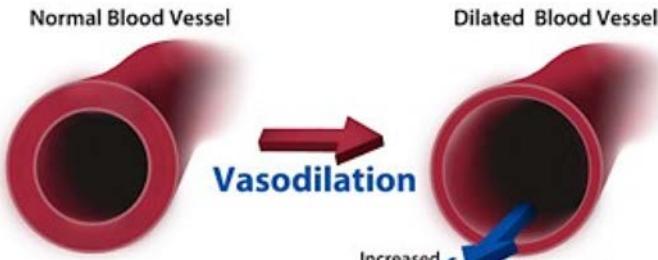
The epigenetic of parental contribution

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Is the observed differential methylation selective?

Vasodilation

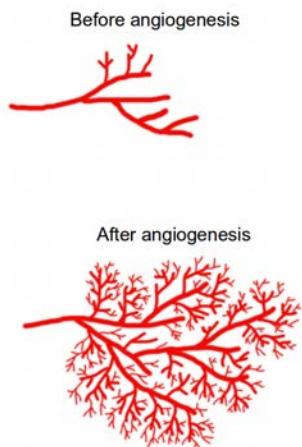


Regulation of blood flow

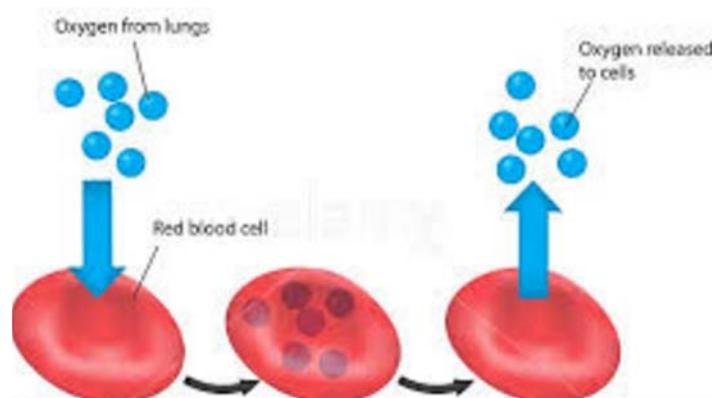


Most genes are related to the increase of oxygen intake and energy metabolism

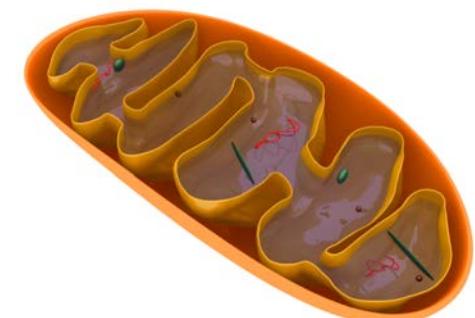
Angiogenesis



Oxygen/nutrient transport



Energy Metabolisms



Conclusions

- Fish acclimate to higher water temperatures in just one generation.
- This acclimation is possible thanks to metabolic compensation across multiple generations.
- Parents transfer the information of the “**new environment**” to the next generation by selective DNA methylation of specific loci.



Real-time, long-term genetic and ecological monitoring of the impact of coastal development on coral reef ecosystems in Okinawa

- In December 2020 at Onna Point the construction of the Four Seasons Resort and Private Residences Okinawa has started.
- This is a site with a healthy fringing coral reef.
- The site is easily accessible for long-term monitoring and sampling.
- This is a 2/3 years long project.



Study site in Onna-son, Okinawa



Study site in Onna-son



Monitoring methods and strategy

- **Monthly seawater sampling for eDNA analysis.**
 - Primers for: Fish, Coral and Dinoflagellates.
- **Underwater transect via SCUBA every 3 months.**
- **Areal video survey via drone every 6 months.**

