

Investigating the two-year transcriptomic response of outplanted colonies of *Acropora muricata*

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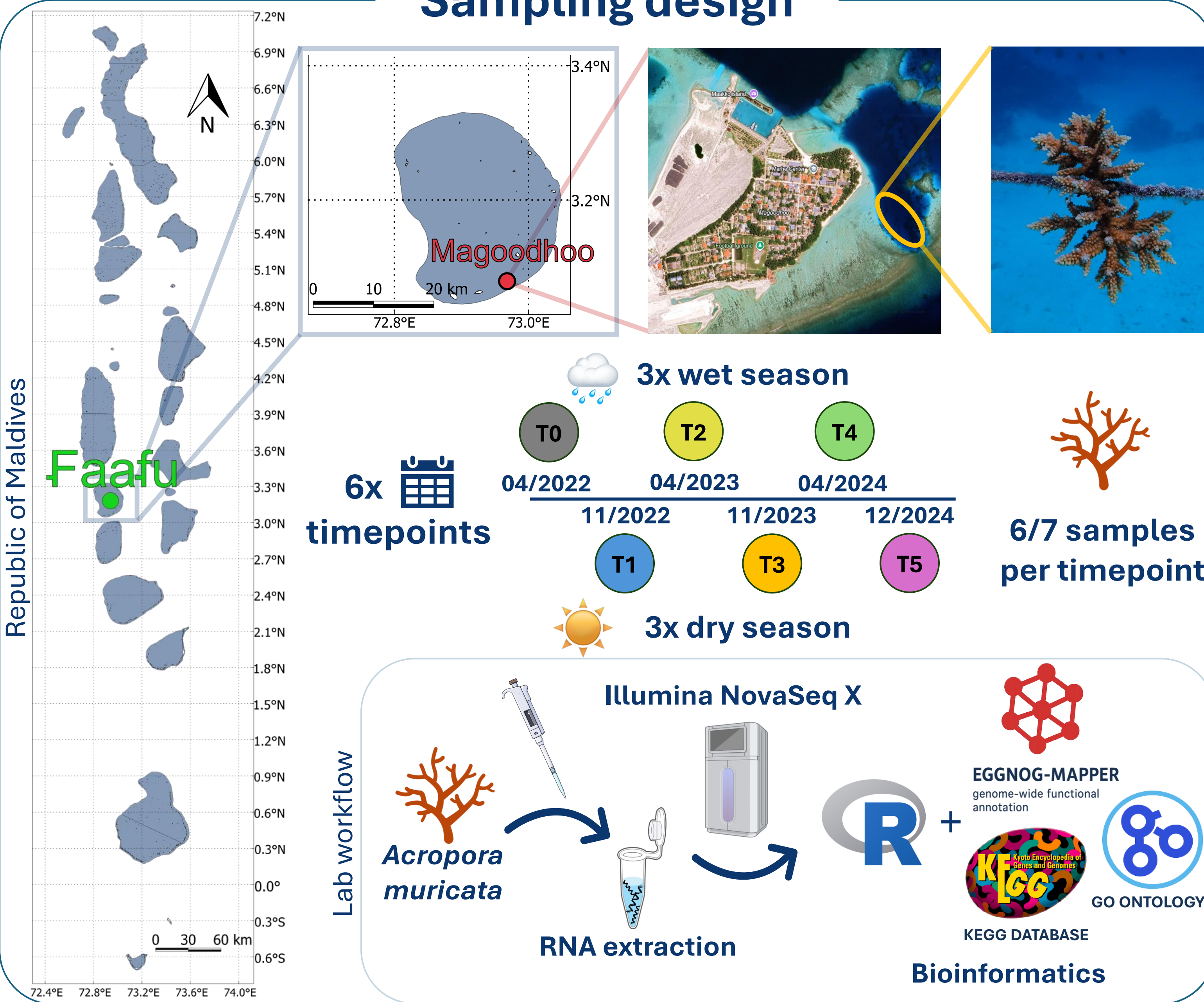
Background

Coral **transplantation** has become one of the most widely implemented approaches for active reef restoration [1,2], yet outcomes remain highly variable, with compiled studies reporting **survival** typically in the **60–70%** range [3]. In the Maldives, repeated **mass bleaching** events, including the 2016 the recent 2024 global bleaching episode [4,5], have intensified the need for restoration and local validation of restoration strategies. However, standard ecological metrics such as survival and growth do not capture why some transplanted corals acclimate and persist while others decline. **Transcriptomic** approaches can help address this gap by revealing gene-expression responses associated with **stress**, **acclimation**, and **long-term survival**.

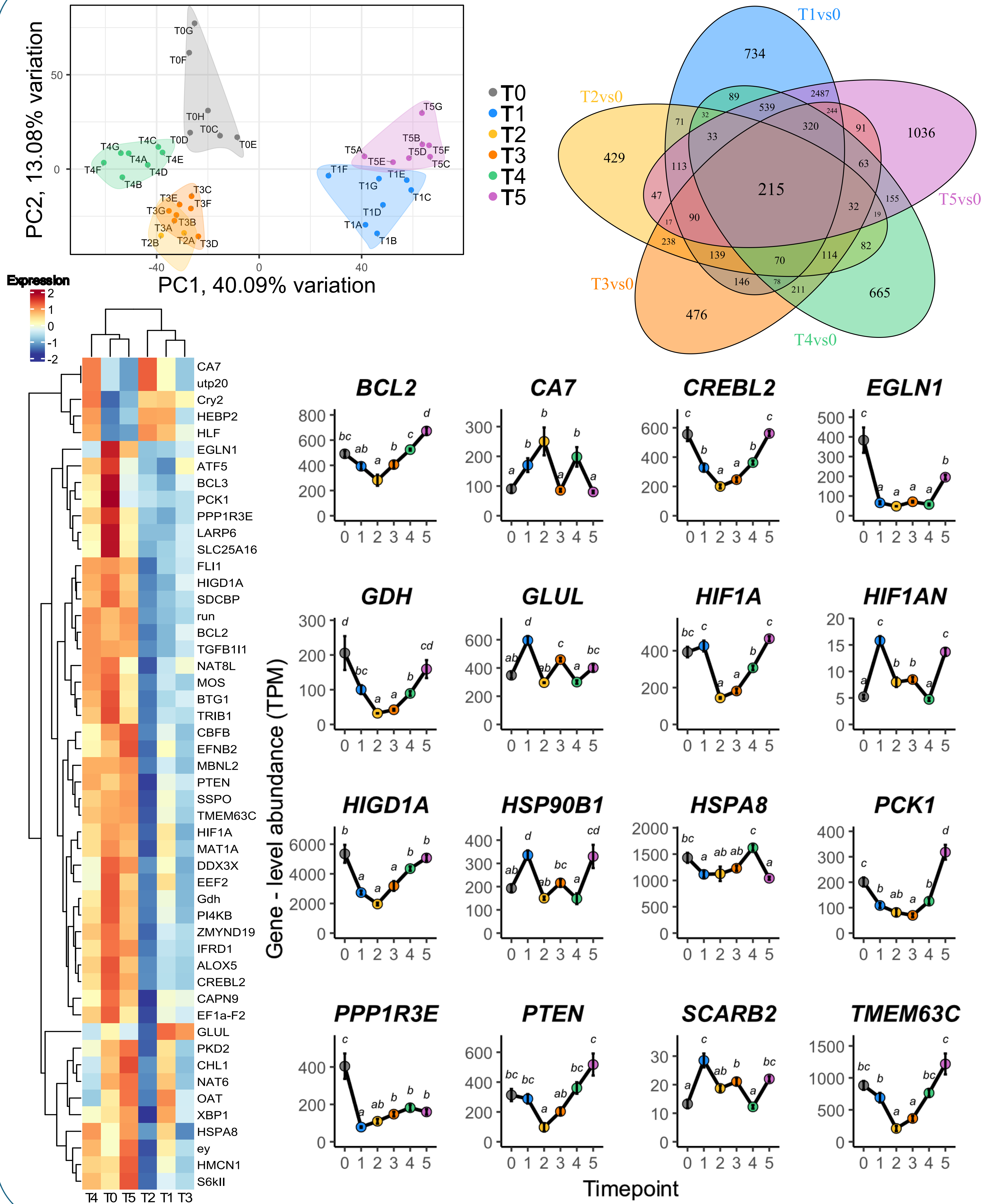
Aim

This study aims to characterise the **two-year transcriptomic response** of *Acropora muricata* colonies outplanted from a restoration nursery to a natural reef in Magoodhoo Island, Faafu Atoll, Maldives. Specifically, it aims to analyse **molecular trajectories**, signs of **stress**, **adaptation** or **seasonality** patterns to identify transcriptional signatures that may underpin successful long-term acclimation to transplantation.

Sampling design



Transcriptomic response



Seasonality

- CA7
- GLUL
- HIF1AN
- HSP90B1
- SCARB2

GLUL, SCARB2, HSP90B1, and HIF1AN peak during the **dry season**, consistent with an **enhanced heterotrophy**, and **oxygen - stress regulation**; CA7 peaks during the **dry season**, consistent with increased carbon supply for **calcification** and **photosynthesis**.

Adaptation

Metabolism

- PCK1
- CREBL2 (CD36)
- PPP1R3E
- GDH
- GLUL

Cell division and protein folding

- BCL2
- PTEN
- BTG1
- XBP1
- HSPA8 (HSP70)
- HIGD1A

Hypoxia stress

- EGLN1
- HIF1A
- HIF1AN
- P4HTM
- TMEM63C
- HSP90B1

The persistent regulation of metabolic genes together with hypoxia/stress markers indicates **long-term reprogramming of energy use, oxygen sensing, and cellular homeostasis** after transplantation. At the same time, enrichment of stress, protein-folding, apoptosis, and immune-related genes and defense suggests repeated activation of **protective and repair pathways**. Together, these patterns are consistent with a coral holobiont that is not simply recovering from outplanting stress but is undergoing **seasonal physiological cycling** plus sustained **acclimatization** to the reef environment.

References

[1] Ferse et al. 2021; [2] Young et al. 2024; [3] Boström-Einarsson et al. 2020; [4] Montefalcone et al. 2026; [5] Cowburn et al. 2019