Introduction:

Cnidarians are often perceived as simple animals yet display some of the most remarkable regenerative capabilities across the entire animal kingdom. Regeneration model organisms, *Hydra sp.* and *Nematostella vectensis* are capable of whole-body regeneration which is defined as the replacement of body parts lost though injury (cite). Less studied are colonial cnidarians, specifically of the order Scleractinia (stony corals), who display an incredible prowess for tissue regeneration following mechanical damage. (example demonstrating regenerative capacity here) (cite). Despite great capacity to regenerate from injury, there is evidence that regeneration can come at an energetic cost (cite). Previous studies have associated the energetic cost of regenerating lost tissue to negatively impact coral growth (cite) and fecundity (cite), resulting in physiological tradeoffs (cite). Maintaining an energetic budget which can amend tradeoffs with regeneration may be feasible by acquiring new energy through food intake (cite) or leveraging stored resources (cite). Indeed, it is habitual for corals to routinely heal from sublethal predation by corallivores without succumbing to death. However, under stressful environmental conditions where energy acquisition is inefficient and stored resources are exhausted is when physiological tradeoffs will be most acute. For tropical corals, which exist in a narrow range of seawater temperature, anthropogenic ocean warming threatens to reduce the energetic capacity for tissue regeneration.

Tropical stony corals are unlikely to meet temperature driven increases in energetic demand through heterotrophy because they rely heavily on photosynthate derived from their endosymbionts (Symbiodinaceae) as their primary energy source (Muscatine et al. 1981). The impact of extended periods of elevated temperature on coral is often detrimental as it results in the breakdown of the coral-algal symbiosis (coral bleaching). Bleached corals have lower growth rates (cite), reduced fecundity (cite), are more susceptible to disease (cite), and have high rates of mortality depending on the duration and intensity of heat stress (cite). Lowered fitness due to heat stress is also detectable before visible signs of bleaching (Brown et al. 2023). Increased coral metabolism (respiration) and reduced symbiont productivity (photosynthesis) and photosynthetic efficiency are documented examples of physiological stress when corals are exposed to temperatures at or above their bleaching thresholds (Paradis et al. 2019, etc..)). While there is substantial literature documenting the effects of temperature on coral physiology, examining the interaction of tissue regeneration and elevated temperature is lacking.

Coral performance under multiple stressors such as mechanical injury and elevated temperature are of heightened concern as climate change increases the duration and frequency of heating events on tropical reefs. However, the small number of previous studies examining the interaction of injury and temperature on coral physiological performance have produced varying results. Injuries simulated as corallivorous fish bites interacted positively with elevated temperature to increase growth for fragments of *Pocillopora verrucose* (Lenihan & Edmunds 2010), maintained growth rates for *Pocillopora spp.* despite additional stressors including anthropogenetic nutrient enrichment (Rice et al. 2019), and interacted negatively with temperature to reduce growth in *Porites spp*. (Edmunds & Lenihan 2009). Another laboratory study found coral fragment growth rates for 8 Indo-Pacific coral species to decrease with increasing temperature over 60 days when inflicted with a small artificial injury (3 mm in diameter) (Dias et al. 2018). These studies examined temperatures at or above their study species respective bleaching thresholds, however reduced skeletal calcification has also been recorded for injured *Acropora aspera* while exposed to heat stress of 2 degrees Celsius below their bleaching threshold (Bonesso et al. 2016). The influence of temperature on the rate and extent of injury regeneration is also variable amongst these experiments. In some studies, injuries simulated as corallivorous fish bites recovered at similar rates despite temperature treatments (Edmunds & Lenihan 2009, Lenihan & Edmunds 2010) and in others healing rate decreased at elevated temperature (Rice et al. 2019). For corals at moderate levels of heat stress, regrowth of fragmented apical tips was depressed compared to injured corals at ambient temperature which fully regenerated within 12 days (Bonesso et al. 2016). Interestingly, the regeneration rates of multiple Indo-Pacific coral species increased at 30 C but decreased at 32 C and ultimately experienced significant mortality after 60 days (Dias et al. 2018) suggesting a limit in regenerative capacity under heat stress for tropical stony corals.

Several field and laboratory studies report *Acropora* as a thermally sensitive coral genera, likely due to high respiration rates (metabolism) which contributes to their high growth rates (Gates & Edmunds 1999). Additionally, the decline of *Acropora* due to temperature induced bleaching events and its fast-growing life history strategy have made these corals, specifically branching species, the main target for reef restoration to increase coral cover on degraded reefs. Therefore, the energetic capacity of *Acropora* to regenerate tissue and skeleton lost from mechanical damage due to corallivore predation or human fragmentation may be reduced by ocean warming conditions. To better understand the physiological cost of multiple stressors in inducing energetic tradeoffs in tropical stony coral, we examined the effect of elevated temperature on wound regeneration from two injury types (abrasion and fragmentation) in the Indo-Pacific branching coral, *Acropora pulchra*. *A. pulchra* is an important habitat building coral in the fringing reef of Moorea, French Polynesia where it is preferentially eaten by corallivorous fishes (Cole et al. 2008). We hypothesize that at elevated temperature injured A. pulchra will display an energetic tradeoff between growth and wound regeneration as heat stress will raise coral metabolism and decrease symbiont productivity (Paradis et al. 2018) and efficiency, straining the corals energetic budget for physiological homeostasis. Alternatively, if heat stress does not produce a bleaching response, slight increases in coral metabolism may increase overall growth and regeneration rate.