



Quarry-based Mariculture of the Caribbean king crab in Support of Reef Restoration

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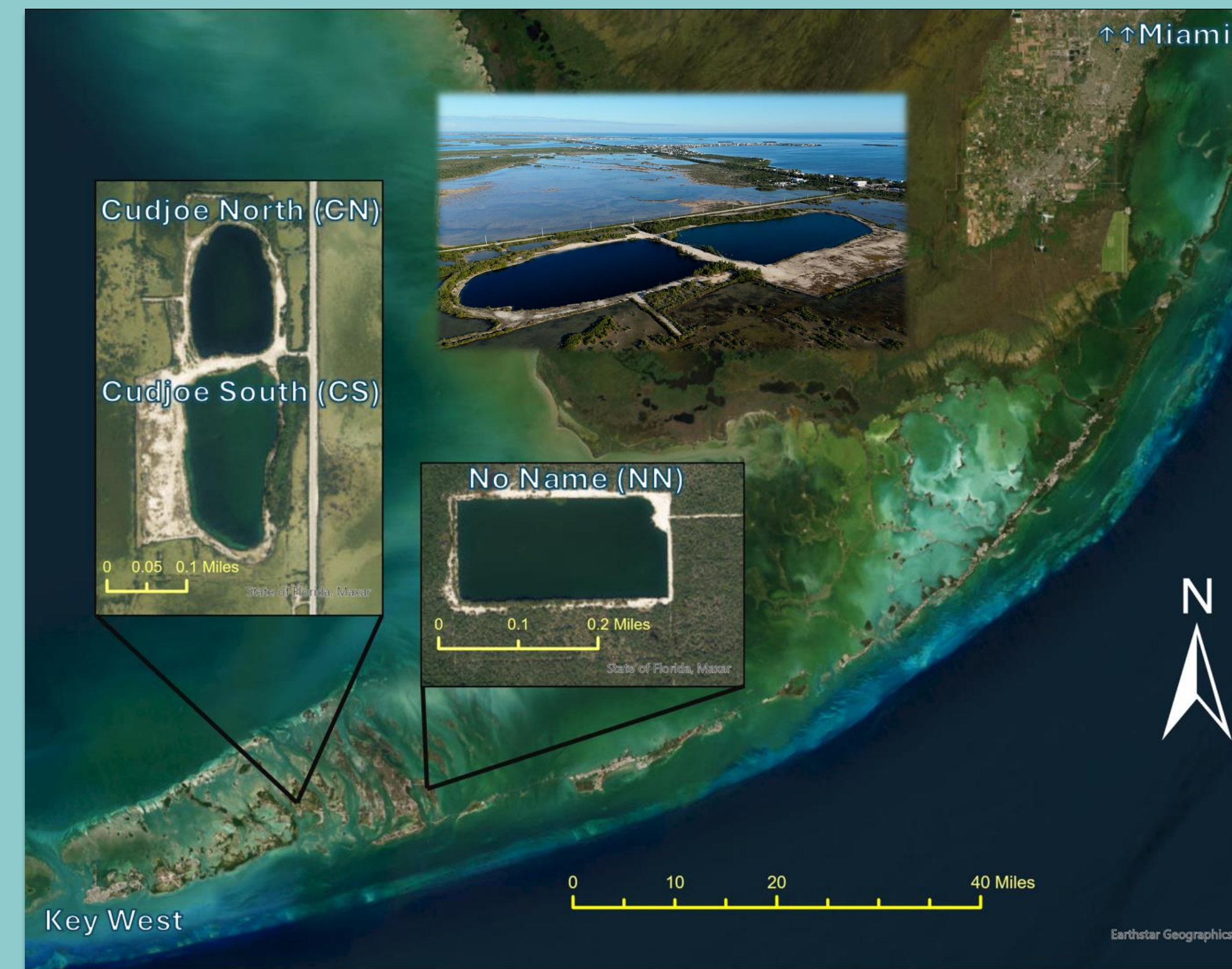
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Introduction

- Coral reefs in crisis:** Florida Keys coral cover dropped from >25% to <2% in recent decades due to climate change, disease, and loss of herbivores (Hughes et al., 2017; Toth et al., 2019)
- Algae dominance:** uncontrolled macroalgae growth prevents natural coral recovery and impacts coral outplant survival (van Woesik et al. 2018)
- Restoration efforts:** FKNMS "Mission: Iconic Reefs" plans to stock hundreds of thousands of herbivores, including Caribbean king crab (*Maguimithrax spinosissimus*) (NOAA 2025)
- The challenge:** *Ex situ* grow-out of grazers to reef-ready size is typically limited by space, energy, and feed requirements (Wilson et al. 2025)
- Solution:** Protected saltwater quarries used as intermediary crab grow-out sites with existing natural populations (Glover & Butler 2025)



Experimental Design

Question: Can quarry-based mariculture grow juvenile crabs from 5mm to restoration stocking size (>30 mm) at scale?

Sites: Cudjoe North (CN), Cudjoe South (CS), and No Name (NN)

Experiment 1: Laboratory vs. Quarry Grow-out (Nov 2022 - Feb 2023)

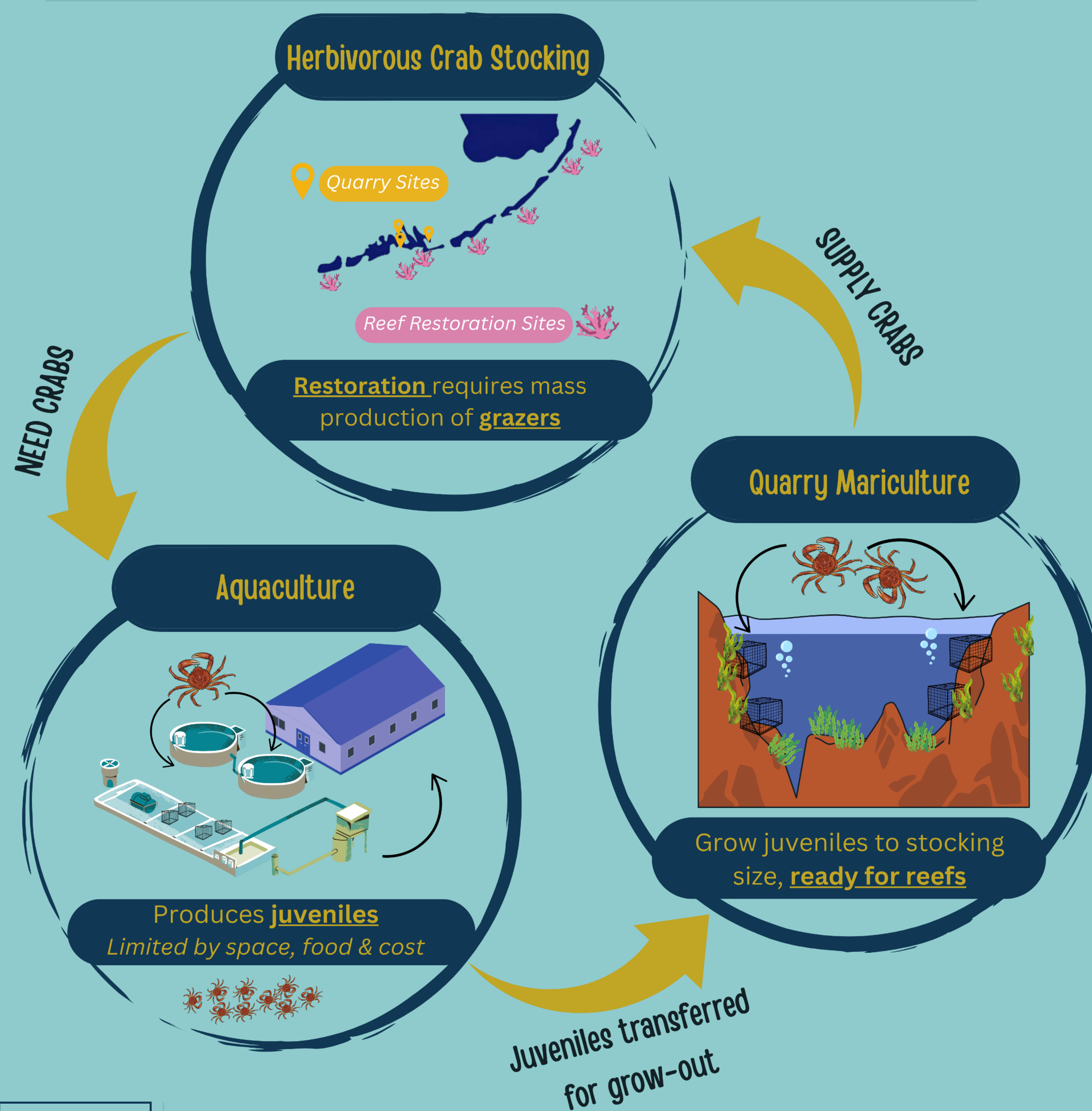
- Single clutch split between recirculating lab tanks and quarry cages
- 4 cages in quarries and 8 in lab (equal crab density per volume)
- Lab: daily maintenance; Quarry: monthly checks only

Experiment 2: Multiple Quarry Performance (Jun 2024 - Jan 2025)

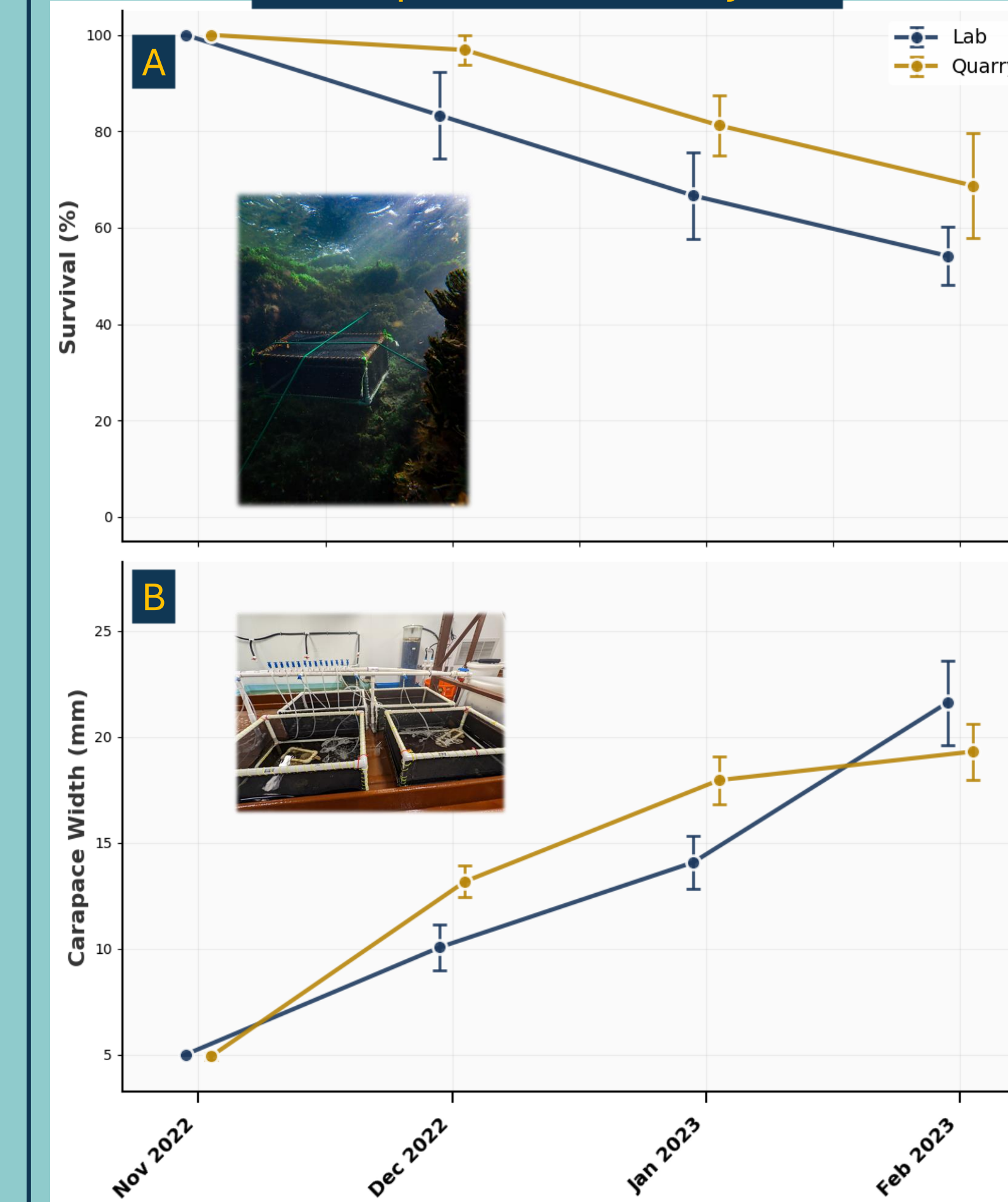
- Crabs from 3 quarries reared at NHMI, juveniles deployed in the 3 sites
- 5 cages per quarry, 15 juvenile crabs per cage

Experiment 3: Density Effects on Quarry Grow-out (Jun 2024 - Jan 2025)

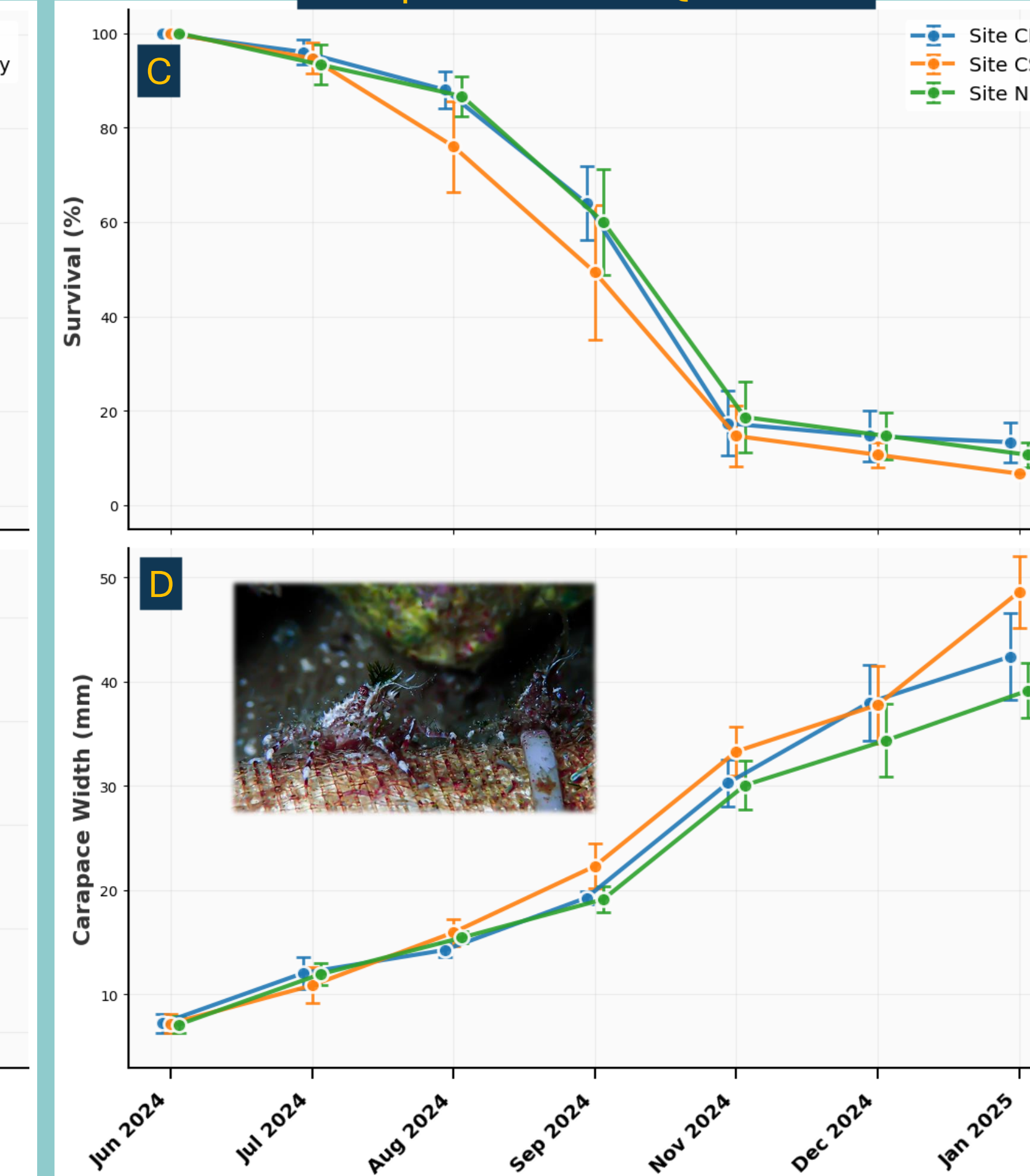
- Three densities tested: Low (1), Medium (4), High (10) crabs per 'condo'



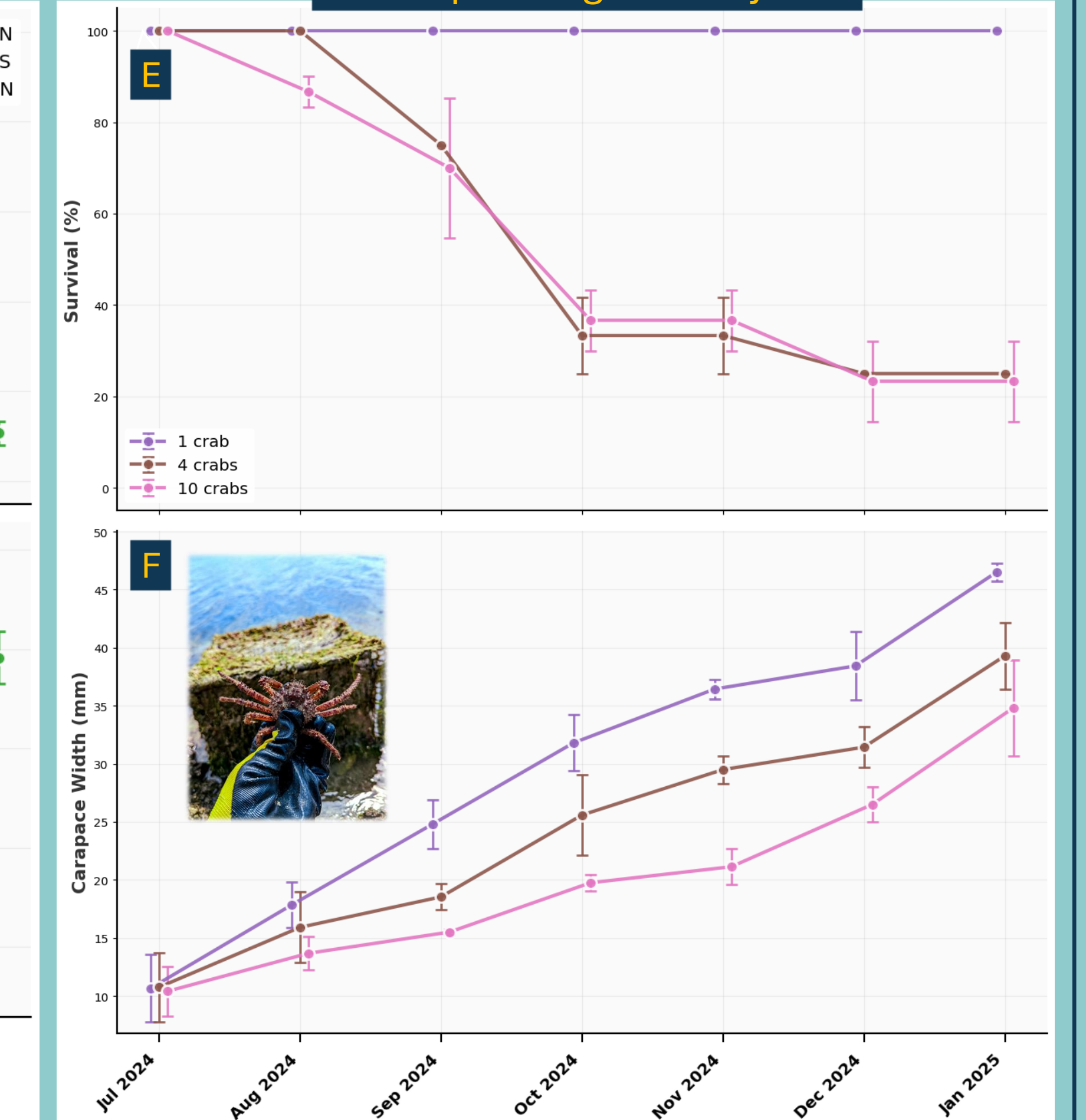
Exp 1 : Lab vs Quarry



Exp 2 : Different Quarries



Exp 3 : Cage Density

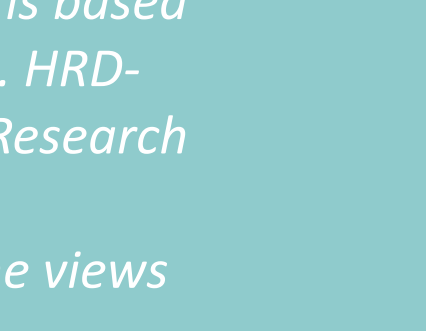
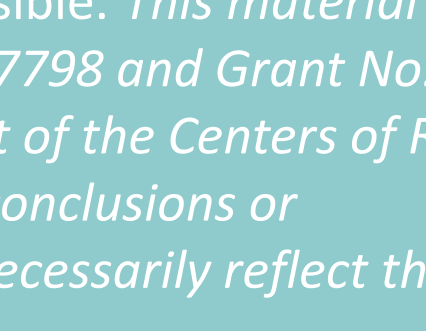
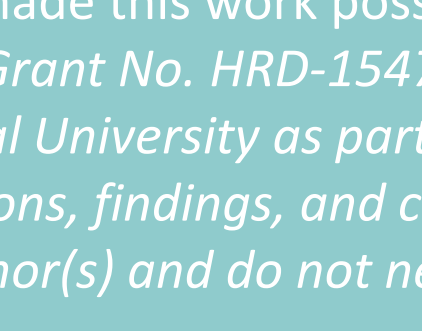
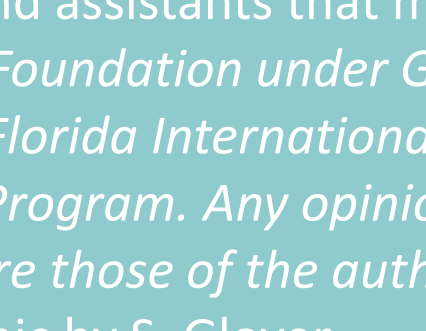
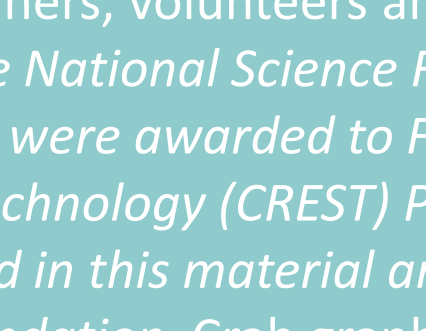
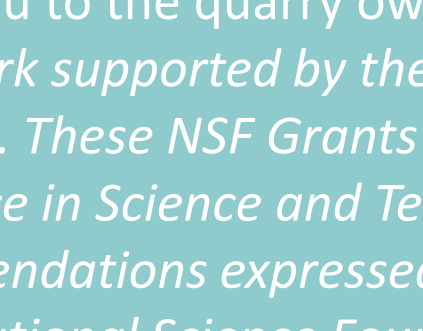
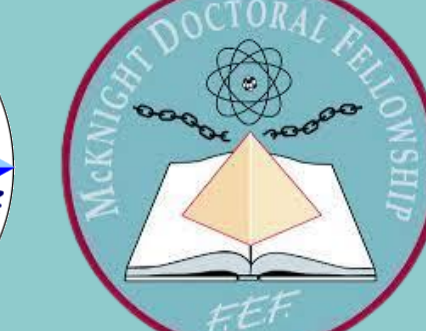


Results and Conclusions

- Similar performance:** quarries matched lab growth (~20 mm in 3 months) with higher survival (69% vs 54%), non-sig difference
- Growth varied among quarries** (37-49 mm in 6 months); survival low (7-13%) at high densities
- Low density maximizes performance:** 100% survival and 5.7 mm/month growth vs. 23% and 3.3 mm/month at high density
- Summer advantage:** growth 27% faster in summer (4.6 vs 3.6 mm/month) likely due to increased algal food abundance
- Ready for reefs in 5 months:** crabs reached 30 mm stocking size in 5 months grow-out (7-8 months from spawning)
- Minimal maintenance, maximum scale:** 100+ saltwater quarries across the Keys require only monthly upkeep while matching lab performance
- Optimize production:** for best outcomes: (1) stock at low density (2) separate by size class, (3) start right before summer, (4) increase mesh size as they grow, and (5) track water quality
- Broader applications:** mariculture model applicable to other restoration and commercial species
- Hurdles:** cannibalism, water quality, genetics, cage mesh size, size class separation, permits, health checks, histology



Citations



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