

# VALIDATION OF PILOT PROTOCOL: DAMAGE SCORING OF PUGET SOUND MOLLUSK SHELLS

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## INTRODUCTION

The water quality of the Puget Sound is integral to the health of the marine ecosystems that dwell there, and, with increasing anthropogenic pressures, monitoring is necessary to detect change over time. The Washington State Department of Ecology's Marine Sediment Monitoring Team (MSMT) is at the forefront of this effort. They use measures of sediment quality to determine whether environmental pressures, such as carbon and nutrient loading, climate change, and chemical contaminant inputs, are having an effect on sediment-dwelling (benthic) invertebrate communities (Dutch et al. 2021). While studying the benthic communities of Puget Sound, the MSMT observed damage to mollusk shells. A pilot protocol was written to allow researchers to quantify the damage. Two researchers independently followed the protocol, including reference photos, for a set of samples collected in 2019 from an urban bay, East Possession Sound.

## METHODS

Two scores were given to each specimen: highest level damage and extent of highest-level damage. An additional score was given to bivalve species: rust/stain. To ensure constituency, only the visible side of the bivalve shells was scored, while the entire shell of gastropods were scored. The sets of scores were compared to determine if the protocol yielded similar values between the researchers. Reference photos were used to maintain consistency in scoring (figure 2 and 3).

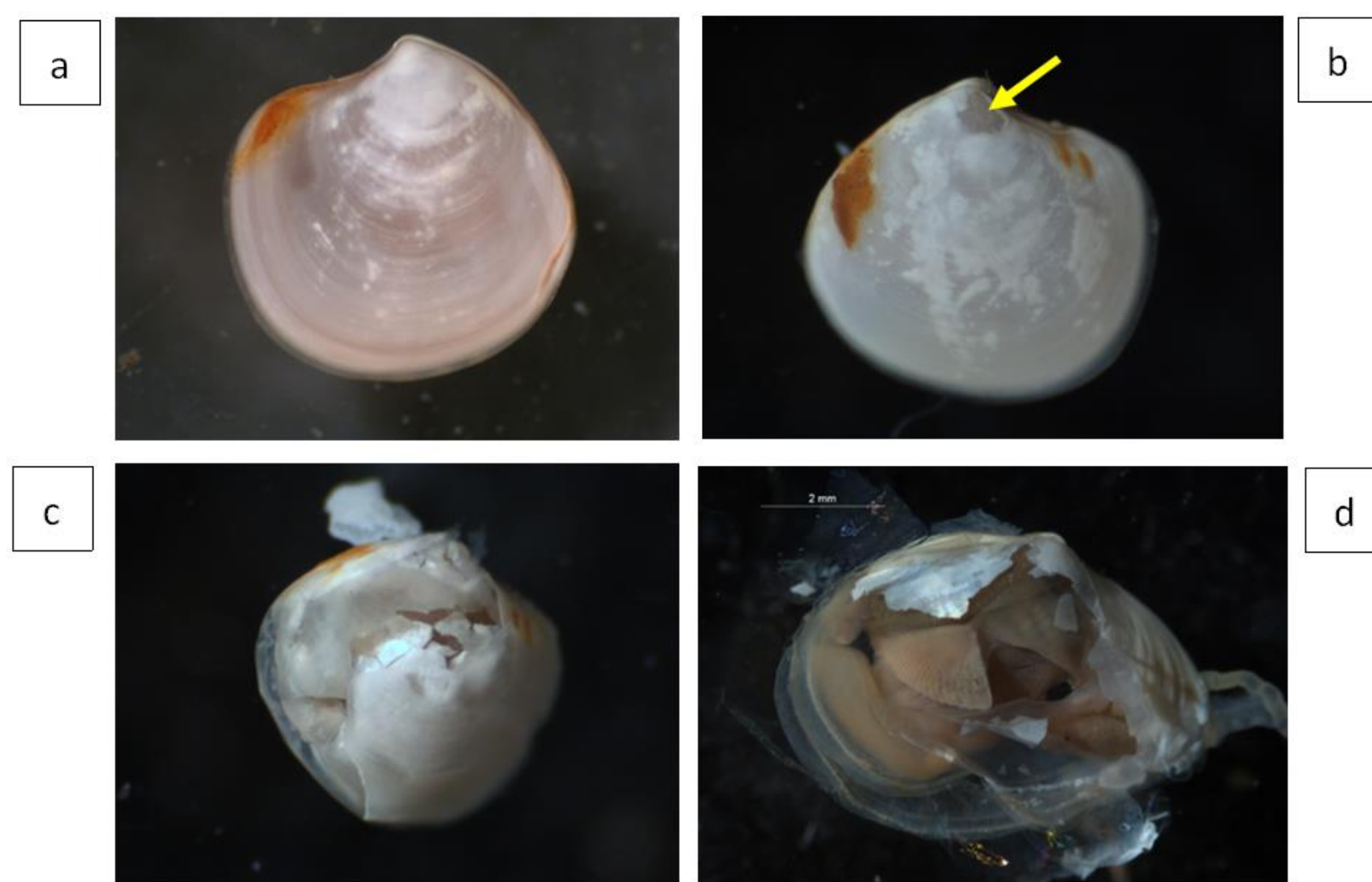


Figure 2. Shell damage exemplars taken from Shell Scoring Protocol. a. Score 1, surface level damage, b. Score 2, decalcification, deep pitting, c. Score 3, crushing damage, cracking, d. Score 4, shell missing

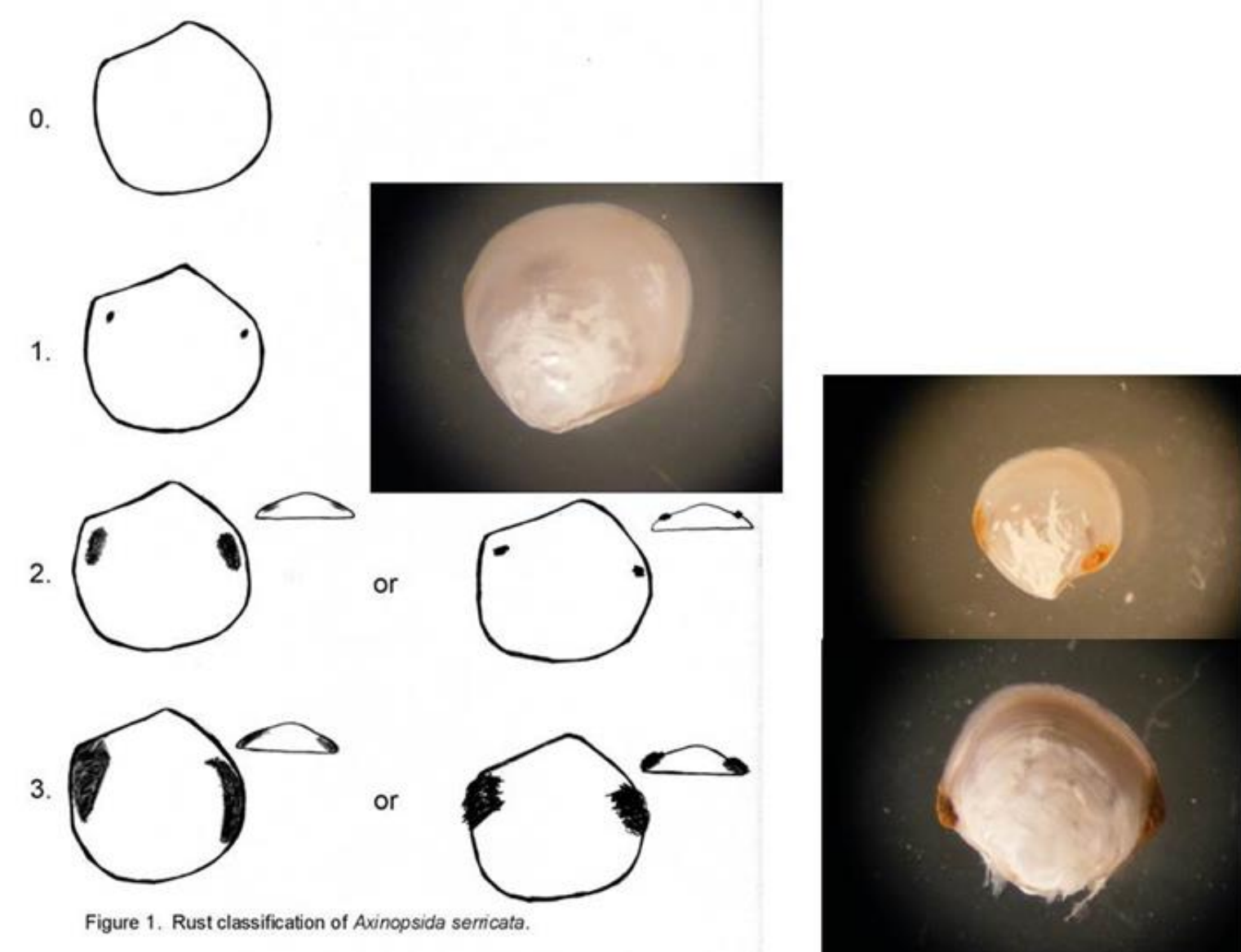


Figure 3. Rust classification exemplars taken from Shell Scoring Protocol

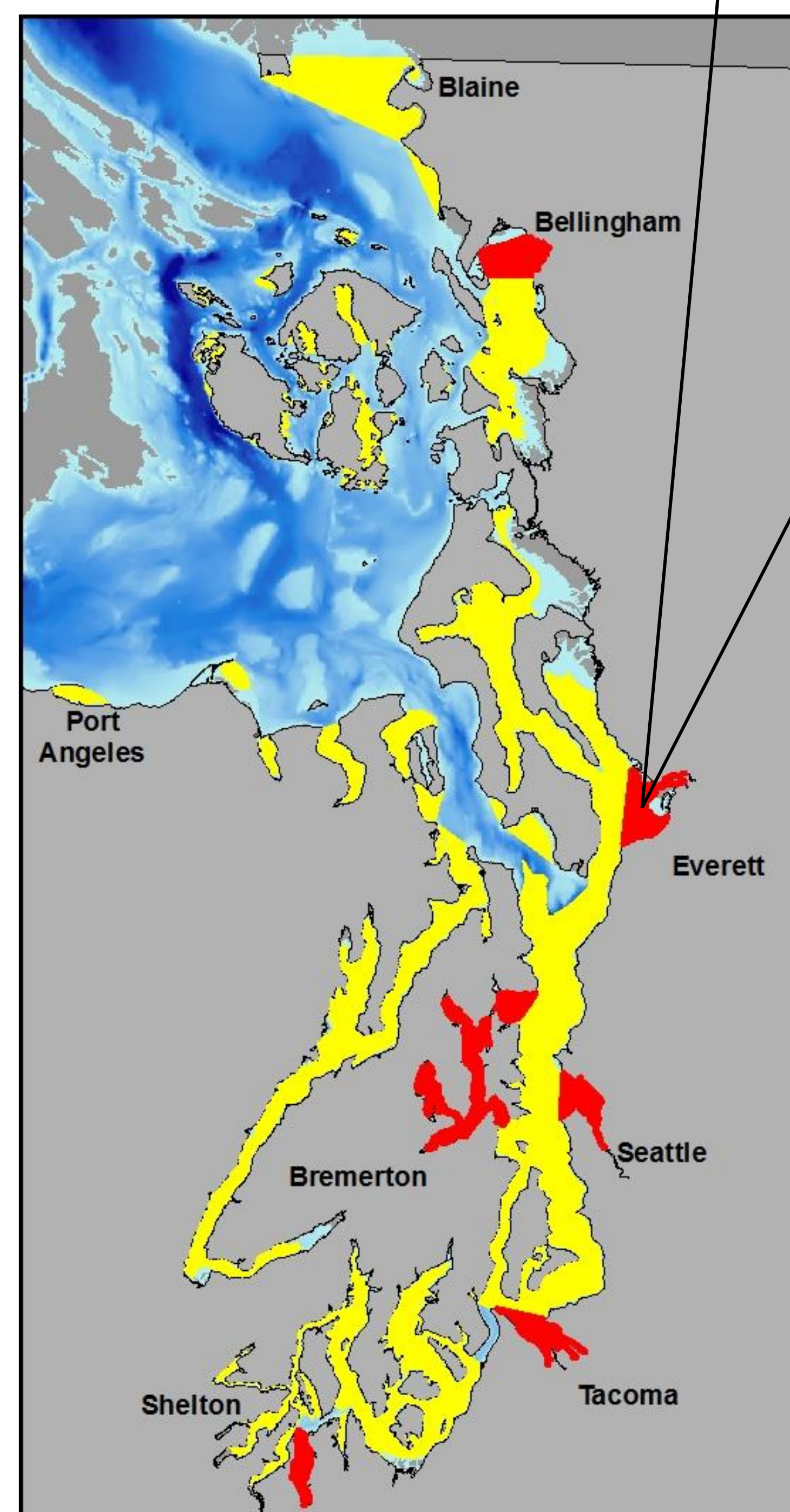
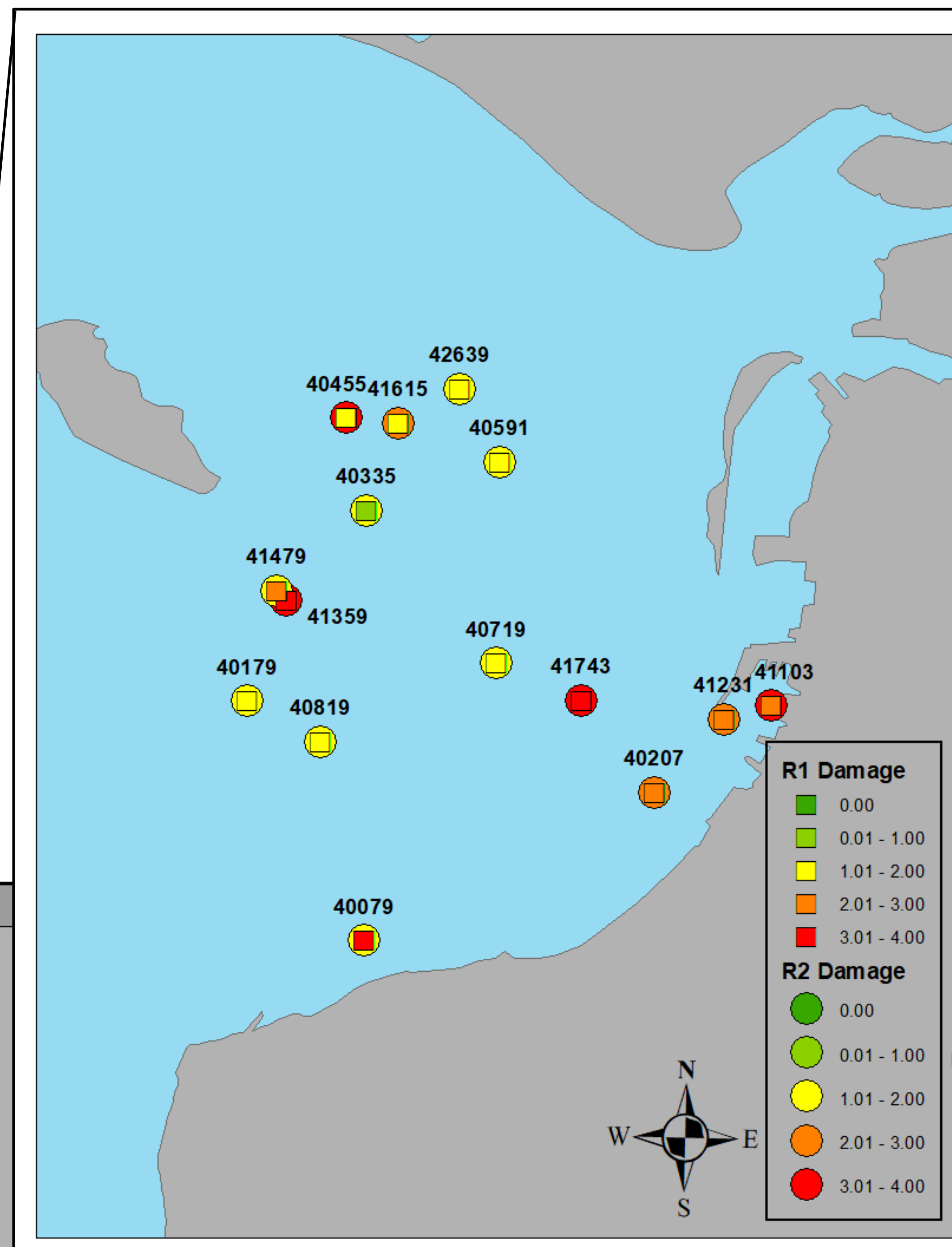


Figure 1. Sampling area by the Marine Sediment Monitoring Team, Yellow & Red: Entire Sampling area, Red: Urban Bays only (Dutch et al. 2018), pop out shows mean highest level damage values at station level for East Possession Sound urban bay for both researchers overlaid for comparison



## NEXT STEPS

The protocol was found to be valid and reproducible at the station level for highest-level damage and extent of highest-level damage. This validation will allow the Marine Sediment Monitoring Team to use this protocol to quantify the observed damage on mollusk species, providing the ability to track changes over time along with finding correlations with other monitoring data. In addition, the differences found on the species level bring into question the application of the protocol to gastropod species. Much of the damage observed on gastropods were broken tips, which placed the in a level 4 for damage, but it is unclear if the tip of the shell is necessary for survival of the individual.

## VALIDATION QUICK FACTS

- The mean for highest level damage (0.750 (P-Value <0.001)) and extent of damage (0.637 (P-Value <0.001)) showed significant correlation at station level.
- Stain scoring was not found to be repeatable (0.544, P-Value = 0.036).
- Species level comparisons revealed variation (figure 4).

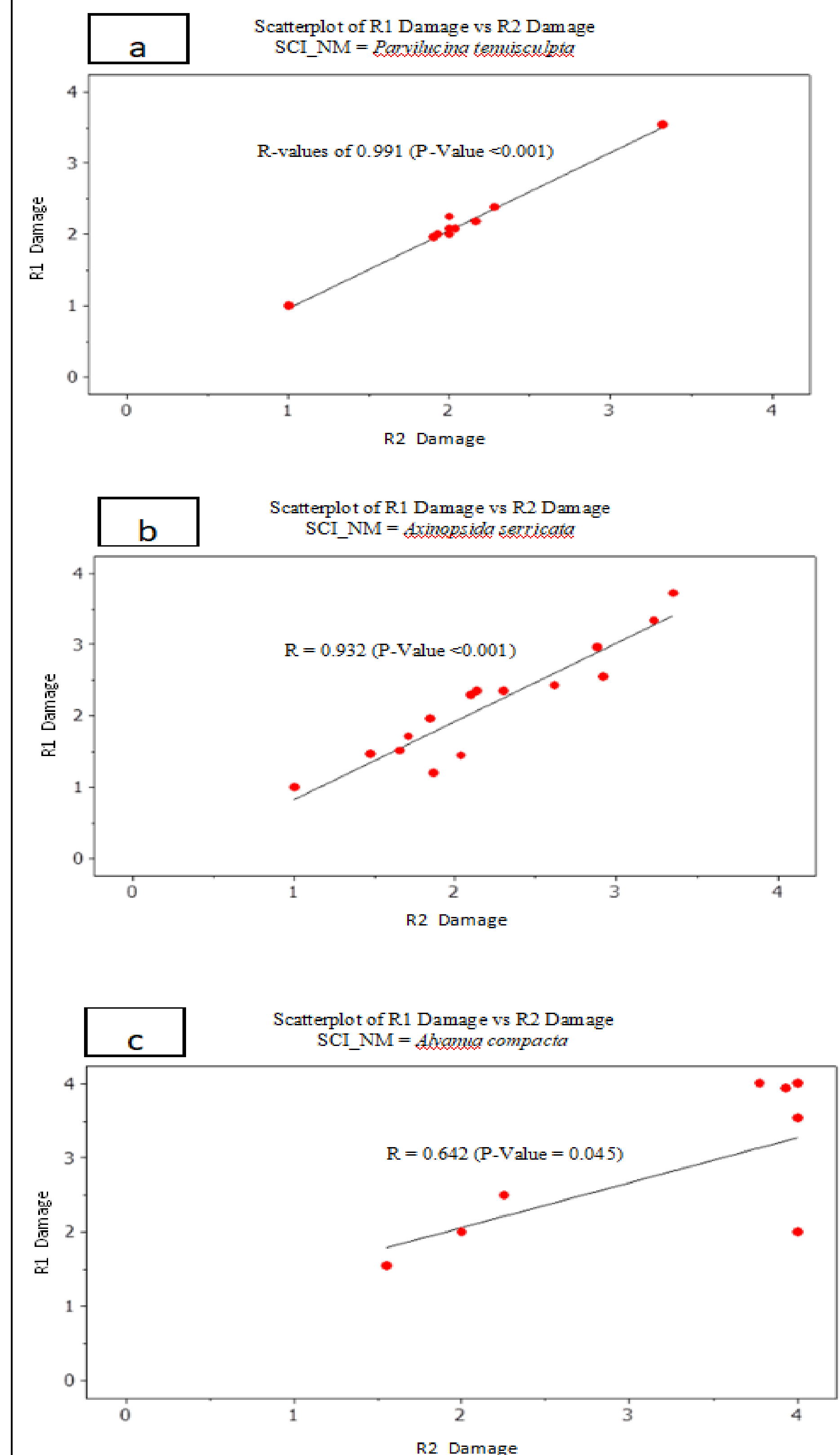
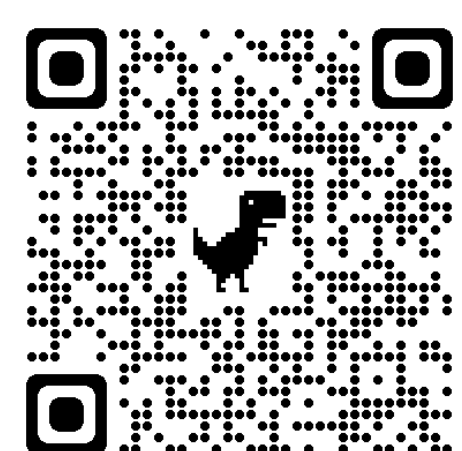


Figure 4: Correlated highest damage data for four species. Plots a and b are for the two most abundant species found in the sampling area. Plot c represents the most abundant gastropod.



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