

Pilot Project Plan

Autonomous Detection of Invasive Crabs in Bellingham Bay

Organization

Coastal Research Robotics
Smart Robotics for Coastal Ecosystem Protection

Pilot Purpose

Evaluate whether an underwater robotics + computer vision workflow can detect and classify invasive green crab observations in shallow coastal habitats with operational usefulness for ecosystem monitoring.

Primary Objectives

1. Detect and classify invasive green crab observations from underwater video.
2. Distinguish invasive vs native crab detections in field conditions.
3. Produce mapped outputs that inform monitoring and targeting decisions.

Study Area

- Primary region: Bellingham Bay shallow-coastal and estuarine-adjacent zones
- Target habitat types: eelgrass-adjacent zones, sandy/muddy substrate, mixed nearshore structure
- Operational depth target: shallow survey envelope suitable for stable ROV operations

Technical Stack (Pilot Scope)

Robotics

- Tethered ROV survey platform
- HD video + lighting configuration optimized for low-visibility water

AI Detection

- Real-time or near-real-time inference pipeline
- Species classes scoped to pilot needs (invasive and key native comparison classes)

Data Layer

Each detection event logs:

- timestamp,
- confidence score,
- depth,
- location proxy (surface GPS + transect context),
- frame reference.

Methodology

Survey Design

- Run repeatable transect-style passes across selected habitat zones.
- Keep movement speed low enough for stable optical capture.
- Record continuous footage for post-mission QA and retraining.

Validation Strategy

- Use manual review subset for detection quality audit.
- Compare pilot detections with baseline references where feasible.
- Track false positives and class confusions by habitat/light condition.

Key Metrics

1. Classification performance under field conditions
2. Detections per survey-hour
3. Survey coverage consistency
4. Detection-to-map utility for management interpretation

Pilot Timeline

Stage 1: Pre-Field Preparation

- finalize classes and labeling protocol,
- complete baseline model,
- dry-run logging pipeline.

Stage 2: Field Acquisition

- execute scheduled survey missions,
- collect broad-condition footage,
- maintain mission logs and QA notes.

Stage 3: Analysis and Reporting

- compute performance metrics,
- generate mapped outputs,
- publish pilot conclusions and next-step recommendations.

Risks and Mitigations

Visibility and Sediment

- Mitigation: mission timing discipline, lighting calibration, conservative interpretation thresholds.

Model Overconfidence

- Mitigation: confidence gating plus human review for critical outputs.

Operational Variability

- Mitigation: standardized survey checklists and mission templates.

Pilot Deliverables

1. Field-tested detection workflow
2. Curated pilot imagery dataset
3. Detection performance report
4. Preliminary crab observation maps
5. Recommendations for scale-up and smart-trap integration

Post-Pilot Path

If pilot outcomes meet threshold targets, progress to:

1. expanded seasonal monitoring cycles,
2. targeted smart-trap workflow testing,
3. broader ecological pattern modeling.