Degradation of Baylands Ecological Density and Flood Risk in South San Francisco Bay: A UAS Based Study

Srivathsan Ramanujam – Founder, Norcal Conservation
Archbishop Mitty High School

Abstract:

Across the Don Edwards / South Baylands, we quantified ecological condition and flood vulnerability using low-cost unmanned-aircraft (UAS) surveys. We produced a **9.4-cm GSD** orthomosaic and a **46.3-million-point** dense cloud, then classified vegetated vs. barren pixels via **VARI**. Flood-sensitivity modeling indicates **degraded cells** may experience up to **+0.15 m** additional inundation under baseline SLR scenarios and **~12%** higher nearshore wave heights during 10-yr storms. The workflow enables **annual monitoring** and **restoration prioritization** to reduce risk for nearby communities.

Background/Rationale:

- Vegetation loss reduces roughness and sediment capture, **amplifying inundation** in adjacent neighborhoods.
- Existing monitoring is costly/infrequent; **student-led UAS** mapping offers high-resolution, scalable updates.
- Managers need clear **where-to-restore** guidance that links **ecology ↔ flood risk**.

Goals & Hypotheses:

Goal 1. Map ecological density (vegetation cover) at high spatial resolution.

Goal 2. Identify "degraded cells" most associated with elevated modeled inundation.

H1. Lower vegetative density correlates with **higher** local flood sensitivity under baseline SLR/10-yr storm scenarios.

H2. A **low-cost UAS workflow** can support **annual** decision-grade monitoring.

Fig 1. Coyote Lagoon Aerial Photo _ DJI Air 2S

Fig 2. Orthomosaic — Don Edwards Wildlife Refuge

Methods:

Study Area. South Baylands (incl. Coyote Lagoon / Don Edwards). Total surveyed **>500 acres**.
UAS Platform. DJI Air 2S, FAA Part 107 compliant; flight AGL ~90–120 m; >70% overlap.
Processing. DroneDeploy → OpenDroneMap;
Orthomosaic GSD 9.4 cm; **Dense cloud 46.3M points**;
Classification. VARI thresholding (veg vs. barren).
Accuracy/QA. CE90 = **3.04 m**; LE90 = **0.81 m**; GPS RMS = **2.02 m**; 3D RMS = **0.36 m**.
Flood Sensitivity. Hydrodynamic sensitivity modeling (baseline SLR + 10-yr storm) using elevation & roughness inputs; per-cell inundation deltas summarized.

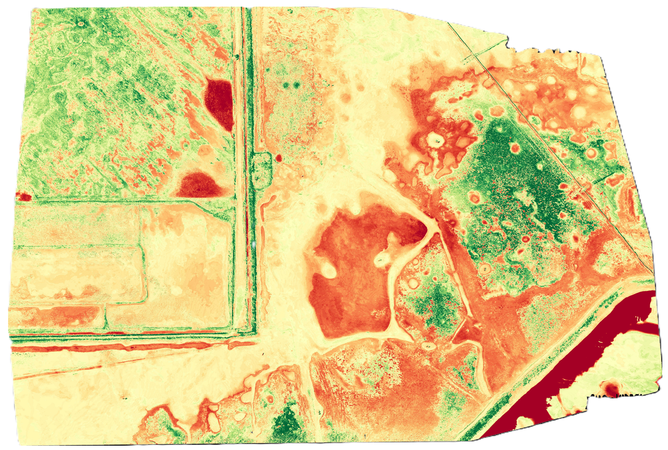

Fig 3. VARI Map. 21% vegetated 79% barren

Conclusions :

- **Vegetation loss** aligns with **higher local inundation** in modeled scenarios.
- A **student-led, low-cost UAS** workflow can provide **annual** decision-support layers.
- **Planners** can target **degraded-but-impactful cells** first to maximize resilience benefits.

Recommendations

- Prioritize restoration in highest-sensitivity cells (map Fig4).
- Institutionalize **annual UAS monitoring** to track recovery and re-rank priorities.
- Integrate layers into county / BCDC planning for **cost-effective** mitigation.

Contact: srivathsan.ramanujam@gmail.com

norcalconservation.com