

Background

Giant kelp is an important brown algae (NOAA 2024) that protects shorelines from erosion, absorbs carbon, and is habitat for hundreds of species (Hall 2024).



Figure 1: Giant kelp forest.
Credit: Douglas Klug, Getty. <https://www.nature.com/articles/d41586-023-01307-3>

Urchins graze on kelp and high densities (9-24 urchins/m²) drove large declines in California kelp forests (Catton & Rogers-Bennett 2019).



Figure 2: Sea urchin barren.
Credit: Ed Bierman, CC BY 2.0. <https://utmsi.utexas.edu/science-and-the-sea/radio-program/urchin-smorgasbord/>

Some Santa Cruz kelp forests started recovering in 2023, but the reason is not known.

People rarely access Santa Cruz kelp beds because the visibility is poor.

Kelp declined, then recovered

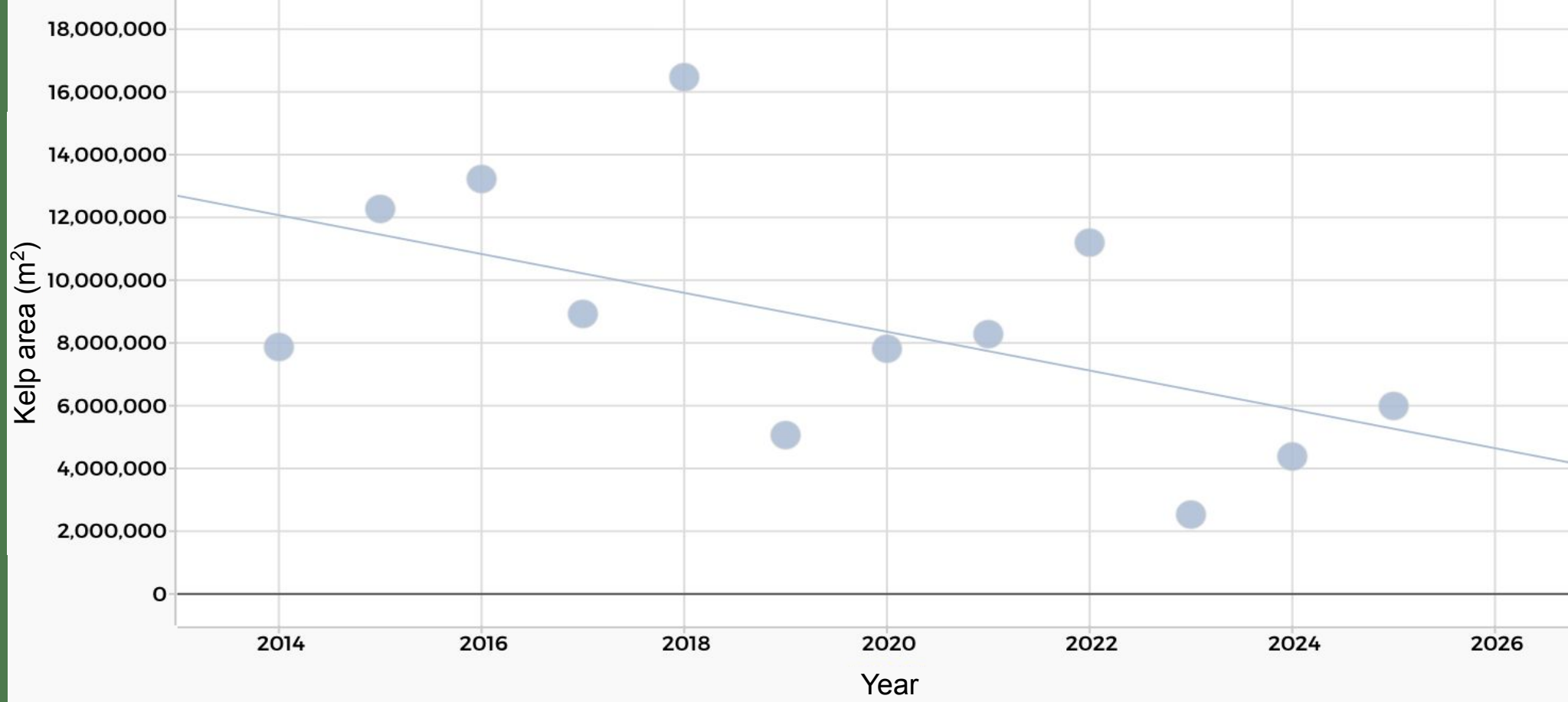


Figure 3. Total kelp area around Santa Cruz in the Monterey Bay.

Graph created by finalist using CODAP, 2026.

Investigating the Relationship of Sea Urchins (*Echinoidea*) to Giant Kelp (*Macrocystis pyrifera*) Bed Recovery

Santa Cruz Giant Kelp Beds are Recovering Despite Sea Urchins

Question

Do giant kelp beds that are recovering have fewer urchins than giant kelp beds that are not recovering?

Hypothesis

Kelp forests that are recovering will have fewer urchins than kelp forests that are not recovering, because urchins are the main consumers of kelp.

1. Find kelp status using satellite data

Trend in yearly kelp area 2023-2025 from Landsat imagery on kelpwatch.org

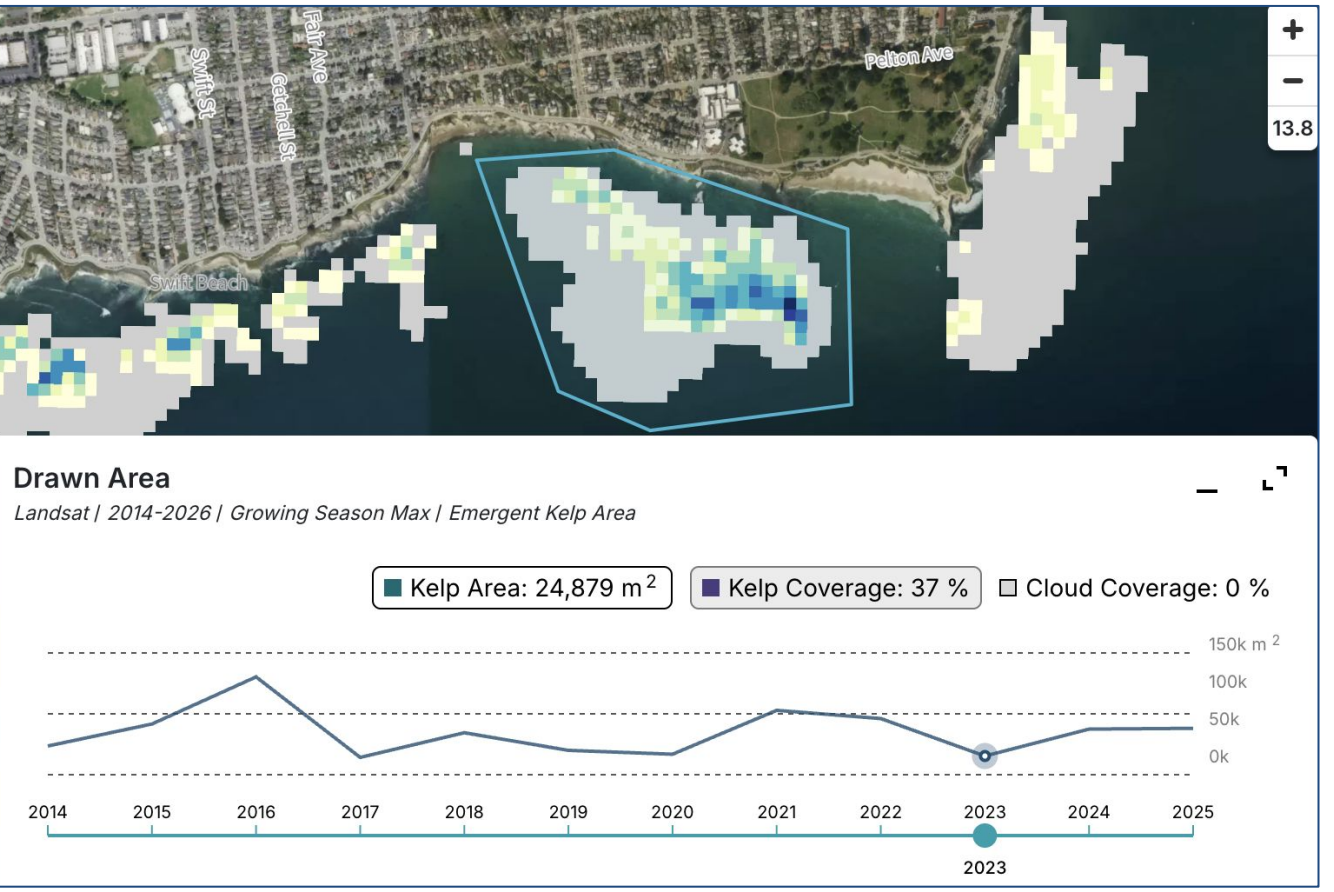


Figure 4: Screenshot of kelpwatch.org.
Screenshot taken by finalist from kelpwatch.org, 2026.

2. Video seafloor with underwater robot

3-minute video with a Trident Remotely Operated Vehicle (ROV).



Figure 5: Attaching tether to ROV (top). Driving ROV (below).
Photos taken by finalist's parent, Malin Pinsky, 2026.

3. Count urchins in videos

Identify maximum number of urchins in a video frame per video.



Figure 6: Screenshot of urchins in video frame.
Screenshot taken by finalist and modified using Preview, 2026.

Where I did my research

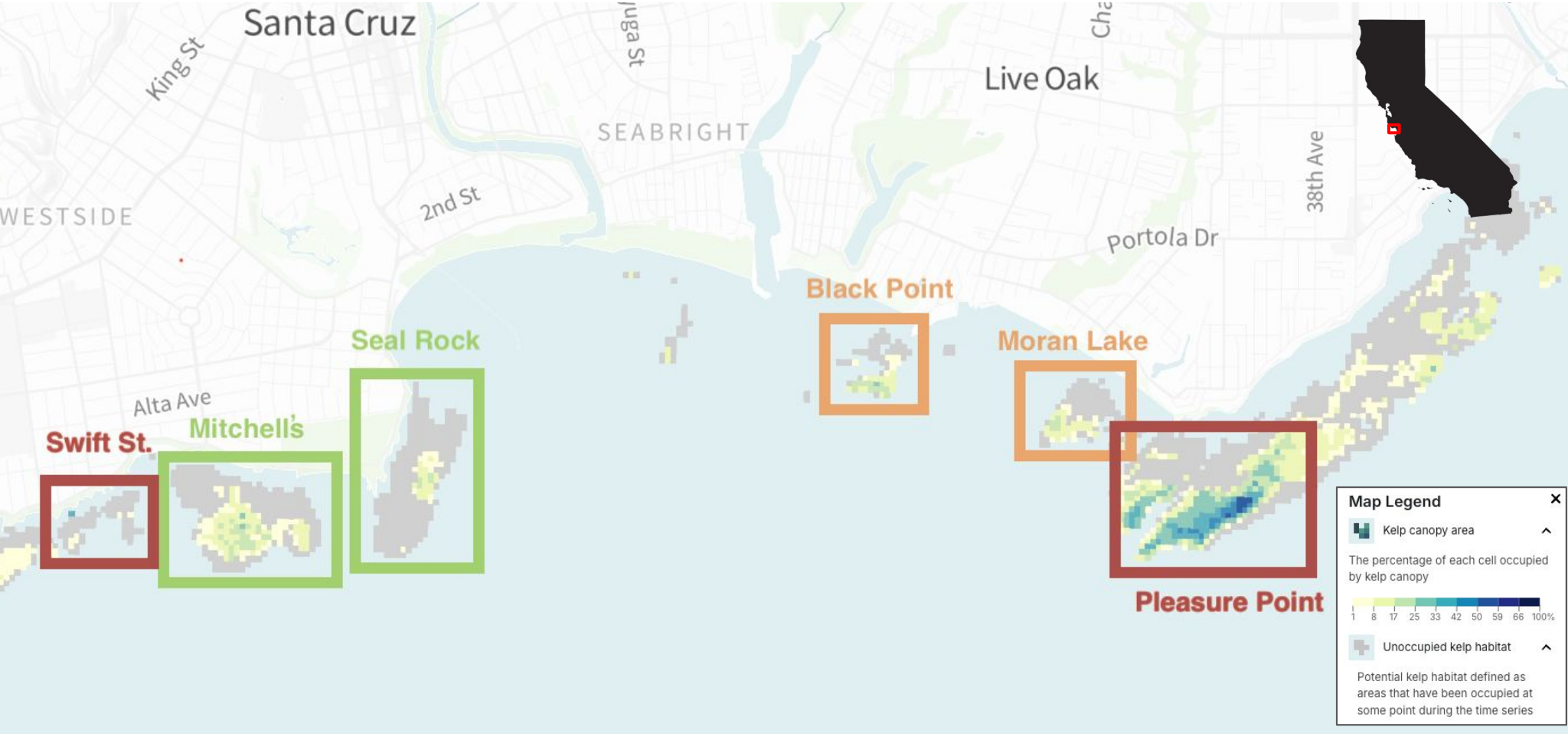


Figure 8. Boxes show whether kelp beds are **Not recovering**, **Stable**, or **Recovering**.
Screenshot from kelpwatch.org, modified using Preview and Google Slides by finalist, 2026.

Conclusions

An ROV provided new information and access to kelp beds where divers rarely go.

Low densities at all locations suggest that urchins are not preventing recovery.

Results suggest urchin culling would not improve kelp recovery.

Next Steps

- Study impact of wave direction, temperature, turbidity, and storm exposure on kelp bed recovery throughout Monterey Bay.
- Use a more stable ROV to provide more consistent transects and clearer videos.
- Use a motorboat to access more kelp beds.

Urchin density was low in kelp beds across recovery status

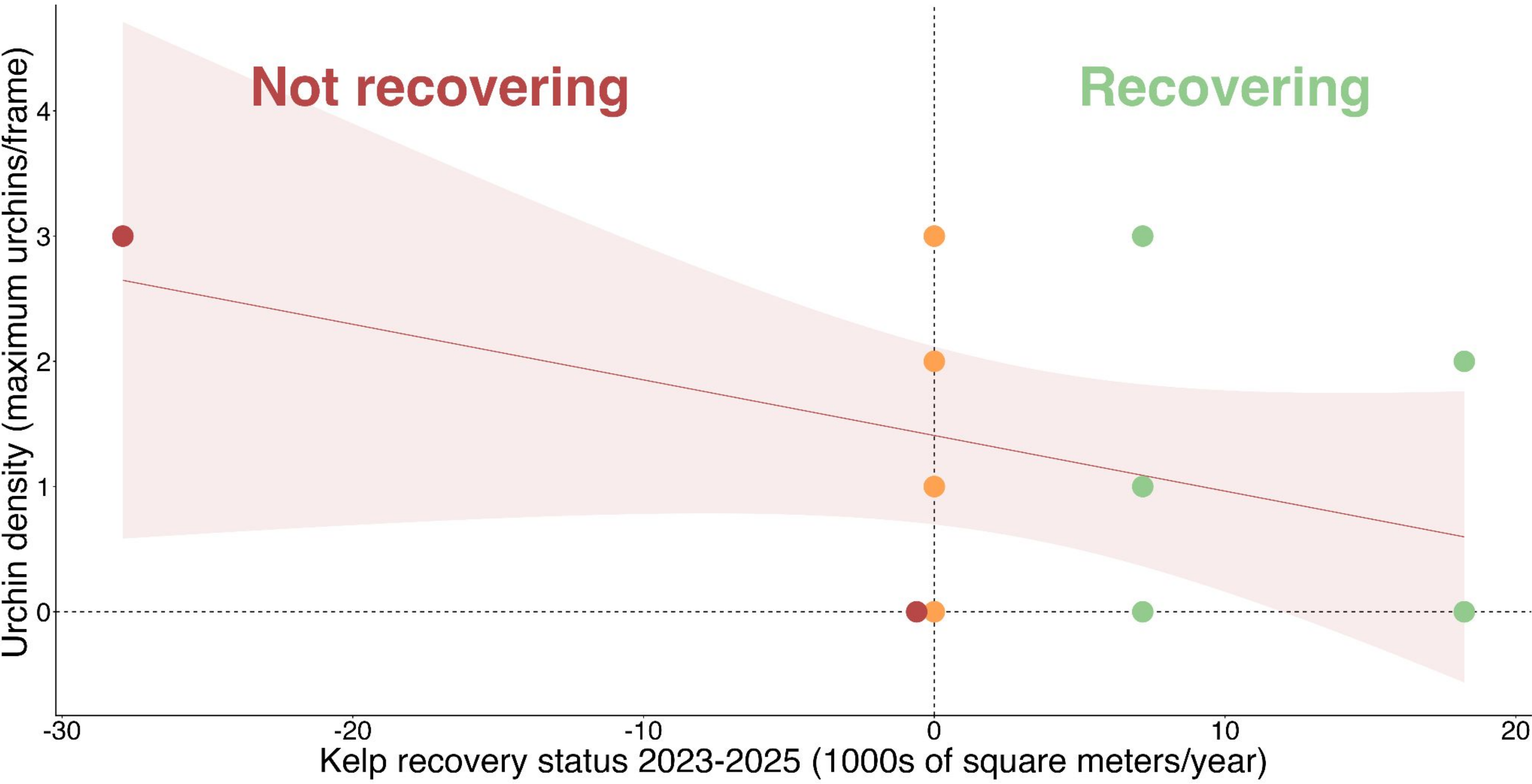


Figure 7. Urchin density was not strongly related to kelp bed recovery ($r^2 = 0.15$). Line is a linear regression with 95% confidence interval.

Graph created by finalist in CODAP and updated for size by finalist's parent, Malin Pinsky, using R, 2026.

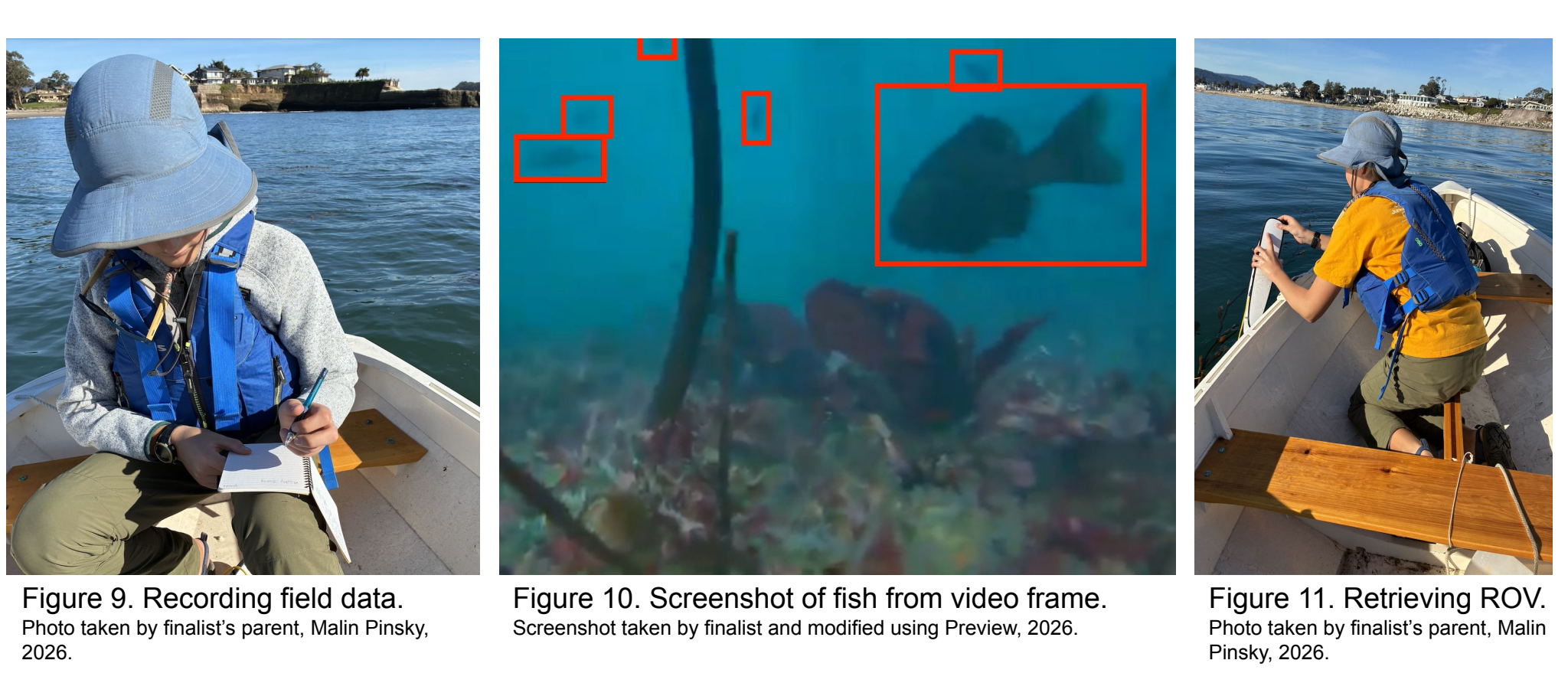


Figure 9: Recording field data.
Photo taken by finalist's parent, Malin Pinsky, 2026.

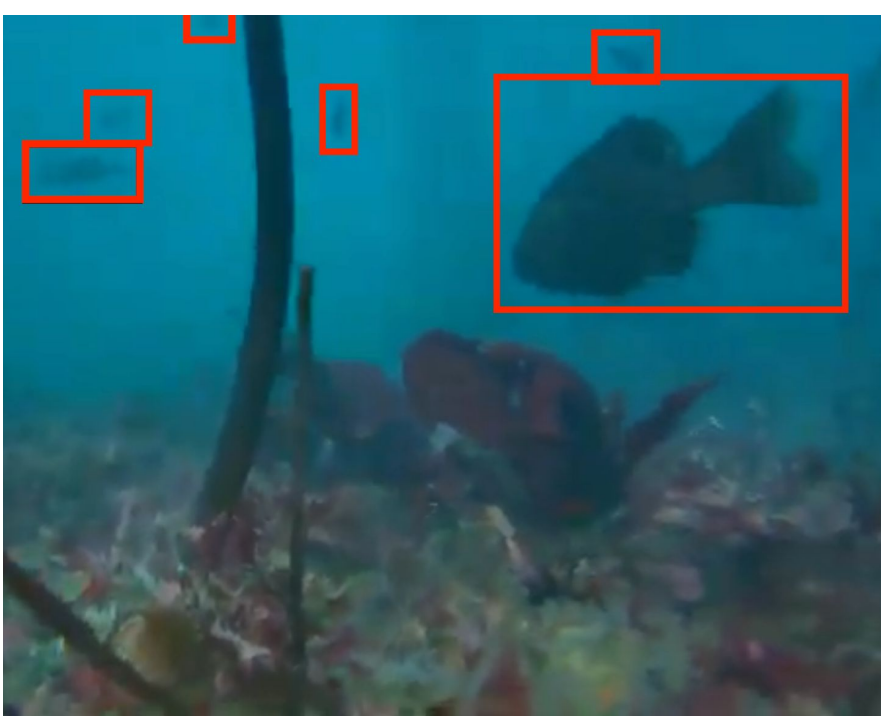


Figure 10: Screenshot of fish from video frame.
Screenshot taken by finalist and modified using Preview, 2026.



Figure 11: Retrieving ROV.
Photo taken by finalist's parent, Malin Pinsky, 2026.

References

- Catton C. A. & Rogers-Bennett L. (2019). Marine heat wave and multiple stressors tip bull kelp forest to sea urchin barrens. *Scientific Reports* 9: 15050. <https://doi.org/10.1038/s41598-019-51114-y>
- Hall, D. (2024). Kelp and Kelp Forests. Accessed Jan. 21, 2026. <https://ocean.si.edu/kelp-and-kelp-forests>
- NOAA. (2024). Kelp Forest Habitat on the West Coast. Accessed Jan. 29, 2026. <https://www.fisheries.noaa.gov/west-coast/habitat-conservation/kelp-forest-habitat-west-coast>