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Effects of Freshwater on Purple Sea Urchin and Bull Kelp Dynamicx at the Mouths of Rivers Along the Mendocino Coast

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Recommended Citation

Storey, Marina; Shirah, Isabelle; Jackson, Duncan; and Moitoza, Franklin, "Effects of Freshwater on Purple Sea Urchin and Bull Kelp Dynamicx at the Mouths of Rivers Along the Mendocino Coast" (2024). *IdeaFest 2024*. 139.

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Preliminary Effects of Freshwater on Purple Sea Urchin and Bull Kelp Dynamics at the Mouths of Rivers Along the Mendocino Coast

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INTRODUCTION

- Anthropogenic stressors have increased *S. purpuratus* (purple sea urchin) populations eradicating the dominate macroalgae *N. luetkeana* (bull kelp) along the Eastern Pacific in the last decade.^{4,5} Many economic and ecologically important fish and invertebrate species rely on kelp for habitat, food, and shelter.^{8,9}
- Urchins are voracious herbivores that mow down kelp forests turning them into urchin barrens.⁶ This regime shift from kelp forests to urchin barrens has led to the closer of the red abalone fishery which had an estimated value of \$44 million dollars.
- In Mendocino CA, bull kelp has been observed persisting at the river mouths in making an interest to local and scientific communities. Urchins are known to not do well with lower salinities possibly leading to this phenomenon.^{3,7}



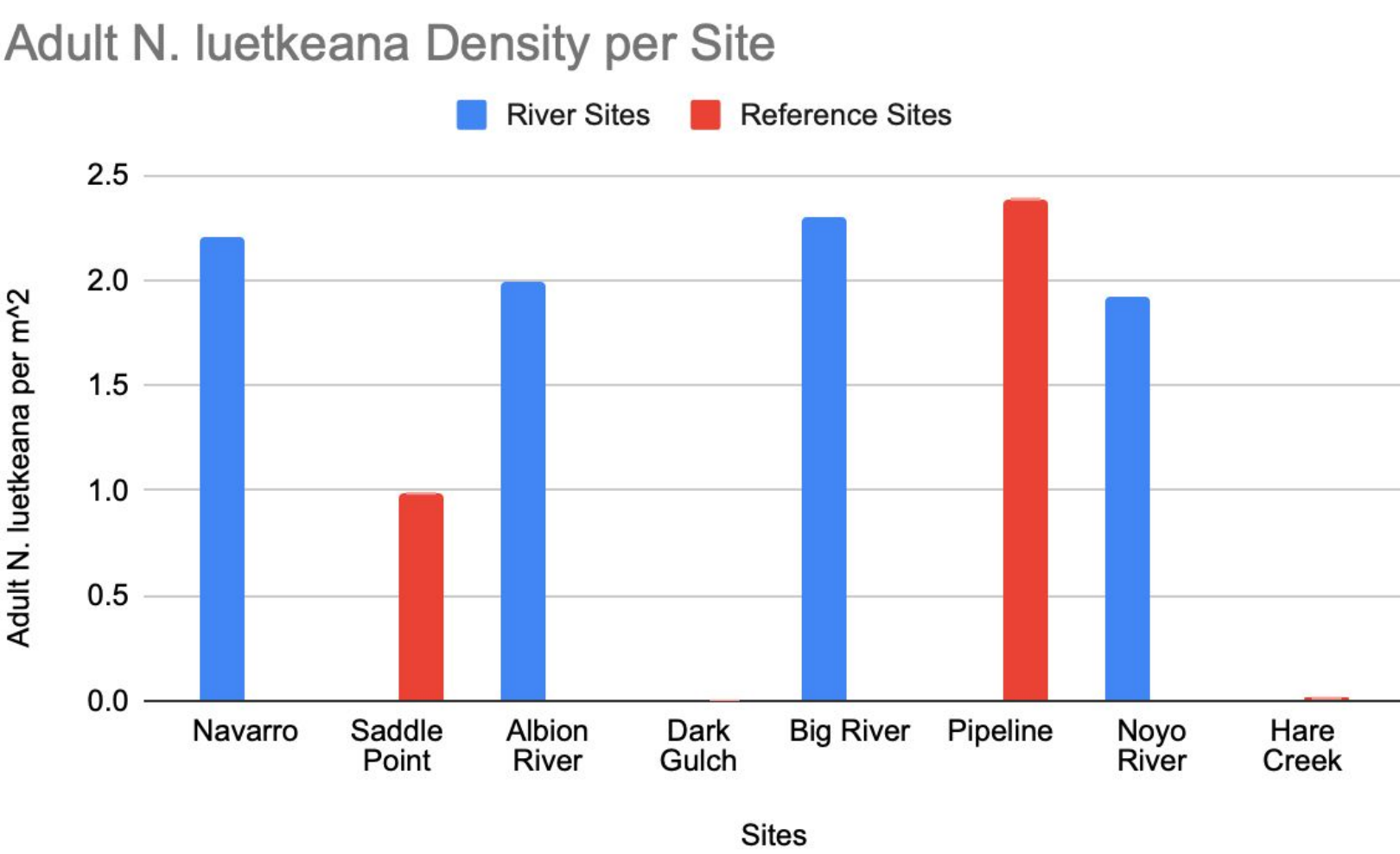
METHODS

- Data for species abundance and densities at all sites was collected in 2023. Sampling was conducted by divers placing a 5m transect tape and counting *S. purpuratus*, *N. luetkeana*, and other species that may influence kelp and urchin abundances, within a meter of each side of the tape. Eight transects were completed at each site.
- Other species that were counted include *M. franciscanus* (red urchins), *P. ochraceus* (Ochre star), *P. giganteus* (Giant Spined star), *D. imbricata* (leather star), *L. setchellii* (Setchell's kelp), *P. californica* (stalked kelp).
- Juveniles for *N. luetkeana* (<1m), pisaster (Juvenile Pisaster) and laminariales (Juvenile laminariales) species to small to identify to species.

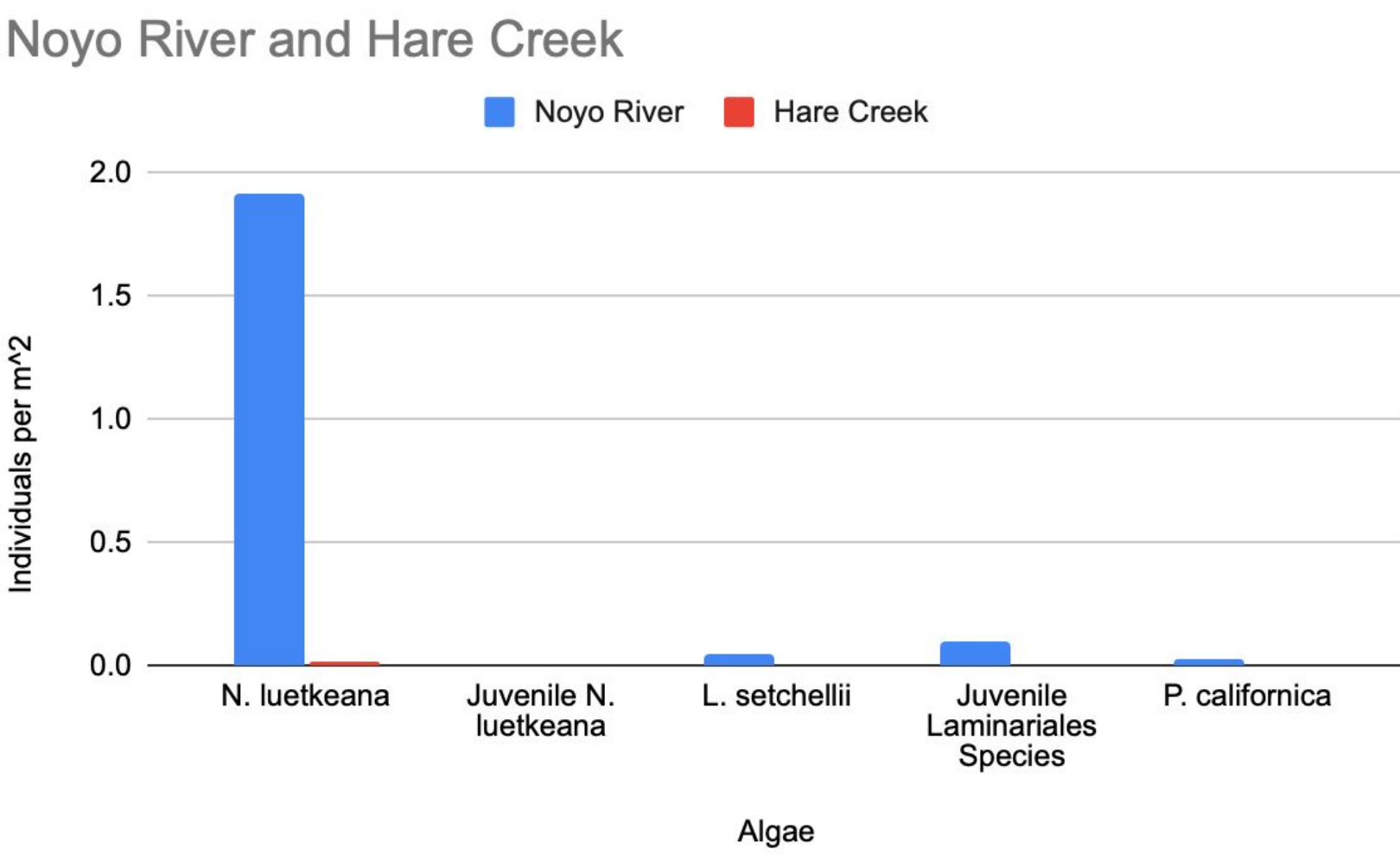
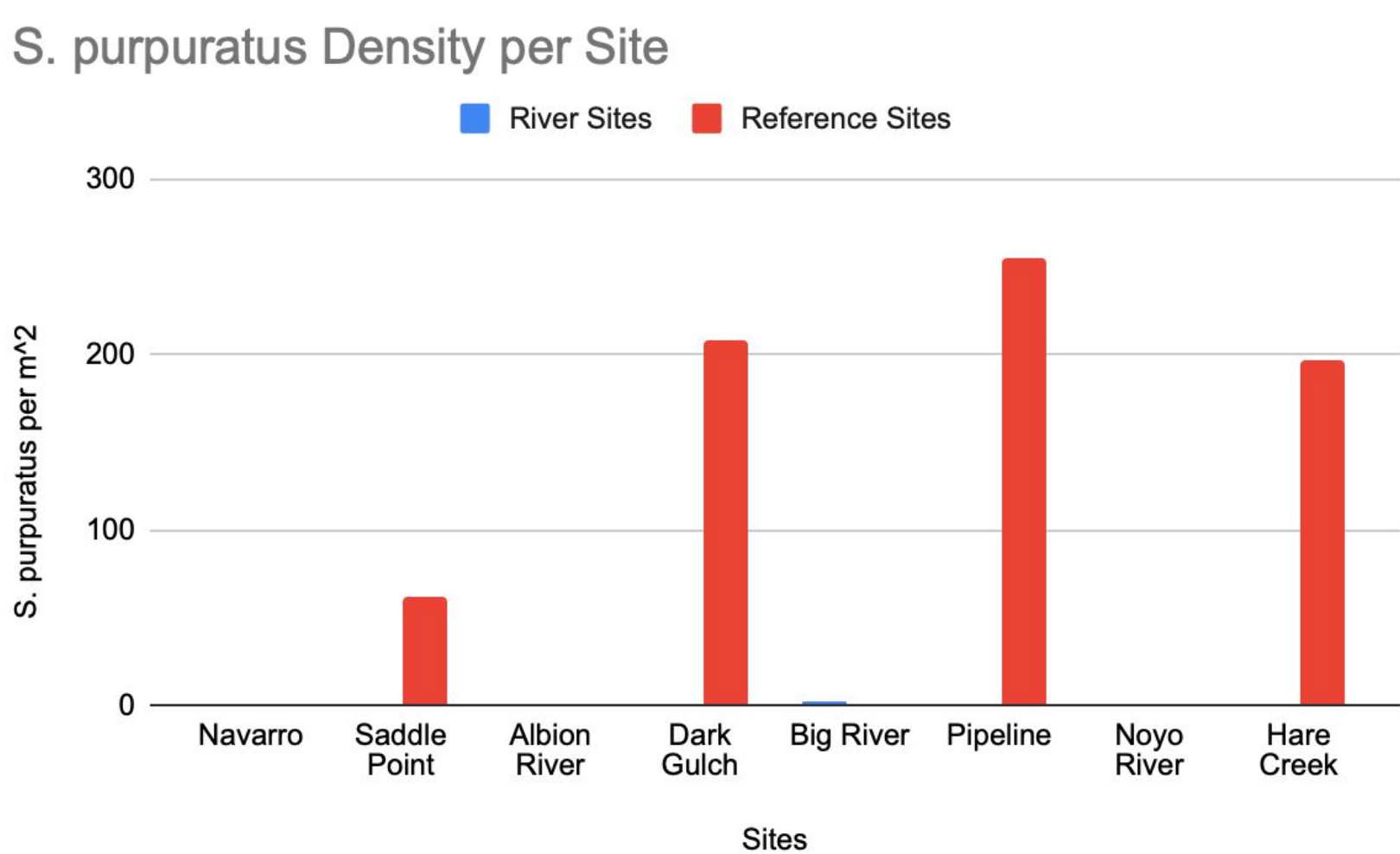
Results

- No significant difference between river mouths and reference sites for *N. luetkeana* densities (p-value = 0.110).
- Significant difference between river mouths and reference sites for *S. purpuratus* density (p-value =0.023*)
- All site pairs had no significant difference between river mouths and reference sites for *N. luetkeana*.
- All site pairs had a significant difference between river mouths and reference sites for *S. purpuratus* densities.
- All site pairs had significance of 0.05 or less and Albion and Dark Gulch were highly significant with a difference less than 0.001 for *S. purpuratus* densities.

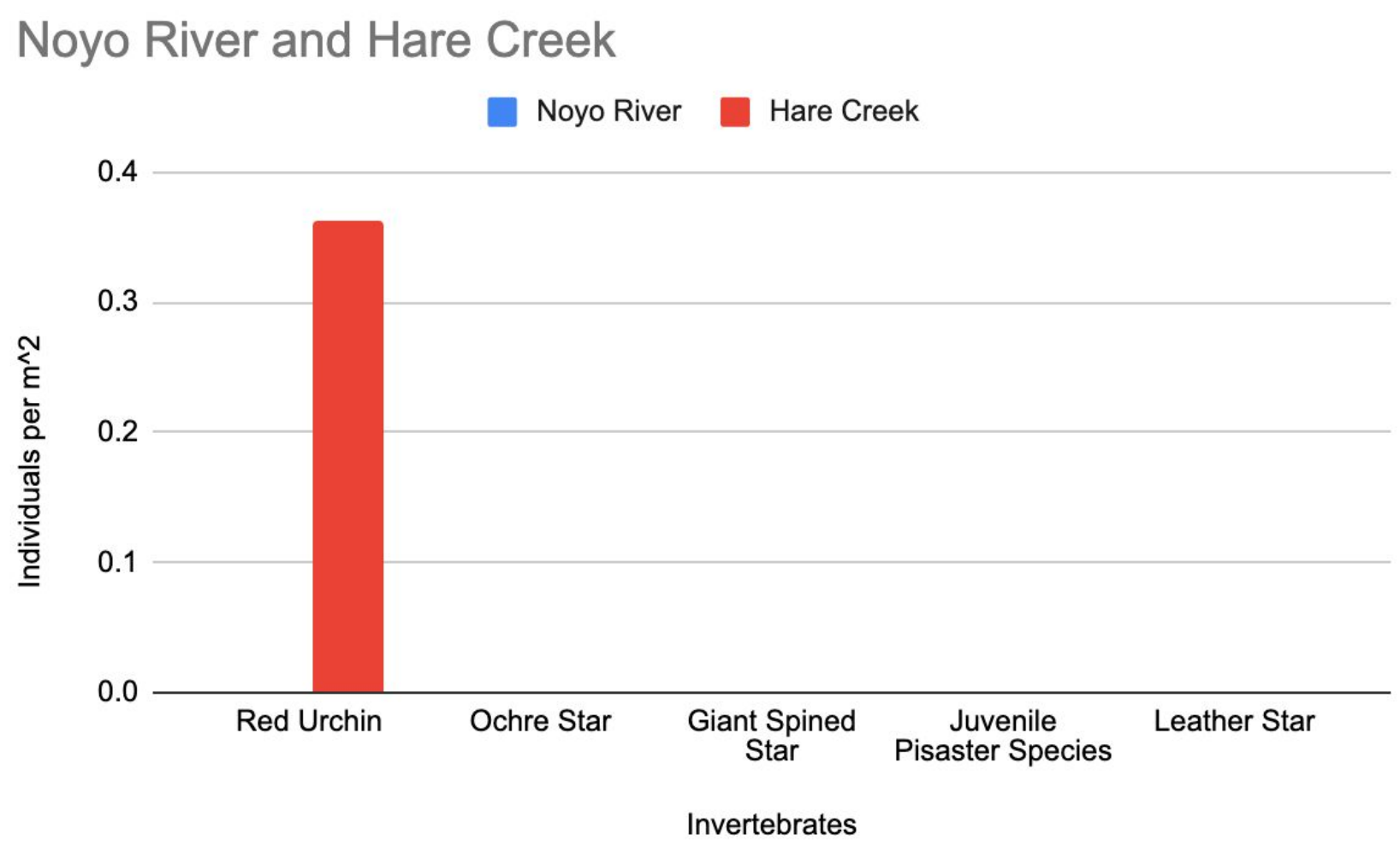
RESULTS



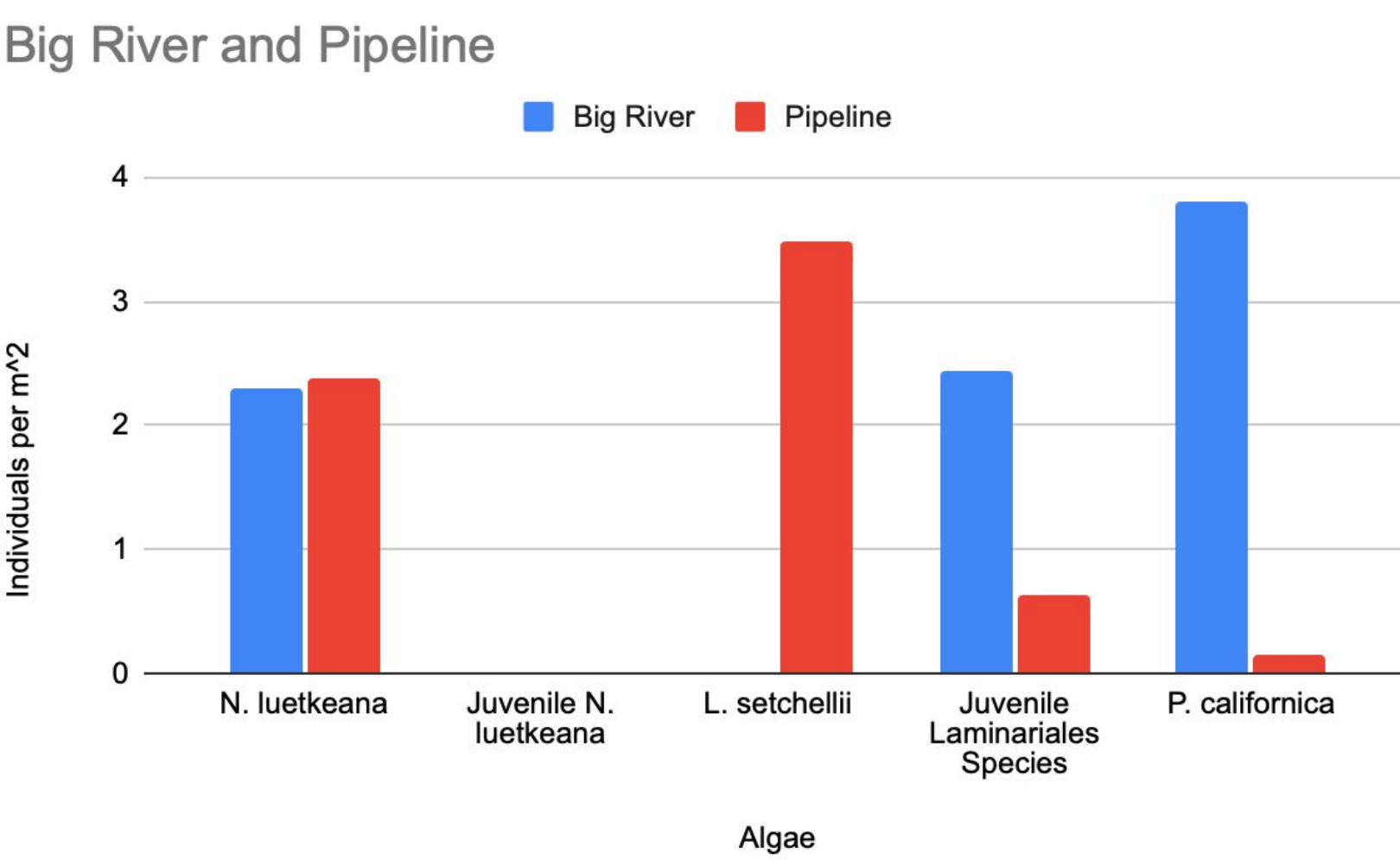
(Left) Adult *N. luetkeana* densities (indiv./m²) from all sites, river sites in blue and reference sites in red. p-value = 0.110). (Right) *S. purpuratus* densities(indiv./m²) from 2 all sites, river sites in blue and reference sites in red. P-value = 0.008*



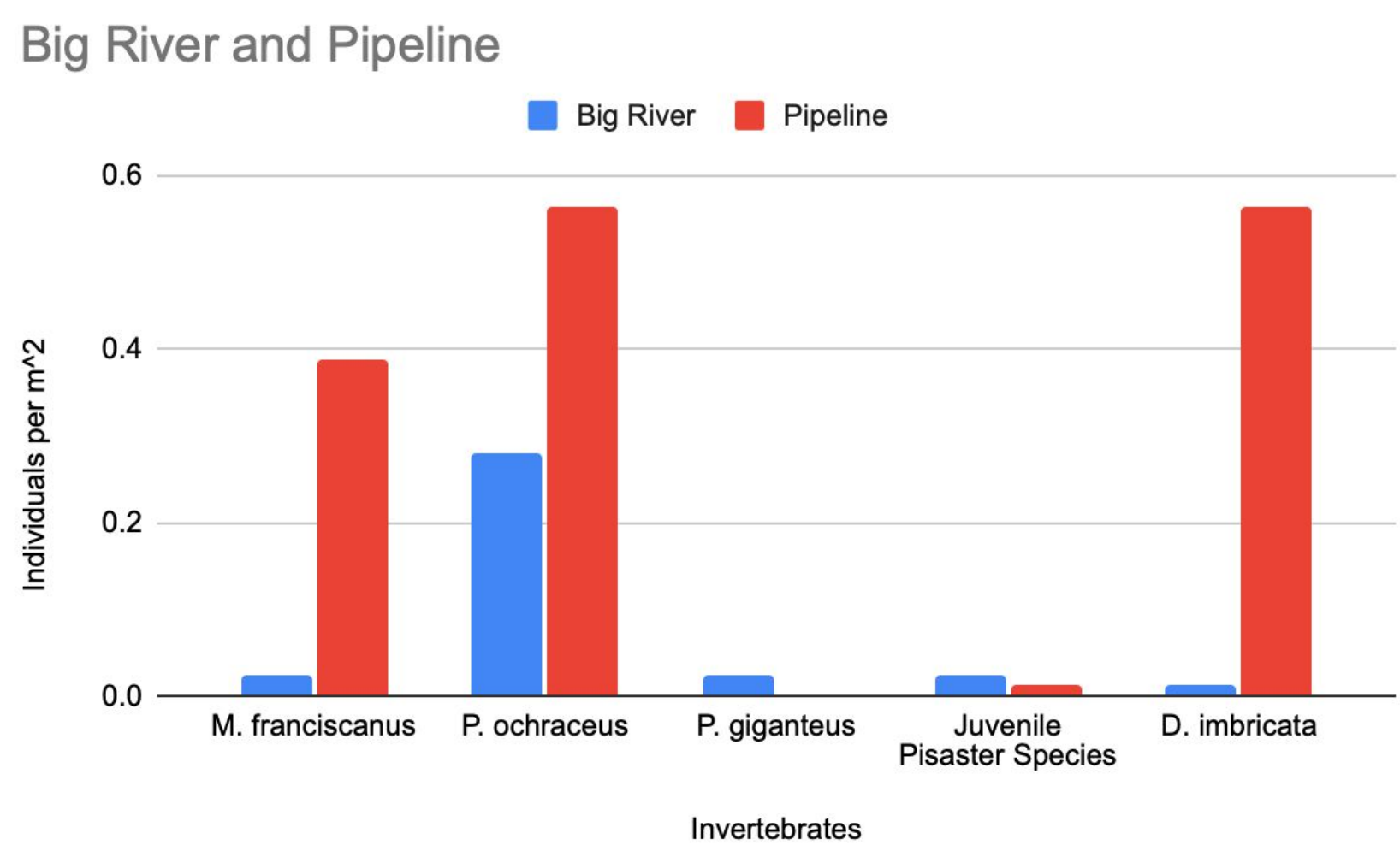
Algae densities (indiv./m²) for Noyo River and Hare Creek, river sites in blue and reference sites in red. P-value = 0.085, for Adult *N. luetkeana*.



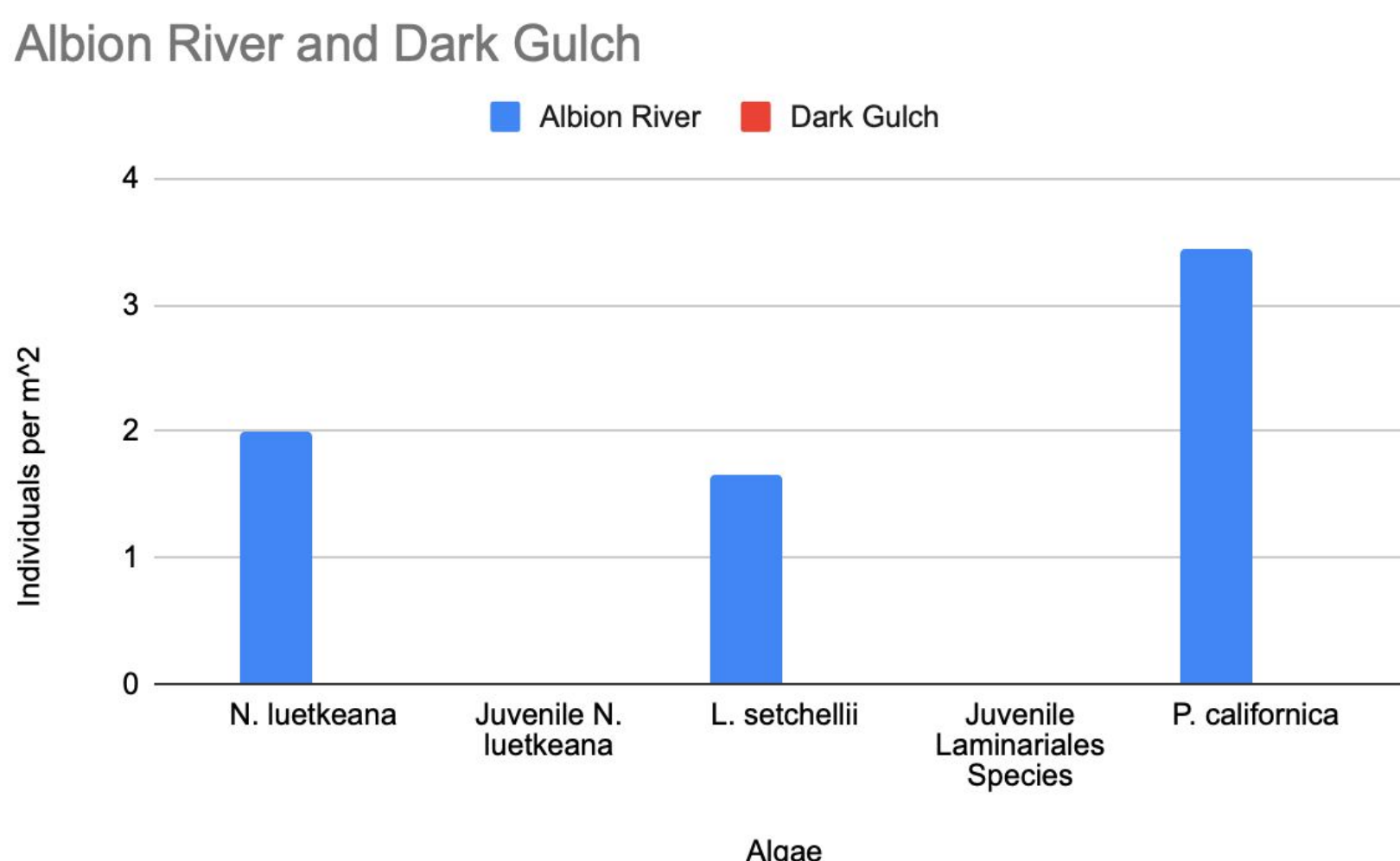
Invertebrate densities (indiv./m²) for Noyo River and Hare Creek, river sites in blue and reference sites in red. (excluding *S. purpuratus* due to scaling) P-value = 0.008* for *S. purpuratus*.



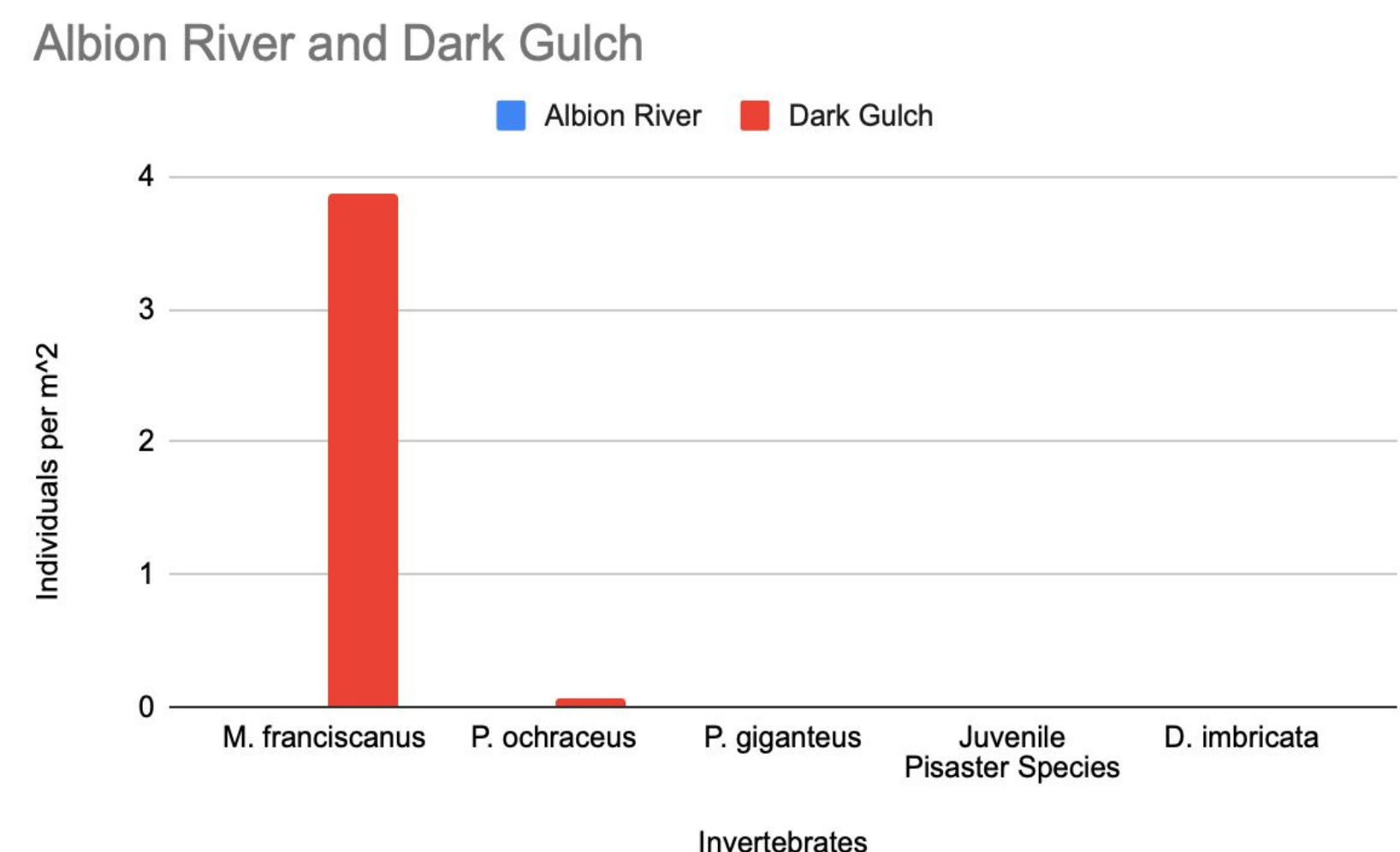
Algae densities (indiv./m²) for Big River and Pipeline (Mendocino Headlands), river sites in blue and reference sites in red. P-value = 0.909 for Adult *N. luetkeana*.



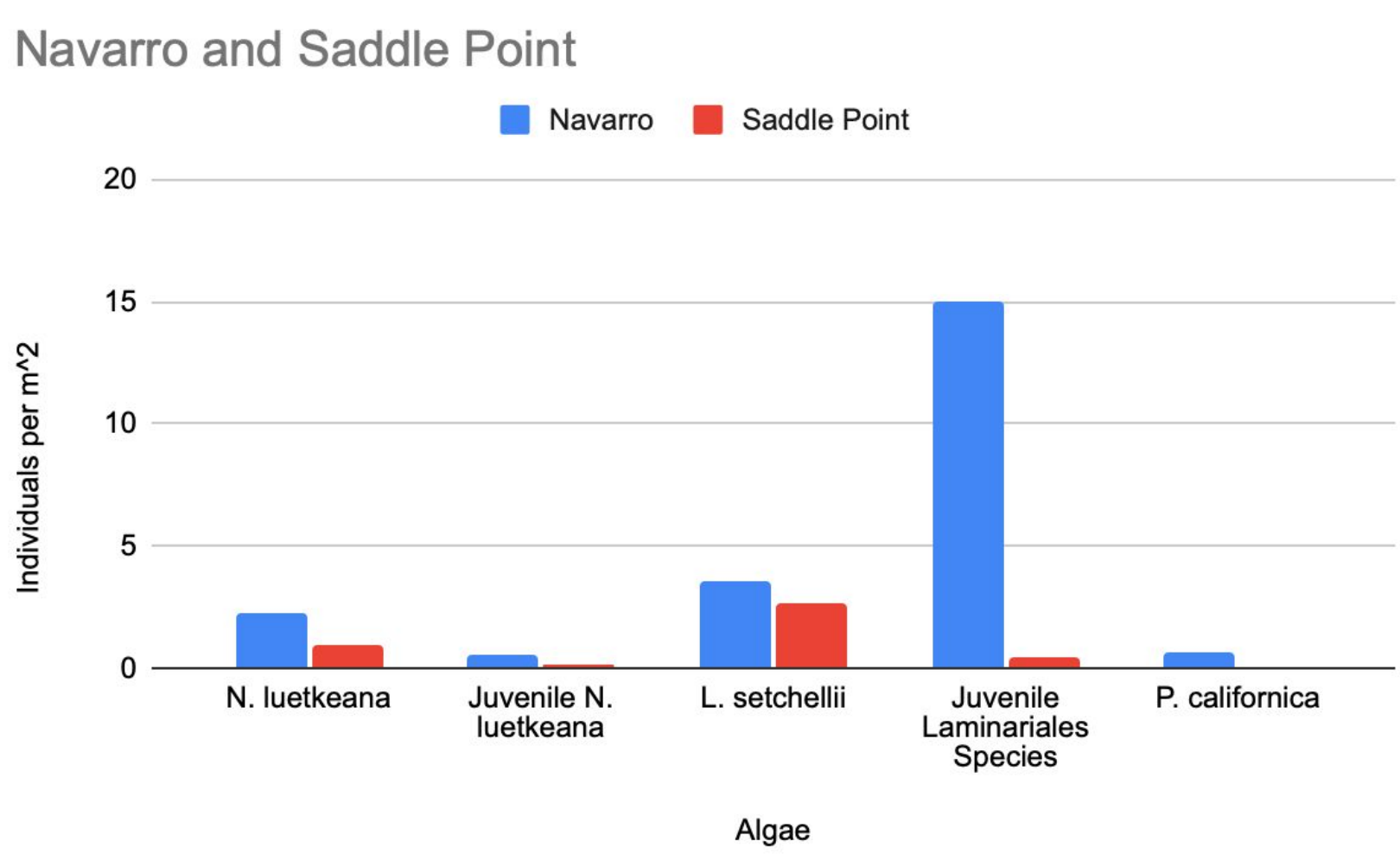
Invertebrate densities (indiv./m²) for Big River and Pipeline (Mendocino Headlands), river sites in blue and reference sites in red. (excluding *S. purpuratus* due to scaling) P-value = 0.002* for *S. purpuratus*.



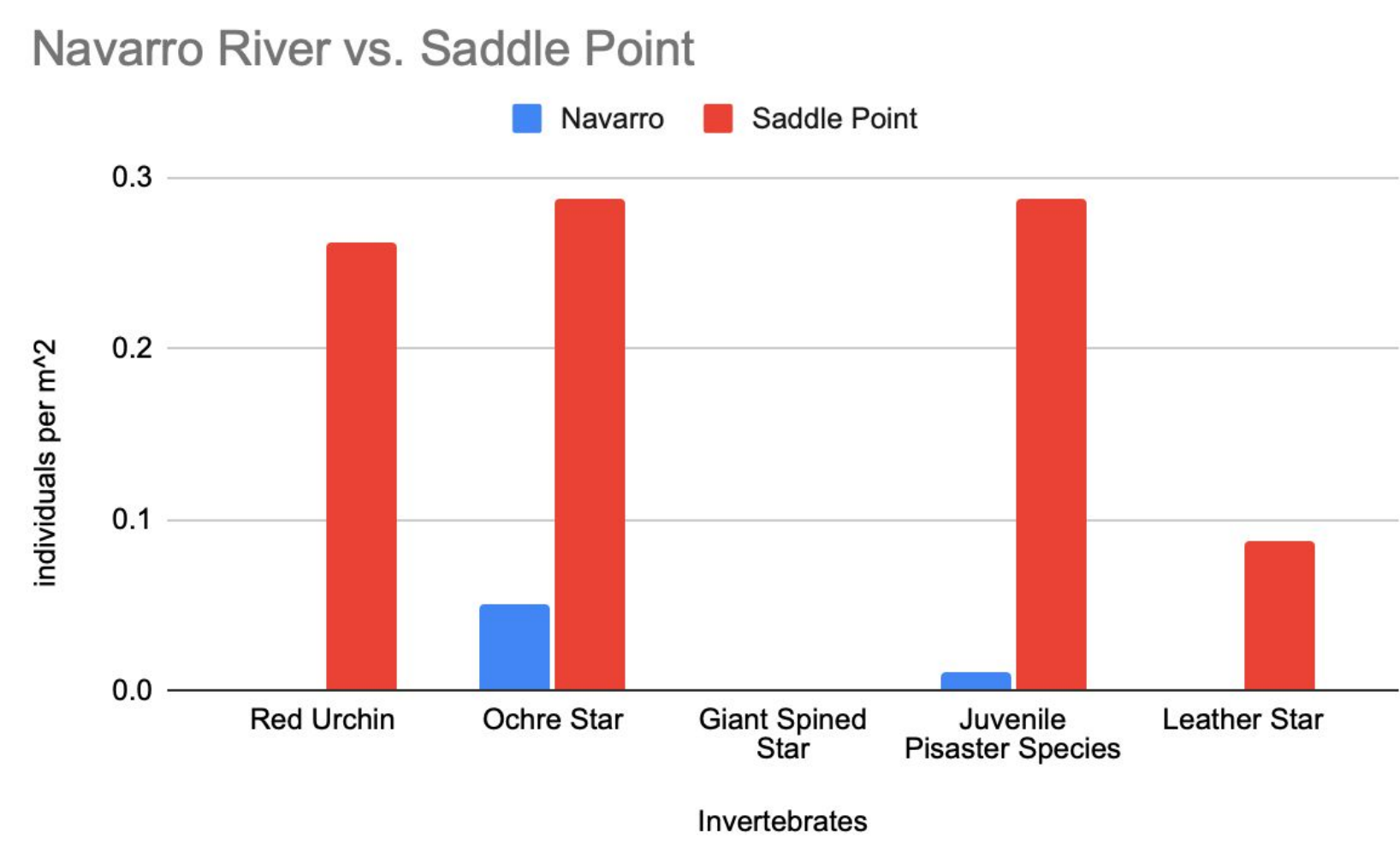
Algae densities (indiv./m²) for Albion and Dark Gulch, river sites in blue and reference sites in red. P-value = 0.064 for Adult *N. luetkeana*.



Invertebrate densities (indiv./m²) for Albion and Dark Gulch, river sites in blue and reference sites in red. (excluding *S. purpuratus* due to scaling). P-value = 0.0000006** for *S. purpuratus*.



Algae densities (indiv./m²) for Navarro and Saddle Point, river sites in blue and reference sites in red. P-value = 0.082 for Adult *N. luetkeana*.



Invertebrate densities (indiv./m²) for Navarro and Saddle Point, river sites in blue and reference sites in red. (excluding *S. purpuratus* due to scaling). P-value = 0.035* for *S. purpuratus*.

ACKNOWLEDGEMENTS

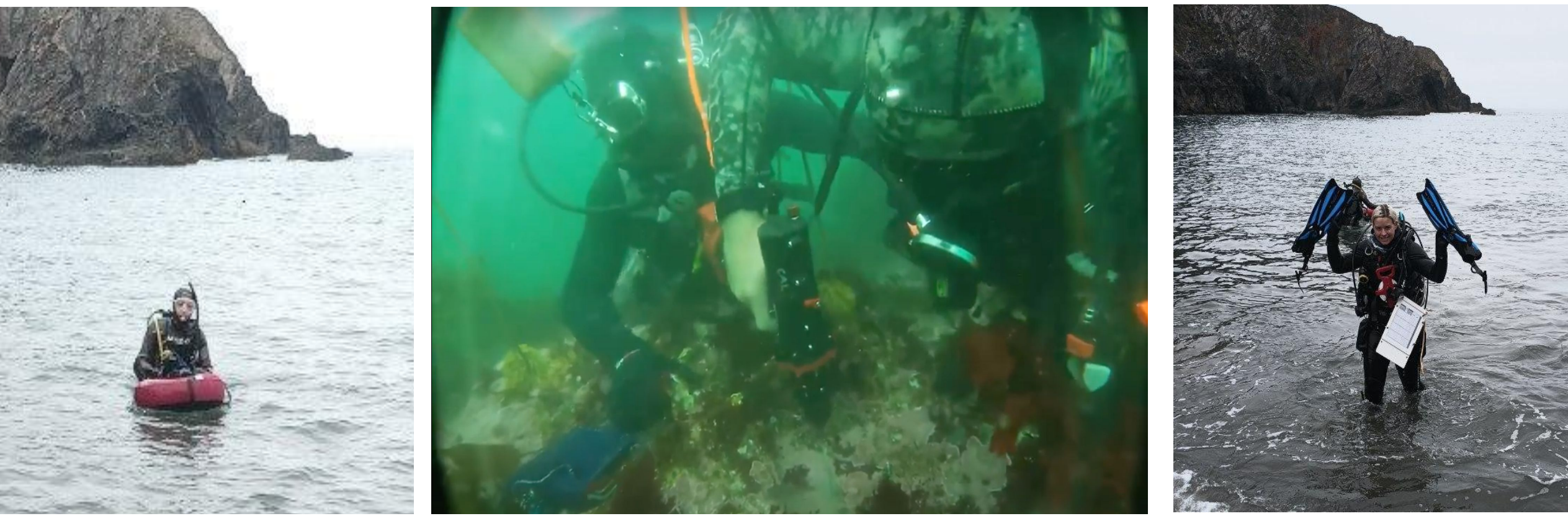
We would like to thank our many scientific divers for their hard work. We would also like to thank Cal Poly Humboldt Diving Safety Officer Rich Alvarez and Boating Safety Officer Steve Monk. This work was completed in collaboration with our partners at UCSC, and UCD. Funding was provided by the National Science Foundation.



Figure 11. Map of sites, River sites in blue and reference sites in red, Noyo and Hare Creek top left, Big River and Mendocino Headlands top right, Albion and Dark Gulch bottom left, Navarro and Saddle Point bottom right.

DISCUSSION

- Our results show that there is strong evidence that these persisting kelp beds at the mouths of river are due to a lack of *S. purpuratus* in these areas. We are able to reject our null and suggest that the riveting sites have a negative effect on *S. purpuratus* with a neutral effect on *N. luetkeana*.
- Further research will be conducted in the lab to see the effects of lower salinities on *N. luetkeana* gametophyte and sporophyte growth and *S. purpuratus* grazing and behavior.
- Our group has also put out Van Essen conductivity loggers to measure the salinity at three river mouths and three reference sites so far. We hope to collect annual data showing changes in salinity.
- We will also be deploying recruitment brushes to assess the urchin larval recruitment and performing urchin gonad index² assessments at these sites in the near future.



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