Lobster Bait Project: Current Development of Optimized Carrageenan-Based Bait

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Abstract

Heavy reliance on increasingly limited quotas of Atlantic herring and changing fish migration patterns due to the warming of oceans are currently contributing to the volatility of the lobster fishery. While meat alternatives to herring exist, they raise environmental and consumer concerns. This project aims to provide a reliable bait source to address the shortages caused by policies and habitat change.

The goal is to develop competitive alternative lobster bait from local, commercially available ingredients and waste products of local seafood processing, to increase the resilience of the lobster fishery.

Approach

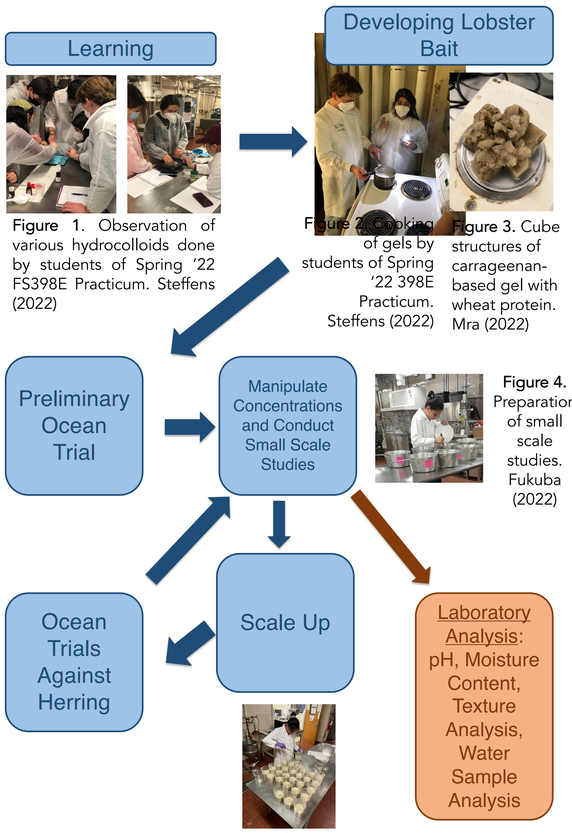

Figure 1. Observation of various hydrocolloids done by students of Spring '22 FS398E Practicum. Steffens (2022)

Figure 2. Cooking of gels by students of Spring '22 398E Practicum. Steffens (2022)

Figure 3. Cube structures of carrageenan-based gel with wheat protein. Mra (2022)

Figure 4. Preparation of small scale studies. Fukuba (2022)

Figure 5. Scale up of carrageenan-based bait. Fukuba (2022)

Results

Measurement of Phosphorous and Nitrogen Released from Lobster Bait Over Time Using Ocean Water in Tanks

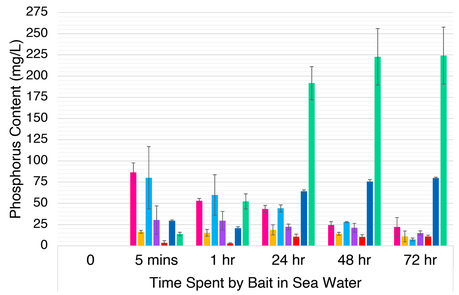

Figure 6. Average Phosphorus Content in 50mL Samples from Sea Water Containing Various Traditional and Alternative Bait

Note: Phosphorus content is PO4-P in samples.

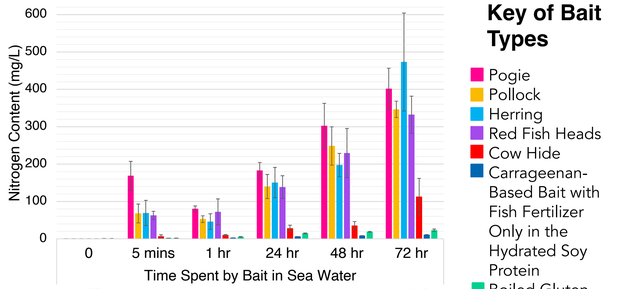

Figure 7. Average Nitrogen Content in 50mL Samples from Sea Water Containing Various Traditional and Alternative Bait

Note: Nitrogen content is the sum of NH4-N and NO3-N in samples.

Note: To determine the release of phosphorus and nitrogen into ocean water, various conventional and alternative baits were placed into saltwater tanks in triplicate and 50mL water samples were obtained from the tanks over time. Water sample analysis was conducted by University of Maine's Analytical Lab and Maine Soil Testing Service.

Optimization of Carrageenan-Based Bait

Table 1. Product Formulations of Different Carrageenan-Based Bait

Variants	Description	% of Carrageenan	% of KCl	% of Fish Fertilizer	% of TVP
V1	Carrageenan Base with TVP to Fertilizer Ratio of 1:4 Produced on 07.27.2022	1.17	1.17	26.67	6.66
V2	Carrageenan Base with TVP to Fertilizer Ratio of 1:7 Produced on 08.03.2022	1.17	1.17	29.15	4.17
V3	Carrageenan Base with TVP to Fertilizer Ratio of 1:4 Produced on 08.09.2022	1.33	1.33	26.66	6.67
V4	Carrageenan Base with TVP to Fertilizer Ratio of 1:7 Produced on 08.09.2022	1.33	1.34	29.16	4.17

Note: Selected prototypes where then sent to the Gloucester Marine Station to compare the bait performance to herring.

Table 2. Performance of Different Carrageenan-Based Bait Against Herring

Variants	Photos		Time Survived		Catch Lobsters?	Herring vs. Variant
			24 hr	72 hr		
V1	N/A*	N/A*	✓	X	✓	Herring
V3	a	b	N/A**	X	✓	Herring
V4	c	N/A*	N/A**	X	✓	Herring

Note: The variants listed are the same as the ones showed in Table 1. The photos are of the variants with a diameter and height of 8cm. a, Top View of V3; b, Side View of V3; c, Top View of V4. Mra (2022) "N/A*" indicates missing data. The last column shows which bait, when compared against herring, caught more lobsters on average.

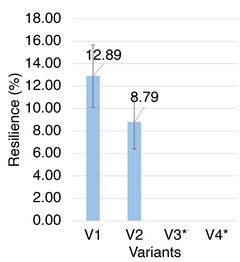

Figure 8. Average Resilience of the Variants Shipped to Gloucester

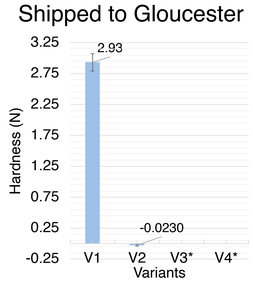

Figure 9. Average Hardness of the Variants Shipped to Gloucester

Note for Figures 8 & 9: Measurements were taken from 2x2x2cm cube samples. "*" indicates samples that were unfit for an accurate measurement.

Conclusions

- According to the trials involving the ocean water tanks, the release of phosphorous and nitrogen suggest that the bait alternatives slowly release the attractant (gurry from the fish fertilizer) into sea water over time.
- Compared to herring as control, field trials indicate that carrageenan-based bait are less resilient, resulting in complete loss of bait shortly after 24 hours.

Future Work

Product Development:

- Continue to optimize the carrageenan-based bait
  - Needs to last at least 72 hours
  - Data from supplier of carrageenan, ISI, suggests that decrease to current KCl to carrageenan ratio can lead to firmer carrageenan-based bait
- Investigate if gluten based structures are more resilient than carrageenan-based structures under real ocean conditions

Stakeholder Engagement:

- Conduct interviews with local lobstermen to understand potential barriers of acceptability of alternative bait and strengthen a collaborative relationship for feedback on future bait development

References

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Acknowledgments

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