Building confidence: Developing a method to reduce barriers to entry and incorporate fishermen in data collection

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Abstract

The ASMFC's American Lobster Stock Assessment requires estimates of molt increment and interval to parameterize the growth transition matrix (GTM) that models how lobsters of different sizes will grow and recruit into the fishery. Tagging studies are an effective method to collect this type of information, but industry buy-in can be challenging. Here, we released 17,704 tagged lobsters in the Gulf of Maine and Georges Bank regions 2015 - 2020 (Henninger et al. 2020). Harvesters were encouraged to submit images of recaptured lobsters with a standard lobster gauge as a scale to estimate carapace length (CL) using ImageJ. Images were analyzed to produce length records and each was assigned a quality score. Image-derived lengths were found to correlate well with measured observations, regardless of the overall image quality. Validating this image-based method of length estimation provided additional length records and increased the likelihood of harvesters contributing data with broad potential for citizen-science applications.

Methods

- To investigate connectivity and collect updated growth information for data poor lobster demographies i.e. large reproductive females, 17,704 lobsters were tagged and released in LCMA 1 and LCMA 3.
- A subset of submitted recapture images with direct measurements and ImageJ length estimates were used to calibrate regression models, *Obs. Length ~ Image Length* and *Obs. Length ~ Image Length + Image Quality*.
- The parsimonious model was selected and used to predict length estimates for an additional 251 images without direct measurements.

Industry Outreach

Figure 1: Example images with traffic light color grading, where a green border is given to a high-quality image, yellow is intermediate quality, and red is low quality.

- The project partners requested industry submit images with recaptures for ImageJ length analysis.
- This slide was presented at Maine Fishermen's Forum 2019 to encourage high-quality image reporting.

Significance

- Updating the GTM to maintain biologic relevancy under changing environmental regimes is an ASMFC research priority (ASMFC, 2015; Townsend et al. 2023).
- Validating ImageJ as a method of length estimation expanded length records by a third, an analog effect to releasing 6,000 additional lobsters.
- Image data reduces the unique materials required to participate in data collection and speeds up the time associated with each measurement.
- Improved accessibility increases participants in fishery-engaged research (Johnson and van Densen, 2007).
- This work has been submitted to the 2023 IWCL Special Edition of Fisheries Research.

Results

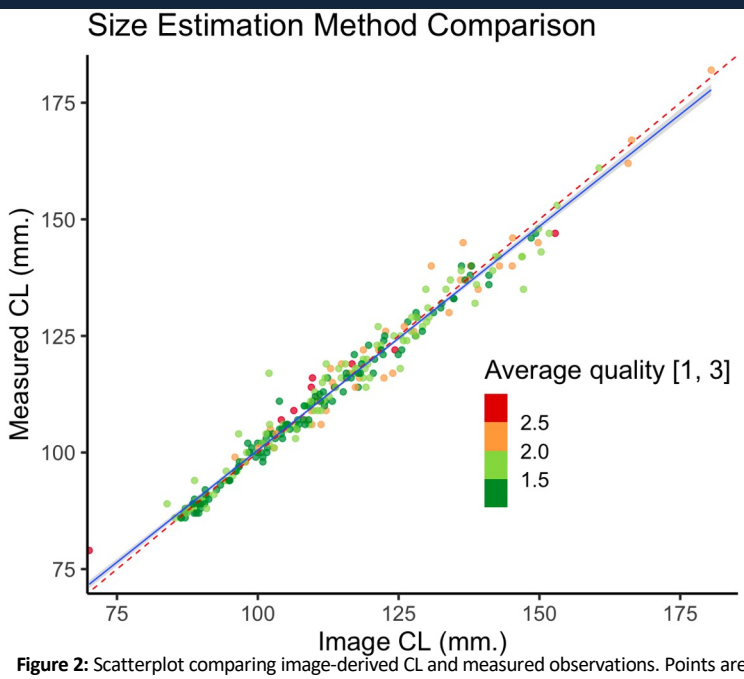

Figure 2: Scatterplot comparing image-derived CL and measured observations. Points are colored according to average quality from 1 to 3, where 1 is high quality and 3 is the lowest quality. A 1:1 line, representing a perfect fit, is drawn in dotted red. A regression line for the model *Obs. Length ~ Image Length* is added in blue with a gray standard error window.

- The inclusion of image quality did not significantly affect the results of regression models. Both models describe observed length values well.

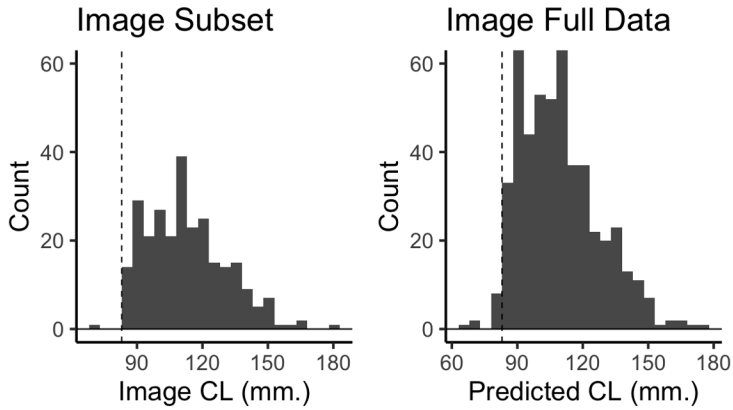

Figure 3: Histogram displaying data availability across size classes for the subset of images with co-occurring length measurements (Left) and the predicted lengths from the full dataset of images (Right).

- Due to the high fidelity between observed and modeled lengths, we were able to use the model in a predictive capacity and estimate length for images that were reported without length observations (n = 251).

Acknowledgements

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