Melon Morphometrics in Northern Bottlenose Whales (*Hyperoodon ampullatus*)

By: Daisy Rubinstein, BSc Honours Marine Biology
Supervised by: Dr. Laura Feyrer & David Gaspard

DALHOUSIE UNIVERSITY

BALAENA INSTITUTE FOR CETACEAN CONSERVATION STUDIES

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Figure 1. NBW photographed in the Gully.

Background

- **Problem**: Northern bottlenose whale (NBW) populations in Canada are vulnerable (Endangered and Special Concern), making effective population monitoring essential to ensure their health and long-term stability.
- NBWs are **sexually dimorphic:**
  - Mature males: larger, squared-off melons.
  - Females + juveniles: smaller, rounded melons.

Mature Male

Female / Juvenile

Figures 2 (left) and 3 (right). Examples of mature male and female/juvenile NBW melon shape.

- **Drones**: potential new, minimally invasive way to determine NBW sex using morphometrically-derived melon ratios and total body length measurements.

Research Objectives

1. Determine whether melon ratios show a bimodal distribution, as predicted by sexual dimorphism.
2. Assess whether sex class is detectable prior to maturity in male NBWs.
3. Assess the effectiveness of using drones as a tool for monitoring NBW demographic ratios.

Methods

1. **Data collection:** 2025 drone footage was collected in the Scotian Shelf (Gully MPA) and Arctic regions.
2. **Measurements & melon ratios:** measured lt, mw1, mw2, and ml for each still and then averaged values for each individual, then computed melon ratios (mw1, mw1/ml, mw1/lt).
3. **Statistical analysis:**
- Visualized data using histograms, linear regressions, Mclust.
- Detected structural breakpoints using segmented regression.
- Classified sex based on melon ratios using logistic regression.
- Determined classification accuracy by comparing this to melon catalogue, then used Binomial test to test classification significance.

total body length (lt)

Figure 4. Example drone still & measurements.

Results

Figure 5. mw1/lt vs lt scatterplot.

All melon ratios showed a strong or moderate **positive correlation** with total body length
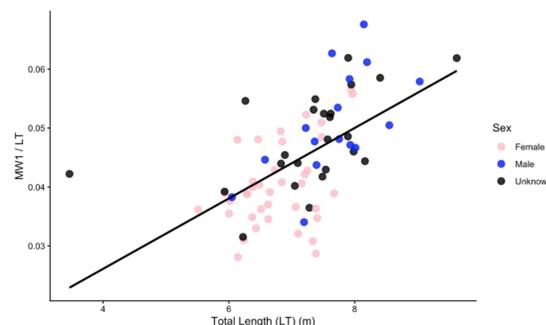
For all melon ratios, males showed **significantly higher** values than females

All melon ratios showed **no clear bimodal distribution**

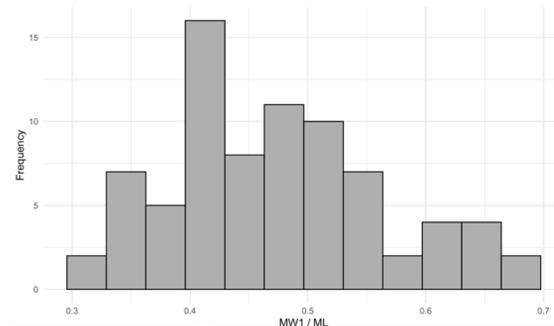Model-based clustering analysis supported **1 cluster** for each ratio
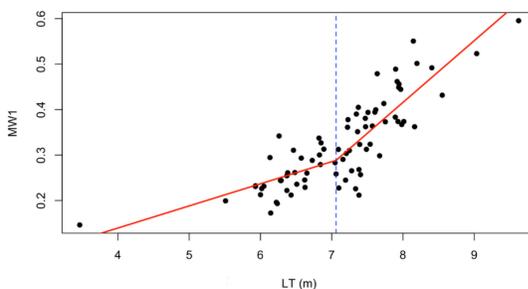
Figure 6. mw1/ml distribution.
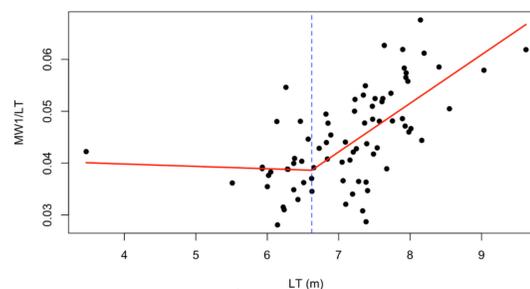
Figure 7. mw1 vs. lt (including breakpoint).

Figure 8. mw1/lt vs. lt (including breakpoint).

There was a significant change in slope (**breakpoint**) detected at approx. **6.6-7.1 m** total body length for mw1 and mw1/lt ratios

No significant breakpoint detected for mw1/ml ratio

Table 1. Melon ratio classification accuracy.

Ratio	Classification Accuracy	Significance
mw1	71%	p = 0.039
mw1/lt	75%	p = 0.021
mw1/ml	61%	p = 0.24

mw1 and mw1/lt classified sex **significantly better** than random

mw1/lt performs best (**75% accuracy**)

mw1/ml did not classify sex significantly better than random

Key Takeaways

- Results suggest that sexual dimorphism in melon curvature is present but **expressed as overlapping, continuous variation**.

- Breakpoint (6.6–7.1 m) aligns approximately with the size NBWs reach sexual maturity (males: 7.3-7.6 m, females: 6.7-7 m), suggests **sexual dimorphism begins near maturity threshold** (noticeable only in mature NBWs).

- Mw1 and mw1/lt classified sex **significantly better than random**, with moderate accuracy (71-75%), consistent with photo-ID sex assignments.

- Overall, drone-based morphometry shows promise as a **minimally invasive, quantitative method of inferring sex in mature NBWs**.

Figure 9. Field team flying the drone.

Figure 10. NBWs photographed in the Gully.

Significance

- Reliably and efficiently sexing NBWs is essential for population monitoring, which is a key component of ongoing conservation efforts.
- Improving non-invasive demographic monitoring techniques is crucial for managing small, at-risk, and difficult-to-monitor populations, including other vulnerable cetacean species.

Acknowledgements

References

Questions?
ds987887@dal.ca