Can Ratios of Linear Morphometric Measurements Delineate among Lake Trout Morphotypes?

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Introduction

- At least four morphotypes (Lean, Siscowet, Humper, Redfin; Figure 1) of Lake Trout (*Salvelinus namaycush*) exist around Isle Royale, Lake Superior.
- Morphological diversity of Lake Trout has been lost in other Great Lakes and other parts of Lake Superior.
- Body fat content, growth, external morphology, and genetic structure of the Lean, Siscowet, and Humper have been extensively described.
- Muir *et al.* (2014) used morphological, ecological, and physiological characteristics to distinguish between the Lean, Siscowet, and Humper morphotypes and the less studied Redfin around Isle Royale.
- Characteristics that consistently discriminate morphotypes are lacking.

Objective

- Determine if simple ratios of linear measurements can be used to delineate between the four Lake Trout morphotypes.

Methods

- 484 Lake Trout were sampled at 14 sites around Isle Royale during Fall, 2010, 2011, and 2014 using bottom-set gillnets.
- Total length and morphotype assignment were recorded for all fish.
- In the lab, eight linear morphological measurements were made from digitized photos of the fish (Figure 2).
- Seven ratios unaffected by head or total length were constructed from the linear measurements.
- Univariate and bivariate analyses with our ratios showed some promise for delineation among morphotypes.
- Multivariate linear discriminant function analysis (DFA) and several clustering techniques were used to determine if statistical groupings based on our ratios matched the field-identified morphotype.

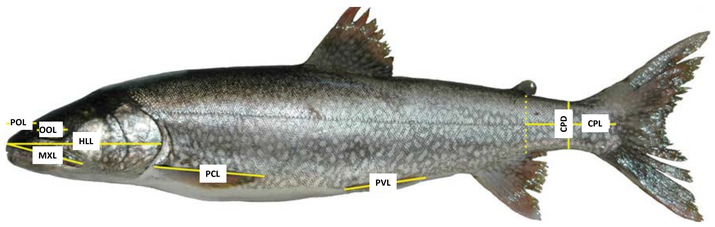

Figure 2. Linear phenotypic characteristics measured on each specimen. Adapted from Muir *et al.* (2014).

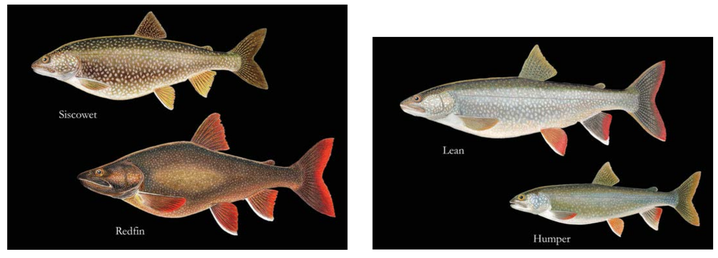

Figure 1. Lake Trout morphotypes from near Isle Royale, Lake Superior. From Muir *et al.* (2014).

Results

- Groups defined by the linear DFA matched the field-identified morphotypes for 63.2% of the fish (Table 1).
- Siscowet were most often correctly matched (92.6%), but other morphotypes were often mis-classified as Siscowet (Table 1).

	Linear DFA Ratio Groups			
Field ID	Humper	Lean	Redfin	Siscowet
Humper	5	0	2	87
Lean	0	20	2	40
Redfin	0	1	5	24
Siscowet	6	13	3	276

Table 1. Linear DFA ratio groups against field-identified morphotypes.

- Kmeans clustering using the first two principal components of ratios did not identify distinct groupings (Figure 3).

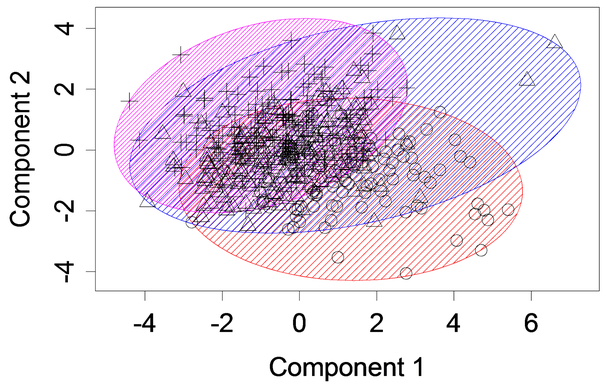

Figure 3. Three Kmeans clusters from using the first two principal components of ratios.

Conclusions

- Simple ratios of linear measurements could not be used to delineate between field-identified morphotypes.
- High variation in ratios within-groups and low variation in ratios among-groups contributed to the inability to delineate between morphotypes.
- Precision of linear measurement may influence variation within-groups.