Sampling efficiency of ichthyoplankton in the northern Bering Sea: an inter-gear comparison

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PICES-2018 Annual Meeting: Bio-Paper Session
Errors & biases in ichthyoplankton sampling

Catch!
Ichthyoplankton assemblages

Avoiding the net
Passing the mesh
Sampling error
Objectives

1. To compare the sampling efficiency
   ✓ Difference in density estimate

2. To evaluate the biases due to gears
   ✓ Difference in size selectivity
## Gears compared

<table>
<thead>
<tr>
<th></th>
<th>Ring</th>
<th>Bongo</th>
<th>MOHT (Matsuda-Oozeki-Hu-Trawl)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mouth opening (m²)</strong></td>
<td>1.3</td>
<td>0.38</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Mesh size</strong></td>
<td>0.33mm</td>
<td>0.5mm</td>
<td>1.4mm</td>
</tr>
<tr>
<td><strong>Towing method</strong></td>
<td>Sea surface</td>
<td>Oblique</td>
<td>Oblique</td>
</tr>
<tr>
<td><strong>Towing speed (knot)</strong></td>
<td>2</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td><strong>Main Target</strong></td>
<td>Fish larvae</td>
<td>Plankton</td>
<td>Micronekton</td>
</tr>
</tbody>
</table>
Sampling procedure

Where: Northern Bering Sea and Bering strait

When: July, 2017

How: 13 stations during the daytime
Sample processing & Comparison

1. Sorting
2. Species ID.
3. Counting
4. Density estimate
5. Measurements
   • Body length
   • Body depth
6. Comparison of size composition

Sampling efficiency

Sampling biases

Type 1

Type 2
Statistic tests

1. Effect on catch composition: comparison among multiple factors using PERMANOVA
2. Comparison of estimated density: Holm’s method of multiple comparison
3. Comparison of estimated abundance of given body size: Man-Whiteny’s $U$-test
Species composition

- 10 taxa
- Dominant groups
  - Flatfish (type 1)
  - Flatfish (type 2)
  - Gadids (3 spp.)

Number%

- No fish

Stn.

Overall

Flatfish spp.1 (Ls + Pq)
Flatfish spp.2 (Hippoglossoides)
Gadids (3 spp.)
Snailfishes
Alligatorfishes
Sandlance
Sculpins
Greenland halibut
Permutation Analysis of Variance (PERMANOVA)

- PERMANOVA -
  - Multivariate analysis of variance using permutation
  - to test which factor was more important

<table>
<thead>
<tr>
<th></th>
<th>DF</th>
<th>SS</th>
<th>F. Model</th>
<th>R2</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>1</td>
<td>0.681</td>
<td>2.573</td>
<td>0.063</td>
<td>0.021 *</td>
</tr>
<tr>
<td>Gear</td>
<td>1</td>
<td>1.657</td>
<td>6.260</td>
<td>0.153</td>
<td>0.001 ***</td>
</tr>
<tr>
<td>Site: Gear</td>
<td>1</td>
<td>0.530</td>
<td>2.003</td>
<td>0.049</td>
<td>0.044 *</td>
</tr>
<tr>
<td>Residual</td>
<td>30</td>
<td>7.940</td>
<td></td>
<td>0.735</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>10.807</td>
<td></td>
<td>1.000</td>
<td></td>
</tr>
</tbody>
</table>
Comparison of sampling efficiency

Bongo-net: most effective (in terms of estimated density)
Comparison of BL Freq. Distribution between gears

Bongo net favors smaller individuals?
Comparison of BD Freq. Distribution between gears

Larvae would slip out the net?
• All species combined
• 13 tows for each gear
• MOHT caught more inds ≥ 9mm BL
• BONGO caught few fish ≥ 13 mm BL perhaps due to avoidance
• MOHT: recommended for sampling of late stage larvae and juveniles
  • e.g. when large number of larvae is needed for otolith analysis
• BONGO caught substantial # of <2 mm fish (i.e. Bering flounder)

• 2 mm BD is equivalent to 7 mm BL (early larvae)

• MOHT is inadequate for sampling of early stages of larvae...

• but is still effective for collecting >2 mm BD larvae
Summary

- inadequate for larvae sampling in NBS

- the best gear when larvae with Body Depths $\leq 2$mm are targeted

- Useful for sampling late stage larvae with body depths $>2$ mm (i.e. $>10$mmBL)
Conclusion

AND

OR

TARGET

RECOMMEND
Thank you for your attentions!