Change in the biodiversity of the demersal fish community in the northern Bering and Chukchi Seas

Sei-Ichi Saitoh*, I Nyoman Radiarta**, Toru Hirawake*, Yasunori Sakurai*, Mamoru Yabe*, Yoshihiko Kamei*** and Shogo Takagi***

* Faculty of Fisheries Sciences, Hokkaido University
** Graduate School of Fisheries Sciences, Hokkaido University
*** School of Fisheries Sciences, Hokkaido University

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Outline

- Background
- Objective
- Study area
- Data (Oceanographic and fish sampling) and Methods
- Results and Discussion
- Summary
The Bering Sea and Chukchi Sea have distinct marine ecosystems that are affected by seasonal sea ice.
T/S Oshoro-Maru

Bottom Trawling
Objective

Study Area

Red polygon indicates area focused for this study
*Dashed red line* indicates border for Chukchi Sea and Bering Sea
Methodology

- Sampling conducted in three different years

  **Bering Sea:**
  - 21-22 July 1991
  - 18-22 July 1992
  - 25-31 July 2007

  **Chukchi Sea:**
  - 25-31 July 1991
  - 26-31 July 1992
  - 7-11 August 2007

- Data collected:
  - Demersal fish using bottom trawl
  - Oceanographic parameter

- The analysis only focused on three Gadidae fish species:
  1. Pacific cod (*Gadus macrocephalus*)
  2. Walleye pollock (*Theragra chalcogramma*)
  3. Arctic cod (*Boreogadus saida*)

(1) (2) (3)
Oceanographic sampling
Demersal fish sampling
Data analysis

- Standardize of fish biomass
  - Using speed, trawling time and distance → standardize weight
- Mapping bottom temperature
- Mapping bottom fish biomass (standardize weight) distributions
- Biodiversity indices based on biomass (Jin and Tang, 1996):
  - Margalef richness index (R)
  - Simpson’s index (D)
  - Shannon-Wiener index (H)
  - Evenness index (E)
## Results and Discussion

### Standardized fish biomass

<table>
<thead>
<tr>
<th>Year</th>
<th>Items</th>
<th>Bering Sea</th>
<th>Chukchi Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pacific cod</td>
<td>Walleye pollock</td>
</tr>
<tr>
<td>1991</td>
<td>Date</td>
<td>21-22 July</td>
<td>2(23)</td>
</tr>
<tr>
<td></td>
<td>N(T)</td>
<td>2(23)</td>
<td>2(23)</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>0.97</td>
<td>3.04</td>
</tr>
<tr>
<td>1992</td>
<td>Date</td>
<td>18-22 July</td>
<td>7(32)</td>
</tr>
<tr>
<td></td>
<td>N(T)</td>
<td>7(32)</td>
<td>5(32)</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>6.31</td>
<td>205.01</td>
</tr>
<tr>
<td>2007</td>
<td>Date</td>
<td>25-31 July</td>
<td>3(16)</td>
</tr>
<tr>
<td></td>
<td>N(T)</td>
<td>3(16)</td>
<td>5(16)</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>5.22</td>
<td>234.49</td>
</tr>
</tbody>
</table>

\[ N(T) = \text{No. of station (Total stations)} \]

Weight: standardize weight
Bottom temperature

1991

1992

2007

Bottom temperature (°C)

Low: -2
High: 10
Demersal fish abundance (1)

Pacific cod (Gadus macrocephalus)

Standardize weight:
- 0
- < 0.5
- 0.5-1.0
- 1.0-1.5
- > 1.5
Demersal fish abundance (2)

Walleye pollock
(Theragra chalcogramma)

Standardize weight

- 0
- < 25
- 25-50
- 50-100
- > 100
Demersal fish abundance (3)

Arctic cod
(Boreogadus saida)

Standardize weight
× 0
● < 0.1
● 0.1-0.3
● 0.3-0.6
● > 0.6
Distribution of the demersal fish occurrences

- Boreogadus saida
- Theragra chalcogramma
- Gadus marocephalus

Number of stations

- 2007
- 1992
- 1991
### Biodiversity indexes

<table>
<thead>
<tr>
<th>Year</th>
<th>R</th>
<th>D</th>
<th>H</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>1.40</td>
<td>0.59</td>
<td>0.69</td>
<td>0.63</td>
</tr>
<tr>
<td>1992</td>
<td>0.37</td>
<td>0.91</td>
<td>0.21</td>
<td>0.19</td>
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<tr>
<td>2007</td>
<td>0.36</td>
<td>0.95</td>
<td>0.13</td>
<td>0.12</td>
</tr>
</tbody>
</table>

R: Margalef richness index  
D: Simpson’s index  
H: Shannon-Wiener index  
E: Evenness index
Summary

- Arctic cod might be an index species to understand the biodiversity change in the bottom fish community.