Investigating the oil and fatty acid composition of Antarctic krill

Jessica Ericson and Nicole Hellessey
Peter D Nichols, Stephen Nicol, So Kawaguchi, Nils Hoem, Patti Virtue
A well managed, sustainable fishery

1/3 of 1% is the total average catch of the entire krill fishery annually.

9.35% is the harvest quota set by CCAMLR.

60.3 million tons of krill in Area 48 alone.

CCAMLR

Antarctica
Why use samples from the fishery?

VS.

Why use samples from the fishery?
Krill fishing grounds
Total Lipids

<table>
<thead>
<tr>
<th>Year</th>
<th>WAP</th>
<th>SOI</th>
<th>SG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2016</td>
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</tbody>
</table>

Total Lipid (mg/g DW) for different locations and years.

N = 391
20:5ω3 (Eicosapentaenoic acid; EPA)

Diatom Algae Biomarker

2014
2015
2016

EPA (mg/g DW)
Flagellate Algae Biomarker

22:6ω3 (Docosahexaenoic acid; DHA)
Percentage composition of EPA and DHA

EPA (%) 

DHA (%)
18:4ω3 (Stearidonic acid; SDA)

Flagellate Algae Biomarker
18:4ω3 (Stearidonic acid; SDA) % composition

SDA (%)

2014  2015  2016

WAP  SOI  SG  WAP  SOI  SG  WAP  SOI  SG
Anthropogenic CO$_2$ (atmos) increasing

$\uparrow pCO_2$

CO$_2$ (ocean) + H$_2$O $\rightarrow$ H$_2$CO$_3$

H$^+$ + HCO$_3^-$

↓ pH

<table>
<thead>
<tr>
<th>Year</th>
<th>Seawater CO$_2$ (ppm)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>~ 400</td>
<td>8.0</td>
</tr>
<tr>
<td>2100</td>
<td>~ 1000 - 1500</td>
<td>7.7</td>
</tr>
<tr>
<td>2300</td>
<td>~ 2000</td>
<td>7.4</td>
</tr>
<tr>
<td>Extreme</td>
<td>4000</td>
<td>7.0</td>
</tr>
</tbody>
</table>
Long-term Experiment (Jan – Dec 2016)

Flow-through seawater system with five CO₂ treatments (400, 1000, 1500, 2000, 4000)

Daily & Weekly Monitoring
- pH, pCO₂, checked for moults + mortalities, feeding, total alkalinity + DIC

Physiology & Lipid Biochemistry
- Extracellular (haemolymph) pH
- Respiration
- Intermoult Period
- Mortality
- Maturation
- Weight
- Total Lipid
- Lipid Classes
- Fatty Acids
Essential ω3 Fatty Acids

![Box plots showing EPA and DHA levels across CO2 treatments in Late Jan and Mid Nov](image-url)
Principal Component Analysis of Fatty Acid Composition (%)

First Month

CO2 Treatment
- □ 400
- ▲ 1000
- ★ 1500
- ● 2000
- ○ 4000
Future Work

Using satellites to look at: relationship between chlorophyll levels, SST & krill lipids

Identify & quantify fatty acids in each of the different lipid classes e.g. diet studies

Regional variation studies in East Antarctica and the Pacific
East vs West vs Pacific
Summary

Keystone species in the Antarctic ecosystem & part of a sustainable fishery

Huge biomass & a rich source of omega-3

Future ocean acidification may alter the lipid biochemistry of krill

Our results can assist the fishery & answer important questions about krill biology & ecology
Special thanks to:

Krill Aquarium Team
- Rob King
- Ashley Cooper
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- Blair Smith
- Guang Yang

CSIRO Staff
- Peter Mansour & Mina Brock

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