Autonomous profiler reveals Arctic zooplankton dynamics during transition to polar night

Ways forward in monitoring ecosystems in inaccessible regions

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The Changing Arctic Ocean

Sea ice:
- Shorter
- Thinner
- More dynamic

Ocean:
- Warmer
- Saltier
- More Atlantic

The Changing Arctic Ocean

Changes in sea ice lead to changes in habitat, food type and availability, and species distribution, thus affecting ecosystem dynamics and biogeochemical cycling.

Knowledge gap: Large-scale and seasonal distribution of zooplankton and fish in the CAO
Objectives of EcoLight

- Investigate the effect of the changing under-ice light field on the abundance and vertical distribution of zooplankton
- Analyze interaction of zooplankton distribution with hydrography and food availability
- Evaluate autonomous AZFP for future studies in the CAO
Automomous buoy array

Future Arctic research needs a **holistic coupled physical-biological approach** and **continuous year-round observations**.

**Buoys cluster**
- CTD
- Ice mass balance
- Snow
- Zooplankton
- Radiation

[Credit: M. Hoppmann]
## AZFP buoy prototype

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sensor Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS position</td>
<td>Garmin 18x</td>
</tr>
<tr>
<td>Atmospheric pressure</td>
<td>Bosch B280</td>
</tr>
<tr>
<td>Air temperature</td>
<td>Honeywell</td>
</tr>
<tr>
<td>4 active acoustic channels (70, 125, 200, and 455 kHz)</td>
<td><strong>ASL Acoustic Zooplankton Fish Profiler</strong></td>
</tr>
<tr>
<td>Chl-a fluorescence</td>
<td>Turner Cyclops</td>
</tr>
<tr>
<td>Salinity (under ice)</td>
<td>Solumetrix BKIN50</td>
</tr>
<tr>
<td>Incoming PAR</td>
<td>Apogee</td>
</tr>
<tr>
<td>Inner buoy temperature, humidity</td>
<td>Bruncin</td>
</tr>
<tr>
<td>Battery voltage/current, CPU load</td>
<td>Bruncin</td>
</tr>
<tr>
<td>Camera (air)</td>
<td>Bruncin</td>
</tr>
<tr>
<td>Camera (underwater)</td>
<td>Bruncin</td>
</tr>
</tbody>
</table>
Parallel: CTD chain buoy, irradiance buoy

- 5 Seabird SBE37IMP CTDs
- Conductivity, temperature, pressure
- Depths: 10, 20, 50, 75 and 100 m

- 3 RAMSES ACC-VIS spectral radiometers
- Incoming, reflected, transmitted irradiance
- (also on the image: light chain, thermistor chain)
Deployment

**Deployments:** MOSAiC September 2020, 89.05°N 107.10°E
Drift 09/12/20 – 02/01/21

09/20/2020

04/26/2021
First results: Light

- Difference above and below pycnocline (PC)
- Increased backscatter above PC at „polar dusk“
- Periodic vertical shifts above PC during twilight
- „even“ distribution below PC
First results: Light
First results: Eddie

Rotation of eddy moves T/S chain up in water column

Eddy has different T/S properties
First results: Eddie
- First crossing of the Arctic Basin with a fully autonomous zooplankton profiler
- Time series of near-surface distribution in complete absence of artificial light during the entire Arctic winter
- Ability to investigate the influence of moonlight and under-ice features such as eddies on zooplankton distribution
- Multi-frequency analysis enables to investigate changes in community composition over space and time