

Sympatric Calanus Species: A High Temporal Resolution of Reproductive Timing and Stage Composition

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Abstract : Members of the genus *Calanus* are key species in the North Atlantic and Arctic marine ecosystems due to their vast abundance and their ability to accumulate high amounts of lipid. As a link between primary producers and higher trophic levels, the temporal presence of each *Calanus* species is important in a time of changing communities and northward distribution shifts. This study focused on the temporal niches of the sympatric species *Calanus helgolandicus*, *Calanus finmarchicus*, *Calanus glacialis*, and *Calanus hyperboreus* in Skjerstad fjord, a Norwegian fjord (67°14'N, 14 °44'E). Three depth intervals were sampled monthly over a year, targeting copepodite stages of the genus *Calanus*. Species determination was carried out genetically using insertion/deletion markers. In addition, during the reproductive season (Jan-May), weekly samples of the upper 50 meters of the water column targeting nauplii and 5 depth intervals targeting copepodites were collected. Nauplii samples were sorted into two groups (NI-NIII and NIV-NVI), and species were genetically identified. Specimens from stage CIV to adults from each depth interval of copepodite sampling were photographed in order to generate a supporting timeline of visual traits, including gonad maturation stage, presence of stomach content, and total lipid content. The most abundant species were *Calanus finmarchicus* and *Calanus glacialis*, followed by *Calanus hyperboreus*. These species were present in the water column throughout the year, whereas *Calanus helgolandicus*, the least abundant species, was only present during the summer and autumn period. Each species showed distinct temporal niches, with *Calanus finmarchicus* occupying the upper 50 meters longer than any of the other species. *Calanus hyperboreus* dominates in abundance early in the spring but are outnumbered by *Calanus glacialis* and *Calanus finmarchicus* after spring bloom sets in. In Skjerstad fjord, *Calanus hyperboreus* is a clear capital breeder with a long period of nauplii presence before the spring bloom. *Calanus glacialis* and *Calanus finmarchicus* both utilize income breeding, with *Calanus glacialis* developing to the larger nauplii stages quicker than *Calanus finmarchicus*, but also having a shorter reproduction period. Indeed, the “traditional Arctic” species *Calanus hyperboreus* and *Calanus glacialis* appear to end their reproduction period earlier than the North Atlantic *Calanus finmarchicus*.

Keywords : calanus, depth distribution, reproduction, stage composition, temporal niches

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