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Autonomous zooplankton profiler reveals high-Arctic zooplankton dynamics during transition to polar night

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With rapid sea-ice decline, ocean warming and increasing Atlantic inflow, the ecosystem of the Central Arctic Ocean (CAO) is experiencing an unprecedented, potentially disruptive transformation. While this transformation is affecting the biodiversity of marine communities and the ecosystem functions they fulfil, major knowledge gaps about the distribution of pelagic macrofauna (zooplankton and fish) complicate the assessment of the impact of this transformation on biodiversity and marine resources. The largest blind spot remains in the central Arctic Basin, which has been difficult to sample with large sampling gear such as fishing nets due to a year-round ice coverage. However, in the face of increasing human activities and international efforts to implement marine management in the CAO, it becomes important to monitor pelagic fauna in this remote area. One possibility to enable a better sampling of pelagic macrofauna is to use sea-ice tethered autonomous observatories. Within the British/German project EcoLight, we developed a new autonomous sea-ice observatory comprising an ASL Acoustic Zooplankton and Fish Profiler (AZFP). The device has 4 frequencies targeting different size classes of animals. It samples automatically at predefined intervals and transmits the data to a server in Europe via Iridium. It is possible to change the sampling parameters via a remote connection at any time. The AZFP buoy was deployed in the CAO in September 2020, shortly before the end of the MOSAiC expedition. Since then, the buoy has been recording the vertical zooplankton distribution in the water column under the ice. First data show a light-induced change of the vertical distribution of scatterers, transitioning from deep distribution during the polar day, through a short period of diel vertical migration during the twilight period, to a constant presence of scatterers in the surface layer in the polar night. Furthermore, AZFP data suggest an enhancement of zooplankton between the upper pycnocline and ~50 m depth during in an eddy transition. The data collected by the EcoLight AZFP buoy constitute the first hydroacoustic record of zooplankton distribution near the North Pole sampled with a fully autonomous system in the absence of disturbing light sources. They demonstrate the feasibility of year-round automated monitoring of macrofauna in the CAO in relation to environmental properties. Similar autonomous devices may serve as key elements in

the future monitoring of biological resources in the CAO and other inaccessible areas.