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Temporal variability of vertical migration of zooplankton at deep-sea floor in the Amundsen Sea, Antarctica

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Vertical migration of zooplankton is ubiquitous behavior in marine plankton community. Observations on diel, seasonal, and interannual variation of zooplankton behavior can support the knowledge for understanding of marine ecosystems. However, daily and seasonal rhythms are little observed in the deep-sea with seasonally ice-covered water. We described the pattern of diel vertical distribution (DVM) above deep-sea floor in a seasonally ice-covered Amundsen Sea. Times series of acoustic backscatter was observed using a bottom-moored, upward-looking Acoustic Doppler current profiler (ADCP) in the depth of 250–550 m. Multi-frequency acoustic backscatter data (38 and 120 kHz, EK60) were collected to identify the composition of DVM between fish and zooplankton using a dB differencing technique. The seasonal vertical distribution of zooplankton was clearly governed by the seasonal phase of surface solar radiation (SSR) and sea ice condition (SIC), while water temperature did not affect on the DVM variation. The main depths of zooplankton were primarily distributed near 250 m with high SSR and low SIC period and found near bottom in the lowermost layers (>400 m) with low SSR and high SIC between mid-April and mid-November. The temporal variation of main depths of zooplankton was significantly correlated with both SSR and SIC ($r = 0.87$ and -0.70, respectively, $p<0.01$, $n=300$). Furthermore, the acoustic backscatter strengths, which can be considered as a relative zooplankton biomass, were enhanced during high SIC period. Mean daily cycles of acoustic backscatter showed distinctive DVM pattern dependence on the SIC. During the low SIC in austral summer, DVM initiate to descent at sunrise, reach a maximum depth at around the highest levels of SSR, and ascend at sunset. However, DVM was not associated with sun's periodicity and remained above the bottom with high acoustic backscatter strength with high SIC in austral winter. It is shown that light is the proximate cue for diel cycle of DVM and both light and sea ice conditions control the seasonal variation of DVM because high SIC can cause to block out the detectable light intensity for DVM. These results might contribute to the knowledge about zooplankton ecology near bottom under ice-covered region at the high-latitude Southern Ocean. We also speculate that DVM of zooplankton can influence the accumulation and resuspension of organic matter near bottom as a contributor of biological pump.