

How does Drake Passage Oscillation Index (DPOI) effect on variability of the Antarctic krill ecosystem in the Antarctic Peninsula region?

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Antarctic krill, *Euphausia superba* Dana, is a keystone species of the Antarctic ecosystem. Environmental and ecological change in Antarctica is one of key issues for the global climate change. An assessment of environmental processes influencing variability of Antarctic krill is important so that krill stock affects the Antarctic ecosystem (Loeb *et al.*, 1997). Naganobu *et al.* (1999) assessed variability in krill recruitment and density in the Antarctic Peninsula region focusing environmental factors (Fig. 1), including strength of westerly winds determined from sea-level pressure differences across the Drake Passage during 1982-1998 as the Drake Passage Oscillation Index (DPOI) (Fig. 2). They found significant correlation between krill recruitment and DPOI. They also found significant correlation between krill density and ozone depletion.

The report of the Intergovernmental Panel on Climate Change (IPCC, 2001) reviewed DPOI and ozone depletion as factors with physical impacts on the biology of the Antarctic Ocean and took interest in its variability in the future. Therefore, we calculated a new time series of DPOI from 1952 to the up-to-date data (2010). In addition, we analyzed relationships between DPOI and oceanic condition (mean temperature from the surface to 200m: MTEM-200) using CTD data with US-AMLR program, NOAA, in the Antarctic Peninsula waters during 1990-2008.

As a result, the average DPOI in austral spring had significant correlation with MTEM-200 (Fig. 3). DPOI suggests influence on the variability of oceanic condition and thus for the Antarctic krill ecosystem. On the other hand, Mangel *et al.* (2010) demonstrated that their modeling results were consistent with the field study of Naganobu *et al.* (1999) on strong negative correlations between krill density and ozone depletion.

Furthermore, the ozone hole has influence on westerly winds and warming over the Southern Ocean (Turner *et al.* Eds, 2009) and then may cause changes in the Antarctic ecosystem. The Antarctic Peninsula region indicates extraordinary changes of climate warming, ice lost, ocean warming and disturbing krill ecosystem. For comprehensive understanding of interactions between these parameters in this remarkable region, long-term monitoring and analysis of DPOI could be the key environmental index in the Antarctic krill ecosystem under advancing global climate change.

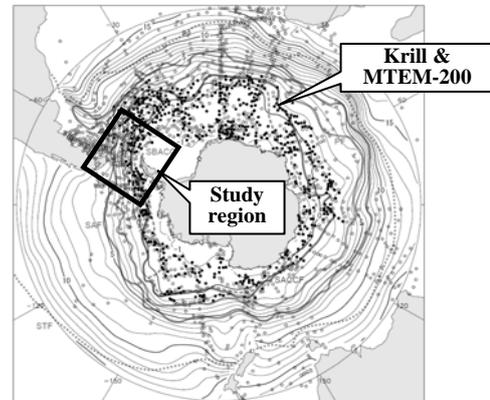


Fig. 1: Why is the Antarctic Peninsula region? Krill distributions (black points) based on the oceanic environmental index MTEM-200 (°C) in the entire Southern Ocean scale (after Naganobu *et al.*, 2008). This region is a key study spot for the Antarctic environmental ecosystem.

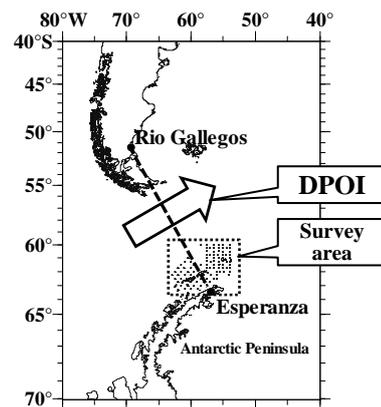


Fig. 2: What is DPOI? Concept of DPOI; Sea-level pressure differences between Rio Gallegos in South America and Base Esperanza in the Antarctic Peninsula as the index of westerly winds. Dotted square: Oceanographic and krill survey area.

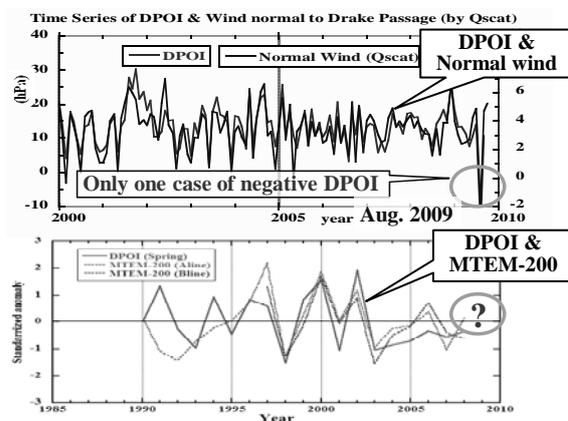


Fig. 3: How are DPOI, winds and oceanic variability connecting? DPOI is the key environmental index so that there are strong correlations between DPOI, normal winds and oceanic surface layer structure (after Kutsuwada *et al.*, 2010) influencing to the Antarctic krill ecosystem.