Study on pelagic ecosystem response to climate variability in the transition zone of central North Pacific Ocean using satellite derived ocean surface current data

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KEYWORD **North Pacific Ocean, climate shift, Marine ecosystem, sea surface height, EOF analysis**

Abstract

The transition region of the central North Pacific Ocean is an important region for understanding of climate and ecosystem interactions. Time series of Pacific Decadal Oscillation Index (PDOI) and Multivariate ENSO Index (MEI) indicates the regime shift in the Pacific Ocean in 1998 which can be attributed to the 1997-98 El Niño (Fig. 1) In this study, we performed the Empirical Orthogonal Function (EOF) analysis by using time series of multisatellite sea surface height anomaly (SSHA) data from November 1992 to October 2012 to derive the dominant spatial features and corresponding temporal variability in the pelagic ocean condition of the North Pacific Ocean. The first mode of EOFs, derived from the time series SSHA data explained about 9.97% of the total variance (Fig. 2 and 3). A low SSHA period was noticed during 1993 to 1998, which was followed by an abrupt rise in 1999 leading to a high SSHA period during 1999 to 2002. This corresponded well with the regime shift detected from the climatological indices (Fig. 1). We examined interannual changes in abundance of the autumn cohort of neon flying squid *Ommastraphes bartramii* during 1979 to 2006 in relation to the large-scale climate shift based on the research survey data and the relevant published works.

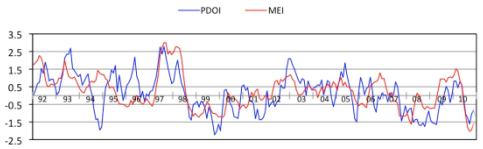

Fig. 1. Time series of PDOI and MEI.

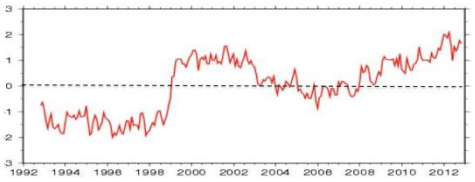

Fig. 2. 1st EOF monthly time series of SSHA (9.97%).

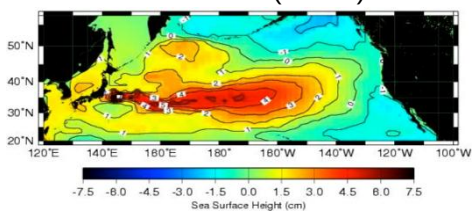

Fig. 3. 1st EOF (9.97%) for SSHA.

Result

The survey driftnet catch per unit effort (CPUE) and commercial driftnet catch of the autumn cohort of the neon flying squid was notably low during the period of 1999 to 2002 (Fig. 4). This period coincided with anomalous climate conditions (Fig. 1). Time series of EOFs for SSHA, which can be used as indicators of temporal and spatial changes in geostrophic transport and vertical structure of the upper ocean, highlights variation of sea level mainly in the transition zone and the subtropical frontal zone of the North Pacific Ocean (Fig. 3). This represents an increase in heat content and depth of the top of the thermocline/nutricline and subsequent reduced enhancement of productivity, which was reflected by a northward shift of the wintertime transition zone chlorophyll front (Polovina and Howell 2005). The stock level has a significant correlation ($r = -0.79$, $p < 0.01$) with SSHA in the main spawning and nursery grounds of the autumn cohort (i.e. 30 to 34° N, 172° E to 140° W) during spawning and nursery periods (October to March) (Fig. 5).

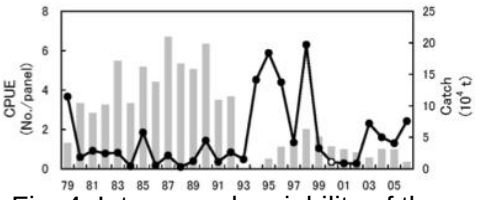

Fig. 4. Interannual variability of the autumn cohort of neon flying squid.

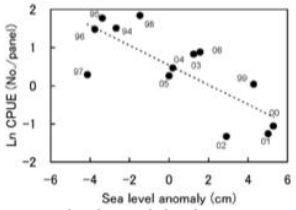

Fig. 5. Relationship between SSHA and stock level of neon flying squid.

Project plan

The results from the present study underlines the potential effect of climate forcing on the oceanographic factors responsible for changes in the fish stock levels. Further assessment of the influence on productivity will be necessary to Integrate climate related issues for sustainable management of fishery stocks.

References:

Polovina J. J. and Howell E. (2005) Recent ecosystem changes in the Central North Pacific. In: King JR (ed) Report of the study group on fisheries and ecosystem responses to recent shifts. *PICES Scientific Report* No. 28, p59-64