
Invited Lecture
on
Marine ecosystems and fish stocks under climate variability and change
by
Svein Sundby, Norway

The world oceans comprise a diversity of marine ecosystems with their specific physical settings and climate regimes. Responses of fish stocks to ecosystem changes, climate variability and climate change are similarly diverse and the critical factors for growth and survival of the organisms in the various marine ecosystems may vary considerably. Additionally, critical factors may also vary with time within a specific marine ecosystem depending on the state of the system. Specific marine species, e.g. Atlantic cod, have developed different strategies of growth and survival (or through evolution developed different adaptations) depending on their habitats. Are there generic solutions to ecosystem-based approach and management under such diverse conditions? The understanding of the variability at lower trophic levels, as well as at higher trophic levels, and the mechanisms of trophic transfer are important factors towards this approach. Moreover, the understanding of how climate influences marine ecosystems needs to be de-convoluted from considering the influence of the thermal regime to exploring the functional effects of the full spectrum of interlinked climate variables. We need to distinguish between the physical variables influencing individual organisms and those having influence at the population level. The ocean dynamics and circulation have greater importance at lower trophic levels. In plankton populations, and particularly, in zooplankton populations, where generation time is long compared to advective times the changes in circulation pattern is the most important climate variable. This makes it important to assess local production compared to advected (or import) production when considering carrying capacity within a certain geographical region. When lacking information on variability in natural fish mortality this variable is often considered as a constant. However, natural mortality does vary with ecosystem state and climate conditions, and therefore effects of fishing mortality cannot be considered separate from natural mortality.

Climate-ecosystem correlations need to be followed by exploring the mechanisms behind. The ecosystem effect of a climate anomaly is dependent on the persistence. Multi-decadal climate variations have other effects on the ecosystem than decadal-scale and interannual climate variations. Although the amplitudes of interannual and decadal-scale climate variations are much larger than the amplitudes of multi-decadal climate variations, the latter seem to influence marine ecosystems more profoundly. This has implications for how we assess effects of climate change. The identification and understanding of the mechanisms of reversible and irreversible ecosystem responses needs to be done. The mechanisms behind irreversible ecosystem responses depend on the spatial scale considered. The issue of regime shifts is therefore also scale-dependent. Changes in ecosystems that appear as a regime shift on a limited spatial scale do not necessarily appear so on a larger spatial scale.

The issues of genetic separation of populations and identification of metapopulations are important aspects in the management of fish stocks, but the understanding of the mechanisms that keep fish stocks apart or mix them are poorly understood. The physical processes linked to climate change have the potential to influence such interactions, particularly during the egg, larval, and early juvenile stages.

Biography

Svein Sundby is principal oceanographer at the Institute of Marine Research, Bergen, chief scientist at Bjerknes Centre for Climate Research, and adjoint professor at the Geophysical Institute, University of Bergen. He started his scientific career as a physical oceanographer at the Institute of Marine Research in 1975 and later became a doctor in marine ecology. He has worked with fish recruitment processes in Arctic and boreal ecosystems as well as in upwelling ecosystems in the southern hemisphere, with emphasis on physical-biological interactions and ocean climate effects. He has been working with both modelling and field observations. As a professor at the Geophysical Institute he lectures in physical-biological processes. Sundby knows GLOBEC from its early days. He was part of the small group of scientists that developed the ICES Cod and Climate Change Programme in the early 1990s. He was member of the GLOBEC Interim Steering Committee and later GLOBEC SSC that developed the Science and Implementation Plans until he stepped down from the committee in 1998. He was member of the IGBP/SCOR Task Team that developed the IMBER plan during 2002–2004. Under EUR-OCEANS European Network of Excellence he is currently leading System 1 on the Arctic and Nordic Seas. He has directed a number of national research projects and programmes.

