analytical approach aimed at identifying indirect and nonadditive sources of survival variability. We found that the effect of the spawning stock biomass on the ensuing age-0 abundance (i.e., density dependence) changes in relation to water temperature, with a more direct link between the two variables at lower temperatures. For older life stages (i.e., age-1 to age-3) we found that the predation effect of subadult cod (age-3 to age-6) on younger stages is stronger at higher water temperatures. These results are further investigated in relation to the contrasting life challenges of a maturing cod, such as feeding and growth during the first months of life, and settlement and spatial distribution later in life.

Keywords: recruitment dynamics, density dependence, nonadditivity, Barents Sea cod.

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ICES CM 2005/AA:12

Physical oceanography of Atlantic cod habitats

K. Drinkwater and H. Loeng

This talk will describe and compare the physical environments occupied by cod throughout the North Atlantic. It points out the wide geographic distribution of the cod as well as the diverse habitat and topography they occupy, indicate the wide range of hydrographic properties they inhabit, and note the importance of advection to many of the stocks. Some examples will be given of evidence for the physical environmental affecting on cod. A general description of the circulation in the North Atlantic will be provided with greater emphasis on the currents in the regions occupied by cod. In addition, the role of atmospheric processes including the NAO on the interannual variability in the different cod regions will also be discussed. The vertical and horizontal spatial scales of the temperature variability in all of the major cod habitats will be presented.

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ICES CM 2005/AA:13

The response of Atlantic cod (*Gadus morhua*) to future climate change

Ken Drinkwater

Future CO_2-induced climate change scenarios from Global Circulation Models (GCMs) indicate increasing air temperatures, with the greatest warming in the Arctic and Subarctic. Changes to the wind fields and precipitation patterns are also suggested. These will lead to changes in the temperature and salinity properties of the ocean, as well as the vertical stratification and circulation patterns. Based upon the observed responses of cod to climate variability, the expected responses of cod stocks throughout the North Atlantic to these future climate scenarios are reviewed and discussed. Stocks in the Celtic and Irish Seas are expected to disappear while those in the southern North Sea and Georges Bank will decline. Cod will likely spread northward along the coasts of Greenland and Labrador, occupy larger areas of the Barents Sea and may even extend onto some of the continental shelves of the Arctic Ocean. Growth rates of many of the stocks will increase with increasing temperatures. The effects of climate change on maturity and transport of cod larvae the will also be discussed. Since the response of cod to climate changes will depend also on their prey and predators, some speculations on the changes in these will be presented.

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ICES CM 2005/AA:14

How an oscillating environment may influence cod (*Gadus morhua*) growth and survival during the initial stages and possible consequences to the future recruitment

V. Buehler and F. J. Jochem