

## Theme Session B The Role of Sea Ice in Polar Ecosystems

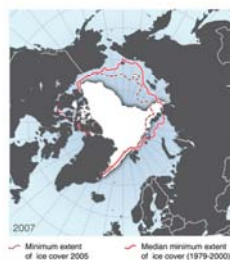
**Co-Convenors: Garry Stenson (Canada), Ken Drinkwater (Norway) and Kai Wieland (Denmark)**

Sea ice is the most dominant feature of Polar Regions and influences the structure and function of these ecosystems. Decreases in the areal extent of sea ice in the Arctic during the last 2–3 decades and particularly the rapid decline in recent years has brought increased attention to the effects of global warming and highlighted the concern that the Arctic could soon be ice free in summer. This possibility has prompted calls from managers, governments and the general public for information on its consequences to the various components of the ecosystem. A theme session on the role of sea ice was convened to improve our understanding of the role of sea ice in polar and sub polar ecosystems.

Following a plenary lecture on the possible effects of retreating sea ice on subarctic and Arctic ecosystems by Dr Victor Smetacek of Germany that provided an excellent introduction to the topic, the session consisted of a total of fourteen oral and seven poster presentations representing scientific studies from six different countries and both polar regions. The presentations examined the effects of sea ice on the physical oceanography as well as influences on all of the trophic levels from ice algae to marine mammals. The following presents some of the highlights from the theme session.



### Why Theme Session on Sea Ice?



Decreasing  
Sea Ice in the  
Arctic and  
Subarctic

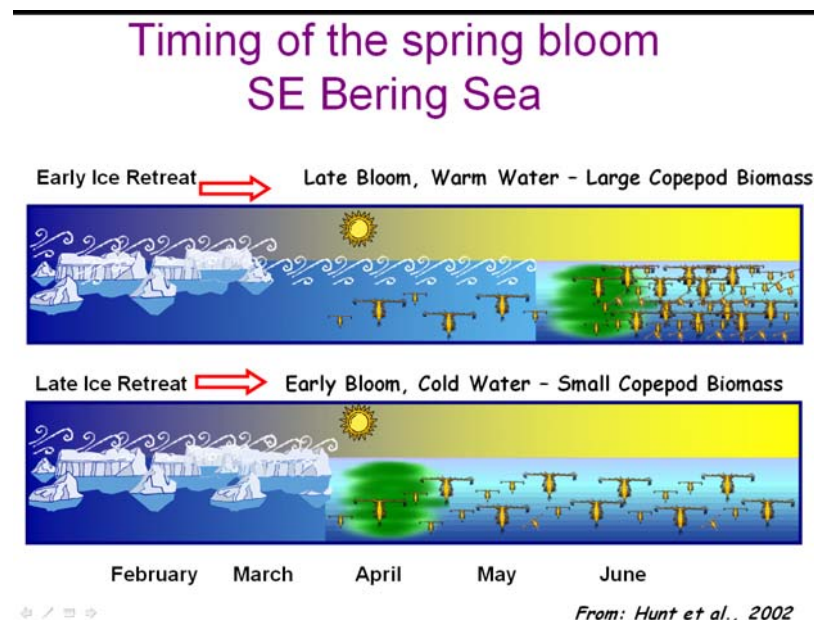
Further  
reductions  
under climate  
change

#### **ICES CM 2008/B:06. The role of sea - ice in subarctic marine ecosystems, Ken Drinkwater**

The areal extent of summer sea ice in the Arctic Ocean was shown to have declined by approximately 40% between 2006 and 2007 setting a new minimum record and has remained low in 2008. This rate of decrease of sea ice is much faster than the IPCC and most other models had predicted and are due to a combination of anthropogenic warming, unusual atmospheric pressure patterns, bringing warm air masses into the Arctic, the albedo feedback effect, and increased inflow of relatively warm Atlantic Water into the Arctic Ocean. These have contributed to a new ice climate state in the Arctic that is unlikely to revert to previous ice conditions (especially regaining the multiyear ice) unless there will be an extended period of cold conditions. Interestingly, the Bering Sea ice extent appears uncoupled with the Arctic conditions with large increases in the amount of sea ice during 2006–2008. The session was informed that the IPCC models have not been able to adequately reproduce the sea ice observations with the models usually generating too much ice. Recent regional modeling

results of the North Atlantic using downscaled climate conditions from a Global Circulation Model (GCM) were presented. Possible future temperature and ice conditions in four subarctic regions were examined in detail. While warming and reduced sea ice cover occurred in almost all regions (the exception was a region south of Greenland where temperatures cooled), it was cautioned that downscaling should be carried out using several GCMs to ensure the statistical reliability of the results. Studies on polynas in the Canadian Archipelago of the Arctic revealed that several of these are generated by tidal mixing. These areas exhibit high productivity even in the absence of seasonal ice cover.

Several studies on polar ecology revealed significant differences between open ocean and ice-covered regions and indicated the importance of ice in structuring their particular ecosystems. While ice algae is generally important in initiating the large spring blooms in the marginal ice zone, advection of open ocean plankton species was also shown to be important. The timing of the bloom is also linked the timing of the ice retreat although it does not always follow immediately upon the retreat. In the Bering Sea, for example, an earlier retreat of the sea ice results in a later spring bloom because winter storms prevent development of the bloom due to intense mixing. The bloom does not occur until heat-induced temperature stratification occurs. The timing of the spring bloom affects subsequent availability of zooplankton which in turn, affects the ecosystem structure and function including at the higher trophic levels. The majority of the ice-associated blooms usually sinks to the ocean floor to stimulate benthic production. It is not clear if the amount of primary production reaching the sea floor in present ice-covered waters will increase or decrease under climate change. The percentage of primary production reaching the ocean bottom in these areas is expected to decrease suggesting a likely decrease in the amount reaching the benthos but with the reduced sea ice causing increased light levels in the upper water column and a longer production season, this may result in an increase in the total annual primary production and the possibility of a higher absolute amount of phytoplankton reaching the sea floor. While ice extent was the index most



**ICES CM 2008/B:08. The effect of seasonal sea ice cover on the structure of the eastern Bering Sea pelagic food web, George Hunt, Jeffery Napp, Kenneth O Coyle, and Phyllis Stabeno.**

commonly used for examining the statistical relationship with the biota, it is often the quality of ice that is important. For example, ring seals need a particular type of ice for pupping and protection of the pups. Ice type is seldom represented in sea-ice models. The reduction in sea ice under future climate change is expected to have a particular large impact on seals that use sea ice for pupping. Examples of increased pup mortality due to poor ice conditions from the Gulf of St. Lawrence were provided. A combination of reduced ice extent, thinner ice and increased frequency of storms is thought to have played a role in the increased mortality in recent years. Studies of the effects of sea-ice on capelin and snow crab showed significant statistical relations but mechanisms linking the fish and shellfish to the ice were unclear. There were no presentations on forage fish and ice, which is felt to largely reflect the lack of work in this area within the ICES community.

A short discussion at the end of the session began with Dr Victor Smetacek sharing some thoughts and insights he gained during the session. He noted that while much is made of the decline in summer sea-ice extent in the Arctic, the wintertime extent has not changed much. Thus there has been a large change in the amplitude of the seasonal variability. In the Antarctic there has been little change in the ice extent in either season. This is because the continental shelves around the Antarctic are narrow and there is little scope for decreases in summer. In winter, even if there was warming, it is still cold enough in the Antarctic to form ice. The question was asked whether walrus and seals may have used land more often in the past especially before humans arrived. If they did, then these species should be able to survive in contrast to the dire predictions under future climate change. Walrus would be expected to be able to use land for resting but seals that require ice for pupping and breeding would not.

It is clear that studies of the influence of sea ice will continue and will become more important if Arctic summer ice extent continues to decline. It was noted that further work is needed in several areas, especially on the downscaling from the GCMs to regional models using several GCMs, improved understanding of the processes linking sea ice to various ecological components (particularly finfish), and the effect of climate change on the benthic production in ice-covered regions.