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1.1 Annual ice and multi-year ice

The high-latitude ocean areas are ice-covered for much or all of the year. Multi-year ice and annual ice have different physical and chemical properties that make them also differ in (e)3(r)]T2-5 TwTd[(di)((t)t)2(t)6(h)-4(at)-3.9(m)100 Td 0 Td Td Tdy2l0aa fo8(h)f5 TwTd(h)f5-1

1.2.1 Primary production and lower trophic level communities

Around the annual ice, in general there are steep gradients in temperature, salinity, light and nutrient concentrations creating different habitats throughout the ice, the 0.2 m on the lower ice surface having the most favourable conditions for growth among the interior communities (Arrigo 2003). However, with respect to biomass and contribution to primary production, the sub-ice community is the most important in annual ice. In addition there are seasonal trends and inter-annual variations in species composition, biomass and production as a result of several factors, including light, age and origin of the ice (e.g., distance to land and water depth). Thus, there is a high spatial heterogeneity when larger areas are considered.

Sea-ice algae start their growth ahead of phytoplankton. An extended growth season in the Arctic areas forms ice algal communities that are grazed actively by both ice fauna and zooplankton and may be an important component of the diet of some species during the winter. Ice algae contribute 4–26 percent of total primary production in seasonally ice-covered waters (Gosselin et al. 1997, Sakshaug 2004). Apherusa glacialis probably the most numerous amphipod species in the central Arctic Ocean. Onisimus glacialismay be common in some areas.

fare better. Species with limited distribution, specialized feeding or breeding requirements, and/or high reliance on high-latitude ice for part of their life cycle are particularly vulnerable (Meltofte, 2013. In the Antarctic, seal and penguin species dependent on ice distribution seem to be likely to respond to changes in extreme events, as had happened in some years of anomalous El Niño – Southern oscillation events. Significant declines in ice – even at the regional or local scales – may lead to the replacement of antarctic by subantarctic species (Turner et al., 2009, pg. xxv).

Krill plays a central role in the trophic structure of Antarctic ecosystems. Its abundance and distribution depend on the coupling of reproductive events and oceanic circulation. It is not clear to what extent its population declined and which are the factors involved (Ainley et al., 2005; 2007). The decrease in krill abundance and the increase in salps abundance are thought to be related with changes in ice cover (Loeb et al., 1997).

There are indications that populations of Pleuragramma antarcticum, a key fish species of the trophic web, and whose reproduction is closely associated to high-latitude ice, declined at some localities, to be replaced by myctophids, a new food item for predators (Turner et al. 2009, pg. 360).

Reduced high-latitude ice, especially a shift towards less multi-year ice, will affect the species composition in these waters. With decreasing ice cover, the effects on the ice fauna will be strongest at the edges of the multi-year high latitude ice. Seasonal/annual ice has to be colonized every year, as opposed to multiyear ice. In addition, multi-year ice has ice specialists that do not occur in younger ice (von Quillfeldt et al. 2009). The previously very low biological production of the deep basins may also change in this region as light, temperature and storminess increase and currents shift. In addition, wind-driven mixing of the ocean is more efficient over open water and over the thinner, more-mobile, seaso

Already, 10 per cent of the world's oil and 25 percent of the world's natural gas is produced in the Arctic, with the majority coming from the Russian Federation (AMAP 2007, see also chapter 21 of this Assessment).

In the Antarctic, the sea-ice cover is predicted to decrease by 33 per cent in this century (Turner et al., 2009, pg. 384) as well as coastal ice shelves. This would imply a significant stress for marine organisms but no species might be singled out as candidate for extinction in this period. Signy Island and some sites at the West Antarctic Peninsula have witnessed an explosion of the fur-seal numbers that may be related to decreased ice cover resulting in increasing areas available for resting and moulting, but which may also be related to population increases; the growing seal population in Signy Island has had deleterious impacts on the local terrestrial vegetation (Turner et al., 2009, pg. 360).

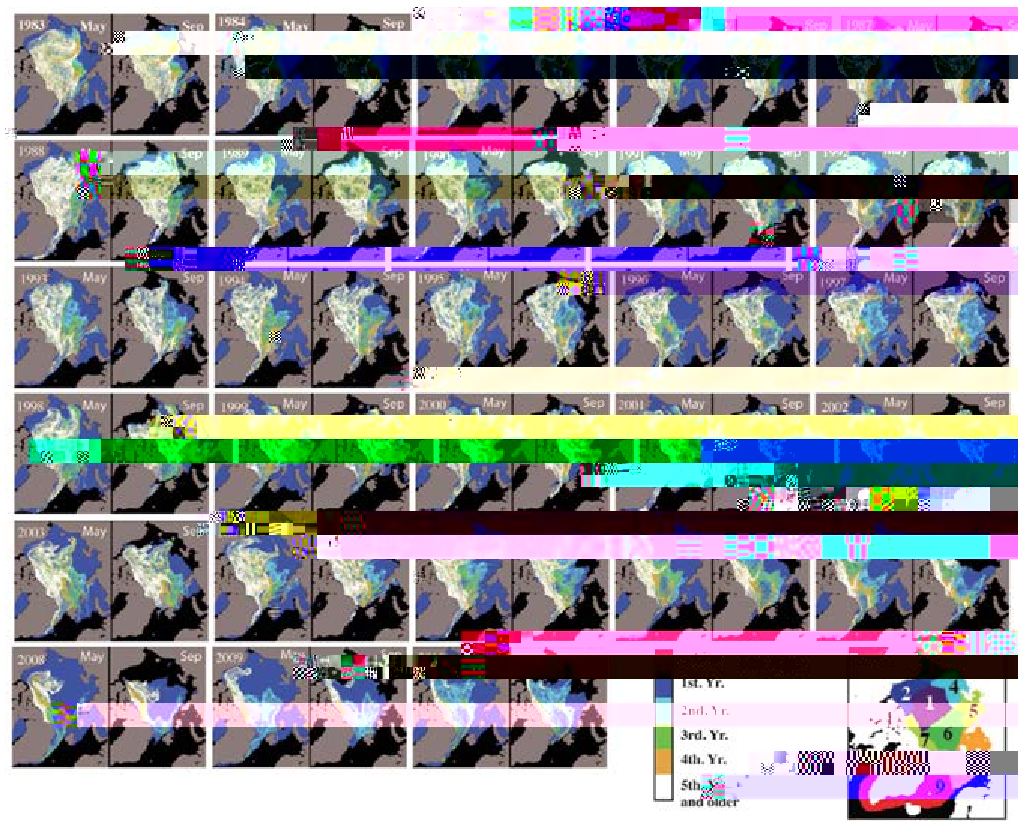

Figure 1. Multi-year Arctic sea-ice 1983 – 2010 (taken from Maslanik et al. 2011).

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