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SPATIAL AND TEMPORAL OPERATION OF THE SCOTIA SEA: INTEGRATED ANALYSES AND CIRCUMPOLAR LINKS

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The Scotia Sea is the most physically energetic and productive region of the Southern Ocean. Here we review the operation of the Scotia Sea ecosystem and consider the wider Southern Ocean links. The Antarctic Circumpolar Current (ACC) and its interaction with the Scotia Arc dominate the physics and chemistry of the region. The ecosystem is highly heterogeneous, maintained by the generation and dispersal of energy across the Scotia Sea in the current systems and up through trophic levels. The flow of the ACC is deflected north by the Scotia Arc, pushing polar waters to the lower latitudes. The interaction with the bathymetry generates intense mixing, introducing micronutrients into surface waters, and fuelling phytoplankton blooms that at times extend over more than 0.5 million km^2. Within the zooplankton communities, copepods may consume substantially more phytoplankton than Antarctic krill. However, krill are the key species in transferring energy to higher trophic levels. Krill grow and develop more rapidly in areas of high phytoplankton concentration but in the more northern regions higher summer temperatures limit their growth. The flows of the ACC and associated currents carry the krill to areas around South Georgia and the northern Scotia Arc where they subsidize local food webs. During summer upper trophic level predators forage across the region bringing back prey to breeding colonies, highlighting the localised concentration of consumption in the food web. During winter the spatial distribution and trophic links in the food web change dramatically and many of the upper trophic level predators leave the Southern Ocean. The effect is a dynamic mosaic of areas with changing balances of autochtonous and allocthonous production. Interannual variation in winter sea ice distribution and sea surface temperatures is linked to southern hemisphere-scale climate related processes. This variation also affects regional primary and secondary production, biogeochemistry and food web dynamics. There is also clear evidence of marked decadal changes across the region that have led to major changes in the operation of this ecosystem. Developing integrated analyses of the Scotia Sea ecosystem requires understanding of the circumpolar operation of Southern Ocean ecosystems.