

Trophic structure in open waters of the marginal ice zone in the Scotia-Weddell confluence region during spring (1983)

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Received: 25 June 1992 / Accepted: 17 January 1993

Abstract. The structure of the food web was investigated in open waters adjacent to the marginal ice zone in the southern Scotia Sea in spring 1983. Diets were defined for dominant zooplankton, micronekton, and flying seabird species and then aggregated by cluster analysis into feeding groups. Most zooplankton were omnivorous, feeding on phytoplankton, protozoans, and in some cases, small metazoans (copepods). Only two species were found to be exclusively herbivorous: *Calanoides acutus* and *Rhincalanus gigas*. Micronekton were carnivores with copepods being the dominant prey in all their diets. The midwater fish *Electrona antarctica* was the dominant food item in seven of the nine seabird species examined. Cephalopods, midwater decapod shrimps and carrion were also important in the diets of a few seabird species. Comparison (cluster analysis) of diets in spring with other seasons (winter, fall) indicated that over half the species examined (18 of 31) had similar diets in all seasons tested. The significant intraspecific shifts in diet that did occur were attributable to regional, seasonal, and interannual effects. A scheme is presented that describes the major energetic pathways through the open water ecosystem from phytoplankton to apex predators. At the base are phytoplankton and protozoans which are the principal food resource for the biomass copepods and krill. Krill and the biomass copepods are the principal forage of the midwater fish *Electrona antarctica* which, in turn, is the central diet component of flying seabirds as well as important food for the Antarctic fur seal and cephalopods. Krill are a major diet element for the fur seal and cephalopods, and the principal food of the minke whale.

sons, spring (1983), fall (1986), and winter (1988) during the Antarctic Marine Ecosystem Research in the Ice Edge Zone (AMERIEZ) program. This paper describes the structure of the food web in open waters adjacent to the ice edge in the southern Scotia Sea in early spring. The trophic structure in fall and winter has been reported in earlier papers (Hopkins and Torres 1989; Ainley et al. 1991; 1992; Lancraft et al. 1991; Hopkins et al. 1993). The data set was based on collections from the RV *Melville* at open ocean locations north of 60° 45'S, the northern limit of the pack ice. Feeding in dominant zooplankton and micronekton species is described and the results integrated with data from other studies on top predators, i.e., birds and mammals, found in this region during spring. Feeding patterns in 1983 are also compared with those determined for other seasons in the Scotia-Weddell Sea region and major caloric pathways through the ecosystem from phytoplankton to apex predators are proposed.

Regional setting, spring

The physical characteristics and aspects of phytoplankton production and distribution in the study area have been presented in Nelson et al. (1987). Sampling was conducted in a hydrographically complex region of the southern Scotia Sea where water emerging from the Weddell Sea mixes with the eastward flow from the Bransfield Strait and Drake Passage. The northern extent of pack ice was encountered at approximately 60° 45'S (Fig. 1). The surface temperature showed a general gradient, with temperatures increasing from southeast to northwest. Temperatures south of 58° 30'S ranged from –1.6°C to 0°C while to the north the range was 0°C to +1°C.

Phytoplankton biomass (chl *a*) in the upper 150 m averaged 1.7 mg m⁻² which was 7 to 12 times that in fall and winter. Mean primary production, estimated at 590 mg C m⁻² d⁻¹, was twice that in fall and 20 times that in winter (unpublished data by Smith, and Smith and Cota). Standing crop and production were highest in the

The marginal ice zone in the southern Scotia Sea and the northwestern Weddell Sea was investigated in three sea-