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Main bio-productivity features of the Western Arctic LMEs

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Among five LME modules, one of the key is bio-productivity. The production of the Arctic seas includes organic matter, produced by plankton, benthos, birds, and marine mammals.

The synthesis of the primary organic matter, with plankton algae being the main producers, forms the basis of the ecosystem pyramid. According to the most common assessments, the Norwegian Sea and Iceland Shelf LMEs are referred to as highly productive Arctic shelf areas (more than 300 g C/m^2 per year); the Chukchi Sea, Bering Sea, Faroe Plateau, and Southwestern Barents Sea are determined as areas with moderately high productivity (150 – 300 g C/m^2 per year). The rest of the Arctic water areas and the Arctic basin proper are considered as low productive.

Based on results of more than 40 MMBI cruises on board the nuclear icebreakers the functioning of detritus trophic chain in the Barents and Kara Seas coastal zones during the polar night has been determined. Plankton bacteriocenoses preserve steady structure and high production activity under solid ice cover with temperatures close to seawater freezing point. Bacterioplankton in the winter season is the only food substrate for zooplankton organisms before cryoflora vegetation.

The total productivity of key links of trophic chain plankton component for the Barents, White, Kara, and Laptev Seas weakens towards the East-Siberian Sea (Fig. 1).

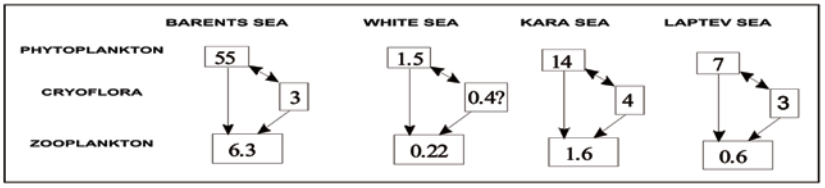

Fig. 1. Production (mln ton C_{org}/year) of separate links of trophic chain in the ecosystems of the Barents, White, Kara, and Laptev Seas

Production and biomass by-growth rates of bottom communities in the southern coastal areas of the Barents Sea have been calculated and determined. By our data, zoobenthos productivity ranges depending on inner-secular climate fluctuations and bottom communities' succession stages. On average, the benthos of soft and mixed grounds produces around 70% of the total averaged biomass (P/B = 0.7) per

year, the communities of hard grounds – around 60% (P/B = 0.6). Somatic production in coastal areas is approximately by 2–3 times higher than in the open Barents Sea shelf with values of P/B-coefficient being 0.25 – 0.30 (Berezina, 1963; Konstantinov, 1967). Overall, the Barents Sea coastal bottom biocenoses production rates yield to such boreal seas as the Sea of Okhotsk and North Sea (where P/B-coefficients are 1.2 (Dulepova, 2002) and 1.5 (Dommasnes et al., 2001) correspondingly), but close to the Bering Sea indices (P/B-coefficient is 0.9 (Dulepova, 2002)).

When studying the Arctic LMEs it is important to assess quantitatively the role of every ichthyofauna species in the cycle of matter and transformation of energy in the ecosystems of the northern seas.

Until recently, only tentative production values (P/B-coefficient) of 0.125–0.170 (Zenkevich, 1947) were applied for the Barents Sea fishes.

Quantitative indices of production (P/B-coefficient) of fishes in different water bodies vary. For example, it is 0.46, on average, for the Barents Sea cod and 1.0 – for the White Sea. Production of the Arctic-Norwegian population of the Atlantic cod ranged within 0.4-2.0 mln tons from 1946 to 2006 and somatic by-growth was 81%. The generative production was assessed as of 42-479 thousand tons and the ratio of eggs was 58%. The mean long-term P/B-coefficient of the fisheries part of the population of Atlantic cod was 0.47.

Assessment of production (P/B-coefficient) of one of the commercial demersal species – deepwater redfish (perch) indicated that the mean annual by-growth of the population biomass was twice higher than considered before, and was of 30%.

Thus, the principal model of productivity of the main food links of the Arctic marine ecosystems may be presented with the Barents Sea being exemplified (Fig. 2) (Matishov et al., 2003).

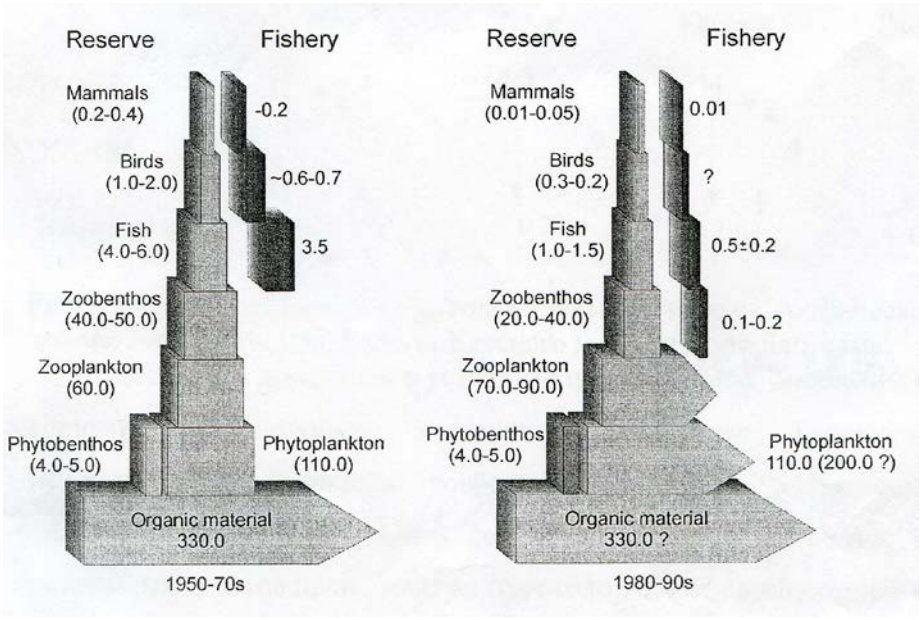

Figure 2. Pattern of the Barents Sea ecosystem pyramid changes in the 1950s to the 1990s (annual production and the fishery stress, million tons)

Determined values and regularities of the LME bioproductivity are of theoretic and practical importance and may be the basis for further improvement of ecosystem forecast methods and selection of marine bioresources optimal exploitation ways.