Barents Sea water masses variety and latitudinal extent of this reservoir creates spatial heterogeneity of its population zoogeographical composition and temporal shifts of seasonal biological processes in different sea areas (Bogorov, 1941). It determines the dynamics of local systems’ productional level. These variations depend on the activity of the Gulf Stream, which advection of warm Atlantic waters is extremely important for keeping up the life in severe polar waters (Zenkevich, 1963).

The extent of Atlantic advection influence can be judged by the distribution of water masses and water exchange intensity (Dobrovolsky, 1961; Tantsura, 1959; Mukhin, 1975; Kudlo, 1961). In accordance with the distribution of Atlantic waters, the south-western sea is inhabited by boreal fauna and the north-east by the arctic one (Deryugin, 1915; Hofsten, 1916; Filatova, 1938). The boundary between them almost coincides in different ecological groups of marine organisms (plankton, benthos, nekton). It is located at the level of 35-40°E (Cheremisina, 1948) and its year-to-year position depends on annual shifts of faunistic complexes. The influence of water masses on plankton is more indicative. Its composition and abundance at the eastern border of the Atlantic waters penetrating into the Barents Sea is reliably recorded in the Kola Meridian hydrographic section (33° 30’ E) crossing three Atlantic flows - the coastal and main branches of the Murman Current and the Central Branch of the North Cape Current (Tantsura, 1959).

The first mass collecting mesoplankton in the Kola Meridian Section was carried out by the State Oceanographic Institute of the USSR Academy of Science in 1929-1930, and in 1959 PINRO started to conduct regular annual plankton surveys, which were in progress till 1993. In total, 660 plankton samples were collected.

Already at the first stage of all-the-year-round investigations, in the 30s, the idea of extraordinary homogeneity of plankton specific structure all over the latitudinal length of the section with predominating group of Calanooida, among which C. finmarchicus made up 80-90% of the total biomass; of the short-term summer period of plankton intensive development with abrupt increase in biomass; of the latitudinal shift of growth peak along the Kola Section during summer months...
(Yashnov, 1939) was given. The displacement of development “wave” along the sea area corresponds to the periods of plankton spring-summer growth in different latitudes (Drobyshova, Nesterova, Nesvetova, 1988) (Fig.1). Based on it, it was assumed, that reproduction of C. finmarchicus in the Barents Sea was monocyclic and that the southern (Atlantic) and northern (the Arctic Ocean) groups with a boundary at the level of 73-74°N represented different populations not related to each other genetically and different in biological characteristics (Yashnov, 1939).

Those propositions became initial when our analysing structural and quantitative dynamics of C. finmarchicus southern group status by the data from collecting plankton in the Kola Meridian Section in the 60-90s, in the period of biomass reaching maximum in summer (May-June), and concentrating in the surface 50 m water layer. The purpose was to clear up the reasons of variability of the main populational characteristics of C. finmarchicus from the southern group.

The period investigated was characterised by prolonged cooling following the intensive warming in the 20-40s and lasted till the 90s with minute exemptions (1973-1975) (Kudlo, Shpaikher, 1973; Mukhin, 1975). Therefore, cold (1978, 1979, 1980, 1981) and warm (1983, 1984, 1990, 1991) years of that period were the most indicative.

During all the years specific composition of May-June plankton southern group in the surface waters became enough stable. Against the unchangeable predominance of boreal C. finmarchicus only small changes in specific structure due to the portion of minor small copepods fluctuating and appeared species-indicators of warm and cold waters took place. In cold years the number of Pseudocalanus elongatus decreased and typically cold water species Metridia longa and Aeginopsis appeared, the number of Euphausiacea was great; in the warm years the number of Oithona similis increased and that one of juvenile euphausiids reduced (Fig.2).

The differences in plankton age composition in different flows of Atlantic waters because of the lateness of development periods in the more northward areas were more significant.

During all the years of our investigations copepodites of C. finmarchicus I-III stages (Fig.3) prevailed in the surface layer plankton everywhere. But in cold 1979, when water temperature anomaly was negative, but rapidly reduced from winter minimum (-1.5°C) to 0.2°C towards late summer, the number of juveniles was great all along the Kola Meridian Section and the peak was at the north stations of the section, in the waters of the North Cape Current northern branch (74°N) (Tereshchenko, 1999). The similar picture was kept in the following cold years – 1980, 1981. A different situation was observed in warm 1983 and 1984 - the number of Calanus juveniles was greater at the southern stations, i.e. in the waters of the North Cape Current coastal and main branches (70-72°N), when warm water masses predominated in the area of the Kola Meridian Section. For this, the number of older individuals was noticeably less than in the cold years.

Obviously, year-to-year quantitative differences and latitude trends in distribution of Calanus juveniles at I-III stages are well-explained by different growth periods. Delayed growth in cold years resulted in growing individuals staying too long in
the surface layers, especially, at the north stations, early growth in warm years – in early descending of growing year-class to the lower water layers and, hence, rapid depletion of the upper ones. By the way, the fact, that the number of older individuals was considerably more in late May, than in the warm years, indicated this. Consequently, mean plankton biomass in the Kola Section, containing three water flows, reflects summary conditions of spring-summer growth, but does not connect with water temperature at the certain moment.

Long-term series of May-June plankton biomass averaged by the section shows the fluctuations within the limits of \( SO-600 \text{ mg/m}^3 \) (Fig.4). Such great amplitude was observed in the 60s and mid-80s, but during the prolonged period of 1967-1984 the biomass level was enough stable, and its variations did not exceed \( 80-250 \text{ mg/m}^3 \). It would appear reasonable that both system variations in biota under the influence of abiotic conditions and the change of biotic press on plankton might be the reasons of those fluctuations. The integral index of the first one are water temperature fluctuations, of the second one - abundance of main consumers - juvenile cods and capelin (Drobysheva, 1990). Since the boreal species \( C.\text{finmarchicus} \) was the main component of plankton community in the area surveyed, it was natural to expect synchronous fluctuations of temperature and biomass. However, the analysis of long-term fluctuations of plankton summer biomass in the Kola Meridian Section revealed four periods of different biomass correlation with water temperature (see Fig.4): A and C - negative correlation was accompanied by anomalous biomass leaps (from 50 to 600 \text{ mg/m}^3); B (asynchronous) and D - positive (synchronous) correlation was characterized by stable interannual producing at the mean level of biotic potential - 150-200 \text{ mg/m}^3.

Evidently, the mechanism of forming plankton community was different in those periods, i.e. there was a change of leading factor.

Asynchronous stages coincided with abrupt reduction in the Barents Sea fish abundance as a result of their intensive fishing: in 1957 the stock of cods decreased to 2.0 mill. t under 4.5 mill.t in the previous years, in 1987 capelin stock was reduced to 0.09 mill.t under the mean annual value of 5.3 mill.t in the previous ten years (ICES, 1999). Plankton and \( C.\text{finmarchicus} \) population, in the first place, rapidly responded to the slackening of biotic press by surplus survival (Drobysheva, Dolgov, Nesterova, 1991; Orlova, Matishev, 1993). H. Skjoldal drew the same conclusions (Skjoldal at all, 1991). Against this total biological background, which is the similar for all the zoogeographical groups, the impact of hydrodynamic conditions was veiled, as the biotic factor was more effective regulator of plankton production level.

Synchronous periods coincided with high and relatively stable abundance of fishes, and, hence, with more even press of grazing. It caused stable low level of biomass, on the background of which the effect of Atlantic waters advection was evident.

Ultimately, the character of annual variations of plankton biomass was the following:

1. Biomass correlation character and water temperature varied from time to time.
2. In the periods of direct dependence the level of mean biomass was low (150 mg/m³) and annual fluctuations did not exceed the increase in 2-3 times; when the dependence was reverse, the mean value of biomass was two times higher (300 mg/m³) and annual fluctuations were increased in eight times.

3. Synchronous fluctuations of plankton temperature and biomass were observed in the periods of even fish-consumer press; while the asynchronous ones - in the years of anomalous fluctuations of fish stock.

Therefore, temperature background provides relatively stable plankton community functioning at the level of natural biological potential according to zoogeographical status of species predominating; abrupt biotic disturbances change reservoir ecosystem connections, on principle, therefore, become the main reason of extreme fluctuations of plankton abundance in the Barents Sea.
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Fig.1 Chart of seasonal shift of "red Calanus" (IV-V stages) in the Barents Sea area.

Legend: 1 – location of zone in May; 2 – in June; 3 – in July; 4 – in August. Figures in the chart mean maximum summer biomass in proper area of the Barents Sea.

Fig. 2: Specific structure of mesoplankton in the surface waters

- Fritillaria borealis
- Euphausia jui
- Oithona similis
- Pseudocalanus elongatus
- Calanus finmarchicus

Legend: 1 - C. thimarchicus CI - CIII; 2 - C. thimarchicus CIV - CV.

Fig. 3: Age structure of Calanus thimarchicus population at the stations of "Kola Meridian" Section in

[Diagram showing age structure with labels and scales for latitude, year, and abundance.]

[Graph showing data points and trend lines, possibly indicating population changes over years and latitudes.]
Mean biomass of Calanus in 50.0 m/layer, mg/cubic meter

Fig. 4. Average abundance of Calanus hyperboreus from the Baranof Sea and water temperature on "Kola Meridian" Section

Mean annual water temperature in 200 - 0 m/layer, °C.