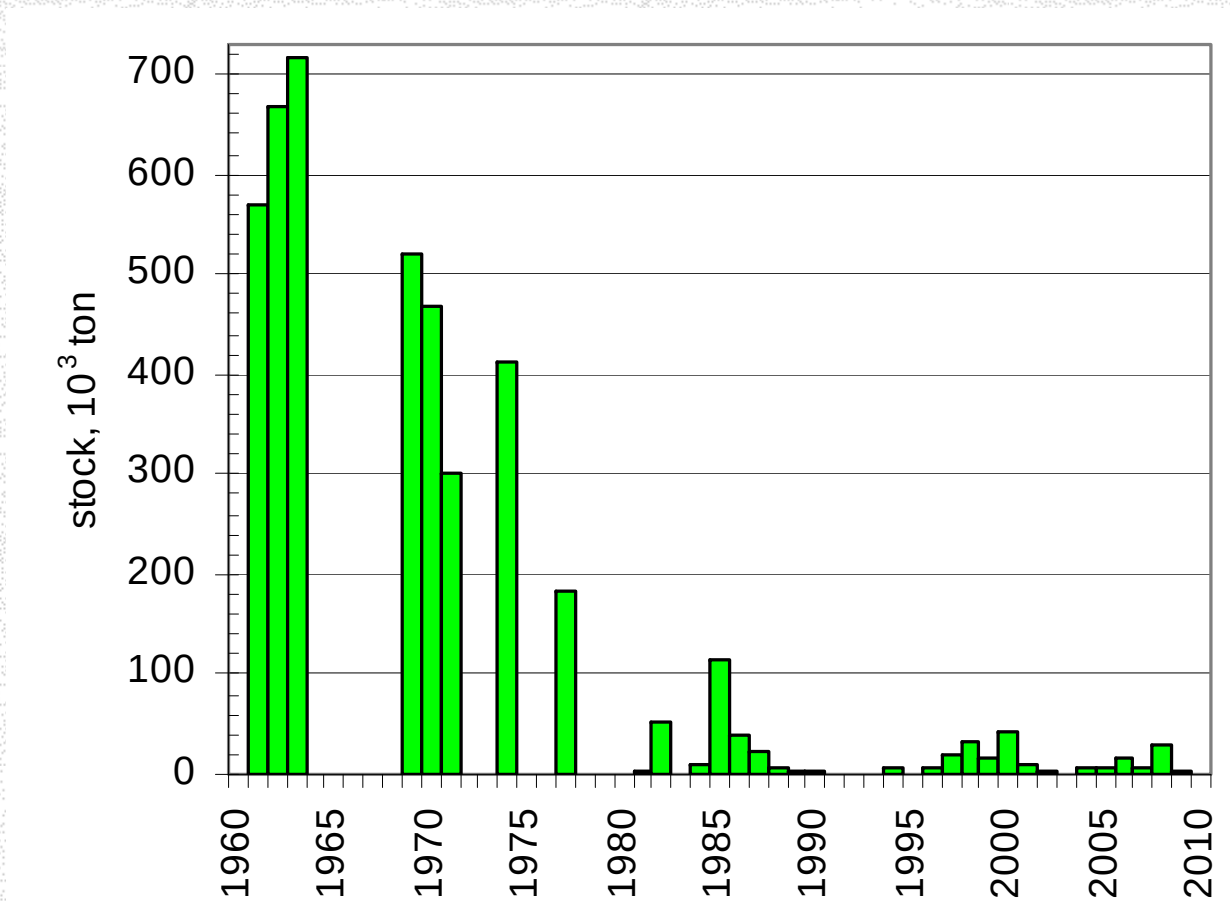


Climate change influence on development of *Laminaria japonica* early stages in the coastal waters of Primorye



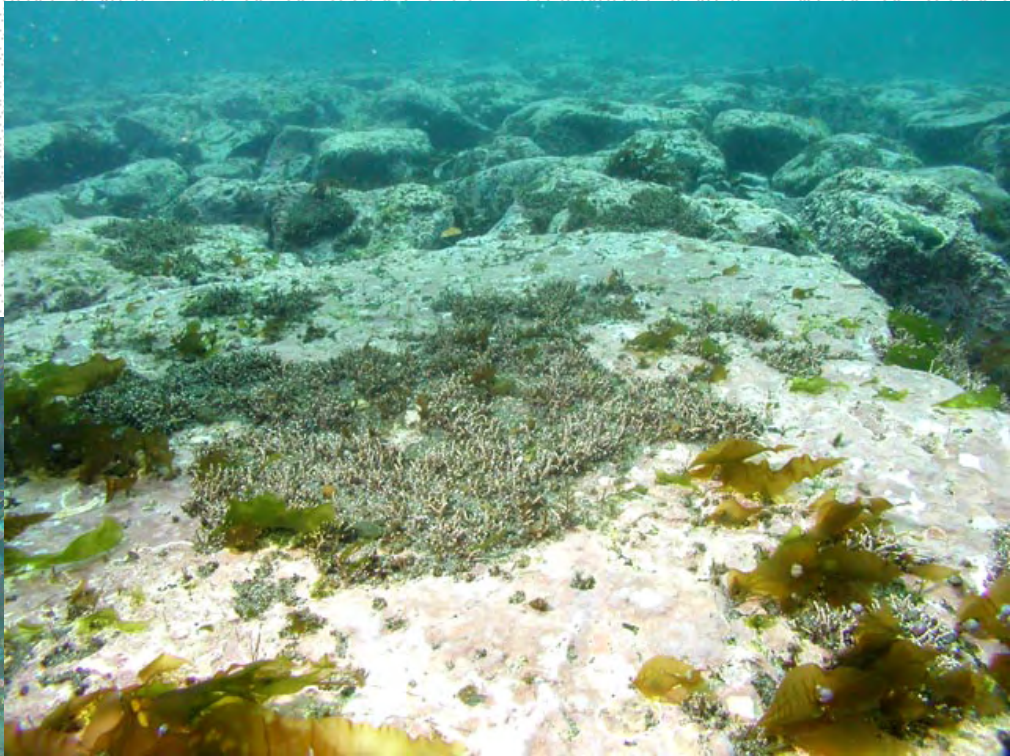
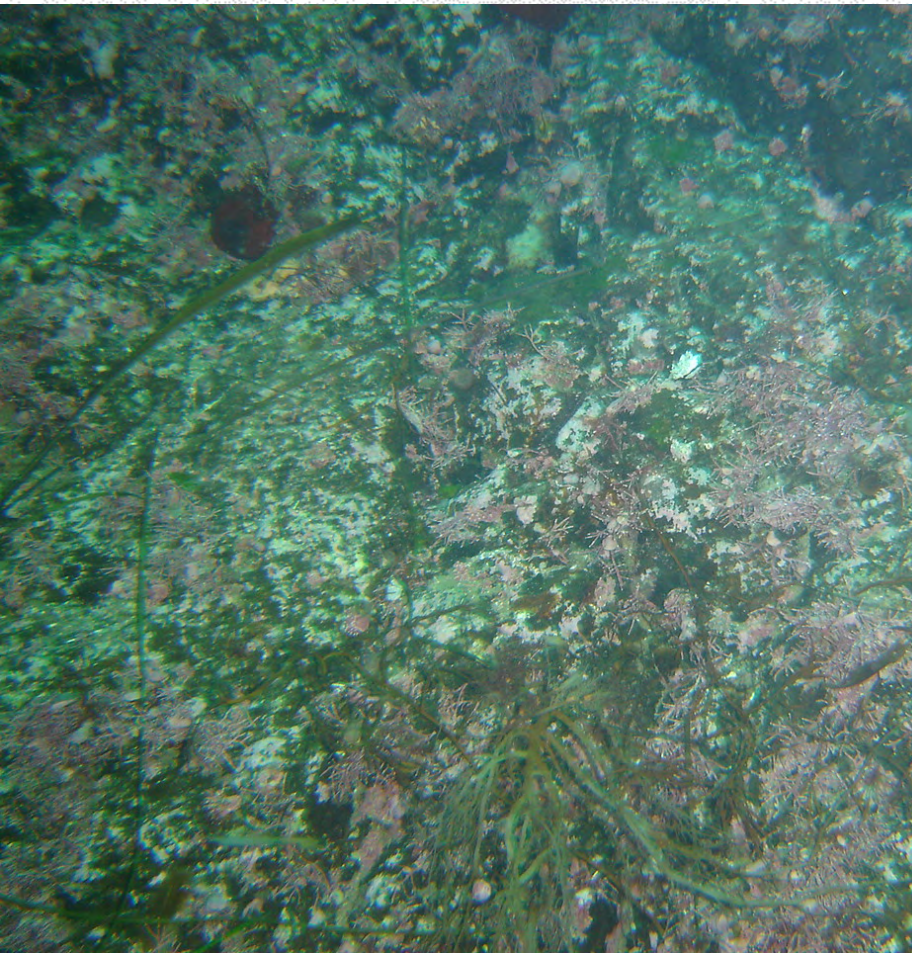
Tatiana Krupnova, Yury Zuenko
Pacific Fisheries Research Center (TINRO), Russia

Stock of *Laminaria japonica* on the shelf of Primorye (from the data of diving surveys)



No data for the years 1964-1968, 1972-1973, 1975-1976, 1978-1980, 1983, 1991-1993, 1995, 2003

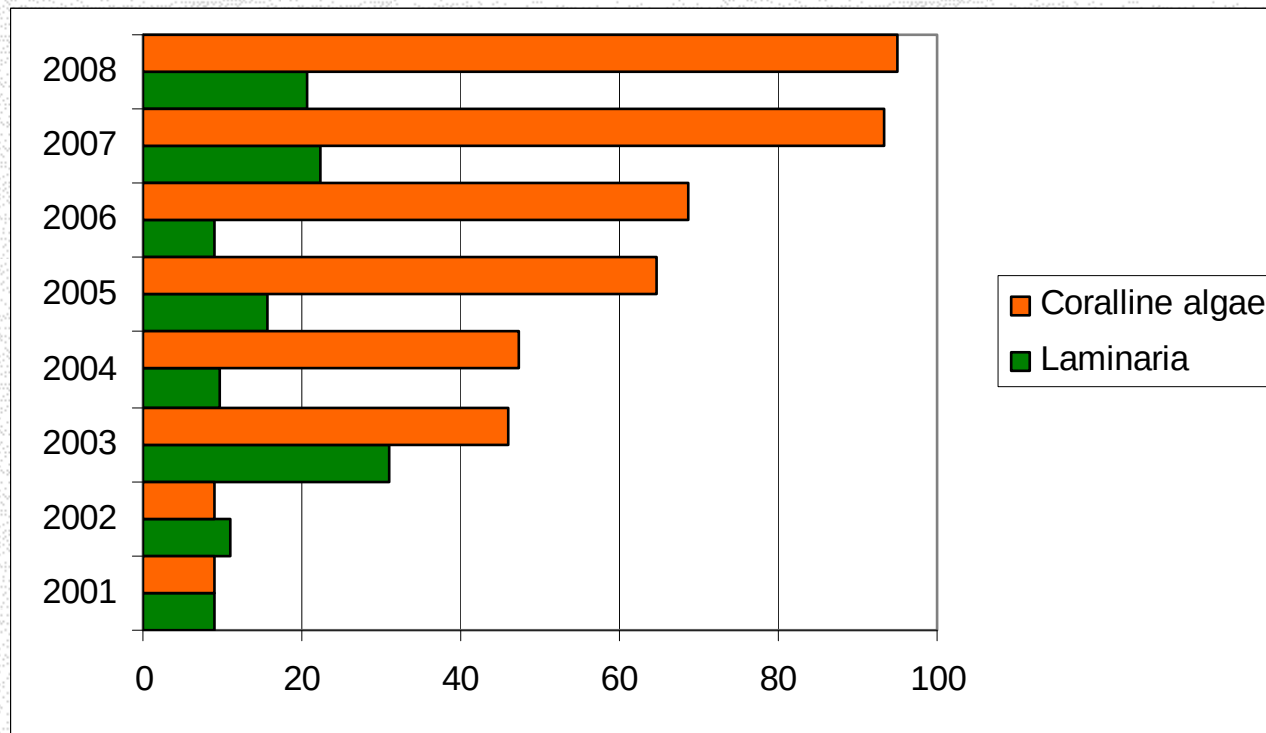
Fields of coralline algae



Competitors of *Laminaria japonica* for substratum at Primorye coast

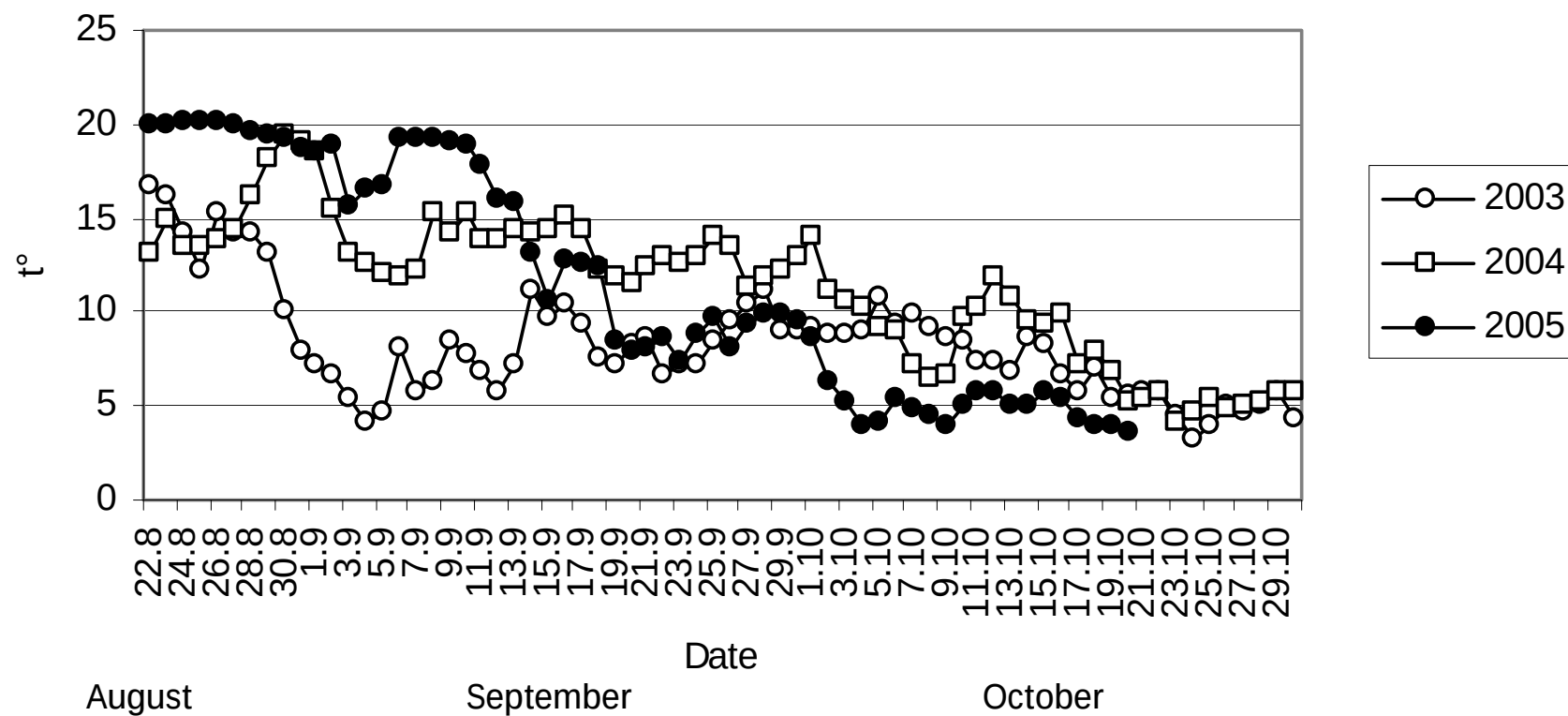
Costaria costata
Desmarestia (Dichloria) viridis
Lithothamnium sp., Lithophyllum sp., Clathromorphum sp., Bossiella cretaceae, Corallina pilulifera
Phyllospadix iwatensis

Frequency (%) of the grounds occupied by *Laminaria japonica* (green) and coralline algae (orange) at the southern part of Primorye coast

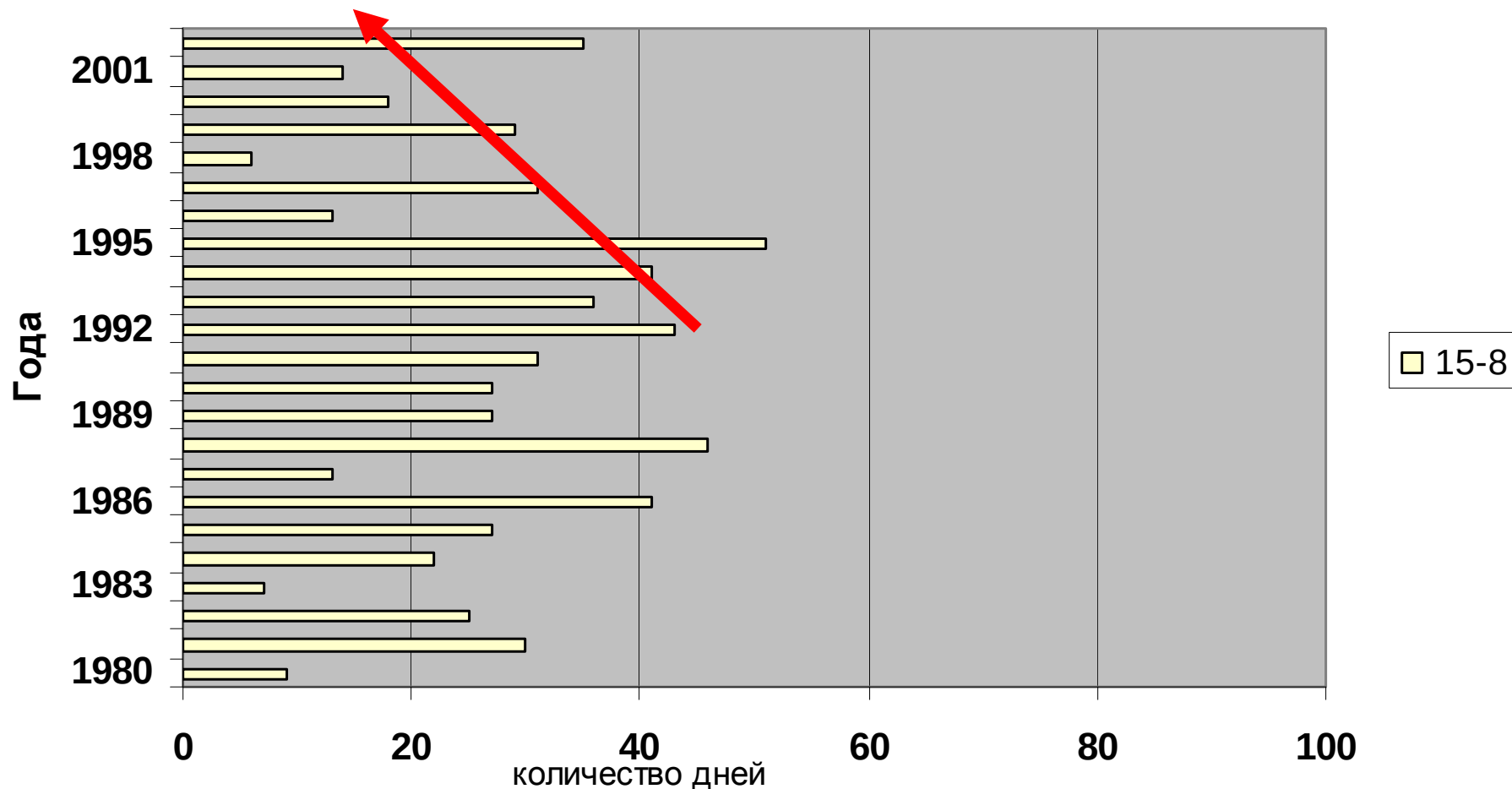


Recently the coralline algae occupy almost the whole (97 %) upper shelf of Primorye

Daily temperature at the sea bottom for a station with depth 10 m located in the southern part of Primorye coast

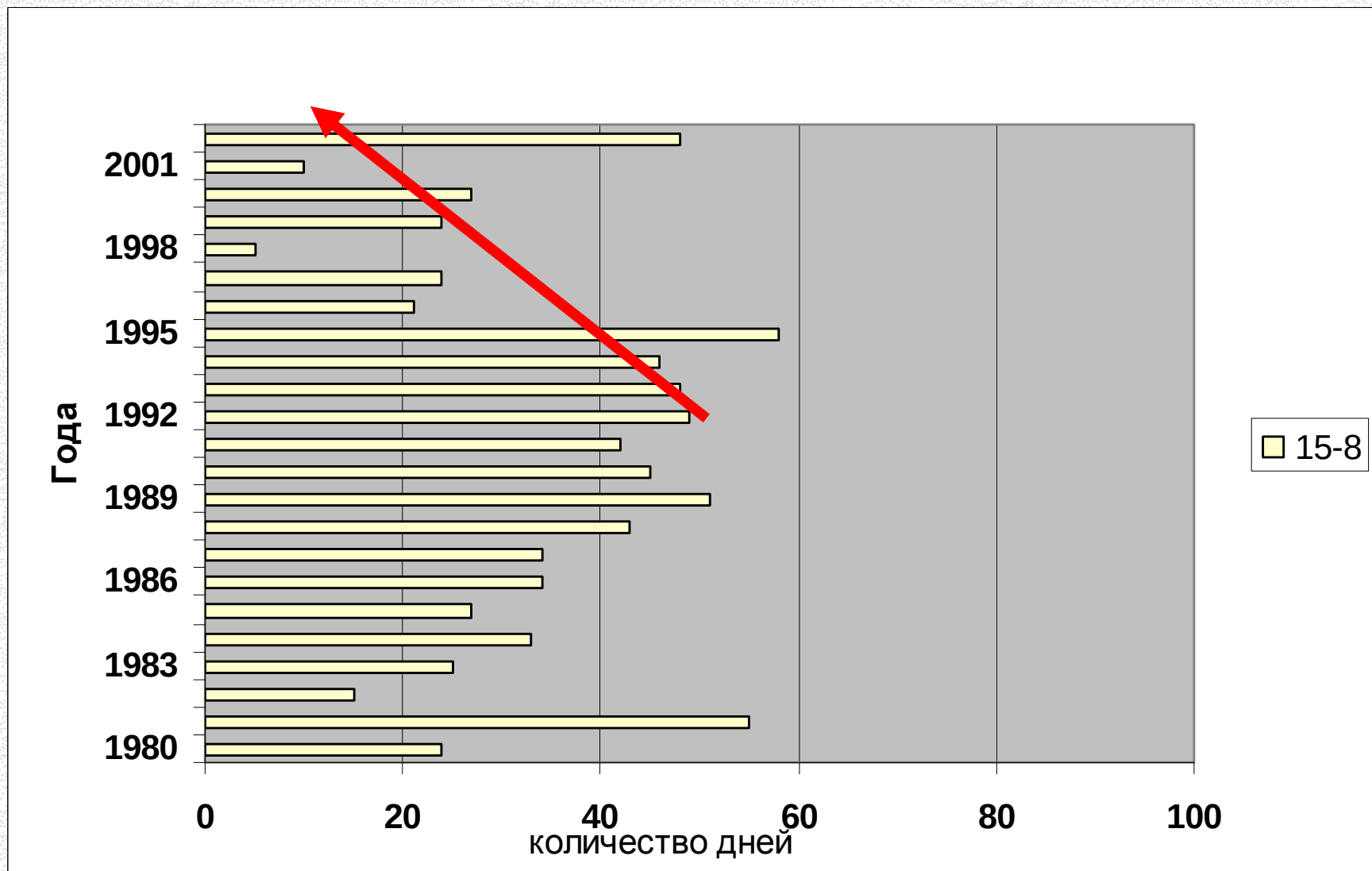


**Periods (days) with the water temperature between 15° and 8°C
favorable for Laminaria zoospores growth and gametophytes development
at the southern part of Primorye coast**



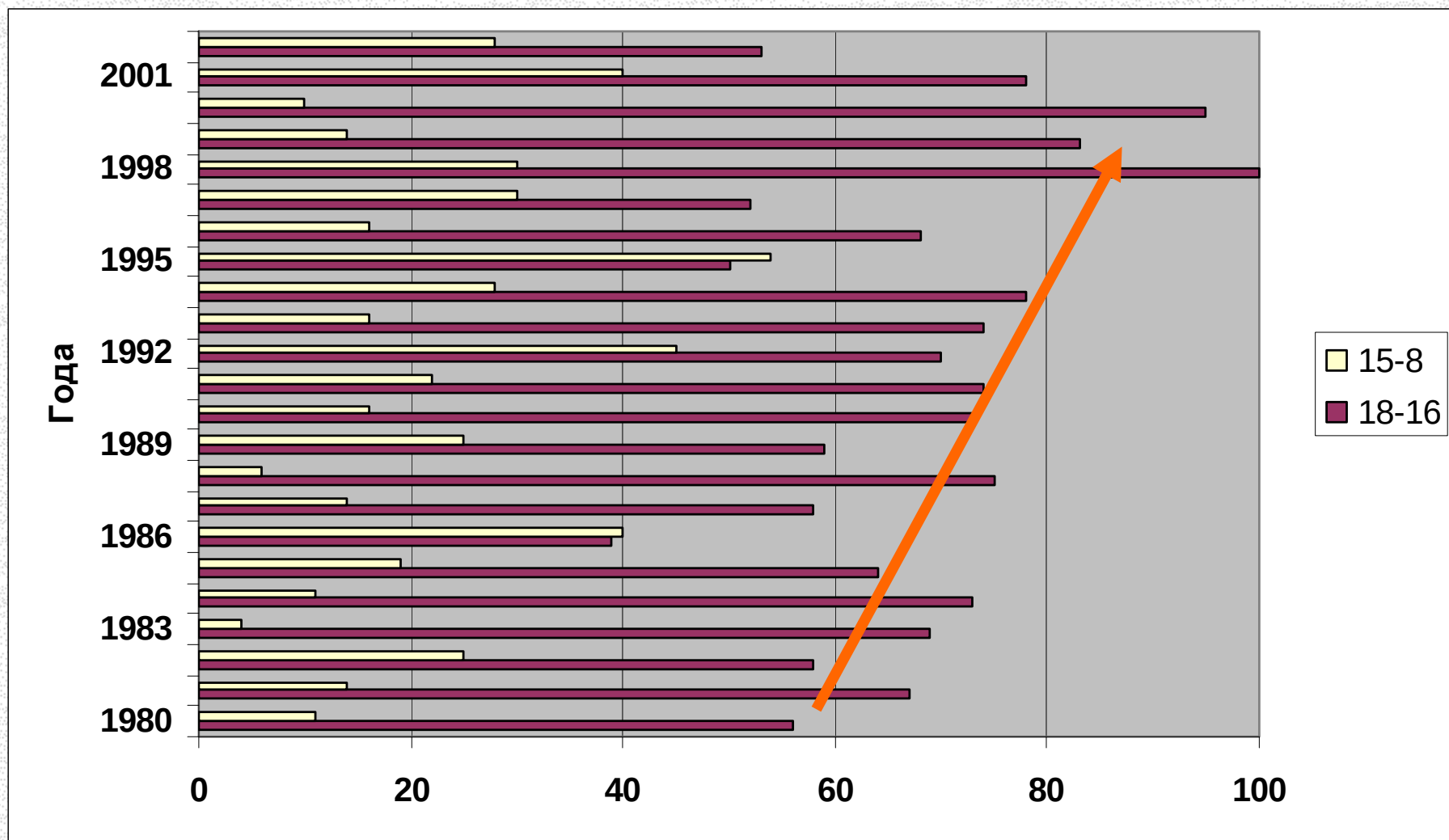
The periods have a tendency to shortening in the last two decades

**Periods (days) with the water temperature between 15° and 8°C
favorable for Laminaria zoospores growth and gametophytes development
at the northern part of Primorye coast**



The periods have a tendency to shortening in the last two decades

**Periods (days) with the water temperature between 15° and 8°C
favorable for Laminaria zoospores growth and gametophytes development
and with the temperature above 16°C unfavorable for them
in Peter the Great Bay**

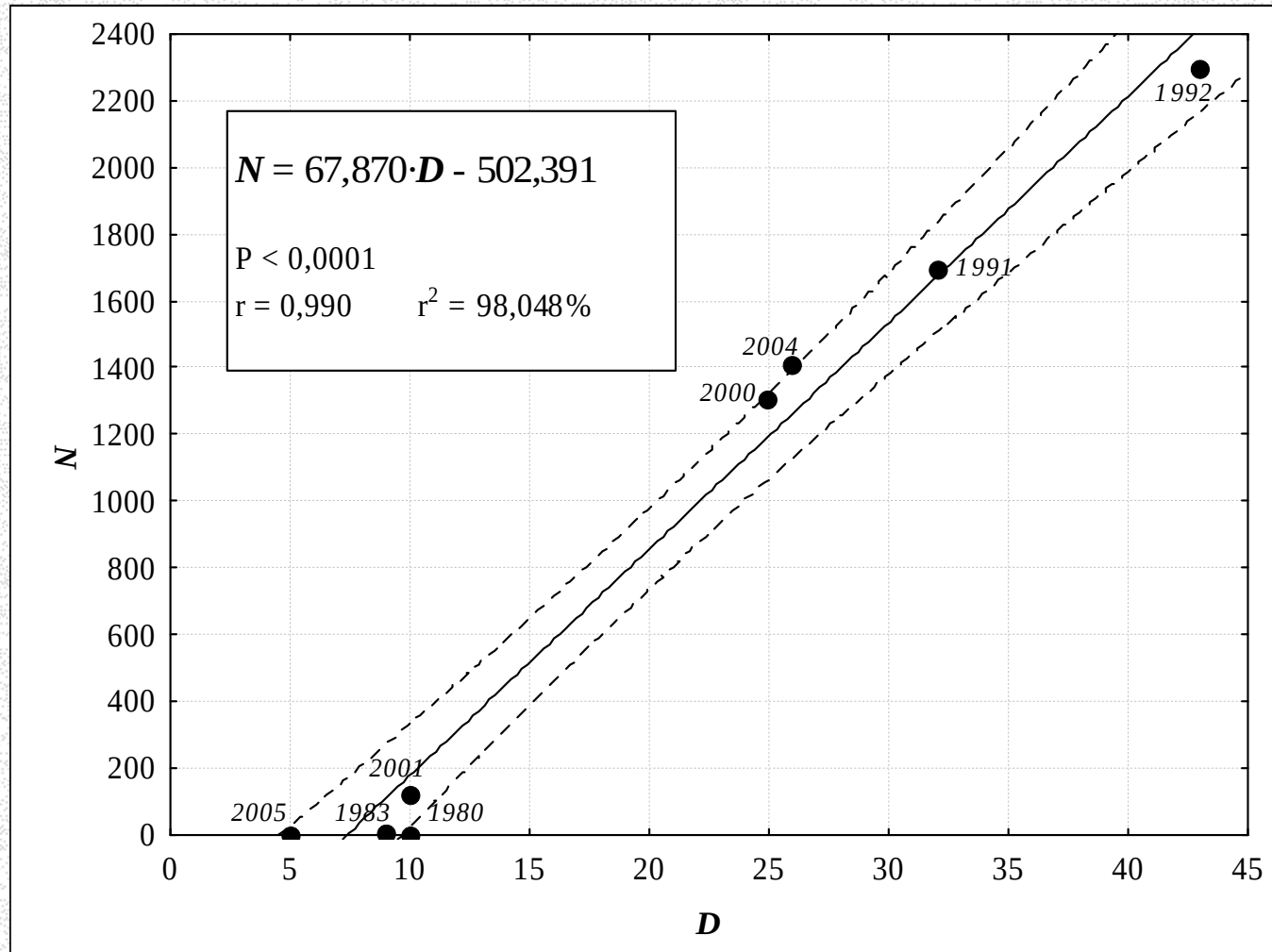


The unfavorable periods have a tendency to lengthening in 1980-1990s

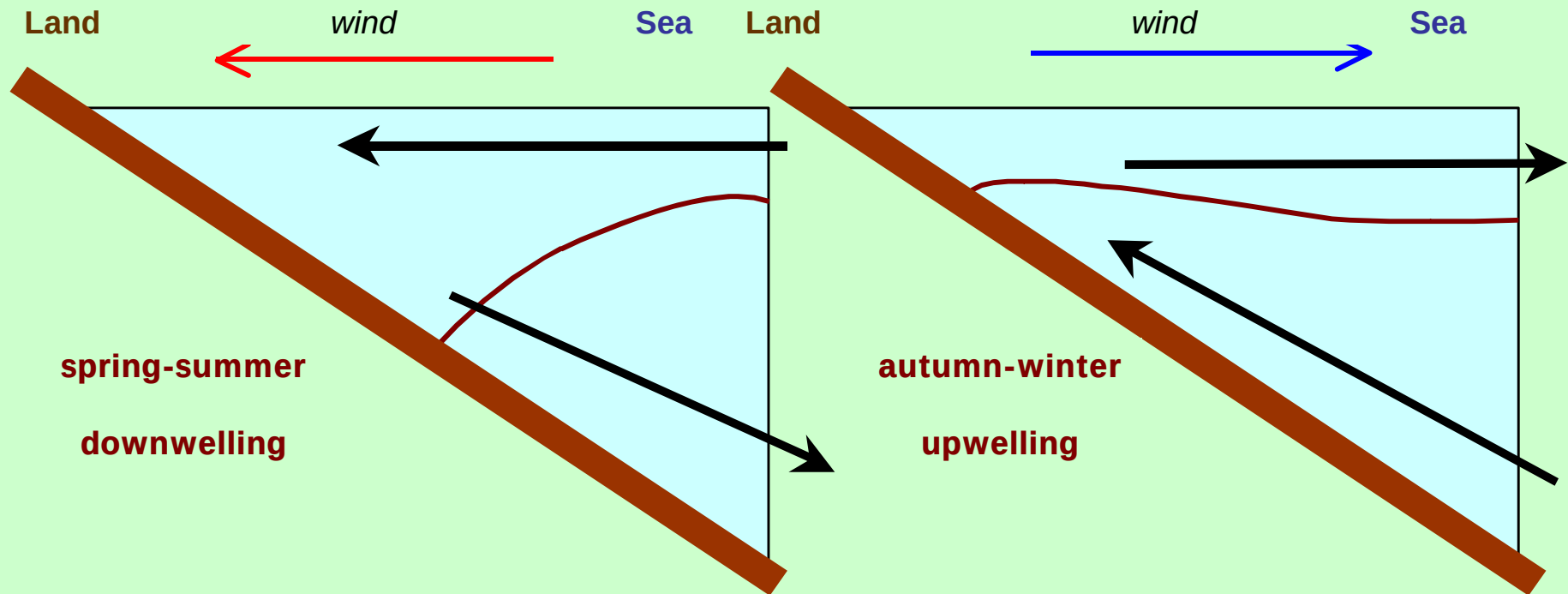
Correlation between the length of period with temperature 15-8°C in autumn and the number of *Laminaria japonica* germs in the next spring

D – length of the period with favorable temperature in autumn

N – number of germs (sp./m²) in the next spring

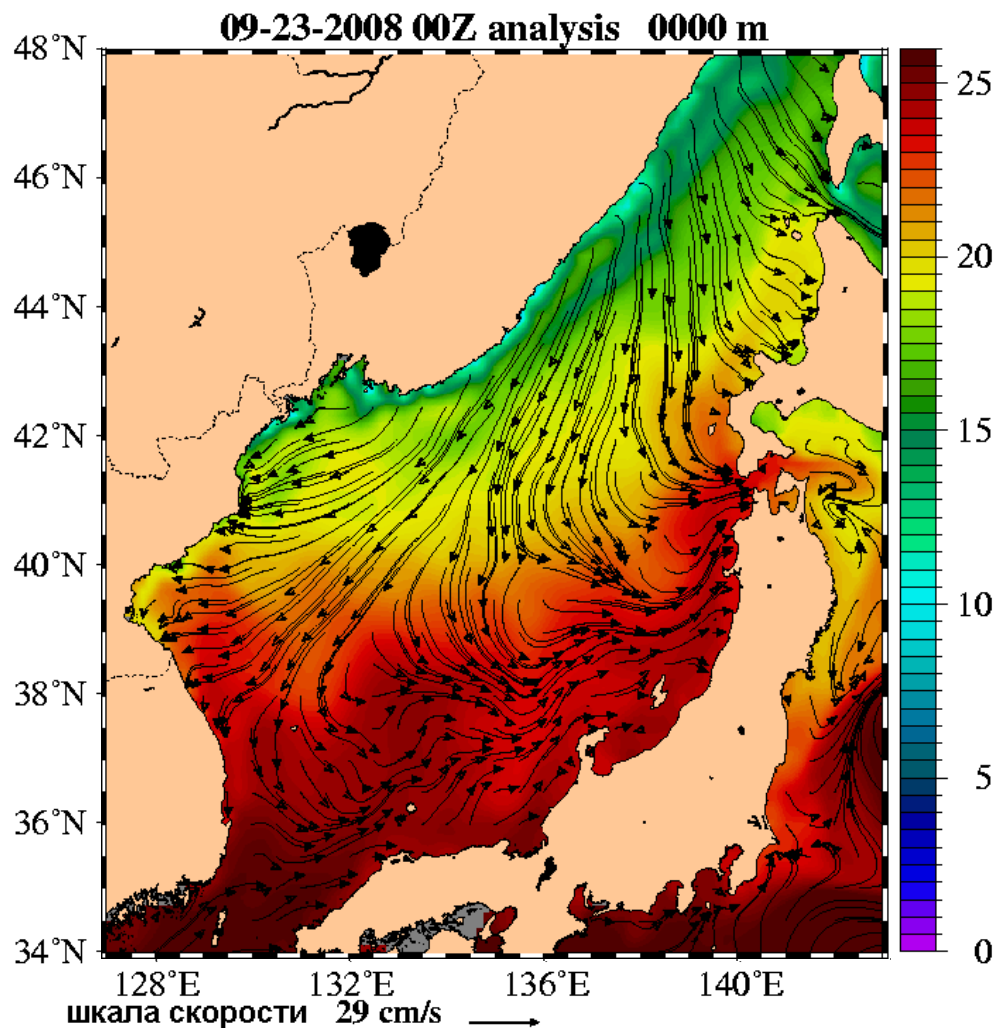


Scheme of cross-shelf water circulation at Primorye coast driven by summer and winter monsoons

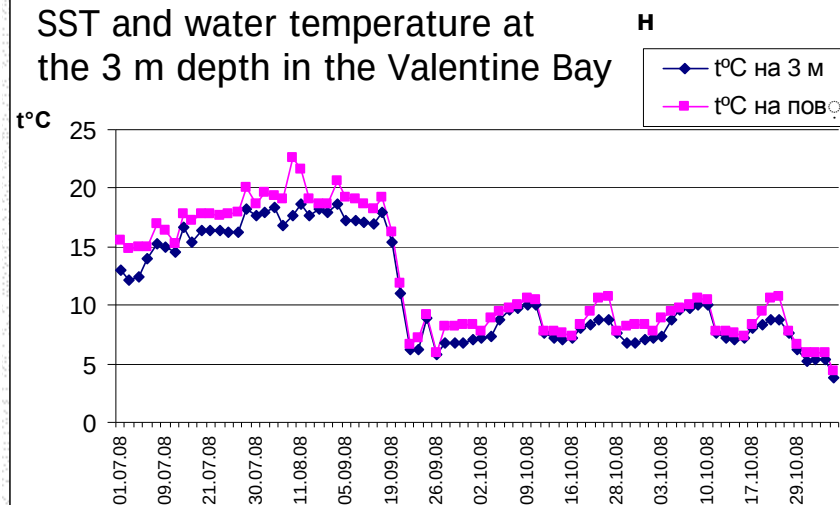


Abrupt cooling events at Primorye coast in the autumn of 2008

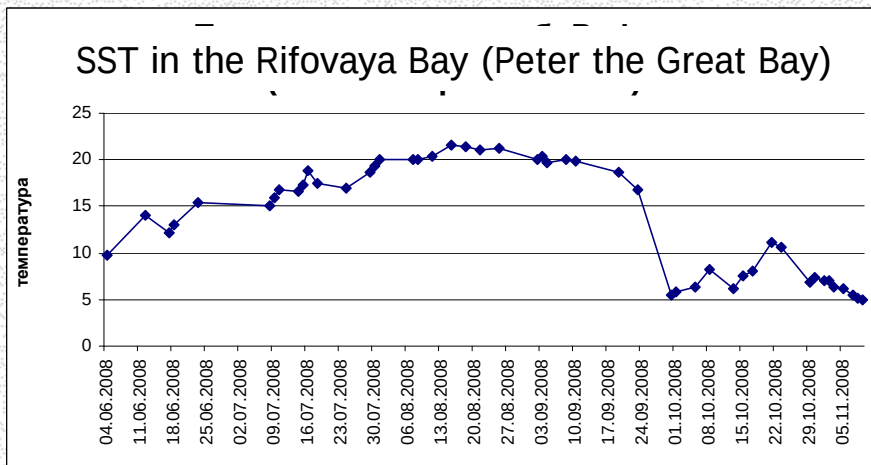
SST and currents at the sea surface
in late September of 2008
(satellite data)



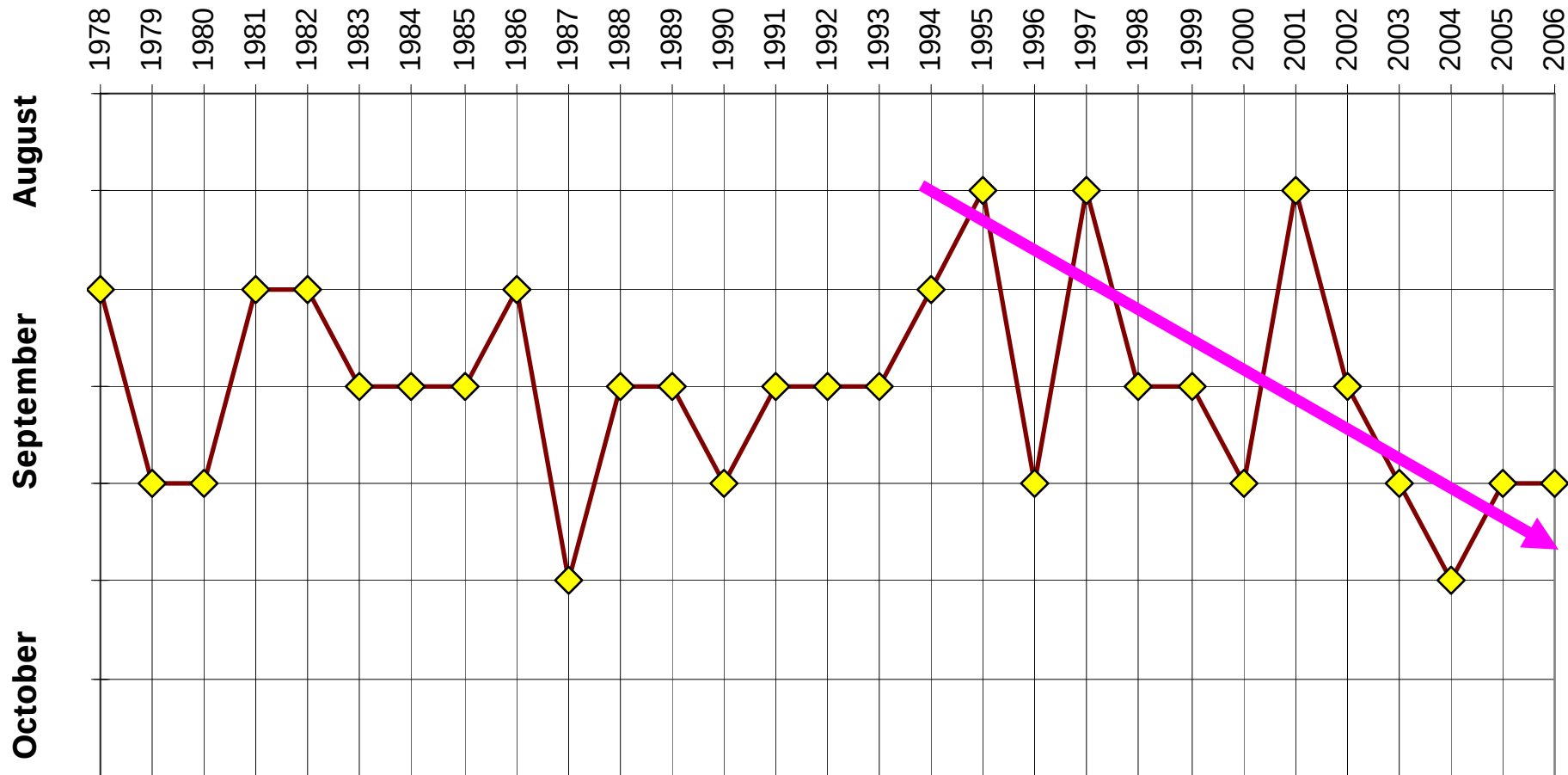
SST and water temperature at
the 3 m depth in the Valentine Bay



SST in the Rifovaya Bay (Peter the Great Bay)

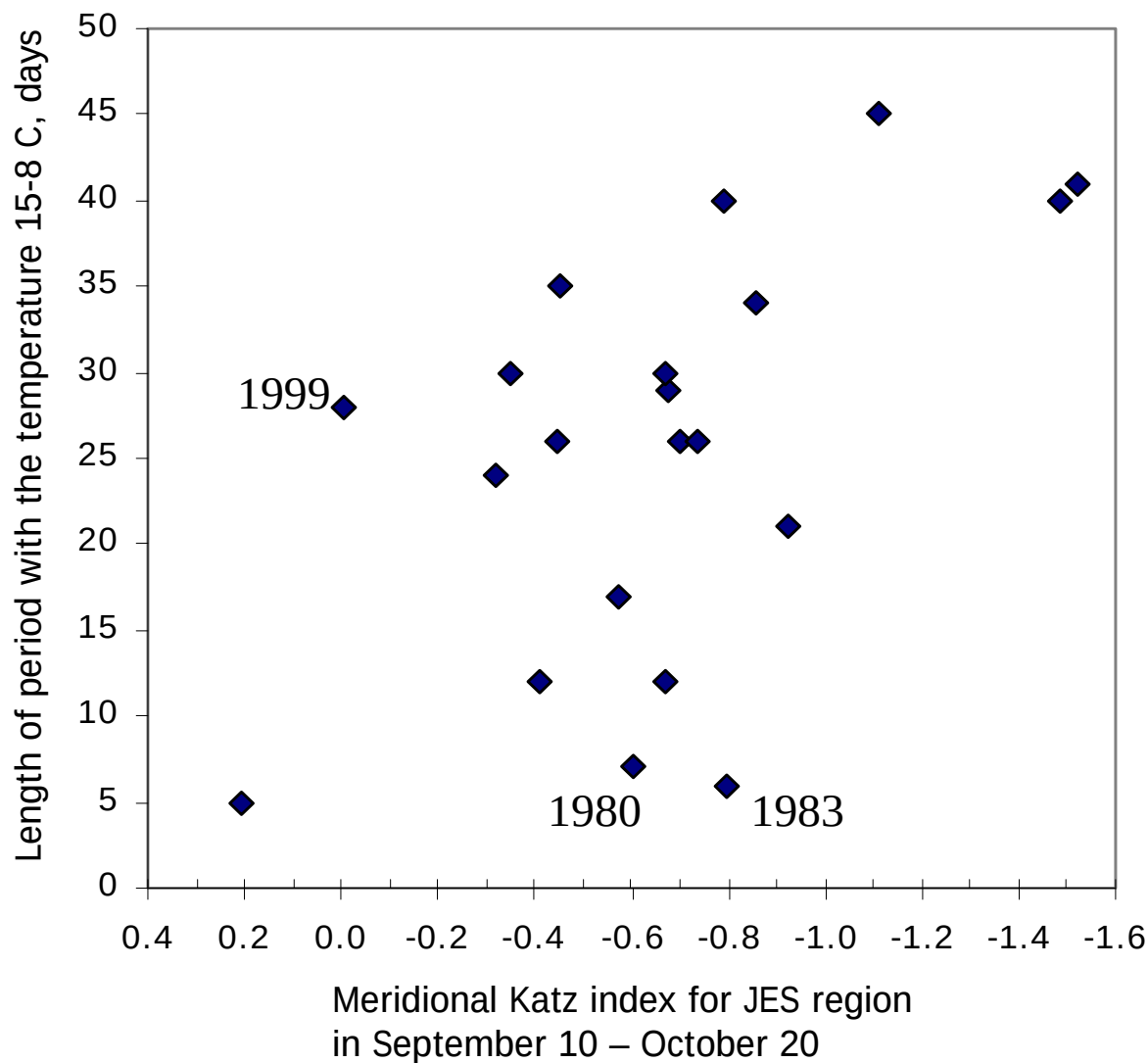


**Time of monsoon change from summer to winter type
as the time of change the sign (from positive to negative)
of the meridional Katz index of atmospheric circulation for the JES region**

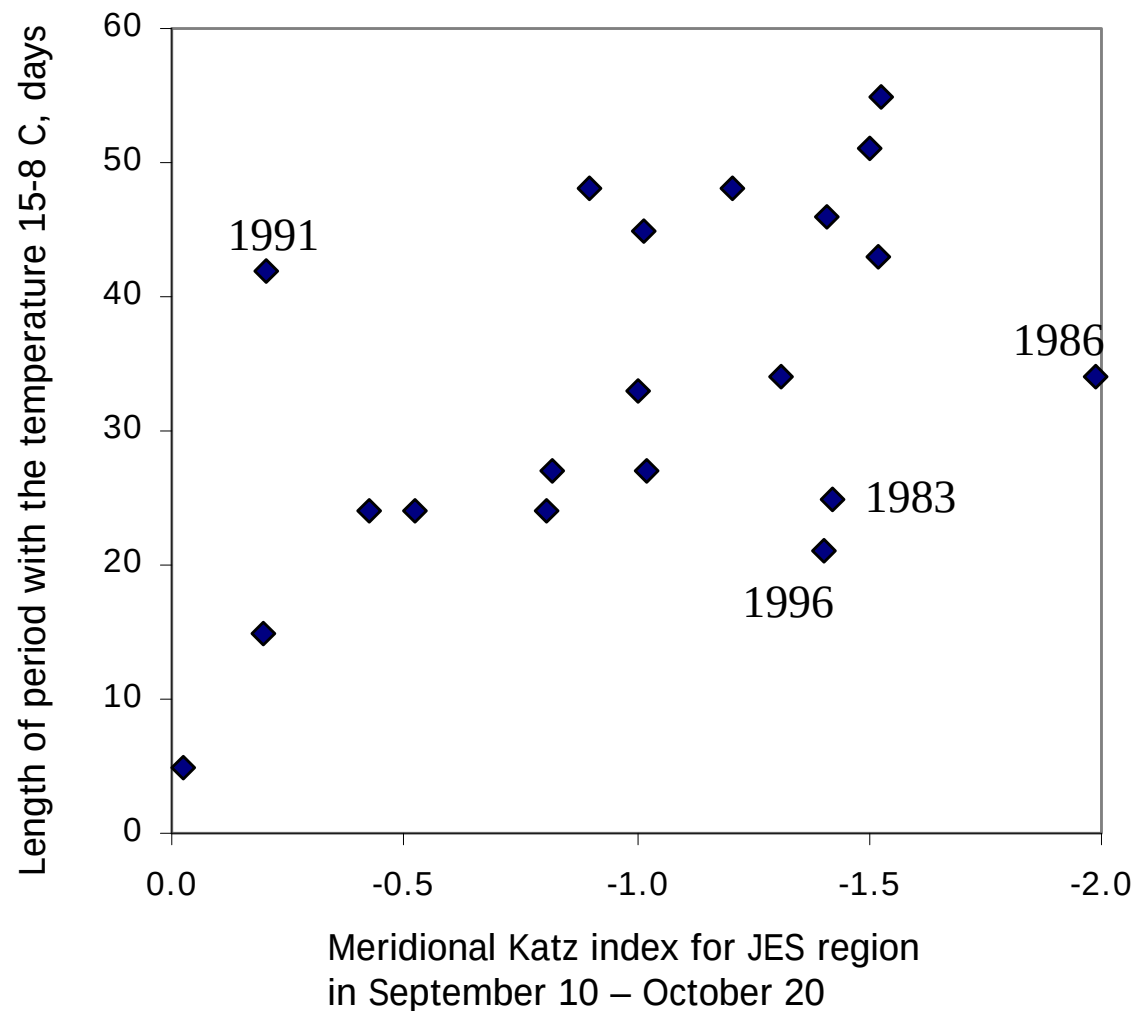


Winter monsoon beginning has a tendency to delay in the last two decades

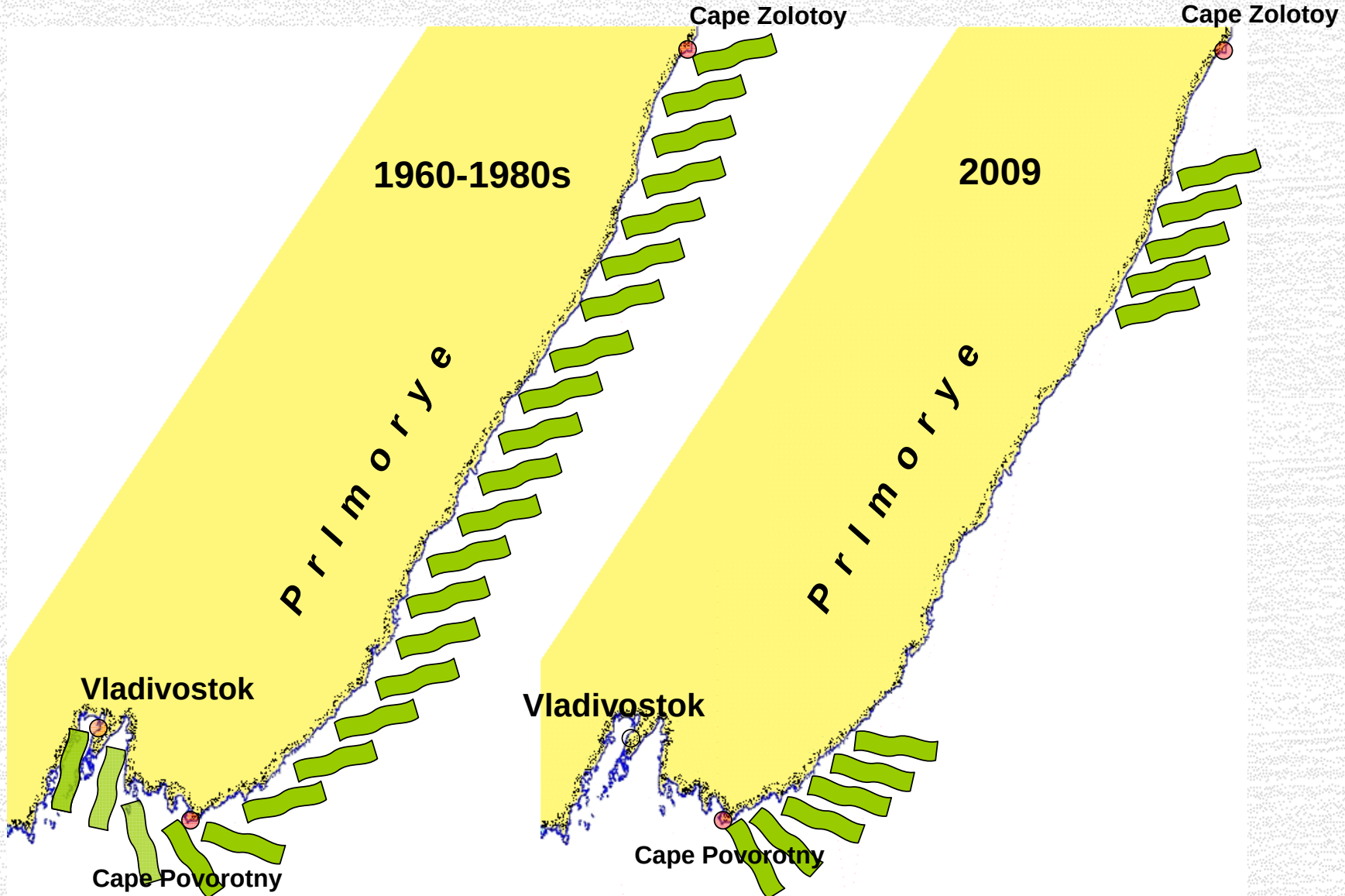
Relationship between the length of period with water temperature 15-8°C and the meridional Katz index for the JES region averaged for the period from September 10 to October 20 for the **southern part of Primorye coast**



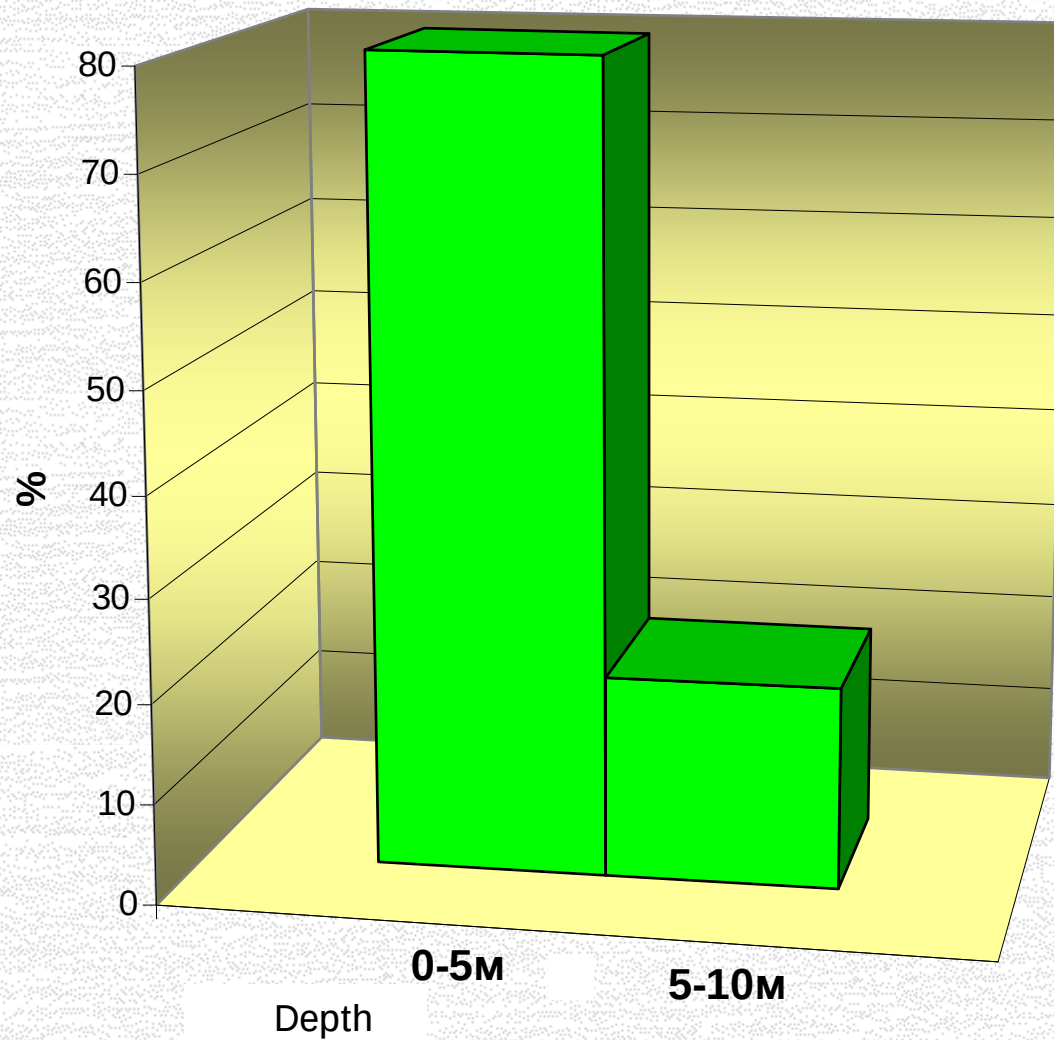
Relationship between the length of period with water temperature 15-8°C and the meridional Katz index for the JES region averaged for the period October 1-20 for the northern part of Primorye coast



Scheme of *Laminaria japonica* fields available for commercial use

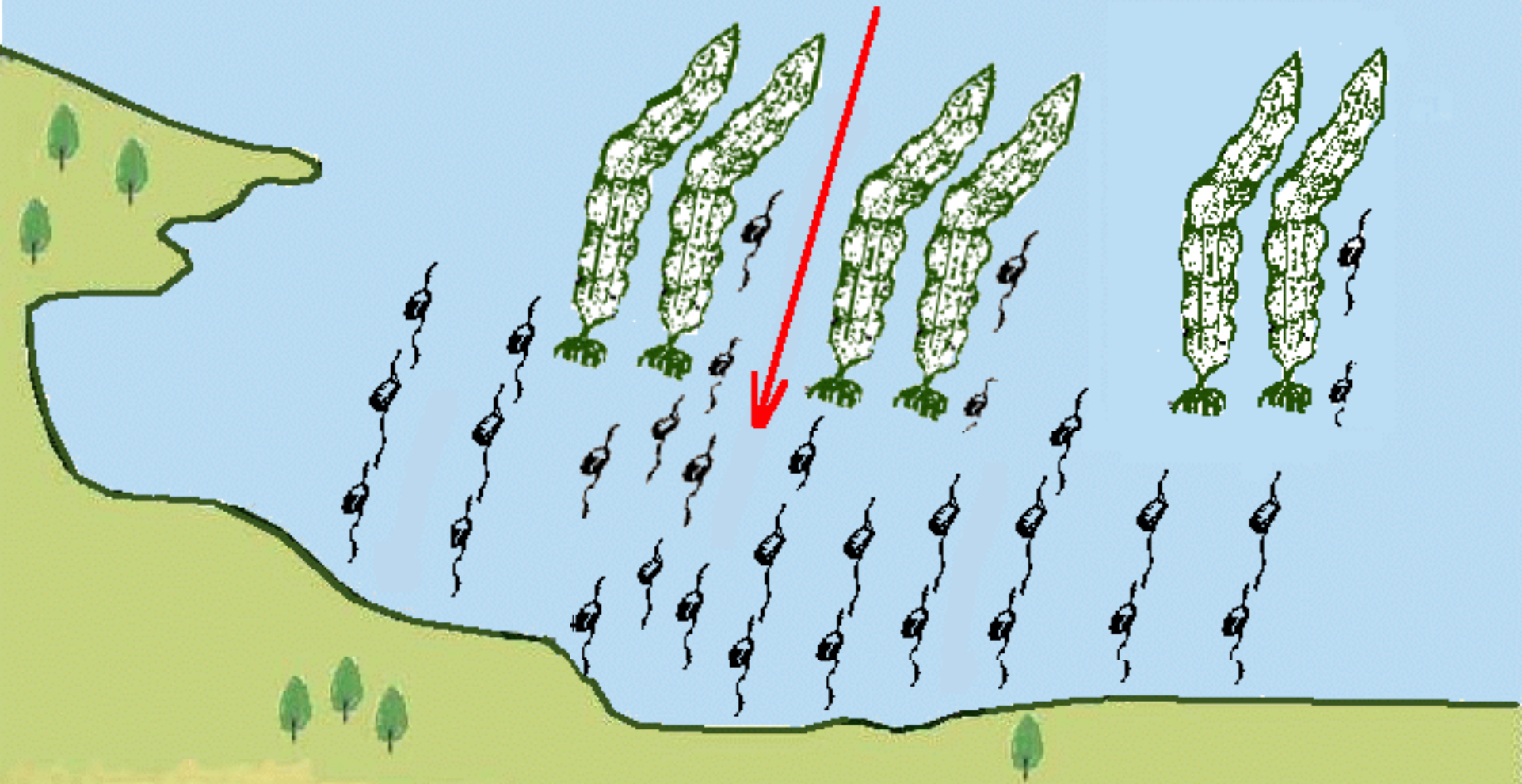


***Laminaria japonica* fields distribution by depth at Primorye coast**



Recently the remnants of *Laminaria* occupy the most shallow part of the shelf

Direction of the motion of zoospores after their output from the uterine thalluses

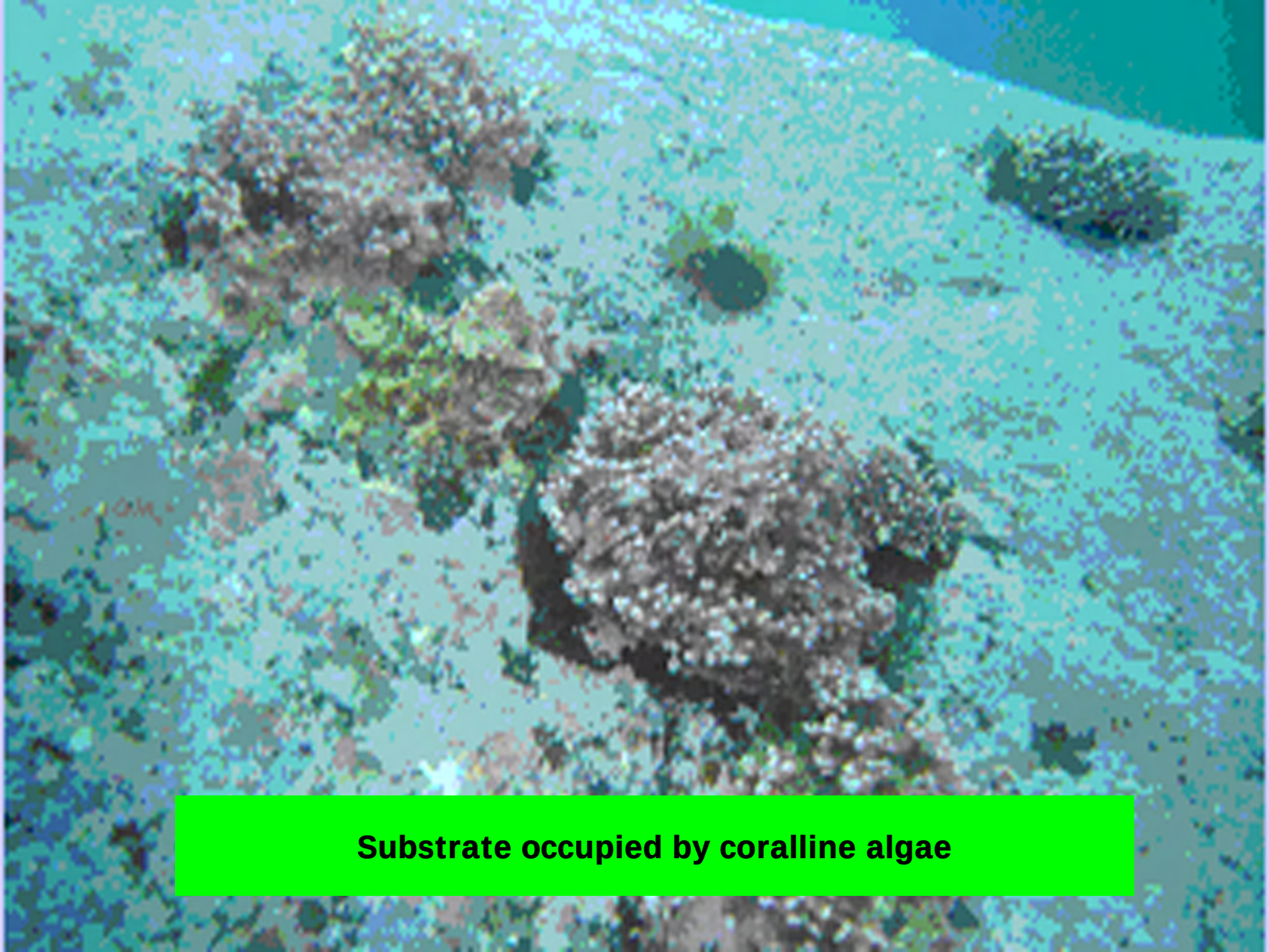


An underwater photograph showing a rocky seabed. The rocks are light-colored and have a rough, textured surface. Several smooth, rounded stones are scattered across the scene. The water is clear, and the lighting is bright, highlighting the textures of the rocks and the small, white, branching structures of the coralline algae.

Empty rocky substrate (not occupied by coralline algae)



Mobile substrate (pebble) not occupied by coralline algae



Substrate occupied by coralline algae



**Substrate occupied by coralline algae
with sprouts of *Laminaria japonica***



Thank you for your attention!